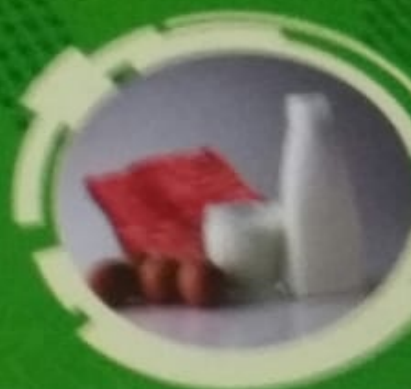




Proceedings of the 4th International Conference on Sustainable Animal Agriculture for Developing Countries



SAADC2013

The 4th International Conference on
Sustainable Animal Agriculture
for Developing Countries

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PROCEEDINGS OF

**THE 4TH INTERNATIONAL CONFERENCE ON
SUSTAINABLE ANIMAL AGRICULTURE FOR
DEVELOPING COUNTRIES (SAADC2013)**

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PREFACE

SAADC2013 is the fourth in the biennial conference on *Sustainable Animal Agriculture for Developing Countries*; the first being held in Kunming, China in 2007 and the second and third in Kuala Lumpur, Malaysia and Nakhon Ratchasima, Thailand in 2009 and 2011 respectively. This series of conferences is designed to provide a platform for the exchange of experience and knowledge among academicians, researchers, graduate students and producers for development of sustainable animal industry in developing countries. A total of 181 Extended Abstracts have been accepted for presentation during the 4-day conference and are published in this proceedings.

The Extended Abstracts, submitted by participants from 26 different countries, consist of 2 Keynote addresses, 10 Plenary lectures, 13 Lead papers and 162 scientific presentations. They cover policies and management strategies, nutrition and feeding, physiology, breeding and genetics, production systems, and biotechnology pertaining to the development of sustainable livestock industry.

The SAADC2013 had assembled together a proficient team for the Editorial Board. However, their duties were constrained by the late submissions of many abstracts, hence these will appear 'as is' with minimal editing. The accuracy of the contents, including methodologies and results of the Abstracts are the sole responsibility of the authors.

I would like to extend my sincere gratitude to the members of the SAADC2013 Editorial Board for their commitment and diligence in coming up with this Proceedings.

With best regards

Chairman SAADC2013 Editorial Board

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Keynote 1

Sustainable Animal Production In The Developing Countries

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Implication

In Asia, the consumption of animal products has been steadily increasing, thus creating a greater demand for feed crops. Although India is currently self-sufficient in maize and soybean, Japan and South Korea still rely heavily on imports. China has shifted from exporting to importing maize in recent years. A rapid increase in the demand for animal products, together with the changes in international trade, has led to a great expansion of China's food animal industry. Livestock production has been growing faster than any other agricultural sub-sector in China in recent decades. By 2010, livestock had contributed to 30% of the total agricultural output of China in sales. In 2011, the total yield of feeds was 181 million tons in China, which accounted for approximately \$100 billion. Production of feedstuffs and maize were 610 and 100 million tons, respectively, but 57 million tons of soybeans were still being imported in 2010. In China, a rapid increase in the supply of animal products is mainly due to the substantial growth of pig and poultry industries. Currently, the yields of pig and poultry production reach over 600 million and 10 billion, respectively. As the quality of life progresses, people's demand for animal protein increases. In 2010, the animal protein intake per capita was 30 g/d, which accounted for only a half of that in developed countries, yet 104 million tons of soybeans were imported for the animal protein intake per capita to increase by 5 g/d. In 2010, the shortage of protein feedstuff reached 20 million tons, which means China needed to import more soybeans. Improving the quantity and quality of animal products with such restricted feed resources has been a big challenge to Chinese economy and livestock production. China hosts 20% of the world's population, but occupies only 7% of the land area, and an even smaller percentage, a minimal area of 1.2 million km², can be used as farmland for agriculture. China is researching on the development of a variety of transgenic crops aiming at producing a higher yield of plant foodstuffs such as corn, soybean, rice, and wheat. Meanwhile, China is in the midst of establishing a feed database, which uses near infrared technology to measure the available energy, standardized ileal digestibility of amino acids, and net energy for accurate nutrient content prediction and efficient use of feedstuffs in animal production. Another undertaking in China, the Meat Quality Modulation Project, seeks to significantly enhance animal welfare and quality of animal products. In the next 5-10 years, even greater challenges will be encountered in meeting an ever increasing demand for animal protein products in developing countries. Therefore, there is an urgent need for new technological innovations in livestock production to ensure global food security and the stability of global economy.

Introduction

With rapid population expansion, urban development, and improved quality of life in most parts of the world, agricultural development is playing an increasingly important role in

global economy. This is relevant for bringing millions of people out of poverty and starvation and also for food security, all of which are important to maintain a stable society. Livestock industry is the most crucial part of agricultural development and has been growing at an unprecedented pace in the last few decades. Livestock products which contribute 40% of the global sales of the total agricultural output, is growing faster than any other agricultural sub-sector, and is expected to contribute at more than 50% by 2015. In Asia, changes in the international trade policies, population growth, limited resources, and environmental destruction has created a huge challenge to the livestock industry.

Profile on Asian Livestock Production Output

Asian livestock production has been growing steadily in the past decade. In China, the livestock industry has experienced a rapid growth. In 2010, livestock accounted for 30% of the total agricultural output in sales in China. As seen in Table 1, China stocks the largest numbers of chickens, pigs, goats and sheep in Asia, with chickens and pigs accounting for approximately 50% and 80%, respectively, of the total in Asia. Livestock numbers have increased during the last five years both in China and in the region as a whole, with the highest growth seen in the poultry industry. The major animal products have also followed a similar trend (Table 2). A rapid rise in the contribution of animal products is mainly from eggs and meat, with China being the main producer. In 2010, the production of eggs of China reached 28.00 million tons, which accounted for 89.5% of Eastern Asian production of eggs and 65.9% of the Asian production. The meat production was 81.12 million tons in China in 2010. This takes 93.8% of Eastern Asian meat production and 65.8% of the Asian meat production. On the other aspect, China is not the main contributors to milk production. From 2006 to 2010, the milk production has been maintained at 15-16% of the Asian milk production.

However, the production quantity per capita is much lower in Asian than the world average or the U.S, except for the number of egg production per capita, which is slightly higher than the world average, but is still lower than the U.S. In China, only egg quantity per capita exceeds the U.S. (Table 3). The same is true for chicken meat production in China, which is slightly higher than the world average (Ma, 2010). The gap in the livestock production between Asia and the world has gradually decreased in the past five years. For example, for protein intake the same trend appears (Table 4).

With increasing annual livestock production, the demand for feedstuffs is also rising. However, the yields of maize and soybean in Asia have not increased much in the last five years. China and India are the top two feed producers, harvesting about 80% of maize and 90% of soybean in Asia when combined (Table 5). In 2011, the yield of feed was 181 million tons in China, which accounted for approximately \$100 billion. The amount of foodstuff, maize, and soybean meal produced were 610, 193, and 15 million tons, respectively (FAO, 2011). However, a drastic gap exists between the feedstuff production and a rapid expansion of the livestock industry.

If the feeding formula is standardized to contain 60% of grain energy and 20% of protein, China needs 340 and 110 million tons of grain and proteins for feed manufacturing, which means the annual demand for maize and soybean meal amounts to 300 and 80 million tons, respectively. In 2009, 4.68 million tons of maize was imported to China, and was boosted to 6.21 million in 2010, resulting in an increase of 32.5% (Table 6). This number is expected to increase further in the next five years, and China would become the largest maize importing country, ahead of Japan. A steady increase in soybean imports also occurred in the last several years, with 57.01 million tons of soybean being imported to China in 2010 alone. Even if that was the case, the shortage of protein feedstuff still reached 20 million tons in

2010, indicating a need to import more soybeans. Other Asian countries in Asia are facing a similar situation, except for India, which can meet its basic demand for maize and soybean.

Table1. Livestock in Asian countries/regions, 2006-2010 (million heads)

Item	Year				
	2006	2007	2008	2009	2010
Cattle					
China	87.55	82.07	82.82	82.62	83.80
Eastern Asia	97.17	92.12	93.19	93.30	94.28
South-Eastern	43.93	45.66	46.67	47.15	47.64
Asia					
Southern Asia	268.45	273.70	278.91	284.15	290.40
Asia	446.07	448.66	457.71	464.35	472.73
Chickens					
China	4451.87	4211.58	4355.40	4522.20	4592.72
Eastern Asia	4867.90	4634.77	4774.27	4940.57	5253.29
South-Eastern	2009.70	2130.18	2170.82	2322.78	2644.21
Asia					
Southern Asia	1467.46	1575.60	1681.27	1777.79	1882.90
Asia	9188.73	9218.09	9425.70	9831.98	10570.93
Goats and sheep					
China	298.20	283.95	280.03	281.06	284.73
Eastern Asia	332.21	323.11	322.27	324.00	317.09
South-Eastern	32.35	34.56	35.07	36.53	38.19
Asia					
Southern Asia	434.83	443.03	455.94	466.02	477.37
Asia	959.85	967.94	981.49	990.69	994.07
Pigs					
China	440.55	425.71	446.66	469.50	476.27
Eastern Asia	462.48	447.61	467.70	491.16	498.22
South-Eastern	67.52	69.35	68.58	70.66	70.71
Asia					
Southern Asia	12.76	12.24	11.73	11.25	10.80
Asia	545.51	531.90	550.46	575.48	582.20

Source: The data were collected from Food and Agriculture Organization of the United Nations (<http://www.FAO.org/>).

The Challenges Faced by the Livestock Industry

Rapid population growth, urbanization and improving lifestyles have all resulted in more diversified dietary patterns in the past few decades, which has driven the growth of the global livestock sector. This attracts government attention. Consequently, the livestock sector is facing several challenges due to increased product demand, dietary changes, climate changes and food security. At the global level, these are factors that would limit livestock development and impair the competitive capability for many Asian countries.

Per capita consumption could not meet society's expectations

Change of urbanization and lifestyle alters patterns of food consumption and increases the demand for livestock production. Livestock is the main source of protein, calories and fat. Due to population growth and increased living standards, a rapid growth in consumption of animal products has forced the livestock industry to adapt and expand in order to satisfy society's expectation. Many factors can boost the consumption of livestock production, such as production yield, product type, income and population. The changes above not only

require the quantity for adaption, but also require the food quality, as more food varieties and higher quality are desired in many countries or regions. In South Asia, there has been a slow but steady growth in consumption of animal products, contributed by increases of milk and poultry meat (Steinfeld, 2003). In East Asia, pork is the predominant contributing product. However, in China, poultry and poultry eggs have been included more during the last decade. Table 3 shows main livestock product production per capita from 2006 to 2010. Based on such data, we can conclude that per capital consumption of main livestock products is expected to increase with different rates. The annual growth of eggs, meat and milk in Asia is projected at 9.08, 7.99 and 11.85 percent, respectively, which are higher than the global rate (5.58, 5.41 and 3.43 %); this demonstrates that consumers in Asia are demanding more meat, eggs and dairy products (FAO, Table 3). This may have a relationship with the rapid development in the livestock sector and economy in Asia.

Table 2. Total animal product quantity in Asian countries/regions, 2006-2010 (million tons)

Item	Year				
	2006	2007	2008	2009	2010
Eggs					
China	24.60	25.66	27.37	27.77	28.00
Eastern Asia	27.79	28.96	30.67	31.03	31.27
South-Eastern Asia	3.39	3.68	3.71	3.86	4.07
Southern Asia	4.31	4.49	4.58	4.92	5.05
Asia	37.35	39.11	41.03	41.98	42.50
Meat					
China	72.69	70.54	74.58	78.31	81.12
Eastern Asia	78.09	76.02	80.13	83.88	86.51
South-Eastern Asia	13.50	14.21	14.65	15.04	15.86
Southern Asia	10.94	11.51	11.94	12.42	12.79
Asia	109.30	109.01	114.08	119.05	123.22
Milk					
China	36.47	39.82	40.20	40.39	41.15
Eastern Asia	47.29	50.54	50.89	51.06	51.35
South-Eastern Asia	3.19	3.24	3.52	3.90	3.96
Southern Asia	144.04	154.07	158.97	165.41	171.98
Asia	228.64	244.07	250.39	258.15	266.95
Item	2006	2007	2008	2009	2010
Eggs					
China	24.60	25.66	27.37	27.77	28.00
Eastern Asia	27.79	28.96	30.67	31.03	31.27
South-Eastern Asia	3.39	3.68	3.71	3.86	4.07

Source: The data were collected from Food and Agriculture Organization of the United Nations (<http://www.FAO.org/>).

Changes in the livestock sector

Rapid growth rate and technological innovations have led to profound structural changes in the livestock sector; these changes offer opportunities to improve the security of food and to reduce poverty. One of the changes includes a move from small-scale farms towards large-scale livestock industry. Continuous growth in demand for livestock products drives the

forming of large-scale corporations in the livestock industry. The industrialized units can give a full response to the growing livestock demand, and have a clear advantage over small-scale holders. In contrast to the small farms, which are characterized by small-scale organization with dispersed use of inputs, delayed responses to variations in the market, lack of technology and resources, and insecurity in the face of natural disasters and market turbulence, the large-scale corporations often enroll in the global commercial market for a long term and exhibit a more resilient capacity. Large corporations can cover the whole food supply chain, from food production to marketing for distribution, and keep systems stable despite changes in market demand. Food security should also be taken into consideration.

Table 3. Animal production per capita in Asian countries/regions, US and world, 2006-2010(kg/yr)

Item	Year				
	2006	2007	2008	2009	2010
Eggs					
China	18.29	18.98	20.15	20.34	20.41
Eastern Asia	17.99	18.65	19.66	19.80	19.87
South-Eastern Asia	5.98	6.42	6.40	6.58	6.86
Southern Asia	2.68	2.75	2.77	2.93	2.97
Asia	9.36	9.70	10.06	10.19	10.21
World	9.49	9.66	9.91	9.98	10.02
US	18.13	17.82	17.46	17.38	17.44
Meat					
China	54.05	52.18	54.88	57.18	58.85
Eastern Asia	50.54	48.97	51.37	53.53	54.96
South-Eastern Asia	23.83	24.78	25.26	25.64	26.72
Southern Asia	6.80	7.05	7.21	7.39	7.51
Asia	27.40	27.03	27.98	28.89	29.59
World	40.65	41.14	42.01	42.31	42.85
US	135.68	137.86	141.00	135.34	135.86
Milk					
China	27.12	29.46	29.59	29.57	29.99
Eastern Asia	30.61	32.55	32.63	32.58	32.62
South-Eastern Asia	5.64	5.65	6.07	6.65	6.67
Southern Asia	89.54	94.37	95.98	98.45	100.92
Asia	57.32	60.51	61.41	62.65	64.11
World	101.39	102.95	103.75	103.89	104.87
US	275.28	278.51	282.56	279.12	281.83

Source: The data were collected from Food and Agriculture Organization of the United Nations (<http://www.FAO.org/>).

Considering food security

With globalization, people must acknowledge that food safety is important. All countries, especially those in Asia, should make policies to insure food safety. Many people in the world are impoverished and/or malnourished; they rely mainly on local livestock and plants for food. The livestock industry critically needs to address these circumstances. Increased livestock production requires large-scale suppliers and large quantities of animals. This would increase the chances for the onset and spread of animal diseases, most of which have

been related to human health and may cause global trouble (FAO, 2009; FAO, 2011). Some diseases have been identified and dealt with previously; but the emergence of new diseases could impair production performance and, in cases of high mortality, produce severe economic losses that might greatly reduce China's competitive edge in the global trade sector; thus, food quantity and quality require critical management for food security.

Table 4. Protein supply quantity per capita in Asian countries/regions, US and world, 2006-2009 (g/d)

Item	Year			
	2006	2007	2008	2009
Eggs				
China	5.2	5.4	5.7	5.8
Eastern Asia	5.2	5.3	5.6	5.7
South-Eastern Asia	1.5	1.6	1.6	1.7
Southern Asia	0.7	0.7	0.7	0.7
Asia	2.6	2.7	2.8	2.9
World	2.6	2.6	2.7	2.7
US	4.3	4.2	4.1	4.1
Meat				
China	17.4	17.0	18.0	18.7
Eastern Asia	17.0	16.7	17.6	18.1
South-Eastern Asia	8.0	8.4	8.6	8.9
Southern Asia	2.3	2.4	2.5	2.5
Asia	9.5	9.5	9.9	10.2
World	13.7	13.8	14.1	14.1
US	42.0	42.1	41.3	39.8
Milk				
China	2.5	2.6	2.7	2.8
Eastern Asia	2.9	3.0	3.0	3.1
South-Eastern Asia	1.4	1.4	1.3	1.4
Southern Asia	7.1	7.3	7.5	7.6
Asia	4.9	5.1	5.1	5.3
World	7.7	7.9	7.9	8.0
US	22.3	22.4	22.3	22.3

Source: The data were collected from Food and Agriculture Organization of the United Nations (<http://www.FAO.org>).

Environmental changes

The rising demand for livestock products can impact natural resources, as the livestock sector affects both climate and agricultural security. It is a big source of gaseous emissions which could result in greenhouse effects followed by higher sea levels and implications against biodiversity. The increasing demand for expansion of the livestock sector can therefore, be harmful to the environment. Meanwhile, the exploitation of natural resources also puts pressure on the land, forest, and coastal ecosystems, resulting in the possibility of land degradation, water pollution and biodiversity losses (FAO, 2010). Increased livestock organization increases the need for water supply, fuel supply, and crop production. As a result, planting limited species of crops could impair the biodiversity, natural resources, and

genetic improvement. Some rare species are at risk of extinction. Along with the development of the feed industry and livestock breeding, there is increased pressure on environmental ecosystems. For example, pollution on land and in groundwater originating from the livestock industry could condensed in plants and eventually harm human health. In addition, the entire agricultural and ecological harmony could be irreversibly transformed. Special considerations should be made to protect human health and ensure environmental sustainability.

Table 5. Production quantity of maize and soybean in Asian countries/regions, 2006-2010 (million tons)

Item	Year				
	2006	2007	2008	2009	2010
Maize					
China	151.73	152.42	166.03	164.11	177.54
India	15.10	18.96	19.73	16.68	14.06
Thailand	3.92	3.89	4.25	4.62	4.45
Eastern Asia	153.55	154.09	167.54	165.89	179.30
South-Eastern Asia	27.51	30.66	35.11	37.11	36.99
Southern Asia	23.09	28.15	28.81	24.75	22.77
Asia	210.38	219.03	238.43	234.55	245.75
Soybeans					
China	15.50	12.73	15.54	14.98	15.08
India	8.86	10.97	9.91	9.97	12.74
Japan	0.23	0.23	0.26	0.23	0.22
Republic of Korea	0.16	0.11	0.13	0.14	0.11
Thailand	0.22	0.20	0.19	0.18	0.18
Eastern Asia	16.23	13.41	16.29	15.70	15.76
South-Eastern Asia	1.52	1.40	1.57	1.77	1.75
Southern Asia	9.13	11.23	10.19	10.26	13.00
Asia	27.01	26.16	28.17	27.89	30.72

Source: The data were collected from Food and Agriculture Organization of the United Nations (<http://www.FAO.org>).

Strategies for Future Development

In recent decades there have been significant changes in the allocation of feed resources to livestock. High production of meat and egg production from non-ruminants is mainly based on the low cost during production (FAO, 2010). This encourages producers to use more types of new, raw materials that are cheaper and more convenient for producing feed, such as cereals and common oil meals. These materials are more variable in composition and nutrition value compared with regular feed material. Additionally, industrial by-products and feed processed by new techniques can be used as feed energy and protein sources (Szebiotko, 1985). The modern livestock industry will rely on advancing its technology to keep pace with the demands placed upon it.

Research on feed nutrient availability and dynamic modeling of nutrient requirements aimed at improving efficiency in utilization of feed resources

Environmental changes and improvement in crop genetics raise major concerns for

quantifying the variations of nutrients and their compositions, such as those in maize, soybean, and other crops. Quantification is important for the efficient application of these plants in feed production. China is establishing its own database by sampling extensively across the nation and analyzing the nutrient composition of feed materials. This database contains a dynamic model for chemical analysis of feed materials, which is modeled according to accurately-predicted nutrient requirements of animals. Feed evaluation for non-ruminants is mainly based on the assessment of energy and protein (with essential amino acids), which are the two major quantitative components for a diet. Currently, China is exploring digestible energy (DE), metabolizable energy (ME), net energy (NE), standardized ileal digestibility of amino acids (SID), available phosphorus and calcium prediction equations via chemical analysis; We are currently establishing the equations of each (with the exception of calcium) by near infrared transmission; and researching the dynamic model of these components for animal production

Table 6. Trade quantity of maize and soybean in Asian countries/regions, 2006-2010 (million tons)

Item	Year				
	2006	2007	2008	2009	2010
Exported maize					
China	3.07	4.92	0.25	0.13	0.13
Eastern Asia	3.07	4.92	0.25	0.13	0.13
South-Eastern Asia	0.57	0.74	1.38	1.88	0.81
Southern Asia	0.64	2.74	3.54	2.69	2.52
Asia	4.55	8.46	5.30	5.13	3.58
Exported soybeans					
China	0.38	0.46	0.47	0.35	0.16
Eastern Asia	0.39	0.47	0.47	0.36	0.18
South-Eastern Asia	0.07	0.08	0.07	0.12	0.06
Southern Asia	0.01	0.01	0.05	0.03	0.02
Asia	0.48	0.57	0.60	0.51	0.26
Imported maize					
China	5.14	4.53	4.23	4.68	6.21
Eastern Asia	30.95	29.86	29.96	28.47	31.09
South-Eastern Asia	5.80	4.16	3.53	5.07	6.79
Southern Asia	2.91	3.20	3.36	4.47	6.67
Asia	45.40	44.81	43.72	45.25	52.02
Imported soybeans					
China	30.66	33.15	39.53	44.92	57.01
Eastern Asia	35.89	38.58	44.64	49.46	61.75
South-Eastern Asia	3.09	4.55	3.59	3.57	4.56
Southern Asia	1.10	1.21	1.28	1.20	0.99
Asia	42.41	46.99	51.93	56.85	70.49

Source: The data were collected from Food and Agriculture Organization of the United Nations (<http://www.FAO.org/>).

Exploring new feed resources is crucial for accomplishing this task. Unlike ruminant feed, the feed resources of monogastric animals are comparatively limited. A potential solution is to substitute part of the feed of monogastric animals with ruminant feed. Previous studies were conducted to explore the nutritional evaluation on hay, especially Rumexpatinetia, R. Tianschanicus, and cv. Rumix K-1 in swine diets (Ren, 2003). Researchers found an increased growth rate and decreased cost when 10% of the concentrate of feed was replaced with Rumix K-1 (Ren, 2003). This is an exciting result from exploring more feed sources for producing monogastric animal feed. In addition, more ways must be found to apply non-conventional feed containing agro-industrial by-products and wastes to animal feed production, such as using by-products of the sugar and cereal industries. However, for effective utilization, more complicated treatment needs to be conducted on these materials.

In addition, phytogetic feed additives have gained considerable attention in the feed industry as a wide variety of herbs, spices and products derived thereof contain essential oils. However, numerous new feed additives still need to be researched to improve the efficient utilization of feed resources.

The wide application of advanced biotechnology and feed processing technology

Feed enzyme, Antimicrobial peptide and new solid-state fermentation technique.

Taking additives into consideration, research will contribute to the conservation of feed. High-technical additives were emphasized as digestibility enhancers and gut flora stabilizers among various kinds of feed additives. Exploring feed enzymes, antibacterial peptides, and probiotics can help to promote the sustainable development of the livestock industry.

Feed enzymes, such as phytase, xylanase, cellulase, mannanase and some antibiotic peptides, have been widely used. An optimized mannanase from *Aspergillus sulphureus* was developed by molecular-directed evolution technology. The modified mannanase showed high activity, broad pH values and thermostability. These properties suggest that the enzyme could function in the harsh environment of the monogastric gastrointestinal tract (data not published). A study was conducted to investigate the effects of this mannanase in corn-soybean meal-based diets on performance and apparent total tract digestibility (ATTD) in growing pigs. The weight gain was increased 16.1% and feed efficiency was improved 17.7% compared with the unsupplemented diet (Lv *et al.*, 2013).

Cecropin AD, a chimeric antimicrobial peptide obtained from cecropins, is effective at killing specific microorganisms. Chen *et al.*, (2009) expressed the cecropin AD gene in *Bacillus subtilis* by the introduction of isopropyl- α -D-thiogalactopyranoside (IPTG). The purified cecropin AD displayed antimicrobial activity against some pathogens, such as *Staphylococcus aureus* and *Escherichia coli*. The recombinant cecropin AD enhanced pig performance through increasing immune status and nitrogen and energy retention, as well as reducing intestinal pathogens in weaned piglets (Wu *et al.*, 2012).

Anaerobic solid-state fermentation carried out in multilayer polythene bags equipped with a one-way valve is very unique. Multilayer polythene bags equipped with a one-way valve is modeled on Chinese traditional pickle jars (Chiang *et al.*, 2010; Hu *et al.*, 2008). Substrates are packaged and sealed in multilayer polythene bags equipped with a one-way valve after inoculating with a mixed culture, which usually contains yeast, lactic acid bacteria and *Bacillus subtilis* (Yu *et al.*, 2009; Gao *et al.*, 2009; Ying *et al.*, 2009). During the initial stage of fermentation, yeast rapidly consumes the oxygen and sugar in the bag. When the oxygen in the system is exhausted, yeast converts carbohydrates to carbon dioxide and alcohol. In the absence of oxygen, this procedure creates a barotropic state. The gas pressure

from carbon dioxide is discharged through a valve, but the valve does not allow external air into the bag. The metabolite synthesized by *B. subtilis* could decrease the number of *E. coli*, *Salmonella* sp., *S. aureus* and other pathogenic microorganisms, but have no effect on the growth of lactic acid bacteria and yeast (Yu *et al.*, 2009; Gao *et al.*, 2009; Ying *et al.*, 2009). This fermentation technology has three obvious advantages: 1) Raw materials could be directly used without sterilizing. 2) The difficulty of heat release and contamination by pathogenic microorganisms outside the bag are not concerns. 3) Agricultural byproducts (such as soybean curd residue and pomace) with high moisture content could be used in a large proportion in order to achieve the recycling of resources (Chiang *et al.*, 2010; Hu *et al.*, 2008). It has been proven that the shelf life of anaerobic solid-state fermentation feed with this technique could be 2 years if the bag remains sealed. The number of viable cells of *Lactobacillus* in the feed could be more than 10^7 cfu/g. Using about 5% of anaerobic solid-state fermentation feed could significantly improve the health of livestock (Hu *et al.*, 2008).

Transgenic crop

Aiming to increase yields and enhance resistance, biotechnology is performed on transgenic crops, such as maize, soybean, rice, cotton and wheat, which are appearing all over Asia (Chambers *et al.*, 2002). Breeding new crop species is considered the basis of the future development of the feed industry. Compared with the conventional strains, the optimized crops obtained by modern breeding technology have plenty of advantages as a new variety of feedstuff. Improving the utilization of nutrients and eliminating or minimizing the content of anti-nutritional factors is the primary objectives. Although recent biotechnology research may increase the crop production or improve the disease resistance, it seems that the absorption and utilization of nutrients have no improvement. Therefore, more emphasis has been put on other breeding technologies, such as marker-assisted selection.

Transgenic crops have a more rapid growth rate compared with conventional strains, and will be the future direction for crop breeding. China is studying transgenic crop varieties with insect resistance, herbicide resistance, quality improvement, stress resistance and other favorable traits (Garcia and Alieri, 2005). Among them, three kinds of transgenic corns with insect resistance, high-lysine genes, and phytase genes have been developed. Corn yields can be enhanced by introducing genetic traits such as insect-resistant and drought-tolerance. With regard to transgenic corns containing a phytase gene, the phytate will be broken down into inorganic phosphorus to help animals meet their growth requirement as well as eliminate adverse environmental impacts. It is worth noting that all the transgenic crops must be tested for safety. Researchers from Chinese Academy of Agricultural Sciences developed transgenic maize with high-level expressing phytase. Phytase activity in transgenic maize seeds reached approximately 2,200 units per kg seed, about a 50-fold increase compared to non-transgenic maize seeds (Chen *et al.*, 2008). The transgenic maize passed the safety assessment of Ministry of Agriculture, and obtained the first certificate of genetically modified (GM) safety for corns in China in Dec, 2009.

Transgenic animal

Breeding of transgenic animals is also under research. The pharmaceutical protein produced by the cow mammary glands can be applied in industries, and similar work on pigs, chickens, goats, and fish are still ongoing. Human lactoferrin (hLF) is a multifunctional glycoprotein involved in iron absorption in the intestinal tract as well as in broad-spectrum primary defense against bacteria, fungi, protozoa and viruses. In addition, several studies also suggest that hLF modulates the inflammatory response, regulates gene expression, and promotes bone growth. These properties suggest that hLF may have important therapeutic applications, such as in prophylaxis treatment, nutritional supplementation, and food and/or medicine preservation. Yang *et al.*, (2008) reported, for the first time, recombinant hLF (rhLF) was

expressed in the milk reaching a level of 3.4 g/l. Moreover, the biochemical properties and bioactivities of rhLF were similar to that of natural hLF. Transgenic animal technology can improve the genome of animals, thus changing the genetic inheritance of those animals. The genetically modified animal contributes to the accelerated growth of livestock, yield increase of eggs and milk, and improvement of meat quality, as well as enhancing the utilization of feed and disease resistance in animals. We expect that the products of these transgenic animals will be launched into the market in the near future (Niemann *et al.*, 2005).

Intensive animal husbandry is vitally essential for livestock industry

The development of livestock in Asian regions with restricted economies and societies is imbalanced. Large variation can be found within a single country. For example, there is a gap between eastern and western China. Newly sprouted policies have been published to encourage the training of workers in west China where livestock development has been relatively delayed. In addition, 70% of livestock in China is produced from small holders. Limited by the outdated knowledge and technology, they are weak competitors in the grander market economy. Yet, these small holders' use of agriculture by-products and their low labor costs are advantages. So, a more focused resolution on creating a mode of intensive husbandry is necessary for livestock development in China.

The development of the livestock industry urgently requires grouping advantages to improve the competitiveness of regional products to meet rising consumption needs of livestock products. The government should take all the efforts to support the joint of livestock processing industry. A training process according to numerous aspects is highly recommended.

Development of livestock industry depends on contributions from society, thus enhancement of personnel technical training is essential. Relevant personnel includes manufacturers of feed, veterinary drugs and their managers, workers of livestock breeding, milk station practitioners, working staff on the production work line of animal products, and the persons who are responsible for livestock storage, refrigeration and transportation, among others.

An optimized government regulatory system is of importance to ensure products are made with quality and safety and toward expanding development. The government should strengthen the supervision at the starting point of the production work line to ensure the quality control of livestock products. Technical services should be used widely in large-scale farms. National farmers should also pay more attention to self-monitoring quality control by obeying the government regulations on usage of veterinary drugs, feed additives and so on.

Conclusions

Actually, the development of animal production is largely dependent on the research of animal nutrition and feed science. Following new requests to broaden the market and feed industry, precise studies should focus on the above addressed points to increase the output and quality of livestock products. Based on the conducted research, four issues will be investigated, including exploring new physiological functions and mechanisms of nutrients, enhancement of carcass quality via optimized nutrition, reducing excrement pollution via reasonable feeding strategies, technique integrity of traditional nutrition and molecular biotechnology.

By 2015, the yields of meat, eggs, and milk will reach 85, 29, and 50 million tons respectively, and the output of livestock in terms of value should account for 36% of that of total agriculture in China. The percentage of large-scale breeding will increase by 10-15% and extensively fulfill the national need for livestock products. The yield of industrial feed will reach 200 million tons. In the next 5-10 years, the demand of livestock products will be met; but this has to be approached with application of new technologies in the agricultural field.

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Keynote 2

Enhancing Animal Agriculture In Developing Countries Through International and Regional Collaboration

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Abstract

Growing populations and rising living standards in ‘developing countries’ fuel increasing consumption of food, particularly of higher value food items such as fruit, vegetables, and animal source food (meat, milk, eggs and fish). Global demand for animal source food is projected to increase by 270% in 2050 (from 2000 as base year). Animal agriculture is adapting to this tremendous increase in demand by increasing livestock numbers, a shift towards shorter-cycle species (i.e. pigs and poultry numbers growing faster than cattle, sheep and goats), acceleration of production cycles (to a large extent due to increased use of concentrate feeds), larger farming units characterized by high-input and high-output and their spatial concentration (close to feed sources), stratification and vertical integration of production and the globalization of supply chains. This adaptation comes at a major cost to health security (human and animal), the environment and the social fabric of agriculture. Provision of sufficient and safe supplies of animal source food, while managing the concomitant risks of sector growth, necessitates much more than traditional technology development and transfer but calls for concerted and coordinated actions across countries, disciplines and policy domains by an array of diverse stakeholders. International organisations have a key role to play as catalysts for moving forward a holistic and collaborative approach to livestock sector risk management.

Introduction

By 2050, global human population will be 50% greater than in 2000 with a 2.4 times higher per capita income. Growing populations and rising living standards in ‘developing countries’ fuel increasing consumption of food, particularly of higher value food items such as fruit, vegetables, and animal source food (meat, milk, eggs and fish). Global demand for animal source food (ASF) is projected to increase by 270% in 2050 (from 2000 as base year) while global grain demand is projected to double over the same period, mostly due to the increased demand for ASF, much of which will be grain-fed. Asia, with more than half of the world’s population and its high growth in disposable incomes takes a central position in shaping the global development of the agri-food sector.

Increasing livestock production by 270% and doubling global grain production without compromising environmental integrity, social stability / equity and public health is a tremendous challenge, complicated by the multiple and intricate linkages between these public goods.

This paper reviews development trends in animal agriculture with a focus on the three major Asian subregions (South, East and Southeast Asia), summarizes the major risks these

development trends pose to human welfare and outlines the requirements for a holistic and collaborative approach to livestock sector risk management.

Trends in Asian Animal Agriculture

Asian livestock populations (including farmed aquatic animals) have exhibited remarkable growth over the past 20 years (Table 1). This growth has, however, not been uniform across Asia's sub-regions, livestock types and time. Poultry numbers have shown the strongest growth in all three sub-regions and over both decades, with numbers doubling in South Asia over the past decade. In East Asia, the growth of livestock numbers appears to be decelerating across all species (and in the case of large ruminants numbers are even declining), while in South and Southeast Asia, livestock population growth was stronger in the decade 2000-2010 than in the decade 1990-2000 (with the exception of pig populations in India, which have declined). In South Asia, small ruminant populations have exhibited the second largest increase in numbers, 45% growth over 20 years, while in Southeast Asia pig populations have grown by 75% over the same period. East Asia saw a strong growth in small ruminant populations in the decade 1990-2000 but numbers of small ruminants appear to have stabilized while pig populations still exhibited moderate growth in the decade 2000-2010.

Table 1. Livestock populations (million head, poultry in billion) and livestock population growth (%) in Asian sub-regions, 1990 to 2010

Sub-Region	Species	1990	2000	2010	2000/1990	2010/2000
South Asia	Large ruminants	364.1	377.6	438.8	104	116
	Small ruminants	338.6	399.4	490.3	118	123
	Pigs	12.6	14.4	10.8	114	75
	Poultry	0.7	1.0	2.0	149	204
East Asia	Large ruminants	111.5	138.3	117.9	124	85
	Small ruminants	232.5	308.8	317.1	133	103
	Pigs	383.2	460.1	498.2	120	108
	Poultry	3.0	4.9	6.4	164	131
Southeast Asia	Large ruminants	52.1	52.7	62.5	101	119
	Small ruminants	24.9	29.4	38.1	118	130
	Pigs	40.6	52.4	71.4	129	136
	Poultry	1.0	1.7	2.9	165	167

Source: FAOSTAT, 2012.

Asian animal agriculture sectors are not only growing but also intensifying, a process that has started earliest and progressed furthest in East Asia and in the poultry sector. In East Asia, chicken numbers have slightly more than doubled between 1990 and 2010 while meat output has tripled. In South Asia, by contrast, much of the growth in chicken meat output was the result of increasing chicken numbers. Robinson *et al.*, (2011) estimated that in 2005, 80% of poultry in East Asia were reared under intensive conditions while in South Asia the corresponding figure was 30%. In terms of intensification, Southeast Asia lies between the East and South Asian regions. The pig sectors of East and Southeast Asia are undergoing

similar processes, again with higher rates of intensification in East Asia vis-à-vis Southeast Asia.

Larger farming units and concentration of units in proximity of feed sources, increased animal throughput / turnover and stratification of production (breeders, multipliers, finishers), often with vertical integration and contract farming are hallmarks of livestock sector intensification. Increases in animal turnover in intensive livestock production systems are the result of selection for production traits, enhanced management, particularly disease control, and rations with a higher nutrient density compared to traditional livestock raising systems. As Asia's agricultural areas have little potential for expansion, intensification of livestock production has led to major increases in feed imports, which, in value terms, have grown by 330%, 900% and 850% between 1990 and 2010 for East, Southeast and South Asia respectively. China now accounts for almost 60% of global soy meal imports (up from 8% in 1990).

Economic development is linked to stronger integration into international supply networks, which allow for regional specialization with concomitant increase and shift of local, regional, and global trade patterns. Thus, Asia's intraregional trade and trade with the rest of the world have grown even faster than production. While in the 1990 more than half of Asia-Pacific exports went to other world region, presently more than 50% of Asia-Pacific exports are to other countries in the region. These export figures do not include un-official cross-border trade which, for livestock and livestock products can be quite substantial as price differentials between Asian countries are high for certain livestock types / products. An assessment of the international agri-food trade network by Ercsey-Ravez *et al.*, (2012), concludes that this network has evolved into a highly heterogeneous, complex supply-chain network, which provides a vehicle suitable for the fast distribution of potential contaminants and pathogens but unsuitable for tracing their origin. The authors warned that even if food contamination was less frequent, for example, due to better local control of production, its dispersion/spread has become 'more efficient'.

Consequences of Asian Animal Agriculture Development

The rapid expansion of and structural changes in Asia's livestock sectors has ensured increased supplies of ASF for Asia are growing and more affluent populations. This remarkable development has, however, come at the expense of:

- (i) increased risks to human health from pathogens harboured by animals, either wildlife or livestock themselves;
- (ii) environmental degradation, pollution and acceleration of climate change through livestock associated emission of green house gasses, and
- (iii) marginalization of smallholder livestock keepers and exploitation of agricultural labourers.

Health

The intensification of agriculture and livestock production is not always a health risk amplifier and a number of zoonotic diseases actually decrease as livestock systems intensify and animals are moved into highly regulated environments (e.g. trichinellosis). However, the rapid growth and intensification of livestock production within a poorly regulated environment and without the concomitant strengthening of public health systems not only generates health risks for local populations but compromises regional and global health security, particularly in view of expanding trade and increased human mobility.

Environment

Large proportions of Asia's vast rangelands are considered degraded due to overgrazing while animal wastes originating from intensive livestock systems have become a liability rather than a valued input for soil improvement (as is the case in mixed livestock-cropping systems). Globally, animal agriculture is now responsible for nearly half of the total non-CO₂ GHG emissions (methane and nitrous oxide) directly attributable to agriculture. (In 2005, this amounted to 2.4 of the 6.1 billion tons CH₄ and N₂O CO₂ eq from agriculture (US EPA, 2006)). The livestock sector further contributes to climate change (CC) by inducing land use changes and associated land degradation reducing CO₂ absorption capacity of vast tracts of land.

Social

Rapid expansion of industrial food animal production and marketing systems carries the risk of social exclusion for many small-scale livestock producers and processors due to barriers to entry and non-level playing fields thereby blocking one of the possible pathways for rural poverty reduction. Furthermore, legal arrangements between large-scale corporate enterprises and private contract farmers tend to be tilted in favour of the former while hired labour is often subjected to exploitative employment conditions with little if any legal recourse.

Ensuring Sufficient, Safe, Sustainable and Socially Desirable Food Supply

Enhancing contemporary animal agriculture requires concomitant pursuit of the goals of providing sufficient and wholesome food, safeguarding human (and animal) health, maintaining (and restoring) environmental integrity and limiting collateral social damage. Even marginal achievement of the above goals necessitates much more than traditional technology development and transfer but calls for concerted and coordinated actions across countries, disciplines and policy domains by an array of diverse stakeholders. The latter comprise representatives from the private sector, research institutions, NGOs, CSOs, donors and international financing institutions, governments, regional economic communities and international organisations.

Undoubtedly, enhancing animal agriculture will require major investments in infrastructure, most of which, as far as production capacity is concerned, will be borne by the private sector, both individual and corporate. However, private investment will need to be complemented by investment in public goods provision, such as, for example, animal health systems capable of addressing major disease threats and able to guarantee food safety. Investments in the public goods infrastructure will mostly have to be borne by local and national authorities, complemented by financial support from donors and international financing institutions.

Enhancing knowledge through research and analysis is another area requiring complementary investments. As above, the private sector will finance research into productivity enhancing technologies, such as novel feed formulations, genetic improvement, vaccines or equipment and machinery to name a few. Public sector research carried out by national research institutions, universities and the international research system is required to elucidate the negative side effects (externalities) of animal agriculture and to identify means of controlling these.

National and international non-government and civil society organisations (NGOs and CSOs) and international organisations (e.g. FAO's Animal Production and Health Commission for Asia and the Pacific – APHCA) fulfill the important role of awareness

raising, information dissemination and advocacy in a variety of fora influencing decision making at local, national and regional levels.

Finally, governments, regional economic communities (e.g. ASEAN, EAC, SAARC) and normative international organisations (FAO, OIE) have to rise to the challenge of formulating effective policy and regulatory frameworks which are harmonized across regions and set boundaries for individual actions without stifling entrepreneurship.

Given the magnitude of challenges, national, regional and global partnerships are needed to address the most pressing issues. Without a doubt, however, an endeavour of the envisaged scale requires true champions as the driving force to move forward this holistic and collaborative approach to livestock sector risk management from rhetoric to tangible actions.

As urgent action is required to enable animal agriculture to meet the variety of economic, social, environmental and health objectives, FAO had decided to develop a Global Agenda of Action in support of sustainable livestock sector development. This global Agenda of Action is suggested to address the natural resource challenges of the global livestock sector and aim at improving the efficiency of their use. Land, water and nutrients are the initial primary focus, but further, important interfaces with FAO's other major programmes in the livestock sector, notably the One Health Initiative and the Global Plan of Action for Animal Genetic Resources need to be developed and capitalized upon.

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Plenary 1

Economic Perspective Of Food Safety In Food Security: Trade-off or Convergence In Emerging Economies

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Introduction

The challenge of food security is to assure that all people have access to enough food to lead productive lives, but an integral part of food security is assuring that the food is safe from a chemical, physical or biological risk. Food safety is thus receiving more attention as the links between food and health are increasingly recognized, at the same time, as food trade expands throughout the world, food safety has become a shared concern among both developed and developing economies.

Efforts to improve food safety in emerging economies, however, must be evaluated in terms of their impact on additional costs and returns to farmers, risk reduction, demand by middle-class consumers, food security, poverty alleviation, export earnings, economic gains for the domestic industry, and positive spill-overs for food safety in the domestic food system. This will require policymakers to develop better capacity for evaluating policy trade-off as they seek to enhance food security or to expand food trade. This paper therefore elucidates whether the food safety efforts will complement or requires a trade-off in the food security objectives in the emerging economies.

Food Security Issues in Emerging Economies

The right to food is the basic tenet of the food security policy of any nation. The guiding framework is based on the World Food Summit (1996) interpretation which stated that: food security as existing when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (FAO, 2003). Most developing economies had translated their food security drive by a number of policy measures to ensure accessibility, availability and utilisation. Malaysia, for example, uses self-sufficiency levels as proxies of food security situation in the country.

The food security agenda in the twenty-first century faces a totally new set of challenges. Domestically, the competition for resources (land, labour and capital) continues to intensify as urbanisation and industrialisation grow rapidly. Lack of innovations and technology in food merely depletes food sector's ability to compete. Limited investment in food and agriculture have made this sector lagged on all fronts; productivity, efficiency and development. The effect of climate change is showing, aggravated further by unsustainable practices such as overuse of chemical fertilisers and poor water management. However, it is in the international market that poses the bigger challenge to developing countries' food security in particular "extreme volatility". The trajectory of the global food system is no longer in the main determined by the resolution of demand and supply fundamentals. External shocks are emerging from a complexity of sources and are having a profound

influence in causing vulnerability in food systems. The detrimental impact of volatility is further magnified by structural problems such as: poor infrastructure, poor supply response, inefficient market, and susceptibility to climactic disturbances.

The conventional fundamental framework is still applicable as demand is chasing over stressed supply due to serious resource constraints. The awakening of the populous Indian and Chinese economies has put pressures on food supply of the world. The volatility of the crude oil prices, for instance, as well as its increasing trend have increased the demand for biofuel feedstock which lead to lesser resources for food production and competition for land. The advancement in ICT is responsible in energising the speculative markets which are affecting the commodity and food price fluctuations and volatility. Lurking actively is the climactic changes which are affecting production, yield and harvest. A study by Vaghefi *et al.*, (2011) on the Malaysian rice indicated that there would be a reduction in the yield of 0.36 tonnes per hectare if the temperature increases by 2°C and the CO₂ level at 383 ppm.

To ensure food security, the food sector in emerging economies requires bigger investment in infrastructure, productivity improvement, new innovations in sustainable practices and weather resilient varieties, crops and hybrids, better market information system, effective risk management system, and social safety nets.

Food Safety in Emerging Economies

Food safety was initially a public health issue, and has become a major concern in the early 1900s after the incidences involving *E coli* bacteria in hamburger, Salmonella in poultry, and Listeria in dairy products. This concern was heightened with the discovery of bovine spongiform encephalopathy (BSE or mad cow disease) initially in Europe and later in North America. Many pesticides have been banned from the market because they have been found carcinogenic in test animals. As a result of these incidences, consumers are demanding for the ability to trace food safety problems from the consumer products to the farm.

Illness from foodborne pathogens is a significant global health concern (Rocourt *et al.*, 2003). Population level incidence estimates, however, are uncertain due to underreporting and difficulty in attributing illness to food consumption. In the U.S. the Centres for Disease Control estimated that contaminated foodborne pathogens cause approximately 76 million illnesses, 325,000 hospitalizations, and 5,000 deaths among a population of 273 million each year (Mead *et al.*, 1999). The World Health Organization believes incidence rates in OECD countries are similar (Rocourt *et al.*, 2003). In developing countries, where it is more difficult to separate water and foodborne illness, approximately 2.2 million people die from these causes (Rocourt *et al.*, 2003). Such a level of illness and mortality drains productivity, imposing an in-kind of tax on human energy.

Available data suggest that food-related hazards (and in particular microbiological illnesses) are a significant problem world-wide, imposing a significant burden in terms of both human morbidity and premature mortality and economic costs. Whilst there is a paucity of data on the incidence in developing countries, those data that are available, as well as information on the incidence and associated costs in industrialised countries, suggest the burden is considerable. Indeed, the available evidence suggests that both the incidence and related costs are greater than in comparable high-income countries. It is also evident, however, that better and more extensive surveillance of food-borne illness is required, not only as a means to assess the magnitude of the problem faced by developing countries and the impact of interventions, but also to guide the development and design of such interventions in a bid to maximise policy efficiency.

Economic Perspective of Food Safety

Market failure

Other than a public health issue, food safety is also economic and market development issues. But a major concern by the emerging economies, including Malaysia, is the financial implications of maintaining acceptable levels of food safety. The negative effect of food safety, however, can be substantial in terms of loss of export market, fall in domestic sales, changes in consumption, large expenditure, and cost of changes in farm practices. Thus there is a trade-off between safety and costs. How much safety can be expected? There must be at an optimum level of safety, which is at the socially acceptable level of optimality.

It would be, however, impossible to provide a risk-free food supply. Since there are costs associated with increasing food safety, society must decide how much, if any, it is willing to spend on food safety and where this expenditure will have the greatest impact. The optimum level for food safety would be where the marginal cost of creating one more unit of food safety equals its marginal benefit. The marginal costs would be the costs to food processing plants to meet new food safety plans and the cost of government programs aimed at educating consumers, retailers and food service workers about safe food handling. The marginal benefits are the reduced illness and mortality associated with a safer food supply.

There are several factors in which a market economy can “fail” in providing the optimum - asymmetry in knowledge of risks, aspects of food safety which are public goods, existence of externality, social costs of food safety, and may be the divergence between scientific evidence and consumer perception. Supply and demand analysis is also further complicated by the fact that safety attributes are not usually directly observable by consumers, and often are either not observable to producers or observable by them only at a cost.

There are also potentially significant externalities associated with the impact on human health. These health effects will be dependent on the safety of the product, on one hand, and any potential beneficial effects on health (for example the nutritional value of the food) on the other. The key issue here is the extent to which the costs associated with human disease, for example health care and loss of productivity, are borne by society as a whole rather than the individual consumer. To the extent that these costs are borne by society, it is unlikely that the supply and demand functions will fully embody the economic consequences of the consumption of the food.

Currently, the market provides few incentives for producers to provide levels of food safety beyond those mandated by government regulations, or to offer the public other than the most rudimentary information about the safety of their food product. The cost of having products linked to outbreaks of food-borne illness, both to reputation and sales, provides some incentive for producers to ensure the safety of their products. However, the complexity of the process whereby food travels from farm to table makes warranting food safety a risky business for producers. The liability associated with claims of perfect safety, if proven false, is a significant disincentive for producers to advertise their food as “safe.” Constrained from advertising “safe” food and thus reaping market rewards, producers have no vested interest in making information about the safety of their food product more available to consumers.

Most government regulations will have some type of economic effect on producers and consumers. Regulations governing how food products, for example meat and poultry, are produced can raise costs of production. Regulations require resource commitments which, in turn, may raise costs and product prices. On the other hand, the regulations, which improve the safety of the food supply, will generate benefits for consumers by reducing the number and severity of food-borne illnesses.

Consumers would be more willing to buy the food products, since they are now getting a safer good for their money (Unnevehr, 2000). This represents a shift out of the demand curve, with consumers now willing to buy more of the safer food and to pay a higher price. However, the individual consumer is not able to capture all of the benefits of having the safer food; some of these benefits go to society. Therefore, in some cases, consumers might not be willing to pay as much as it costs for the product to meet the most socially beneficial safety standard. In such cases, the net effect would be a decrease in sales with a higher price, although this higher price better represents the true cost of supplying the food product with the higher level of food safety. Thus from the economic perspective, with market failure, there is convergent to the social optimality with appropriate government interventions.

Trade and market access

Food safety issues are also becoming increasingly important in international trade. As countries begin to lower agricultural tariffs and become increasingly integrated into world markets, they purchase more food from abroad. With the improvement in consumers' income, they also focus more on the attributes of their food, its safety, nutrition, and environmental friendliness. Increased income is translated into willingness to pay for such characteristics (Hanis *et al.*, 2010). With this trade development, the food safety presents a challenge to food suppliers in developing countries to have access to export markets. The process of adaptation by the developing countries to standards and expectations originally set for developed country consumers, however, could potentially bring benefits in emerging economies.

One of the main issues facing by most third countries in Asia exporting products to the international market such as EU and USA is the harmonization of its national legislation with the respective exporting countries. The national legislation should be developed as risk-based in order to improve food safety and public health of consumers. This step will eventually improve the regional and international trade opportunities. Measures and control systems should be equivalent, transparent and proactive in order to improve control system and fewer suspensions from exporting products to the international markets and lesser inspections and rejections. The implementation of the new standard in the importing countries should also be considered. For example, aflatoxins in the EU will have a negative impact on exporting products such as cereals, dried fruits and nuts to Europe. The new EU standard, which was claimed to reduce health risk by approximately 1.4 deaths per billion a year, will decrease the exports of these products by 64% or US\$ 670 million (Otsuki *et al.*, 2011). Food management systems such as HACCP and economics rendered by the developed-country approaches to the management of contaminants in foods are sometimes impractical in developing-country settings.

Looking to the future, the growth in demand within developing countries for highly valued products, such as meat, fish, and horticultural products, will increase the returns to improved food safety for both domestic producers and consumers. The perishable high value food products that most often give rise to safety concerns will become important building blocks of South-South trade. But the benefits from food safety improvement will only be captured if policymakers in developing countries understand both food safety risks and their impact on public health, and the synergies between development of the domestic food system and food export industries. In addition, developing countries must establish processes for food safety policy development that are inclusive, in that they take into account the interests of many different groups, and competent, in that they are based on the best available information about the magnitude and distribution of benefits and losses.

Burden of Health and Food Safety

The burden of cancers due to consumption of contaminated foods in developing countries is high and has been underestimated. For example, the prevalence and level of human exposure to aflatoxins on a global scale indicated that ≈ 4.5 billion persons living in developing countries are chronically exposed to largely uncontrolled amounts of the toxin. The aflatoxin exposure and the toxic effects of aflatoxins on immunity and nutrition combine to negatively affect health factors (including HIV infection) has accounted for >40% of the burden of disease in developing countries where a short lifespan is prevalent.

Food waste and Food Safety

The needs of environmental protection from waste generated are largely overlooked, and a lack of knowledge about the impact on the environment and its health effects constitute food security/safety problems. More food production has inculcated the use of pesticides, herbicides, antibiotics and chemical fertilizers which add to current food waste. Phthalates, PFOA, BPA, commonly used in plastics and personal care products, are found in unacceptable concentrations in waters. They, too, contribute to food contamination and long-term health risk. The expired, spoiled, contaminated foods that are discarded constitute to the reduce in consumption of foods and affect food security,

Moving Forward

With the potential of externalities with regards to food safety, the consumer pressure necessary to impact the market on food safety will not occur until there is full symmetry of information. Until then, an optimal level of food safety is not likely to be achieved within a non-regulated market, and there will trade-off between marginal cost and benefit that leads to market failure. The "public goods" nature of the food safety activities is another reason for public intervention. Individual producers or firms may not be able to adequately control an environmental food safety hazard without cooperative effort, thus the public sector may be needed to enforce controls or invest in the necessary supporting infrastructure.

Governments can take a number of policy initiatives to induce producers to provide higher levels of food safety. Governments could, in theory, tax unsafe food, raising the firm's costs of providing unsafe food, and therefore creating an incentive to provide safer food. However, this assumes that the amount of unsafe food that is sold can be measured, which would be difficult. Most governments, therefore, turn to regulations, setting minimum safety standards that food producing firms have to meet before they can sell their products. Basically, this is an attempt to increase the amount of food safety provided by the market, as the market *al.*, one will usually not provide the socially desirable level of food safety. Regulations can specify particular processes that a firm must use to produce food, or they can simply specify a level of safety for the final food product. The latter are generally considered more efficient, as they allow the firm to select the least expensive method of arriving at the desired product. As the food system has grown complex, however, safety can no longer be managed solely through reliance on command and control regulations. There is also a desire to rely more heavily on performance standards and other approaches that allow firms flexibility in how they achieve public health, economic and trade objectives. Thus, increasingly, it is recognised that several stakeholders have a role to play in the successful implementation and operation of a food safety control system. These include agricultural producers, food industry, importers and exporters, industry organizations, academic, and research institutions.

Other measures that the emerging economies can initiate includes capacity building to participate in the international forum that allows them to engage in and influence regulations

governing food safety and negotiate market access. Investments in infrastructure, which is a public good, such as the development of rural sanitation and water supply infrastructure that support better hygiene at the beginning of the food supply chain as well as marketing infrastructure can also improve food safety. These kinds of public sector investments can also set the stage for better export market performance.

In conclusion, the food safety initiatives, due to the externalities, seem to be a divergent from social optimality, implying that there is a trade-off between improvement in safety and costs. However the benefits from food safety in terms of public health, economic returns and trade market access, with regulated markets, there is a convergent between food safety and costs, implying that the food safety initiatives are socially optimal.

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Plenary 2

Managing The Pandemic Public Health Threats From Animal Agriculture

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Where animals are farmed to meet the needs of society, an informed society will have a legitimate expectation that the husbandry of these animals will not result in a health threat to people.

Defining the Problem

Animal agriculture has changed significantly over the centuries. Nomadic pastoralism has been complemented by different forms of confinement of animals to enable expenditure on various management procedures that increase productivity and profitability. These confinement and husbandry strategies include the fencing of paddocks, the building of pens and the provision of housing. The culmination of these approaches has seen the advent of the intensive animal industries, particularly for the farming of poultry and pigs. However other animal industries such as beef cattle feed lots, dairies and even farms for the rearing of mink and palm civets have adopted intensification in various forms.

Where animals are farmed intensively the dynamics of disease transmission have the potential to be different from those in open range, village or back yard “traditional” systems. Since animals are more closely in contact, transmission may occur more readily, or more successfully. Animal to animal chains of transmission of an infectious agent can be maintained for longer without “dying out”, since both the number of susceptible animals is more and the opportunity for a susceptible to be in sufficiently close contact with an infected animal for transmission to occur is greater. The overall size of the animal population is greater, and on farms where both breeding and rearing occur new susceptible animals enter into the animal population at regular intervals, giving opportunities for transmission of an infectious agent from one generation of susceptible animals to the next.

In situations where the structure of the animal population allows frequent transmission of an infection and maintenance of the infection over time there may be opportunities for mutations that result in the emergence of new strains of the agent, with different phenotypic characteristics. Introductions of new agents into the population will likely result in their long term maintenance in the population as well, and if different strains of an agent are transmitted among the farmed animals at the one time there will be opportunities for emergence of new strains of agent through the processes of genetic reassortment, as seen particularly with influenza viruses (Li et al, 2004).

Infections of farmed animals may have a range of impacts, depending on the agent. They may have little or no deleterious effect on the animal, or may cause morbidity which reduces the productive capacity of the animal. Such effects are typically expressed through death (mortality), reduced production such as weight loss, or drop in milk or egg production or through reproductive failure resulting in fewer new animals being born into the population during a period of time. These types of diseases affect the efficiency and hence the

profitability of the farm. Also important are infections which also cause disease in people, so-called zoonotic diseases, or zoonoses.

As with production related diseases of animals, zoonoses can have a range of effects in people. Zoonotic infections may be associated with food safety issues, causing gastro-enteric disease in people or being associated with antibiotic drug resistance. There are well known and understood zoonoses which occur at different levels of prevalence in different countries, which may be transmitted person to person but are not usually highly contagious and do not usually result in large acute epidemics of human disease. Such diseases would include bovine tuberculosis, brucellosis, leptospirosis and Q fever. In more recent times a new class of emerging infectious disease (EID) has come to prominence, zoonotic infections that either show high mortality in infected people or show a high level of contagion among people, being readily transmitted among human populations globally. Such diseases have become known as pandemic threats.

The emerging infectious diseases that are considered pandemic threats usually are classified in biorisk analyses as necessitating high or even maximum levels of biocontainment when worked with in laboratory settings because of their pathogenic potential. They may be readily transmitted from one person to another or, alternatively, not ordinarily easily spread among people. For some effective treatment and preventive measures are available but for others such measures do not currently exist. Severely pathogenic disease agents in the latter category require the highest levels of biorisk management in laboratory settings. Where such high risk infectious agents are found to occur in farmed animal populations there is obviously cause for concern and the desirability of a considered response to manage the risk to people.

The first occasion that an infection with a biorisk profile necessitating maximum levels of laboratory biocontainment was discovered in farmed animals was the Nipah virus outbreak in Malaysia (Chua et al, 2000). Pig farm workers became sick and died with a case fatality rate of 40% from a disease caught from the pigs on farms; a risk unheard of previously. Fortunately Nipah was not contagious among people and so it did not spread globally. Conversely, pandemic H1N1 2009 influenza did spread quickly among people globally and it was classified by WHO as a pandemic. Fortunately human pandemic H1N1 2009 influenza infections were not usually lethal. Of relevance to the current consideration, analyses of that virus indicate that it too arose in intensively farmed animals (Novel Swine-Origin Influenza A (H1N1) Virus Investigation Team, 2009).

Currently there are two avian influenza virus infections propagated in domestic poultry causing high human case fatality rates, particularly in a number of Asian countries: highly pathogenic avian influenza H5N1 (with infected countries widely distributed internationally) and avian influenza A(H7N9) (confined to China). As of 4 June 2013 there have been 630 human cases of H5N1 disease with 375 deaths – 60% (WHO, 2013a), while as of 30 May 2013 132 human cases of human infection with H7N9, with 37 deaths – 28%, had been reported (WHO, 2013b). Both are considered by WHO and the international public health community as having pandemic potential, but at present are not contagious among people in their current forms.

In many countries of the world reassortant influenza viruses are being discovered in pig populations (Vincent et al, 2013) and these are sometimes transmitted to people where there is close contact between people and infected pigs, again causing public health concern (WHO 2013). Reassortant viruses between pandemic H1N1 and human seasonal influenza strains not seen in the human population for decades in some cases have been discovered on

separate pig farms in Australia, associated with disease syndromes in pigs. These novel influenza viruses have not yet been found in people but clearly have zoonotic potential.

Given these considerations, that human diseases with high case fatality rates have arisen in intensively farmed animals and in some cases continue to be maintained in such animals with ongoing infection of people, it is reasonable to consider what is done to manage the risk. This is particularly so as new examples of similar infections which also are potentially pathogenic for people continue to be detected.

Unfortunately, although the international community through its animal health agencies the World Organization for Animal Health (OIE) and the Food and Agriculture Organization of the United Nations (FAO) have developed comprehensive guidelines for the detection and control of animal influenzas, there is little prospect that the H5N1 and H7N9 infections will be eradicate in affected countries, or that new strains of influenza will be prevented from arising in pigs or poultry. As the Nipah virus outbreak in Malaysia showed, and the detection of Ebola-Reston virus in farmed pigs in the Philippines (FAO 2008, WHO 2009), these concerns are not restricted to influenza viruses. Infections with members of viral families that contain viruses highly dangerous for people can, and do, occur. Hence intensively farmed animals are establishing a risk profile as a source of undesirable human diseases. The emergence of the next outbreak is unpredictable, as are its essential characteristics: pathogenicity and transmissibility.

Considering Possible Responses

In the main, the zoonotic EIDs of farmed animals described above have been detected because they have caused disease in the human population, a less than ideal situation causing international concern as indicated by this statement from Chatham House (2010): *Often identification of an infectious agent occurs in humans after human-to-human spread has begun, rather than in the animal from which it comes, and opportunities for control in animals and prevention of human infection are lost.*

There is an increasing expectation that those responsible for animal health, the owners of farmed animals and the animal health agencies, will identify public health risks before they cause a public health problem. Hence the proposition stated at the beginning of this paper: *Where animals are farmed to meet the needs of society, an informed society will have a legitimate expectation that the husbandry of these animals will not result in a health threat to people.*

Delivery on this over-arching proposition, and in the process responding to Chatham House type concerns, requires *a priori* detection. It is foreseeable then that in the future managers of intensively farmed animals will know the infection status of their enterprise, just as they know any other production related information.

This paper will now explore challenges and solutions to achieving this approach to animal health management, perhaps a slightly new business model for intensive animal agriculture although admittedly more intensively managed businesses already monitor the health status of their animals for specific diseases that threaten profitability.

Surveillance

In veterinary work surveillance is the term for a structured approach to monitoring the health status of an animal population for the purposes of managing the risks associated with infections in the targeted population. It can be seen from the broad objectives of surveillance

listed here that the risks managed may be broadly inclusive of risks to the profitability of enterprises as well as risks to the national economy or society as a whole.

Surveillance can be conducted for the purposes of:

- early detection of animal disease to facilitate control
- early detection of genetic changes in infectious agents that alter the risks to human or animal health
- early detection of phenotypic changes (antigenic match to available vaccines, antiviral susceptibility) with implications for human or animal health
- assessment and management of disease control programs
- improved knowledge of infectious disease agent epidemiology and disease pathogenesis
- monitoring the performance of diagnostic tools

Given the potential benefits to be derived the question arises as to why surveillance is not already a standard or more widely adopted management practice in animal agriculture. However surveillance costs money, and, importantly, is best conducted where there is an agreed, effective, scientifically rational and financially proportionate response to the findings. A recent World Bank paper has explored these aspects in more detail (World Bank, 2010).

In broad terms surveillance may not be undertaken because of an inability to do so, or an unwillingness to do so. Inabilities to detect may be associated with lack of awareness of the process, or be more technically based around a lack of sampling and testing capacity. Concurrently there may be no established reporting and response chain. In the last decade there has been marked developments in understanding of EIDs, the ability of the veterinary services to engage with such matters and the capacity of laboratories to provide testing capability. There is no reason to think that there are insurmountable challenges in the ability to do surveillance in countries that are able to engage in the commercial activity of intensification of animal husbandry.

It follows that any sub-optimal engagement in effective surveillance arises from a lack of willingness to engage in the activity, and there are persuasive reasons why this would be the case. Cost is one factor, including lack of any clear financial advantage and also lack of any mechanism of cost recovery. Importantly, if the activity is not conducted in a well planned and communicated policy setting, there can be inappropriately managed negative consequences. At the international level there can be trade restrictions, nationally there may be movement bans on live animals or animal products, in some cases there may be compulsory slaughter (with or without compensation) and also at the consumer level there may be loss of market or market share if the communications are not well handled. And there must be communication of the findings, surveillance can't be conducted in secret since the purpose is to provide the information upon which informed and well communicated responses can be based.

A prerequisite for surveillance for the better identification and management of public health threats arising in farmed animals is a process of consultation among those likely to respond to findings as well as those likely to be involved in the implementation of the activity.

There are certain key issues to recognize, and then to address.

Who will carry the cost of this surveillance, and any response to the findings? It might be thought that ultimately it should be the consumer, but what will be the mechanism by which the producer can recoup the costs in a price sensitive market? If the consumer is to be sufficiently well informed to want to pay a small margin for a safer product we might expect

that the issues will have to be publicly debated, as are other animal production issues such as animal welfare, antibiotic sensitivity and the putative health benefits of different types of foods.

Secondly, is the scientific basis for the concerns, and particularly for the responses, sufficiently well developed? Can a public health threat be objectively defined, or even a pandemic threat? Agreement is needed in advance upon which findings will be associated with specified levels of response, otherwise the risk of disruption to business continuity through ill conceived or “knee jerk” reactions by regulatory authorities will be sufficient to preclude farmer cooperation. Regulation can be expected to have a role in the process, but regulations that are science based and arrived at through the processes of public-private industry consultation.

Conclusions

If surveillance of farmed animals is to become a normal part of the way business is done then it will be on the basis that an informed public understands the risks and the proposed mitigation steps, and that industry feels confident that the measures in place under the auspices of both public and animal health authorities are science based, well thought through, appropriately costed and effectively manage real risks rather than apprehensions.

The frequency with which new EIDs are being detected, causing deaths of people who were not previously at risk, clearly indicates that the time for these serious discussions has certainly arrived.

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Plenary 3

Role Of Biotechnological Research To Support SAADC-Mitigation Of Methane And Nitrous Oxide And Utilization Of Agricultural Biomass

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Abstract

Rumen CH₄ emission in an enteric fermentation can be accounted as the biggest anthropogenic source. The abatement mechanism of rumen CH₄ emission may be divided to direct and indirect suppression to methanogens in the rumen. The most significant strategy to mitigate ruminal CH₄ emission in indirect manner is to promote alternative metabolic pathway to dispose of the reducing power, competing with methanogenesis for H₂ uptake. The efficient prebiotics and probiotics have been innovated to mitigate rumen CH₄ emission instead of ionophores in respect to food safety. They are mostly propionate enhancers which consume metabolic hydrogen (H₂) compete with methanogens and abate rumen methanogenesis in indirect manner. However, assimilate nitrate reduction in the rumen which shows strong redox potential is effective to mitigate rumen CH₄ emission without toxic nitrite accumulation when L-cysteine is simultaneously administered. Furthermore, *Escherichia coli* modified genetically has been developed to promote nitrite reduction abating ruminal methanogenesis. One of protease-resistant antimicrobial substances (PRA) has been isolated from *Lactobacillus plantarum* as a direct suppressor of rumen methanogens. The suppressing effect of PRA on rumen methanogenesis were examined using the *in vitro* continuous methane quantification system. The possible use of agricultural biomass consisted of non-edible parts of crop plants such as cellulose and hemi-cellulose and animal wastes was proposed for the creation of alternative feeds, renewable energy and nitrogen sources. The ammonia stripping from digested slurry of animal manure in biogas plant to apply three options of nitrogen recycling to mitigate N₂O emission. In the first option of the ammonia stripping the effect of ammonolysis on feed value of cellulose biomass was evaluated on digestibility, energy metabolism and protein utilization. Saccharification of the NH₃ treated cellulose biomass was confirmed in strictly anaerobic incubation with rumen cellulolytic bacteria, *Ruminococcus flavefaciens*, to produce bio-ethanol as the second option of ammonia stripping. In an attempt of NH₃ fuel cell, the reformed hydrogen from the NH₃ stripped from 20 L of digested slurry in thermophilic biogas plant could generate 0.12W electricity with proton exchange membrane fuel cell (PEM) as the third option. As an alternative way to mitigate N₂O emission derived from animal agriculture, denitrifying effect of *Alcaligenes faecalis* No.4 on excess amount of ammonia nitrogen was evaluated in the organic wastewater collected from piggery around Shanghai, China.

Introduction

The mitigation of anthropogenic four GHG, carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O) and sulphur hexafluoride (SF₆) and two groups of GHG, hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs) have been established as legally binding commitments in The Kyoto Protocol (IPCC, 1996). Important GHG attributed to animal agriculture are CH₄ and N₂O. Rumen fermentation of ruminant livestock and anaerobic fermentation of agricultural organic waste including animal manures are major contributors of CH₄ emission as anthropogenic sources (Moss, 1993).

To abate the GHG, the development of mitigation methods of rumen CH₄ is the most significant issue in the world ruminant livestock production. The prompt increase of atmospheric N₂O since last century is closely related to abrupt expansion of human and animal population after an innovation of Haber-Bosch process. Severe environmental pollutions were caused at the same time though the reactive nitrogen withdrawn from atmosphere as stable paired nitrogen brought about prosperous food production. To secure food production preventing environmental catalyses by global warming, sustainable development of animal agriculture should be sought in not only developed but also developing countries as an alternative way. Inventories of emitters and their abatements should be accurately assessed in both GHG. The key element of these recycling must be low-input for sustainable animal agriculture in developing countries. Carbon and nitrogen recycling in the agricultural biomass as alternative feeds, renewable energy and nitrogen resources might contribute mitigation of CH₄ and N₂O (Takahashi, *et al.*, 2003).

The present paper deals with perspective on biotechnological approaches to GHG control and possible uses of biomass towards sustainable animal agriculture.

Possible control of indirect action of prebiotics and probiotics on rumen methanogenesis

The stoichiometric balance of VFA, CO₂ and CH₄ indicates that acetate and butyrate promote CH₄ production whereas propionate formation conserves H₂, thereby reducing CH₄ production. Therefore, a strategy to mitigate ruminal CH₄ emission in direct manner is to promote alternative metabolic pathway to dispose of the reducing power, competing with methanogenesis for H₂ uptake. Rumen manipulation with ionophores such as monensin has been reported to abate rumen methanogenesis (Mwenya *et al.*, 2005). However, there is an increasing interest in exploiting secondary metabolites such as saponin and tannin, prebiotics and probiotics as natural feed additives to solve problems in animal nutrition and livestock production as alternatives of the antibiotics due to concerns about incidences of resistant bacteria and environmental pollution by the excreted active-antibacterial substances (Mwenya *et al.*, 2006). Particular interest concerning bacteriocins which produced by lactic acid bacteria has increased recently.

Bacteriocins, antimicrobial proteinaceous polymeric material substances, are ubiquitous in nature being produced by a variety of Gram-negative and Gram-positive bacteria, and typically narrow spectrum antibacterial substances under the control of plasmid. Nisin is produced by *Lactococcus lactis* ssp. *lactis* which is an amphiphilic peptide composed by 34 amino acids with two structural domains that are connected by a flexible hinge, and is classified into the group of lantibiotics. Nisin has a mode of action similar to ionophores, which show antimicrobial activity against a broad spectrum of Gram-positive bacteria and is widely used in the food industry as a safe and natural preservative. It is generally recognized as safe (GRAS) and given international acceptance in 1969 by the joint Food and Agriculture Organization/World Health Organization (FAO/WHO) Expert Committee on Food Additives.

Recent works have indicated that *Lactococcus lactis* subsp. *lactis* produce nisin Z, which has been identified from Korean traditional fermented food “Kimchi” besides nisin A. They have similar antibacterial ability to mitigate methane emission (Santoso *et al.*, 2004; Sar *et al.*, 2006), to inhibit growth both of *Clostridium amoniphilum*, which is obligate amino-acid fermenting bacteria and lactic acid-producing ruminal Staphylococci and Enterococci. *Leuconostoc mesenteroides* ssp. *mesenteroides*, *Leuconostoc lactis* and *Lactococcus lactis* ssp. *lactis* were isolated from “Laban” which was a traditional fermented milk product in Yemen and determined the mitigating effect on in vitro rumen methane production. These strains isolated from Laban enhanced propionate production and decreased acetate/propionate ratio. In consequence, they reduced methane production remarkably. For *Leuconostoc mesenteroides* ssp. *mesenteroides*, in particular, the mitigating effect was amplified with GOS, which was degradable about 80% within 1 hour incubation in the artificial rumen fluid due to the stimulation of reduction reactions consuming metabolic hydrogen. However, direct involvement of bacteriocin or lower molecular substances produced by the strain on rumen methanogenesis remains to be elucidated.

Abatement of rumen methanogenesis by direct action of lactic acid bacteria as prebiotics producer

For low molecular compounds, small amounts of volatile fatty acids (acetic acid, formic acid), hydrogen peroxide, β -hydroxy-propionaldehyde (reuterin) are produced by lactic acid bacteria as antibacterial substances in addition to lactic acid. Because lactic acid bacteria themselves don't have a group of catalase, considerable amount of hydrogen peroxide accumulates in the bacterial cells. Many strains of the genus *Lactobacillus* are commonly referred to as having high ability to produce hydrogen peroxide. Its antimicrobial activity is effective against numerous Gram-positive bacteria. Although it has been reported that nisin suppress rumen methanogenesis, the suppressing efficacy of nisin on rumen methanogenesis may not be sustained, because proteinaceous nisin is degradable in the rumen due to bacterial protease. One of protease-resistant antimicrobial substances (PRA) has been identified from *Lactobacillus plantarum* isolated from tomato as a direct suppressor of rumen methanogens (Asa, *et al.*, 2010). The PRA maintained their antimicrobial effects after incubation with proteases, while nisin lost its activity. Therefore, the PRA was hypothesized to be a more sustained agent than nisin for the mitigation of rumen methane emission. *Lactobacillus plantarum* produces bacteriocin from many foods PRA was the antibacterial substance produced from a strain of *Lactobacillus plantarum* TUA1490L that was isolated from tomato in Japan. However, methane suppressing activity of PRA was not inactivated by protease treatment. Moreover, aeration cultivation is an essential process for activation of PRA to abate methanogenesis. Therefore, possible mechanism of PRA produced by *Lactobacillus plantarum* TUA1490L on rumen methane production might be assumed as resulting from the direct involvement of low molecule substance such as hydrogen peroxide due to the requirement of aeration for the preparation (Takahashi, 2013).

Creation of renewable energy from anaerobic fermentation (biogas plant) of animal manures and the innovative reuse of the digested slurry to mitigate N₂O

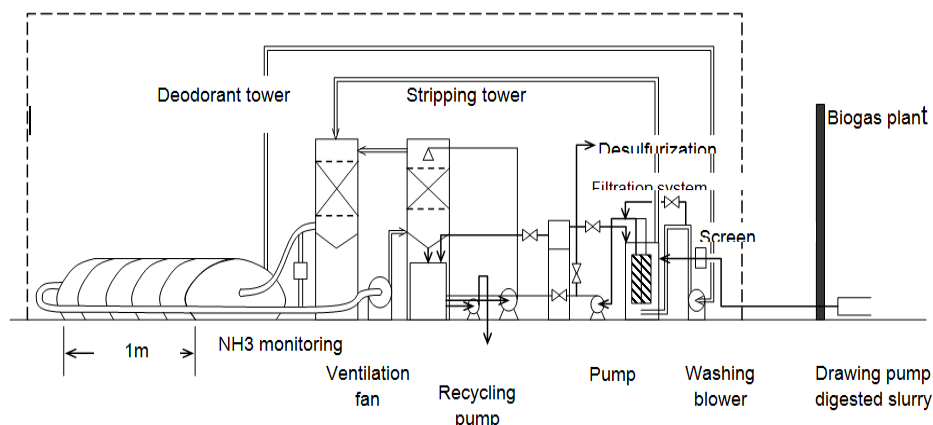


Figure 1. Ammonia stripping apparatus

The increased emissions of CH₄ and N₂O from decomposing unmanaged and bio-based industrial wastes along with the expansion of human activities contribute climate change as GHG. The biogas plant produce biogas including combustible CH₄ as renewable energy using unused resources like animal manures, can provide fuel, heat and electricity (Umetsu *et al.*, 2005), and minimize the impact on the environment thus reducing the amount of pollutants discharged. To mitigate N₂O emission, the ammonia stripping from digested slurry of animal manure in biogas plant was implemented to apply to nitrogen recycling-options (Fig.1).

Ammonia removal with heterotrophic nitrification and aerobic denitrification abilities of *Alcaligenes faecalis* strain No.4

Improper management of livestock wastewater will causes eutrophication in hydrosphere due to nitrate and nitrous oxide emission in atmosphere attributed to excess amount of ammonia nitrogen. It is a common issue in Asian developing countries where abrupt expansions of population and urbanization have been progressing along with economical development. So far, most biotechnological approaches on ammonia removal from livestock wastewater have been implemented by aerobic nitrification and anaerobic denitrification using autotrophs. However, the autotrophic bacteria are presumably unsuitable for livestock wastewater treatment because of high strength of ammonium and organic matters. Furthermore, the long retention for autotrophic nitrification has been designated due to slow proliferation rate of the bacteria. In an attempt to seek ammonia removal ability of heterotrophic bacteria *A. faecalis* strain No.4 was isolated from sewage sludge (Joo, *et al.*, 2006). As an alternative way to mitigate N₂O and nitrate emission derived from animal agriculture, heterotrophic nitrification and aerobically denitrifying effect of *A. faecalis* strain No.4 on excess amount of ammonia nitrogen was evaluated in wastewater collected from the piggery in suburb of Shanghai, China according to the procedure reported by Joo, *et al.*, (2006). Possible removal of ammonia from piggery wastewater using *A. faecalis* strain No. 4 was confirmed under proper control of the C/N ratio and pH.

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Plenary 4

Contrast Between Developed And Developing Countries With Emphasis On Livestock And Its Interaction With Soil, Plants And People.

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Abstract

In this article I will try to describe briefly where and why Western agriculture has gone down the route of separating animals from an interaction with soil, plant and people. I will illustrate with examples from developing countries conditions in which this interaction is still in place and will argue that this interaction should be sustained and improved in developing countries. I will argue that it would be inappropriate for those countries to copy western unsustainable systems in spite of the persuasion of any Western multi-national organisations for them to do so. The advantages of multi-culture with complementary crops will be highlighted both in arable systems and in agro-forestry. Finally, aspects of technology transfer and the real needs of developing countries will be discussed.

Introduction

Having had the privilege of involvement in many rural development projects of about 40 countries in Africa, Asia and South America, I would like to discuss some experiences and contrast their systems with Western systems. I shall seriously question whether Western Agricultural practices should be promoted in these countries, taking into account sustainability and socio-economy.

Agricultural systems in so-called developed countries

Because of the diversity of western agricultural systems, only generalisations can be made here. The biggest change in the direction of such systems took place after the 2nd world war when, owing to inadequate food supplies, governments in Western Europe, USA and to a lesser extent Australia and New Zealand put emphasis on increasing crop and animal production. The high cost of labour in these countries gave rise to specialized crop and animal production to achieve this increase. Until then, animals were kept on almost all farms, consuming some complete crops and crop residues, and their manure from winter keeping was spread on the cropping areas. On the other hand, on drier and lighter soils there was a natural tendency to concentrate on greater cereal crop production, whereas on heavier and wetter soils, the tendency was towards grassland and animal production.

Another, perhaps even more important aspect, was the low cost of fossil fuel relative to labour costs. Fossil fuel, in effect, became a substitute for labour leading to a high degree of mechanization. As agriculture evolved in which animals to a large extent became separated from the land, in particular with pigs and poultry, but also with ruminants, for which indoor fattening in feedlots and large dairy units were features. Crop farms became separated from animals, so that crop by-products were under-utilized and in many instances animal farm excreta became an expensive waste product. Previously both of these were considered a resource. There are now controls on the disposal of animal excreta in some western countries

to avoid the pollution they can cause. Moreover, animal production is reverting gradually to less intensive systems.

The emphasis on crop monoculture became supported by techniques to sustain it as long as possible. Crop varieties were selected for the main product only, with less emphasis on the value of crop by-products as animal feed. Despite this, it was for example, shown that the quality of straw had no relationship to quantity and quality of grain in work by (Tuah *et al.*, 1986.) However if grain yield is reduced due to draught or disease the quality of straw is generally increased due to lack of transfer of sugar to the grain.

Varieties that could respond to very high levels of fertilizer were, and still are, chosen. Herbicides became a part of normal crop husbandry, rejecting the previous retention of crop rotations to achieve some control of weeds. The same crops could be grown year after year provided they were supported by large amounts of herbicides. This aspect has recently been furthered by the introduction of herbicide resistant genetically modified crops (GM), using the herbicide “Roundup”. This approach is receiving some adverse criticism as it is, as yet, inadequately researched for many systems. The effect of feeding GM crops is being critically assessed, particularly in Europe.

Another serious aspect of the highly mechanized monoculture was examined by Blaxter (1989). It was Kenneth Blaxter who calculated that each calorie digested had to be supported by 10 calories of support energy in the form of fossil fuel used in cultivation, sowing, fertilizer, herbicides, harvesting, drying, food processing, transport and waste disposal. This aspect has serious consequences for global warming and even for those countries that have signed the Kyoto agreement to reduce fossil fuel consumption (the USA has not signed). Another serious aspect of mechanized and herbicide-controlled monoculture has been soil fertility and, even more, biodiversity. Birds surviving on weeds are being severely affected (Clerkin 2002). Many bird species that were previously prevalent are now seriously endangered and many have disappeared altogether.

Situation in most so-called developing countries

I will now turn attention to the situation as seen in most developing countries particularly densely populated areas in Asia and Africa. Here in the main, farm animals are multipurpose i.e. they serve several functions such as draught power, security, meat, milk and manure production and they are seen to be in a positive interaction with plants and soils. Crops are regularly rotated and often several complementary crops are grown together.

Multicropping

While appropriate crop rotations in Europe were recognized to support good soil fertility and weed control, growing crops together was less common, but often seen in densely populated areas. In developing countries crops, such as cassava, normally harvested once/year are grown together with legumes e.g. groundnut and soyabeans and even with maize. The leguminous crop, no doubt, contributes to the soil's nitrogen economy. These systems with different harvesting times are labour consuming, but as labour is generally not scarce, labour saving devices provide no solution. A herbicide resistant monoculture, is certainly no solution. Such systems are also useful for soil fertility. In many areas leguminous trees e.g. *Sesbania*, *Glyricidia* and *Leucaena* are grown on the edges of roads and on edges between small fields of rice. These trees have several functions. They accumulate N, and are thus likely to benefit the crops. Their branches are widely used as fodder for sheep and goats in the dry season, the wood is used for domestic fuel and other purposes and their roots contribute to soil stability and N fertility.

Animals in agro-forestry

Grazing under coconut trees

Animals grazing under trees are of frequent occurrence, although such animals are thought by many to damage forests, mainly through browsing on the trees themselves. Seldom have measurements been made. I became involved in a joint project on grazing within coconut plantations.

This was a joint project with the Coconut Research Institute in Lunawila. Large areas of Sri Lanka are covered with coconut plantations owned, both by large industries and by small farmers. Coconut trees do not form a dense canopy so it is always possible to grow other plants under the trees. In many instances cattle are seen grazing under the coconut trees. Here it is often the case that the owners of the coconut trees are not the owners of the cattle. Cattle are owned by small poor farmers and usually the owner of the coconut trees lets them graze at no cost. An experiment was set up to graze cattle under the coconut at a high stocking rate. In fact, the animals were having much less food than they needed for maximum growth and reproduction.

The results are given in Table 1 from Pathirana *et al.*, (1996) and Ørskov (2002). The animals were old at calving, calving interval was long and milk yield was low. Supplementing with imported rice straw improved the animals' reproductive performance and if they were also given rice bran performance was further increased so that the calving interval was then normal at 13 months.

Table 1. Effect of grazing and supplementation on coconut yield, animal production and soil water holding capacity for six seasons (Pathirana *et al.*, 1996; Ørskov 2002) measured.

Treatment	Coconut Yield Nuts/palm	Copra kg/palm	Calves/ Animal	Lactation kg	Lactation days	Water- holding Capacity 0-10cm mm/m
UG	41.1	11.1	-	-	-	16.9
G	47.9	13.3	0.3	181	201	18.3
GS	50.6	14.1	0.6	405	264	18.9
GSS	57.4	16.7	0.9	664	282	17.6
SEM	2.0	0.5	0.03	25	4	-

UG, un-grazed; G, grazed; GS, grazed and supplemented with rice straw; GSS, grazed and supplemented with rice straw and rice bran; SEM, standard error of the mean.

Just grazing increased coconut yield by about 15%. No wonder the owners of the coconut trees encouraged the small farmers to graze their animals under the trees! The increased yield probably owed to a rapid turnover of biomass and to the effect on soil quality, recorded here as water holding capacity.

Grazing under oil palms

The contribution to the socio-economy of a region became very apparent to me recently on a visit to an oil palm plantation in Bengkulu province of Sumatra, Indonesia. The Indonesian company owning the plantations employed workers to collect palm fruit bundles from the plantation and carry them to a road passable by trucks. The employers had taken the initiative to give each worker one Bali beast (*Bos banteng*), for pulling a small cart. This could hold about 15 to 20 bundles, instead of the one carried by the worker, and it increased the capacity

of the worker to attend to 15 ha rather than 10 ha. The feed for the cattle was plants growing under the trees plus leaves and core from the palm fronds which had to be cut down before cutting of the palm bundle. At night the cattle were also given some palm sludge from the factory. It soon became apparent that there was much more feed than one animal could eat so the farm workers were allowed to take several animals with them to the plantation during the working day. At present an average of 6 animals accompany each worker in the morning. What is the possible stocking rate under palm oil trees? I was told approximately 2/ha, even with a full canopy. If this is so, many millions of cattle could be fed under oil palm trees in the world. This procedure could provide a secure living for many families. Similar effects on oil palm production were observed some years ago, to which reference is made recently (Devendra 2004; Table 2).

Table 2. Effect of mixed cattle and goat grazing on annual yield of fresh fruits in oil-palm plantations, Malaysia (Devendra 2004). (Fresh fruit bundles, 1000 kg./ha)

Year	Grazed area	Non-grazed area	Difference
1980	30.55 (C)*	25.61	4.94
1981	17.69 (C)*	15.87	1.82
1982	25.12 (C & G)	22.97	2.15
1983	23.45 (C & G)	18.29	5.16

*C = cattle; C & G = cattle and goats.

Here there were consistent increases in oil palm yield of some 15 to 20%, as a result of grazing with cattle and goats in the plantation. This probably resulted from an increased rate of biomass turnover and possibly also from increased soil water holding capacity. The positive effects of agro-forestry with animals are not unique to tropical areas. Recent work reported by Sibbald (1999) and Sibbald *et al.*, (1991) showed that productivity of sheep grazing under trees was similar to, and in dry years, greater than that of sheep grazing a similar area in open land. In the forest areas Sycamore trees were grown. Clearly this would not be so if there were complete canopy by the trees. It will also depend on the type of animals. In the work of Sibbald the animals were ruminants.

Animals in silviculture

Silviculture as distinct from agro-forestry means simply that the main product is animal production. These systems are of frequent occurrence. Recently I observed a system being exploited in Cuba where rows of leguminous trees, e.g. *Leucaena*, were used, interspaced with grass. Here again the trees provided N for the grasses. However, another aspect of this has been noted, namely some tree leaves reduce the faecal counts of nematodes and coccidia of the grazing animals. This can be illustrated by some work from Vietnam in which a comparison was made between *Leucaena*, jackfruit and cassava leaves with two types of grasses (Table 3, Lin *et al.*, 2003).

The goats were dewormed using anthelmintic and then given the different feeds. The effects of coccidian counts were similar to that of nematode eggs. It can clearly be seen that the increase in egg count after deworming was much less in the goats receiving the leaves of the plants than those receiving grasses. The effect of the browse plants is probably due to the tannin contents though cassava leaves also contain some cyanide compound. It should of course be noted that tannins are not a uniform compound but can, in high amounts, have antinutritive properties. In the work of Lin *et al.*, (2003) live weight gain was also higher in animals receiving tree foliage. The effects of condensed tannins on gastrointestinal parasites are further discussed in Mui *et al.*, (2005).

Table 3. Number of nematode eggs in faeces of goats given different forages (eggs/g faeces) (Lin *et al.*, 2003)

Date	Cassava	Jack fruit	<i>Leucaena</i>	Guinea grass	<i>B. Rusi</i> grass
Before	1757	527	1680	687	438
After deworming					
30 days	23	22	31	86	95
60 days	265	162	107	533	617
90 days	583	433	350	1042	1152
120 days	870	672	502	1872	2425
150 days	1170	1012	722	3870	4312
Live weight gain p/d	43	39	42	34	25

Multiculture with Rice, Ducks and Fish

Another aspect of multiculture is illustrated in Table 4. Here, instead of using herbicides in the paddy fields, ducks were introduced. The result was duck production as well as rice production. In fact there was no reduction in rice yield. After that fish, Carp and *Tillapia* were also introduced together with ducks for growing, or egg-laying. The rice yield may have been slightly increased and the total benefit to the farmers increased by more than 20 times per unit area of land. No doubt, there was more labour involved, but an introduction of herbicide resistant rice would have eliminated the need for both fish and ducks and would have further increased cost. There are many options like this that can be explored with both environmental and socio-economic benefits.

Table 4. Integrated system of rice, rice plus duck, rice plus fish and duck on net financial benefit to farmers (Mill.Vietnam Dong/ha) (1 USD approximately 15000 Dong)

Systems	Rice	Duck Rice	Duck Fish Rice	Layer Duck Fish Rice
Inputs:				
- For rice	6.62	3.92	3.92	3.92
- For duck	-	8.70	8.70	52.92
- For fish	-	-	13.90	13.90
Total	6.62	12.62	26.52	70.74
Outputs:				
- From rice	8.56	8.03	9.85	10.44
- From duck	-	14.50	14.50	68.02
- From fish	-	-	46.39	47.92
Total	8.56	22.53	70.74	126.38
Net benefit	+1.94	+9.91	+44.22	+55.64

Technology transfer from developed to developing countries

I would like now to make a few critical comments about technology transfer that I encounter frequently. I hope it has been made clear that the transfer of labour saving, high fossil fuel consuming, and technologies provide no solution. In fact, maybe some transfer should go the other way as far as environmental sustainability is concerned. Mono-culture, including herbicide resistant GM cropping, is generally not a solution. Introduction of such inappropriate technologies is often fuelled by persuasion, disguised as attractive study tours,

or consultancy fees, for government personnel and purchase of research capacity in universities or research institutions.

So-called upgraded or superior animals, selected for high yield in a temperate country are exported to areas where the environment is not controlled of sub-tropical or tropical countries. In these situations survival possibilities are generally less than 50:50. This is particularly a problem in humid tropics. Survival is better in dry tropical areas. Animals in most developing countries generally cannot be kept in air conditioned houses. Large allowances of grain are unavailable, so the animals are unable to achieve their genetic potential, owing either to climate or to feed quality restrictions. So-called high quality semen is exported from countries such as Canada, but a superior bull in a cool climate may be totally inferior in a hot climate, where rate of heat dissipation is an important characteristic. However, a limited amount of crossbreeding between exotic and native breeds may be successful in some areas. The same comment may be made about export of so called upgraded chickens and pigs. Many such inappropriate technologies are exported in the name of aid. The beneficiaries are generally the exporters.

Rural poverty alleviation

What is the best form in which developing countries can be assisted and rural poverty alleviated? In Africa and Asia by far the largest and the poorest populations are in the rural areas. First of all there is no one solution. Each area has its own constraints and possibilities imposed by climate, soil and socio-economic circumstances. There is, however, one aspect which is common to all such regions, and this must always be remembered. **Poor farmers cannot take risks.** If the choice is between low risk, low gain or high risk, high gain, then the poor will always choose the former. This is important in that if we wish poor farmers to increase their productivity of crops or animals, this increase must be relatively free from risk, otherwise they cannot be persuaded to respond. There is also a problem of fluctuating prices. Such fluctuation can be caused by the dumping of subsidised products from Western Countries and by the WTO, which freely allows trading of highly subsidised products from the west. This trade restricts the ability of developing countries to underpin local prices which give security to the producers.

Another aspect concerning animals is that the poor farmer prefers small to large animals. If the choice is between 10 goats and one cow, he will invariably choose the 10 goats. If one goat is lost there are 9 left. If one cow is lost, all is lost. This is known as risk spreading and is discussed in some detail by Ørskov and Viglizzo (1995). Also, risk can be reduced by better education and small farmers can be encouraged to form co-operatives for marketing and production purposes. Then they become a stronger unit to negotiate with middlemen. Marketing is complex – sometimes governments find it easier to stimulate large peri-urban animal production units creating endless pollution problems.

The increasing urban demand created by increasing urbanisation must, as far as possible, be satisfied by rural production with the alleviation of rural poverty. The demand should not be accommodated by supporting large scale peri-urban animal or crop units, or by the importation of subsidised products from Western countries, except during years of drought and famine.

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Plenary 5

Efficient Use Of Roughage Resource For Sustainable Development Of China's Dairy Industry

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Abstract

In China, there are about 700 million mt of crop residues produced annually. Crop residues, with their substantial output, have been an issue and now given much attention in developing Chinese livestock production. In treatment of crop residues for utilization, ensiling was more accepted than ammonia. Silage additives have been accepted in China, and ammonium bicarbonate becomes the preference in southern provinces as ammonia source to upgrade crop residues. With the development of ensilage and ammonia treatment of crop residues, more attention has been focused on improving the utilization efficiency. Yeast culture, starch, amino acids and other feed additives (Gamma-aminobutyric acid and N-carbamoyl glutamate) show great potential and have been put in practice in animal production system in China.

Introduction

Forage comprises half or more of the diet for dairy cows, affecting dry matter intake and energy intake (Kendall *et al.*, 2009). One of main constraints for China's dairy industry is the shortage of the forage source. With the development of herbivorous animals, the gap between forage supply and demand has been increasing by 10% annually (Li and Wan, 2005). High-quality forages such as alfalfa hay for dairy cows is especially in short supply in China. In 2012, 460 million kg of alfalfa hay had been imported from foreign countries, mainly from the US, whereas only 100 million kg was produced domestically. At the same time, it is estimated that more than 700 million mt of crop straws are produced annually in China, and most of them are not fully utilized. Thus, it is important to find an efficient use for these forage resources for sustainable development of China's dairy industry.

Forage resources in China

Crop residues are the most abundant and widespread non-conventional feed resources. In 2012, it is estimated that more than 700 million mt of crop residues are produced in China. Straw and stovers are the main crop residues, accounting for 84.8 %.

However, low content of nutrients and poor digestibility of most crop residues limit their efficient use in the diets for high-yielding animals. Currently, only about 31.9 % of the crop residues are used as feedstuff in China while 33.4 % are used for fuel and fertilizer, 2.6% for paper industry and the remaining 29.4 % are abandoned or burnt (Figure 1). There is enormous potential to improve the feeding value and increase the use of crop residues in animal feeding

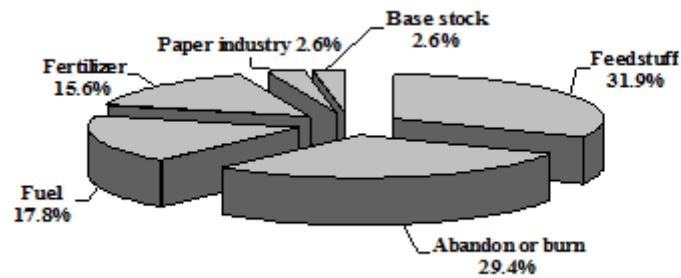


Figure 1. The utilization of the crop residues
(Source: Science and technology education department of Ministry of Agriculture)

Upgrading of forage sources for dairy cattle

Utilization mode of crop residues

The ammoniated straw increased more quickly than ensiled (11.4 % vs. 20.7 %), but from the data of 2000 to 2006, it indicated that ensiling was more accepted than ammonia treatment (Figure 2).

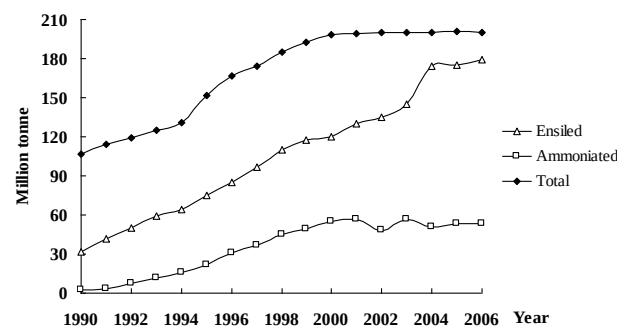


Figure 2. Quantity of crop residues used for animal feed in China during 1990-2006
(Department of Livestock Production, 2007)

Technology of ensiling and ammonia treatment

Use of silage additives

During the recent years, use of silage additives has been encouraged in China to ensure silage quality through promoting lactic acid fermentation, inhibiting undesirable microbes or improving its nutritional value. Commonly-used silage additives include bacterial cultures (Xu and Yu, 2004; Zhang *et al.*, 2004), acids (Guo *et al.*, 2000a; Zhang *et al.*, 2002b; Shen *et al.*, 2004), inhibitors of aerobic damage (Xi *et al.*, 2002; Yang *et al.*, 2004), and nutrients (Guo *et al.*, 2000b). Cereal straws and stover are high in lignocellulose. A mixture of inoculum or enzymes containing cellulase and xylanase is often used (Zhang *et al.*, 1997; Xing *et al.*, 2004; Lv *et al.*, 2005).

Ammonium bicarbonate as source of ammonia for pre-treatment

With regard to ammonia treatment, ammonium bicarbonate, with its abundant source and lower price, has been widely accepted, especially in southern provinces (Zhou *et al.*, 1991; Liu *et al.*, 1991, 1995; Xu *et al.*, 1994). Treatment with ammonium bicarbonate at 5-15 %, N content was doubled, NDF content was decreased by 8 %, and rumen dry matter digestibility was increased by 14 %. Heifers consumed more dry matter from the treated rice straw than

even wild hay. Besides, ammonium bicarbonate was superior to urea in preventing mould in South China (Liu *et al.*, 1990), for ammonia is released faster from ammonium bicarbonate than from urea, especially in warm seasons with high humidity.

Improvement of forage utilization in dairy cattle

Yeast culture to improve milk performance and rumen fermentation of forages

Yeast culture (YC) has been shown to improve lactation performance in a cost effective manner (Desnoyers *et al.*, 2012). The YC contains residual yeast cells, fermentation metabolites and growth media.

The effects of YC addition have been evaluated on in vitro fermentation and microbial communities of low-quality forages (Mao *et al.*, 2013). Total VFA reached peak at 1 g/L YC for rice straw and corn silage with or without grain, and increased linearly for corn stover (Table 1).

Table 1. Effect of yeast culture on fermentation parameters and rumen microbials on low quality forage substrates.

Items	YC (g/L)				SEM	Effect ¹	
	0	1	2	3		L	Q
<i>Rice straw</i>							
Total VFAs (mmol/L)	14.9 ^{ab}	19.6 ^a	17.5 ^a	10.1 ^b	1.53	*	**
Ammonia N (mg/L)	80	89	83	105	7.2	ns	ns
Microbial protein (mg/ml)	3.09 ^b	3.67 ^b	4.03 ^b	6.51 ^a	0.672	**	ns
<i>Corn stover</i>							
Total VFAs (mmol/L)	18.7 ^b	24.0 ^b	26.9 ^{ab}	37.8 ^a	3.49	**	ns
Ammonia N (mg/L)	137 ^c	202 ^a	169 ^b	153 ^{bc}	8.9	ns	**
Microbial protein (mg/ml)	4.59	4.36	5.90	5.93	0.574	ns	ns
<i>Corn silage without grain</i>							
Total VFAs (mmol/L)	21.1 ^b	27.8 ^a	26.6 ^a	16.7 ^c	1.02	*	**
Ammonia N (mg/L)	142	127	158	137	7.8	ns	ns
Microbial protein (mg/ml)	6.76 ^a	8.60 ^a	8.68 ^a	3.50 ^b	0.568	**	**
<i>Corn silage with grain</i>							
Total VFAs (mmol/L)	23.7 ^b	31.3 ^a	25.9 ^b	28.9 ^{ab}	1.59	*	**
Ammonia N (mg/L)	201 ^a	134 ^b	147 ^b	208 ^a	11.1	ns	**
Microbial protein (mg/ml)	4.40 ^b	5.80 ^a	3.80 ^{bc}	2.90 ^c	0.257	**	**

^{a-c}Means within a row with different superscripts differ ($P < 0.05$).

¹L = linear; Q = quadratic.

* $P < 0.05$; ** $P < 0.01$; ns = not significant.

Microbial protein increased linearly with increasing level of YC for rice straw, while it reached peak values at 1 or 2 g/L YC for corn silage with or without grain, respectively. Fungi population was increased with 1 g/L YC for all forages except corn silage without grain. Population of *Ruminococcus flavefaciens* increased at 1 or 2 g/L YC for rice straw and two types of corn silages. Addition of YC can support ruminal fermentation of low quality forages with its stimulating effect on the number of functional rumen microbes, especially fungi populations.

Supplementation with available energy source

Energy source available for the rumen microbial growth may be insufficient when corn stover is used as main forage, leading to a lower milk protein yield (Zhu *et al.*, 2012). Starch as a

major energy source in most feedstuff for dairy cows, accounting for 50 to 100% of non-structure carbohydrate (NRC, 1991), and an increased milk yield and nitrogen (N)-utilization efficiency may be expected with increasing non-structure carbohydrate intake, particularly corn starch, in lactating cows (Rius *et al.*, 2010).

Zhu *et al.*, (2013) found that supplementation of starch to the corn stover (CS) diet had a little lower milk efficiency than cows fed with alfalfa hay (milk yield/DMI = 1.35 vs. 1.39), but the difference was not significant. It is inferred that the supplementation of readily fermentable carbohydrates, such as starch to a corn stover diet achieve a similar lactation performance as alfalfa-fed cows.

Supplementation with amino acids

The Lys and Met are considered to be the most limiting AA for milk protein synthesis in dairy cows (NRC, 1991), and improving the balance of these AA is an effective approach to enhance milk protein production and improve milk protein synthesis efficiency (Cho *et al.*, 2007; Wang *et al.*, 2010).

Sun *et al.*, (2013) investigated the effect of dietary addition of 2- hydroxyl-4-(methylthio) butanoic acid (HMB), a common source of supplemental Met, on milk production and rumen fermentation in dairy cows. There is a tendency to increase the contents of milk protein (3.12 vs. 3.07%) and fat (3.59 vs. 3.50%) and the yield of milk protein (0.94 vs. 0.88 kg/d) and 3.5% fat-corrected milk yield (30.47 vs. 28.58 kg/d) by addition of HMB. Addition of HMB significantly increased concentrations of rumen microbial protein and total volatile fatty acids. Populations of rumen fungi, *F. succinogenes* and *R. flavefaciens* relative total bacterial 16S rDNA increased with addition of HMB. Activity of carboxymethyl cellulase was significantly higher by adding HMB.

With further supplementing rumen-protected AA (RPAA) on lactation performance of lactating dairy cows fed corn stover and starch (CSS) in comparison with alfalfa hay (AH), there were no significant effect on the 4% fat-corrected milk and milk efficiency (Zhu *et al.*, 2013). The contents of milk protein, fat, and lactose were not different among the treatments. Ruminal ammonia N concentration for AH diet was lower compared with CSSAA diet. CSSAA diet resulted in a lower urea N concentration in the milk and blood than CSS, with a medium value for AH. There was no difference between CSSAA and AH on N conversion. It is suggested that RPAA supplementation would further improve the lactation performance and N utilization.

Other feed additives

Feed intake by dairy cattle does not increase as rapidly as the increase of milk production in the early lactation stage. Gamma-aminobutyric acid (GABA) has been shown to increase DMI in lactating sows. Addition of rumen-protected GABA increased DMI and NEL intake linearly, and milk yield quadratically in early lactation dairy cows. Anti-oxidative status was improved by GABA supplementation. The optimal addition level of rumen-protected GABA was at 0.8 g/d for milk production (Wang *et al.*, 2013).

Maximized milk production and decreased environmental pollution have always been a challenge for dairy scientists. N-carbamoyl glutamate (NCG) is a synthetic product of sodium glutamate and considered as arginine raiser. The NCG has variable advantages over arginine. In our previous study (Chacher *et al.*, 2012), the proportion of arginine and NCG degradation in rumen fluid for 24 h was 100.0% and 17.8%, respectively. Rapid degradation of ARG in rumen is a nutritionally wasteful process. Thus, ARG should be spared from rumen degradation, while NCG could be fed to ruminant without need for coating. Furthermore, NCG is much cheaper than ARG [13]. Supplementation of NCG to high

yielding cows altered the plasma ammonia N, nitric oxide and improved the amino acid AA profile that is narrowly related to the AA supplies for milk synthesis, thereby improved the lactation performance and N utilization efficiency in high-yielding dairy cows. The optimal addition level of NCG was 20 g/d/cow (Chacher *et al.*, 2013).

Conclusion

Grain-saving strategy for the animal agriculture and the crop residues-based animal production system promote the sustainable development of China's dairy industry. Ammoniated, ensiled crop residues and supplementations have great potentials for improving crop residues use by ruminants.

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Plenary 6

Converting Agro By-Products For Sustainable Livestock Production

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Abstract

Feeding by-products of the crop and food processing industries to livestock is a practice as old as the domestication of animals by humans. It has two important advantages- these being to diminish dependence of livestock on grains that can be consumed by and to eliminate the need for costly waste management programs. Livestock is vital to the economy of many developing countries. Animals are a source of food, more specifically protein for human diets, income, employment and possibly foreign exchange. For low income producers, livestock can serve as a store of wealth; provide draught power and organic fertilizer for crop production and a means of transport. Consumption of livestock and livestock products in developing countries, though starting from a low base, is growing rapidly. Increasing livestock production is an important component of this process, both because developing country consumers are expected to spend an increasing share of their rising incomes on livestock products, and because taking advantage of favourable livestock-crop production interactions is one approach to a more efficient, sustainable agriculture.

Introduction

Livestock are usually helpful in sustaining agricultural production. However, there are cases where livestock development has had disastrous environmental consequences. While raising animals, more than 70% expenditures are incurred on feed. Due to increasing human population, the area under fodder production is decreasing about 2% after each decade (Leng, 1990). Thus, underfeeding of our animals is one of the main reasons for low production. This is simply because an underfed animal uses a higher portion of its feed for body maintenance. Thus, less of its feed intake is converted into production/ products useful to mankind. There may be many options to overcome the shortage of feed for livestock but one of them is the use of agro by-products.

Agro by-products are one of such feed materials that could be utilized. These feedstuffs which are derived in integrated crop-livestock systems, are materials obtained other than the main product for which the crop is cultivated.

Agriculture-based industry development in every developing country which is exporter of farm commodities, such as rice, corn, sugar, rubber, cassava, chicken, etc, should receive highest priority in national development. Export of raw materials such as those aforementioned should be reduced and saved for local agro-industry. Ready-to-serve foods can get greater export earning than export of raw materials. With good government policy and management, profits from export of agro-industrial products can be equitably shared by

small farmers who produce the raw materials. One of many serious problems of small farmers in developing countries is the low price of farm commodity controlled by local traders and the middlemen. The small farmers have no bargaining power for higher prices due to lack of market access, and other limitations such as small quantity of production, remoteness of the farm, and farmer's debt and financial pressure (Chantalakkana, 2011).

Therefore, the major problems with animal feeding occur in tropical areas subjected to long dry seasons, and there is insufficient plant biomass carried over from the wet season to support animal population. Moreover, acute dry season with insufficient amounts of a low quality and relatively indigestible feed, the protein content is consequently lowered. Thus, developed methodology is needed to improve the quality and sustainable feed for animals as local feed resources (Wanapat, 2011).

Treatment methods of crop-residues and low-quality roughages

In recent years, considerable attention has been given to improve the feed value of fibrous agricultural residues and by-products as well as supplementation strategies. The quantity and quality of feed resources in the tropics have been limited by seasonality and their nutritive values (Devendra, 1990; Wanapat, 1990; Wanapat and Devendra, 2007). However, due to enormous amount of crop residues available in the developing countries potential uses of these resources have been presented (Leng, 1990 and Wanapat, 1993). In general, fibrous agricultural residues contain a large pool of structural carbohydrates which can be potentially degraded by rumen microbes into volatile fatty acids. There are limitations encountered in the utilization of these resources as feeds. Therefore, the strategies of improving the nutritive values by treatments and/or supplementation are needed to overcome the shortfalls and to improve feeding efficiency for the sustainable feeding systems for ruminants.

Crop-residues

It is important to keep the concept of crop residues in perspective. While the term generally refers to various by-products from crop cultivation, we should avoid lumping all residues together. Each residue, and even each fraction of certain residues, is different in terms of its availability, its nutritive value and its potential impact in relation to the overall feeding system. We can, however, distinguish one major group of residues, the fibrous crop residues (FCRs), which have in common their high biomass, and their low crude protein and high crude fibre contents, of approximately 3-4% and 35-48% respectively. These FCRs form the base of feeding systems for ruminants throughout the developing countries, and include all cereal straws, sugarcane tops, bagasse, cocoa pod husks, pineapple waste and coffee seed pulp. Complementary to FCRs are those crop residues that are more nutritious and can therefore be used judiciously to improve the overall diet. This category includes a variety of oilseed cakes and meals, such as coconut cake, palm kernel cake, cottonseed cake and sweet potato vines, which are often used as dietary supplements (Devendra, 2007). Wanapat *et al.*, (1985) successfully demonstrated the efficient use of urea-treated rice straw as a roughage source when supplemented with various levels of concentrate in fattening beef cattle. It was also confirmed on-farm that the use of urea-treated rice straw as a sole source of roughage for fattening beef proved to be economical in the prevailing village system (Wanapat *et al.*, 1992).

Cassava hay

Cassava hay (*Manihot esculenta*, Crantz) was demonstrated to be excellent foliage, high in protein for feeding to ruminants as earlier reported by Wanapat *et al.*, (1997). Higher levels of cassava hay supplementation especially at about 2 kg/hd/d, improved efficiency, reduced

production cost and increased profits (Wanapat *et al.*, 2000). However, Wora-anu *et al.*, (2004) observed that feeding fresh cassava foliage as full-feed resulted in anorexia and ataxia, as well as frequent urination. Therefore, sun-drying of fresh cassava whole crop is recommended.

Leucaena (Leucaena leucocephala)

Leucaena leucocephala leaves have been widely used in diets of all animal species. Cheva-Israkul (1988) reviewed the use of leucaena as a feed. Leucaena can be fed fresh (Wongsrikeao and Wanapat, 1986) or dried (Paengkoum and Traiyakun (2011); Paengkoum, 2011; Paengkoum and Paengkoum, 2010). Paengkoum (2010) reported that supplementing the rice straw diet of growing goats with dried leucaena leaves produced good results (Table 1).

Mulberry (Morus alba)

Liu *et al.*, (1991) reported that the benefits resultant from supplementation with mulberry leaves in sheep diets included an increased intake of the basal diet, lower consumption of concentrate and an increased income.

Samanea saman

Using *Samanea saman* as a feed at 2 kg samanea pods to a basal rice straw diet of buffaloes enabled body weight to be maintained throughout the dry season (Seedtakosed *et al.*, 1988)

Streblus asper Lour

Ruminant feeding systems based on poor quality roughage where protein is one of the first limiting factors may require additional protein to maintain an efficient rumen ecosystem that will stimulate nutrient intake and improve animal performance (Preston and Leng 1987). However, the supplementation of high protein and energy concentrates involve extra cost. On the other hand, foliages from locally grown shrubs and trees such as *Streblus aspe Lour* and *Leucaena* foliages have been successfully tested as protein supplements for ruminants (Aranachal *et al.*, 2002; Kahindi *et al.*, 2007; Paengkoum, 2011).

Table 1. The utilization of local feed resources in goat diets

Treatments	Digestibility (%)		N-balance (g/d)	ADG (g/d)		References
	DM	CP	NDF			
Control	68.3	59.2	55.0	15.4	50.5	Paengkoum (2011)
<i>Streblus asper</i> Lour	66.9	59.8	54.5	17.0	48.0	
<i>Leucaena leucocephala</i>	67.0	59.5	55.2	17.1	47.5	Paengkoum and Paengkoum (2010)
Control	59.1	56.3	50.0	5.6	59.3	
<i>Pithecellobium dulce</i>	56.1	55.1	49.5	5.7	62.9	
<i>Leucaena leucocephala</i>	56.9	49.5	49.2	4.9	62.5	
Control	69.3	58.6	51.7	9.9	55.5	Paengkoum (2010)
<i>Azadirachta indica</i>	67.6	57.9	50.6	11.0	52.0	
<i>Leucaena leucocephala</i>	68.9	57.3	51.8	11.1	53.5	
<i>Artocarpus heterophyllus</i>	64.1	71.0	-	-	-	Paengkoum and Traiyakun (2011)
<i>Leucaena leucocephala</i>	53.2	55.0	-	-	-	

Extrusion-processed mixture of cassava pulp

Studies with an extrusion-processed mixture of grain starch and urea (Starea) indicated that ammonia was released slower from this product both *in vivo* and *in vitro* than when a non-heated control mixture was used and, additionally, this product was superior to urea as a nitrogen supplement for lactating cows and for growing-fattening cattle (Helmer *et al.*, 1970). The research in Thai native x Brahman beef cattle fed with concentrate mixed of extrusion-processed mixture of cassava pulp and urea and varying levels of RUP. The results showed that dry matter intake increased linearly ($p < 0.01$) as the level of RUP increased. Moreover, organic matter digestibility increased linearly ($p < 0.05$) with increasing the level of RUP. Total volatile fatty acid increased linearly ($p < 0.01$) as the level of RUP increased. TVFAs decreased quadratically ($p < 0.01$). Nitrogen absorption was not significantly different among dietary treatments. These results indicated that 35% CP from EMCPU replacement for RUP levels at 40% in concentrate have positive effects on crossbred cattle production (Paengkoum *et al.*, 2012).

Dried Tomato Pomace

Dried tomato pomace may be considered as an alternative feedstuff in ruminant nutrition. The limited literature data that are available so far may be interpreted as indirect and suggestive evidence for diminished ruminal fermentation and bacterial synthesis after substitution of dried tomato pomace for soybean meal (Yuangklang *et al.*, 2010). To reduce the feed costs of animal production, it can be advantageous to replace imported feedstuffs by those produced locally. Dried tomato pomace contains 20-25% crude protein, 9-12% crude fat and 57-67% neutral detergent fiber. There are indications that tomato pomace may be used in ruminant nutrition. It has been reported that the feeding of corn silage mixed with wet tomato pomace to dairy cows left unchanged the production and composition of milk (Weiss *et al.*, 1997). In beef cattle, the feeding of dried tomato pomace as sole source of roughage increased body-weight gain when compared to either hay or fresh grass (Yuangklang *et al.*, 2006). It would appear that dried tomato pomace in the ration can support ruminant production. However, less favorable effects of tomato pomace have also been described. In goats, replacement of soybean meal by dried tomato pomace produced an increase in the ammonia concentration and pH of rumen contents (Yuangklang *et al.*, 2007).

Conclusions

Livestock production will continue to be important component of the farming system and contribute to the well-being of human as protein food products and income generator. Importance of local feed resources will increasingly become more essential for livestock production as well as the role to enrich the environment through the food-feed-system. To empower the scientists especially the graduate students with international perspectives, interactive participation in the scientific forums are deem important and warrant immediate and continuous undertakings by all concerned, particularly senior researchers and high-learning institutions.

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Plenary 7

Grazing Degradation in Central Asia – New Developments Relevant For The Tibetan Situation

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Abstract

Central Asia hosts some of the world's largest grassland regions, and grazing has affected the region over evolutionary time-scales. Pastoral land use has a long tradition in the region, and is adding pressure on the rangelands due to rising numbers in human and livestock. Moreover, herders increasingly abandon the traditional mobile livelihoods. While Mongolian herders are still moving their herds, sedentarization is largely completed in north-eastern China, and rapidly progressing in Tibet (Long *et al.*, 2008, Ptackova, 2011). This is related to increased worries about grazing degradation. Estimates of grazing degradation in Tibet vary hugely; between 9 and more than 35% of Tibet are regarded as degraded (CCICCD, 2000, Gao *et al.*, 2005, Liu *et al.*, 2005a, Liu *et al.*, 2005b, Harris, 2009). A mean estimate would be 500 000 km² of degraded grassland, of which 80 000 km² have only bare soil left; so-called black beach and black soil types (Cui and Graf, 2009, Gao *et al.*, 2010). The high uncertainty regarding grazing degradation renders development of urgently needed management strategies difficult but also makes some of the newly implemented schemes questionable. Among the main challenges rangeland ecology in Tibet, and Central Asia in general faces are the following:

- properly distinguishing between grazing impact and weather / climate constraints
- extending the limited set of experimental (long-term) studies particularly for the typical alpine altitudes above 4000 m above sea level.
- arriving at a consistent set of indicators for rangeland health.

The present contribution briefly reviews data on these three aspects, being admittedly biased towards studies available in the international literature. Some emphasis will be put on comparable rangelands of Mongolia, where traditional grazing systems are relatively intact. Own studies from Mongolian drylands (Wesche *et al.*, 2010, Ronnenberg *et al.*, 2011, Ronnenberg and Wesche, 2011, von Wehrden *et al.*, 2012) will serve as baseline to compare ongoing research in Tibet, with a focus on two own and ongoing projects. In an experimental approach, we study effects of grazing on vegetation, soils and matter fluxes at two sites: Xinghai is representative for the montane to sub-alpine grasslands of the northern and eastern declivity of the plateau, while Kema is representative of the typical alpine *Kobresia* mats that form the world's second largest alpine ecosystem. Effects of grazing are vastly different between the two sites, with grazing exclusion having severe yet partly negative effects on montane pastures (Miehe *et al.*, 2008), while fencing at the alpine sites has much less apparent consequences. Moreover, different indicators such as species richness, community

composition, soil carbon stocks and soil nutrients show different and even partly contradictory responses.

We have thus started the survey-based PaDeMoS project, where grasslands in all major environments of the (eastern) Tibetan plateau are compared in a common framework. Here, we rely on several biotic (plants, small mammals, ants) and abiotic (soil) parameters that give a more comprehensive picture of rangeland health. This supported inferences from the experimental approaches: Grazing effects differ among different environmental settings and can only be compared against comparable indicator systems. This shows the high need of improving the network of grassland research systems, a challenge well taken by Chinese research institutions in the last few years. It highlights the need to develop land use policies that are customized for the local environmental (and social) setting.

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Plenary 8

Establishing A Successful Dairy Community Development Program: The Challenges And Pitfalls

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Abstract

The awarding of a research grant designed to investigate the limitations to dairy animal productivity in socioeconomically disadvantaged communities in a country totally foreign to the successful applicants presents many challenges. This paper highlights some of the key challenges that have been arisen throughout the 6 years of our dairy extension program awarded through the Agriculture Sector Linkages Program established as a co-operative agreement between the Pakistani and Australian governments. Successful sustainable programs depend on the identification of the right partner organizations and staff to conduct the program and then the keeping of accurate records to measure and report on the success of farmers to both sponsors and host organizations.

Introduction

Pakistan is heavily dependent on an agrarian rural based economy, with livestock contributing 50% to the country's economy (Pakistan Economic Survey, 2006). The predominance of villages are populated with farmers owning 3-10 dairy animals, with much of the milk consumed domestically, while a small proportion is on sold into either the local community or to milk buyers operating in a marketing chain culminating in the sale of milk in large cities. However, Pakistan's standing as the world's 4th largest milk producer relies on production of less than 6 litres per day per animal from over 50 million buffalo and cattle. Our aim was to improve the productivity of the national herd

Materials and Methods

Forming the right partnerships

As an Australian dairy scientist funded to investigate ways of "revolutionising" the commercial acumen of these farmers through co-operation with organizations already working in the field with them, it was difficult to know where to start. Governmental institutions like the state or federal Livestock Ministries are the most likely choices on offer from governments.

The advantage of working with a large bureaucracy like a state Livestock Ministry which employs hundreds of veterinary officers servicing the needs of millions of dairy farmers is that there is a structure to work with. Furthermore, there is scope for extension of their activities as only about 20% of small-holder farmers receive any assistance at all.

The disadvantages are that the organization is most often hampered by inertia based on a career structure for the veterinary extension staff that offers no incentive to excel. Some officers can wait for as long as 20 years for promotion beyond base grade. There is no mechanism for promotion based on performance. Thus engaging these staff in a new performance based paradigm presents a real challenge.

The other issue relates to the management of finance, which once sent to the ministry to fund the project, becomes difficult to access because of the bureaucratic process of approval of expenditure. Delays in fund release can cause major delays in progress with program inception. Working with NGO's is an ideal objective, but their activities can change markedly over a short period: therefore there is no continuity in support. Similarly, smaller co-operative companies have their own commercial objectives which often do not align with the welfare of farmers.

Co-operation with other aid agencies

Some countries are awash with funding from a range of international agencies most often with a motive to service the political agendas of countries funding the organization. Their objectives most often overlap, and yet because their funding is dependent on the delivery of a work program decided at the point of signing of contracts, there is little incentive or scope for co-operation of sharing of resources between projects. In some cases, the program can be designed by one consultancy and then implemented by an entirely independent organization which might not be able to deliver effectively.

Shifting objectives

The political agendas of governments can change and therefore the emphases of projects can also change in line with these. A sudden push for a "pro poor" approach to aid, for example, means that flexibility needs to be built into every project to meet the needs of an ever changing political environment.

Choosing the right staff

The rule of thumb is to choose young resilient expatriate staff to immerse directly into the environment in which the project is to be implemented. Their decision making processes will not be influenced by previous project management experience. They then need to have an advisory group who visits on a frequent basis to provide some guidance with program direction and also to assure senior bureaucrats in partner organizations that back-up assistance is never far away. Then newly trained local graduates, who will be compliant with the aims of the project, need to be chosen carefully. Having the right staff in place in both the operational team and among the partner organizations is critical to success. Once local staffs are trained, expatriate staffs need to withdraw to oversee progress with the project from afar. These staff will also need to visit the project team on a frequent basis to monitor progress and offer further suggestions.

Keeping good records

The key to success is to measure the rate of success in the targeted farming communities through accurate record keeping. This involves the development of a comprehensive survey that will provide the baseline for on-farm productivity and community development. This must be constructed carefully as the survey can be conducted only once. Thereafter, accurate on farm record keeping is required to measure progress. The data base needs to be maintained constantly and analysed at fixed times to ascertain responses to the extension activity. There

is a need for constant reviewing of the project approach to ensure that the financial investment is reaping the return demanded by the funding agency.

Results and Discussion

Project sustainability: the key to success

Results can only be evaluated after the sustainability and outcomes of the project can be measured. Success is dependent on developing a working relationship with farmers and collaborating partners based on trust. Rather than offering incentives to farmers to ensure their engagement, a more effective mechanism is to initiate a project with sentinel farmers who are the innovators in any community. These leaders will soon demonstrate the virtues of the project if it is implemented correctly and others will then follow. Engagement with women and children as well as the local school teacher is a critical component for success with extension. Above all, it is essential that the project develops to keep all partners happy. This might mean adjusting the project aims to accommodate the wishes of local industry leaders. In the end, it is critical that a cadre of workers in the partner organizations is left with funding provided from within their organization or from farmers to carry on the project after external aid funding ceases. Persistence combined with flexibility together with accurate data recording and reporting will always pay off in the long run.

Conclusion

Successful extension activities require total involvement of project staff with the communities they are working with. The nature of extension material has to vary to ensure maximum engagement of the whole family. At an organizational level it is essential that an established network of extension staff is in place to ensure that success with the project extends well beyond the period of funding for the program. The leaders of the program must be working cohesively and preferably are from the current generation of young graduates who are the future of the industry we are assisting.

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Plenary 9

Opportunity and Challenges of Liquid Feeding in Swine Production

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Abstract

Development of “eco-feed” is one of the most outstanding outcomes in Japanese animal industry in the past decade. Dehydration, silage and liquid feeding are the major technologies to prepare eco-feed. We have developed a series of technologies for liquid feeding. A fermented liquid diet was formulated solely by using co-products, such as rice in lunchbox, rice ball, sweet bun, milk, soy bean curd residue and vegetable residue without any grain. The diet was prepared by the following procedures: 1) mixing the ingredients, 2) addition of alpha-amylase, 3) heat treatment, 4) addition of *Lactobacillus plantarum* LQ80 culture broth at 40°C, 5) fermentation for 18 h. The pigs given the fermented liquid diet showed better growth and compatible quality of pork can be produced by fermented liquid diet in comparison with formula feed. Other than fermented liquid feeding, we have developed technologies to prepare liquid diet using various liquid by-products generated from food industries by addition of organic acids for preservation.

Introduction

Development of “Eco-feed” is one of the most outstanding outcomes in Japanese animal industry in the past decade. The definition of eco-feed is a use of co-products for animal feeding. Co-products include by-products generated from food industries, surplus and wastes generated in the processes of distribution, retailing and consumption of food.

Co-products used to be primary feed resources for pigs in Japan. The use of co-products, however, declined due to the introduction of commercial concentrate feed and high-performance exotic breeds, accompanied by a change in producers' strategies toward pursuing efficient production. The quantity and the quality of co-products also changed due to changes in lifestyles. Past systems cannot simply be applied in the current system. However, gradual increase of feed prices and a fear for an increase in import of cheap animal products under WTO/FTA system pressures livestock farmers to cut down further production cost. About 60% of production cost is derived from feed. The use of co-products is one of the most attractive measures to cut down the cost.

While some of co-products derived from food industries, whose quality and quantity do not fluctuate, are being used as part of concentrate feed after being dehydrated, the quality of most food wastes fluctuates considerably and its safety is another concern. Consequently, its use as animal feed has been limited. Such co-products have been incinerated and landfilled. This process creates emissions of global warming gases and toxic substances such as dioxin. To alleviate the environmental burden from co-products, the food-recycling law has been enforced since May 1991. Under this legislative system, many projects have been initiated. Most of the activities relate to the production of compost. As acceptance of such compost by crop farmers is limited, the co-products, which can be safely used as feed, should be

processed into feed. The amount of co-products used for animal feed was 2.4 million ton in 2007. The government has set a plan to increase it up to 5.1 million ton in 2015. There have been various activities to develop technologies to produce and utilize eco-feed in Japan. In this paper, technological developments of liquid feeding in swine production are focused.

Processing co-products for animal feed

Methods of processing co-products for animal feeding are generally classified into the following three categories: 1) Dehydration, 2) Silage, and 3) Liquid feeding. Distribution range, delivery system, costs of processing, preservability etc. differ depending on the method, which is mainly related to differences in moisture content.

Dehydration

After the enforcement of the food recycling law, several kinds of model plant were built to manufacture feed from co-products by dehydration. The methods involved in dehydration include conventional dehydration using heat, vacuum heating dehydration, fry cooking, and fermentation-dehydration. Farmers can feed them to animals without modifying the feeding system if the feed composition is appropriate. Or, products can be used as ingredients of commercial concentrate feed.

Silage

Ensiling is another method for processing co-products into feed. While silage is mainly fed to ruminants, it is not used in practice for swine production as silage cannot be delivered through the conventional feeding system for concentrate feed. Therefore, the procedure can be considered to be a temporal preservation method after generation until processing into feed.

Liquid feeding

Liquid feeding is a feeding system to deliver liquid mixture of feed ingredients with water to pig pen through pipeline. One of the major advantages of liquid feeding is a utilization of wide range of co-products which contains high moisture. As high-moisture co-products are easily spoiled, an application of organic acid and lactic fermentation are the major technologies for the preservation.

Liquid feeding Technologies

Fermented Liquid Feeding

We have developed a technology of fermented liquid (FL) feeding (Ohmori *et al.*, 2007). FL diet was formulated solely by using co-products, such as rice in lunchbox, rice ball, sweet bun, milk, soy bean curd residue and vegetable residue without any grain. FL diet was prepared by the following procedures: 1) mixing the ingredients, 2) addition of alpha-amylase, 3) heat treatment, 4) addition of *Lactobacillus plantarum* LQ80 culture broth at 40°C, 5) fermentation for 18 h. In total, 15 pigs (a three-way cross, average BW 69.1kg) were divided into a control group given formula feed and FL group given FL diet. Pigs were kept in an individual crate with free access to water, and feed was given ad libitum. The animals were slaughtered at a public slaughter house when body weight reached 110 kg. Chemical analysis of ingredients for the preparation of FL diet showed that proper separation of co-products according to classifications made a variation of chemical compositions relatively small. Consequently, the chemical composition of prepared FL was stable. Average daily gain of the

pigs given FL diet was higher than that given control diet. Feed conversion ratio on the basis of dry matter of the pigs given FL diet was lower. The study clearly showed that stable quality of FL liquid diet satisfying nutritional requirement of slaughter pigs can be prepared using co-products by the proper separation. The pigs given the FL diet showed better growth and compatible quality of pork can be produced by FL diet in comparison with formula feed.

As FL diet contains high level of lactic acid bacteria, the effect of the diet on gut ecology was examined in piglet in comparison with dry feed supplemented with antibiotics. Antibiotic-supplemented feed slightly increased bacterial diversity in the ileum but reduced it in the caecum while in animals given FL diet bacterial diversity was elevated. FL feeding affects the gut ecology in a different way than antibiotics and contributes to the enhanced bacterial diversity in the gastrointestinal tract (Tajima *et al.*, 2009). The effects of FL diet on the immune response of weaning pigs were also evaluated (Mizumachi *et al.*, 2009). It was revealed that FL diet could alter the immune responses of weaning piglets by stimulation of the systemic or mucosal antibody response, without unnecessary inflammatory reactions. The change in chlortetracycline resistance in *Escherichia coli* strains separated from the faeces of piglets fed FL diet in comparison with those fed with dry feed was also examined (Kobashi *et al.*, 2008). The results showed that FL feeding caused an increase in the number of lactic acid bacteria in the intestines, and suggested a possibility of reduction of antibiotic-resistant bacteria.

Use of organic acids for preservation

There are various liquid by-products generated from food industries. These by-products can be used as an ingredient of liquid feeding. One of the constraints for it is preservability of by-products. The effect of formic acid addition on the conservation of sweet potato distiller's residue was examined (Otuska *et al.*, 2007). The control group (CN) and 0.2% formic acid added group (FA) were incubated at 25°C for 10 days. Changes in pH, number of total aerobic bacteria, coliform and yeast, and concentrations of citric acid and ethanol were measured. The pH was significantly lower in FA. The number of total aerobic bacteria rapidly increased until day 4 in CN. On the contrary, that in FA gradually increased and was significantly lower on days 4, 6 and 8. The number of yeast in CN increased rapidly on days 2, 6 and 8, but the increase in FA was slow and the number was significantly lower than that in CN on days 2, 6 and 8. Concentrations of citric acid in CN greatly decreased on day 6 and disappeared on day 10. Consequently, that in FA hardly changed until day 6 and it was significantly higher than in CN. This suggests that addition of 0.2% formic acid prevented proliferation of microorganism and improved the conservation quality of sweet potato distiller's residue.

The productivity of pigs given commercial formula feed supplemented with liquid cheese whey, which was added 0.1% of formic acid, was examined (Kobashi *et al.*, 2009). A total of 66 weaned piglets were divided into the group of pigs given commercial formula feed supplemented with liquid whey (Whey) and the group given commercial formula feed alone (CN). A total of 267 L of liquid whey was given per animal in Whey group. Mean body weight at ages of 65 days and 173 days was significantly higher in the Whey group than in the CN group. There were no significant differences in carcass traits, meat quality or innate immune function between two groups. These results showed that liquid whey supplement allows acceleration of age at slaughter without affecting carcass traits or meat quality and is useful in improving the productivity of pigs.

Reproductive performance of sows fed with commercial formula feed supplemented with liquid whey, which was added 0.1 % of formic acid, was also examined (Takahagi *et al.*, 2011). Sows were fed with three to five L of liquid whey per day per head. Litter size, rate of

return to estrus within seven days and conception rate of whey-fed sows were significantly higher than those of control sows.

The effect of formic acid or propionic acid addition on the preservation of concentrated rice washing water (CRW) was also examined (Tatsugawa *et al.*, 2011). Formic acid and propionic acid was added CRW and incubated at room temperature for 7 days. Changes in the number of bacteria, yeast, and coliform were counted. The results suggested that addition of 0.6% formic acid prevented proliferation of microorganisms and preserved quality of CRW. A digestion trial was also conducted to examine nutritive value of CRW. Total digestible nutrients of CRW were 97.2%. CRW contained enough nutrients and can be utilized as liquid feed ingredient.

Environmental issues

There is increasing concern about eco-feed from an environmental viewpoint; however, various forms of energy are consumed in the production of eco-feed. Environmental impacts of three scenarios were investigated and compared using life cycle assessment (LCA): production of liquid diet by sterilization with heat (LQ), production of dehydrated feed by dehydration (DH), and disposal of food residues by incineration (IC) (Ogino *et al.*, 2007). The functional unit was defined as 1 kg dry matter of produced feed standardized to a fixed energy content. The system boundaries included collection of food residues and production of feed from food residues. In IC, food residues are incinerated as waste, and thus the impacts of production and transportation of commercial concentrate feeds equivalent to the produced feed in the other scenarios are included in the analysis. Our results suggested that the average amounts of greenhouse gas (GHG) emissions from LQ, DH, and IC were 268, 1073, and 1066 g of CO₂ equivalent, respectively. The amount of GHG emissions from LQ was remarkably small, indicating that LQ was effective for reducing the environmental impact of animal production. Although the average amount of GHG emissions from DH was nearly equal to that from IC, a large variation of GHG emissions was observed among the DH units.

LCA was also used to compare GHG emissions of three methods used to produce animal feed from CRW and disposing of the rice-washing water through wastewater treatment. Four scenarios were compared using LCA: (i) producing concentrated liquid feed by centrifugation (CC) of CRW with wastewater treatment and discharge of the supernatant, (ii) producing concentrated liquid feed by heating evaporation (HC) of CRW, (iii) producing dehydrated feed by dehydration (DH) of CRW, and (iv) wastewater treatment and discharge of non-concentrated rice-washing water (WT). The functional unit (FU) was defined as 1 metric ton of rice washed for cooking or processing. Our results suggested that the energy consumptions of CC, HC, DH, and WT were 108, 322, 739, and 242 MJ per FU, respectively, and the amounts of GHG emissions from CC, HC, DH, and WT were 6.4, 15.8, 45.5, and 22.5 kg of CO₂ equivalents per FU, respectively. The present study indicates that liquid feed production from CRW by centrifugation has a remarkably reduced environmental impact compared with the wastewater treatment and discharge of rice-washing water.

Feed formulation program

Feed formulation program was developed for the preparation of eco-feed. The program can be used for the preparation of liquid feed. The program consists of the following 4 sheets: 1) Requirement calculation, 2) Feed formulation, 3) Feed composition and 4) Cost minimization. The program was written in Japanese and can be downloaded from the following site: <http://www.naro.affrc.go.jp/nilgs/contents/program/ecofeed/index.html>

Conclusion

The self-sufficiency rate of food in Japan is only 40 percent. A very low self-sufficiency rate of feed (about 24%) is one of the major reasons for this. An unbalanced feed supply makes the livestock sector unsustainable. Recycled use of co-products for feed is effective for improving the self-sufficiency rate of feed and reducing the environmental burden from co-products.

In many developing countries, urbanization induces an imbalance in nutrient accumulation. While large amounts of nutrients accumulate in urban areas as co-products, livestock in the countryside suffer from malnutrition. Technological developments in the use of co-products for animal feed will contribute to improving food self-sufficiency and in correcting the imbalanced accumulation of nutrients, which makes animal-agriculture more sustainable.

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Plenary 10

Goats Farming And Livelihood Of Small-Holder Farmers In Indonesia

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Abstract

In Indonesia goats are bred for dual purposes meat and milk. The development of dairy goat small-scale business in Indonesia is run by farmers. Each family usually has 8-10 goats. One of the goals of raising dairy goat is the possibility of the milk production so that the milk can be sold and it can generate regular income for the farmers. The ownership increases with the availability of forage, land, and manpower. The dairy goats are managed in two ways; group management and individual one. In Indonesia, livestock is substantially an integral part of the agricultural sector. Therefore, in the context of rural culture, livestock is the additional activity and alternative income source of all productive economic activities of farmers. The majority of farmers often position "livestock" as a form of savings (biological saving) that can be relied upon as the last alternative financing (the last resource) for both economic and social activities. However, the development of the livestock sector management among farmers is still not optimal so that the income from the livestock sector functions more as additional revenue. Community projects have been developed in Yogyakarta and Central Java by University of Gadjah Mada for group farmers. In West Java, the community services for the farmer have been developed by Bogor Agricultural University with the program name Mobile Nutrition Services, for individual and semi-intensive farmers. The role of universities is to transfer technology and to provide counseling about nutrition, reproduction, health, etc. In some areas, goats are reared for contest. Dairy goats are usually raised in hilly areas so that it is easier to find the forage. Some studies showed that forage crops given vary during the rainy season and the dry season. In the rainy season, there are about 5 types of forage crops, dominated by grass and legume. In the dry season, there are about 22 species. Many studies showed that the forage crops given contain tannins, which function as anti-parasite. Some *in-vitro* studies showed that the use of leaf extracts reduced the number of eggs hatched. Similarly, *in-vitro* studies showed that Papaya and Cassava leaves have good effects as anti-worms /anthelmintic and anti-coccidian, which are the major parasites in villages. It is found that forage crops have high nutrients at the same time they also have anthelmintic properties, making them promising feed since they are able to help farmers in solving problems related to parasites.

Introduction

One of the goals of the program in goat farming is designed to help alleviate poverty in Indonesia through goat livestock development. Increasing rural prosperity of the farmer is a very important issue in meeting food self-sufficiency. One way to achieve this is by doing activities in the field of animal husbandry notably goat farms. Elevating rural wealth has become a top priority in the agenda for national development. Although the animal husbandry

programs to alleviate poverty in rural communities have been implemented, the success of these programs still needs to be improved. One of the weaknesses of the program is the absence of guidance on an ongoing basis. Assisting the less fortunate rural communities needs to be done by doing a variety of activities. The assistance in the form of facilitation, mediation, and advocacy should be done by the local community elements, including the Universities. The role of Universities as one element of educated people in development programs and poverty reduction should be optimized. Universities should help the local communities through the transfer of technology. There are many different solutions to assist in risk management for small farmers. The correct one depends on socio-economic circumstances: 1. Underpinning of prices and stable prices, if the prices are stable and rewarding for the farmers, they will soon respond to it. 2. Infrastructure for marketing. 3. Stimulation in formation of local co-operatives. 4. Political and economic stability in the country. Livestock kept by small farmers in developing countries have a very important product called security. If we ask Indonesian goat farmers when they will sell their goats, the answer always is when they need the money and not when the animal has reached a given age or weight. This banking system of animals of course means that a lot of food is used for maintenance of the animals, rather than for growth and/or milk production.

Goat population in Indonesia increases gradually about 4.6% per year. The total population of goats was around 17.4 million in 2011 involving 3.5 million household farmers (Indonesian Livestock Statistic, 2011). In Indonesia, there are many goat breeds such as the bali, boerawa, etawah, gembrong, jawa randu, kacang, kosta, marica, muara, samosir, kapra, etawah crossbreds and saanen. The highest goat population is in three provinces such as in Central Java (Sleman, Yogyakarta), East Java (Blitar), and West Java (Bogor, Bandung and Garut). From the total goat population, around 3 million are reared for milk production. Farmers usually keep the animals for dual purpose, i.e., milk and meat, while for breeding purposes, only a few of them select goats for milk.

Community Project

Livestock is substantially an integral part of the agricultural sector. Therefore, in the context of rural culture, livestock is the additional activity and alternative income source of all productive economic activities of farmers. The majority of farmers often positioned "livestock" as a form of savings (biological saving) that can be relied upon as a last alternative financing (the last resource) for both economic and social activities. However, the development of the livestock sector management among farmers is still not optimal, so that the income from the livestock sector functions more as additional revenue.

Community projects have been done by University of Gadjah Mada (UGM). This program is the empowerment of farmers to increase family income using goat as a model to provide family income diversification in rural communities (Kustantinah *et al.*, 2006). Mentoring on raising goats and role to increase the family income can be observed from the number of livestock owned. This program is the real proof of the empowerment of rural families who receive assistance from University. In addition to benefitting the farmers, the program also has a positive impact on the environment.

In Indonesia, the majority breed raised by farmers for goat milk is Ettawa cross breed. In fact, the goats in Indonesia have crossed with Ettawa, but divided on meat and milk types. When the goat is milk-type, the performance is closer to Ettawa, which is white-haired, black or brown spot, but when the goat is meat-type, the color of hair is brown, brown-black or a combination and they are more prolific than milk goats. In Indonesia, the locations are different for farmers who raised Ettawa Cross breed goats for milk production and meat production. The ones who raise goats for milk are situated in the hilly and cooler areas e.g.

Kaligesing, Purworejo, Turi, Sleman, Sukorejo and so on while the ones raising them for meat production are situated in the hilly but hot areas. The pattern of goat raising is both individual or in a groups.

The activities always begin with socialization about the duties and rights of members, and participatory of implementation. One of the constraints of raising goats is marketing, thus, to solve the problem, we introduced a buffer marketing system. The background of the creation of this system is in the rural family, generally they will sell their livestock at the time of need, and this culture will not be changed. Farmers raise goats or cattle derive income but it is not treated as the main income. The family income does not depend on livestock, but such earnings are treated as exigency. They will sell the animals when they need money for school fees, ceremony, illness, etc. However, when the income of farmers is strongly influenced by livestock, optimum livestock productivity must be in place. This activity can be formulated into several stages as follows:

1. Socialization Program. Socialization program will be carried out before the event takes place; it is to inform participants of their rights and obligations, and it is done by consensus and counseling. Socialization program was conducted before and after the formation of the group, but if there were community members who disagree with the program to be carried out, they could immediately resign and were replaced by other community members. The goat management system was based on the principle of Gaduhan (Sharing), in which the majority of the women were given two females goats. For every ten females there is available one male goat. Each member of the group had to sign a legal agreement stating the age, sex, weight and price of goat received from the project, that they agree to the system of goat sharing and that they would manage the goats to the best of their ability. After the second pregnancy, the farmers became the sole owners of the female goats and the kids.

2. Counseling in the field of goats husbandry. Once the group was formed, then counseling in the field of animal husbandry followed:- Animals Housing; Reproduction, Disease Prevention and Treatment, Feed and Forage.; Waste management and marketing (buffer marketing system)

3. Improving Animal Housing and Introduction of feed. Goat sheds are made in accordance with the availability of local materials and technical requirements. For the supply of animal feed on site, it is necessary to introduce grass or legumes. Counseling regarding the types, benefits, how to care / cultivation, and ways to preserve food was previously done. Forage to be introduced includes the types of legume trees such as Calliandra, Leucaena, Sesbania and Desmodium rensonii, and Jack fruit etc. It was suggested to choose legume which is not difficult to establish and relatively fit for local conditions and favored by goats

4. Introduction of goats. After the animal housing program and the introduction of livestock feed is completed, then the introduction of goats began.

Performance and Livelihood of semi intensive dairy goat

One of the three main tasks of the University is public services. Faculty of Animal Science, Bogor Agricultural University has a special program named “Mobile Nutrition Services” whose main function is giving technical advice to more than ten semi-intensive dairy goat farmers in Bogor district, West Java which contributes significantly to the goat milk production and marketing. Three of them have been evaluated and supported by the program and received forages (*Indigofera* sp.), feed analysis and health services (see Tables 1 and 2).

a. Breeds: Ettawa crossbred ram is going to be a contest animal while the female goat are still used as milk producers. To improve the production, the farmer crossbred male Ettawa with female Saanen goat in order to get good quality and high milk production. Case study in Bangun Karso farm, with Ettawa-Saanen crossbred showed that the milk production was around 6 L/d. So far there is very low support from the government to improve dairy goat breeding system in Indonesia.

b. Management: Dairy goat feeding depends on native grass, king grass and now being introduced is *Indigofera* sp. Some farmers gave low quality of concentrates (made by them), tofu waste, soybean cake waste and dates waste. Milk marketing has been done directly to the consumers in the form of fresh milk, but some farmers do milk pasteurizing and sell it to the home industries in order to produce a kind of yoghurt.

c. Livelihood: Most farmers in West Java do keep not more than 10 animals, but some of semi traditional farmers keep more than 100 animals with 2-3 laborers. The income comes from milk sales, goat kids and manure. The laborers work from morning 5.00 am until afternoon 5.00 pm with salary of around US\$ 15 – 20 per day (personal communication, 2013).

d. Health status: Data on blood parameters showed the normal range, whereas in Bangun Karso, the farm has better health status as a result of good quality ration. Ration with 50% legumes-grass mixture plus 50% concentrate will give good milk production. Astuti *et al.*, (2008) reported that small ruminants like sheep raised under the tropical forest with low management feeding system had low serum glucose, total protein and triglyceride concentrations.

n Yogyakarta special district, Central of Java, there are about 15 communal goat housing, especially in Sleman sub district with supervision by UGM e.g. Sukorejo I, Turgo lestari, Kemiri Kebo, Pangestu etc. The majority of goats raised in the communal form, for example in farmer group of Sukorejo I, established in 2007 with the support of Orskov Foundation (Suranindyah *et al.*, 2010), has a present population of 220, and on average, the occupancy per farmer is about 8 to 10. The primary job of farmers in this group was producing mixed crop with vegetables and fruits as the majority crop. The main purpose of raising goats in this group was to produce kids and manure. In this

Table 1. Ettawa crossbred Dairy Goat performance in semi intensive farm, Bogor district West Java, Indonesia

	Bangun farm	Karso	Cordero farm	Mitra Primata farm
Population (head) Total	275		206	120
- Doe	202		100	85
- Ram	6		6	25
- Kid	67		100	10
Milk yield and quality				
- Production (L/head/d)	0.8 – 3.50		0.80	0.50
- Density	1.0386		1.0284	1.0280
- Fat (%)	6.90		5.80	4.55
- Protein (%)	6.82		4.30	4.90
- Lactose (%)	3.35		-	3.40
- SNF (%)	11.66		9.37	9.10
- Milk Price (US\$/L)	3.50 – 5		3.50	2.50

Table 2. Hematology and Blood metabolite status of Ettawa crossbred in semi intensive farm

Parameter	Bangun farm	Karso	Cordero farm	Mitra Primata farm
Hemoglobin (g%)				
- Doe	8.40		6	6.50
- Ram	9.50		7.10	7
- Kid	8.60		7.50	8
Glucose (mg/dl)				
- Doe	57		28	30
- Ram	67		28	29
- Kid	83		24	28
Triglyceride (mg/dl)				
- Doe	39		14	32
- Ram	33		22	23
- Kid	44		33	36
BUN (mg/dl)				
- Doe	12		20	10
- Ram	14		11	19
- Kid	11		16	12

group, milking for human consumption only comes from the late lactation. Consequently, there was only little milk to be collected for sale (Suranindyah *et al.*, 2009) (Table 3). The study of half milking (restricted milking) showed a positive effect on milk production.

Table 3. Milk production and lactation period

Variables	Treatment	
	Half day milking	Full 3 months nursing
Lactation period (day) ^{ns}	153.4 ± 6.9	129.6 ± 9.8
Milk production (l/lactation)	63.6 ± 11.5 ^a	20.7 ± 6.8 ^b
Birth weight (kg) ^{ns}	2.97 ± 0.11	3.11 ± 0.28
Weaning weight (kg) ^{ns}	13.10 ± 1.07	15.00 ± 2.45
Daily gain:		
Birth to 1 month of age (g) ^{ns}	137.0 ± 15.9	132.0 ± 11.3
1 to 2 months of age (g) ^{ns}	123. ± 23.2	144.3 ± 23.7
2 to 3 months of age (g) ^{ns}	103.0 ± 29.7	116.7 ± 34.0

a, b means within row with different superscripts were significantly different (p<0.05) ; ns Non significant

Feed Mangement

The provision of feed between dry season and wet season in East of Java were different (Hidayat *et al.*, 2012). In the wet season, leguminous forage was significantly higher compared to dry season. In the dry season, the feed is dominated by non-legume trees. In another study, Kustantinah *et al.*, (2008) found that in the dry season, the type of feed given by farmers came from 22 species, while in the rainy season it involved only 5-6 species. There is some research interest on the effect of forage containing the active metabolite (tannin) against parasites (Adiwimarta *et al.*, 2010). Supplementation of grass with the leaf of cassava or *Carica papaya* both increased nutrient intakes and had an anthelmintic effect by

decreasing Egg Per Gram in the faeces (EPG) and *Coccidia* (Table 4 and 5), as well as *in vitro* (Daryatmo *et al.*, 2012). By using extracts of fifteen tropical forages containing active compounds in goat feeds, the anthelmintic effects of the tannin content against *Haemonchus contortus* eggs, and restriction in worm eggs hatch were observed (Table 6). Further, controlled *in-vivo* experiment studies are required to identify possible effects on the performance of the animals before any potential forage plants can be recommended.

Table 4. Nutrient intakes in goats receiving grass and cassava or Carica papaya leaf

Nutrient intake	Grass	Grass + Papaya	Grass + Cassava
Dry matter (g/kg LW)	33.64 ^b	35.35 ^a	35.36 ^a
Organic matter (g/kg LW)	28.80 ^b	30.59 ^a	30.21 ^a
Crude Protein (g/kg LW)	4.20 ^c	5.26 ^a	5.06 ^b
Crude fibre (g/kg LW)	8.15 ^a	8.13 ^a	7.43 ^b
TDN (g/Kg LW)	15.25 ^b	15.66 ^{ab}	15.83 ^{ac}

^{a,b,c} Different superscripts in the same row indicate a significant difference (P<0.05)

Table 5. Worm egg counts and *Coccidia* counts in faeces of goats receiving grass and cassava or papaya leaf (number/g)

Treatment	Days of collection				
	0	15	30	45	Average
Worm egg count					
Grass	220 ± 164	280 ± 179	580 ± 236	760 ± 152	460 ± 283 ^a
Grass+papaya	670 ± 297	330 ± 241	260 ± 195	210 ± 225	368 ± 289 ^a
Grass+Cassava	520 ± 362	300 ± 71	230 ± 76	160 ± 119	303 ± 228 ^b
<i>Coccidia</i> count					
Grass	130 ± 67	130 ± 67	160 ± 96	230 ± 57	141 ± 69
Grass+papaya	760 ± 1044	240 ± 156	110 ± 89	60 ± 55	141 ± 143
Grass+Cassava	660 ± 609	410 ± 429	120 ± 103	60 ± 42	184 ± 212

^{ab} Different superscripts in the same column indicate significant difference (P<0.05)

Conclusion

Dairy goats in Indonesia are generally kept in hilly areas, where feed is available and suitable for goats. Performance production still needs to be improved, as well as the use of technology in fodder preservation and reproduction. Feed ingredients that contain anthelmintic properties have been used, and this is of benefit to farmers, because it can reduce the burden of drug costs, and should be developed further.

Table 6. Tannin contents of 15 plants and their inhibition (as aqueous infusions) of hatching of *Haemonchus contortus* eggs

No	Treatment	Total tannin (% of DM)	Eggs not hatching (%) ¹
1	Albendazole	-	96.15 ^a
2	<i>Manihot esculenta</i>	2.89	79.15 ^b
3	Crantz	2.49	78.72 ^b
4	<i>Artocarpus</i>	1.23	74.10 ^c
5	<i>heterophyllus</i>	1.22	71.39 ^{cd}
6	<i>Swietenia mahagony</i>	1.85	69.93 ^{de}
7	<i>Sesbania grandiflora</i>	1.19	67.64 ^e
8	<i>Ficus benyamina</i>	1.69	67.47 ^e

9	<i>Albizia chinensis</i>	1.52	66.21 ^e
10	<i>Ceiba petandra</i>	2.10	65.55 ^e
11	<i>Carica papaya</i>	1.63	65.12 ^{ef}
12	<i>Acacia</i> spp.	1.27	61.84 ^f
13	<i>Eugenia aquea</i>	0.60	61.62 ^f
14	<i>Leucaena leucocephala</i>	0.41	61.48 ^f
15	<i>Gliricidea sepium</i>	0.84	57.60 ^g
16	<i>Bauhinia malabarica</i>	0.34	53.42 ^h
	<i>Dalbergia latifolia</i>		
	<i>Musa paradisiaca</i>		

¹Means of three measurements; within a column, means with different superscripts are statistically different (P<0.05)

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Lead Paper 1

Methanogenesis As Affected By Supplementation Of Rumensin In Wheat Straw Based Diets Fed To Lactating Crossbred Cows And Buffaloes

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Introduction

Ionophores such as monensin, lasalocid, laidlomycin, salinomycin and narasin are antimicrobial compounds that are routinely fed to ruminant animals to improve feed efficiency. These antimicrobials specifically target the ruminal bacterial population and alter the microbial ecology of the intestinal microbial consortium, resulting in increased carbon and nitrogen retention by the animal, increasing production efficiency. The most commonly used ionophores is Monensin Sodium in ruminants diets. Monensin is an ionophore approved for use in lactating dairy cows in several countries, including Australia, Argentina, Brazil, Canada, New Zealand, South Africa, and recently the United States. Ionophores have been shown to decrease CH₄ emissions also from cattle, although effects may be transient. The decrease in methanogenesis results from a shift in bacterial population from gram positive to gram negative organisms with a concurrent shift in the fermentation from acetate to propionate. Therefore, the present study was undertaken to evaluate the effect of rumensin in wheat straw based diets fed to lactating cattle and buffaloes.

Material and Methods

Ten animals of adult dairy cattle and buffaloes were taken from the institute herd. Animals were divided into two groups containing five animals in a group as replicates. The groups are identified as control group and treatment group. Animals were selected from the herd on the basis of lactation length, stage of lactation milk yield and body weight of animals. Animals were housed in sheds for conducting feeding trials and methane measurement for a period of 98 days. Roughage and concentrates were fed to the animals as per NRC requirements. Along with Rumensin® Premix was fed @200mg per day per animal in treatment group for both cattle and buffaloes. In between the experimental period, digestibility trial was also conducted after 40days for a period of 7 days. Feed and fodder samples and dung samples were collected for digestibility studies followed by methane estimation using SF₆ method. The data were subject to test of significance between diets using one way analysis of variance (Snedecor and Cochran, 1989) by SYSTAT 7.0 software and statistical significance was expressed at P<0.05.

Results

It was revealed from the results of cattle and buffalo trial that actual dry matter intake per day per animal in both groups remained statistically similar i.e. 11.86 and 12.14 kg in cattle and 14.27 and 14.17 kg in buffaloes in control and treatment group respectively. The results of digestibility of nutrients indicated that all the nutrients digestibility like dry matter, organic matter, crude protein, ether extract, NDF, ADF and hemi cellulose remained similar and the differences remained non-significant in both groups. DCP and TDN intake values were higher in treatment groups however, differences were found to be non-significant between both groups in lactating cattle and buffaloes. It was observed from results that methane production (l/day/animal) was 184.00 and 191.01 in control and treatment group respectively during initial period in which the Rumensin treatment was not given to cattle. The results of lactating cattle with regard to methane production after 50 days of Rumensin premix feeding showed that methane production L per day per animal decreased (12.59%) in treatment group compared to control. Similarly methane production in terms of L per kg dry matter intake and methane production per gram per day per animal was also reduced in the treatment group in comparison to control and the values were 15.77, 13.48 and 117.44, 102.65 respectively in control and treatment groups of lactating cattle. It was further observed in case of lactating buffaloes that methane production L/day/animal was 290.53 and 284.11 in control and treatment group respectively during initial period when the Rumensin treatment was not given. The results of methane production in lactating buffaloes after 50 days of Rumensin premix feeding showed that methane production L per day per animal decreased in treatment group in comparison with the control. Methane was decreased about 17.99% in treatment group compared with control. Similarly, methane production in terms of L per kg dry matter intake and methane production per gram per day per animal also reduced in the treatment group and the values were 21.00, 17.25 and 187.18, 153.49 respectively in control and treatment groups of lactating buffaloes.

Conclusions

It was observed on the basis of in-vivo trials in cattle and buffaloes that digestability of nutrients remained unchanged with the addition of Rumensin in the diet. The similar effect was also noticed on the dry matter intake. Further, it was observed that monensin was effective to reduce the methane production in diet which contains about 60% roughage and 40% concentrate both in cattle and buffaloes. It is further concluded that when Rumensin was fed with wheat straw diet @20mg per kg of dry matter in dairy cattle and buffaloes, reduced methane production up to 12.59% and 17.99% in dairy cattle and buffaloes respectively.

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Lead Paper 2

Role Of Animal Welfare In Sustainable Development Of Livestock Industry

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Livestock production has been and continues to be one of the most important economic and social activities of human culture. Significant developments have taken place in recent years that affect global livestock production. Industrial livestock production had unprecedented growth rates, and international trade is growing fast. Poultry and pig industries are far developed in Brazil, Thailand and the Philippines. Planned growth is in place for the pig industry in Vietnam, and the dairy industry in Pakistan. The dairy industry in China is currently one of the fastest growing food sectors worldwide. The challenge for the next 50 years is to increase the productivity of major livestock species to address the food needs of the world. Since industrialised production systems have the benefit of economies of scale, sooner or later they will be expected to dominate livestock production in the developing countries and the world. Such structural changes have, however, a number of negative side effects like risk of pollution from high concentration of animals and risk of zoonotic diseases, often combined with antibiotic resistance. And likely they also lead to reduced animal welfare. Animal welfare impacts of industrialized farming can include:

- Close confinement systems (cages, crates) or lifetime confinement in indoor sheds
- Discomfort and injuries caused by inappropriate flooring and housing
- Restriction or prevention of normal exercise and most of natural foraging or exploratory behavior
- Restriction or prevention of natural maternal nesting behavior
- Lack of daylight or fresh air and poor air quality in animal sheds
- Social stress and injuries caused by overcrowding
- Health problems caused by extreme selective breeding and management for fast growth and high productivity
- Reduced lifetime (longevity) of breeding animals (dairy cows, breeding sows)
- Fast-spreading infections encouraged by crowding and stress in intensive conditions
- Beak trimming or shortening in the poultry and egg industry to avoid pecking in overcrowded quarters
- Forced and over feeding (by inserting tubes into the throats of ducks) in the production of *foie gras*

The above examples suffice to illustrate the absence of good welfare in industrial livestock production. In general, all livestock in industrial production systems suffer from the same generic set of affronts to their welfare absent in husbandry systems:

Production diseases – by definition a production disease is a disease that would not exist or would not be of serious epidemic importance were it not for the method of production. Examples are liver and rumenal abscesses resulting from feeding cattle with too much grain, rather than roughage. Other examples are confinement-induced environmental mastitis in dairy cattle, weaknesses caused by beta-agonists to increase muscle mass in pigs and ‘shipping fever’ in beef cattle. Loss of workers who are ‘animal smart’ – in large industrial operations such as swine farms, the workers are minimum-wage, sometimes illegal, often migratory workers with little knowledge. Lack of individual attention – under extensive systems, each animal is valuable. In intensive swine operations, the individuals are worth little. When this is coupled with the fact that workers are no longer caretakers, the result is obvious. The lack of attention to animal needs determined by their physiological and psychological natures – technology allows us to keep animals under conditions that violate their natures, thus severing productivity from assure well-being.

However, scientific evidence of the animals’ perspective suggests that we should be cautious, as the relationship between intensive production systems and animal welfare is complex:

- A study of welfare in broiler chickens kept at different stocking densities concluded that ‘care’ of birds (in terms of the environment producers provided for the birds) was of more importance in terms of ‘obvious’ welfare measures (e.g. mortality) than stocking density *per se* (Dawkins *et al.*, 2004). Having said that, it was also the case that some aspects of welfare (including behavior) did deteriorate with stocking density and these may yet be shown to be important (see below).
- A review of laying hen systems (LayWel, 2008) illustrates that moving from battery cages to ‘free-range’ systems tends to replace poor welfare associated with lack of behavioral freedom with poor welfare associated with more physical challenges (e.g. mortality, feather pecking, certain diseases). Thus, whilst battery cages must always be behaviorally restrictive it was argued in principle that ‘free-range’ systems could be improved to reduce physical challenges.
- A study of dairy cow welfare found evidence of better leg health (lameness and leg injuries) on organic compared to conventional farms (Rutherford *et al.*, 2008). The study also identified key factors (e.g. length of time on grass; age at first calving) contributing to the improved leg health on organic units; in principle these risk factors could be addressed by conventional dairy farms.
- It is often assumed that grazing livestock are in better welfare as a result of being seen to live more ‘natural lives’. Yet extensively managed animals face significant challenges to their welfare in terms of variable food supply, extremes in weather conditions, and disease risks (Turner & Dwyer, 2007).

Interest in animal welfare continues to grow, with increasing attention being paid to it by the media, governmental and non-governmental organizations. Increased affluence in many regions for the past few decades afforded consumers the disposable income to purchase products from high welfare systems. The adaptation of more economically efficient farming systems were at the expense of animal welfare and to the financial benefit of consumers, both of which were factors in driving the demand for higher welfare for farm animals. For example, in recent years there has been an increased interest among consumers for animal-friendly products, as there has been for environment friendly products, and this has stimulated the move from experimental studies of animal welfare to its application in practice and to monitoring animal welfare on farms. Traditionally such measurements have been resource based, e.g. specifying the minimum amount of feeding space or the maximum

stocking density, but now the trend is toward animal-based measures, such as the number of lame animals, body condition, etc.

Good animal welfare is necessary if the livestock industry is to be sustainable. The role of animal welfare in sustainable development of livestock industries includes:

Reducing health risks of intensive livestock production:

In intensively managed livestock farms, overcrowded conditions facilitate the rapid transmission of infectious diseases, which are also spread through long distance live animal transport. Some of these diseases have a zoonotic potential, representing a risk for human health as well. High economic loss is associated with their control and eradication. Promoting animal welfare has the potential to improve disease prevention and limit the health risks both to animals and humans as well as make large economic savings.

Good animal welfare is part of food quality:

Some quality assurance schemes have already included animal welfare among their standards, understanding that better animal welfare also brings better food quality, in addition to better economic return.

High animal welfare standards are good for international trade:

Many developing countries have extensive land and relatively cheap labor, which are needed among other requirements for good animal welfare. They can use these advantages in trading their agricultural products, with potential for targeting high-value organic and welfare markets in developed countries.

Animal welfare was not an unaffordable luxury, but an essential part of solutions to the most pressing problems facing the world today, even climate change was impacted by the conditions in which animals were kept. There was more carbon dioxide damage from intensive livestock farming than from the total combined emissions of the gas from cars and planes. Viewing animal welfare as a luxury was hindering progress towards sustainable development.

Animal welfare can be assured or enhanced by following good management practices. The World Organization for Animal Health (OIE) guidelines on animal welfare have become the international reference for animal welfare in the trade of animals and products and the control of eradication of animal diseases. They also act as a guide for the development of national and regional assurance programs and it is envisaged that these guidelines will be used as a basis for bilateral agreements between OIE member countries (International Finance Corporation, 2006).

Research in animal welfare is also crucial for sustainable development of livestock industry. Ensuring animal welfare requires taking into account all available scientific evidence. In future research, emphasis should be based on a sound, scientific understanding of animals and how they are affected by housing, management procedures, and health care measures.

The following provide general fields of research in animal welfare.

Genetic and breed selection

Feed and water

Housing systems

Husbandry practices

Health and diseases

Transport

Slaughter
Stockmanship
Quality management

Increased market awareness of environmental, social, and commercial values, whether in developed countries, developing countries, or those in transition, is driving changes in the way business is done, leading to the recognition of new risks and opportunities. In the case of animal welfare, failure to keep pace with changing consumer expectations and market opportunities could put companies and their investors at a competitive disadvantage in an increasingly global marketplace. Therefore commitment to maintain high standard of animal welfare is a must in order to promote sustainable development in livestock industry.

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Lead Paper 3

Adaptation Strategies of Pastoral Societies in the HKH Region to Changes

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Abstract

Pastoral herders have traditionally adapted to various environmental and climatic changes by building on their in-depth knowledge of the environment in which they live. Migratory pastoralism is an adaptation to a harsh and unstable environment. In the Hindu Kush Himalayan (HKH) region, particularly in the arid and high altitude areas, pastoralism, the main livelihood, is being perceived as vulnerable to climate change. Local herders' perceptions of climate change are required to fill knowledge gapson climate change so that policy makers can better address problems faced by herders and make appropriate decisions about adaption strategies. Livestock grazing makes a significant contribution to the economy of the HKH region both in terms of supporting herders' own households and export earnings. However, changes in lifestyle and variable climate have led to a need to diversify livelihood sources. This paper presents the perception of local herders, diversification of pastoral livelihood and assesses their resilience in terms of adaptation under various socio-ecological pressures. Within the regime of internal diversification the study highlight the need of enhancement of pastoral livelihoods through activities keeping value added in pastoral sectors. For the external diversification policy changes must be made to support free out-migration, market exploitation, and multiple resource use.

Lead Paper 4

Genetic Diversity For Sustainable Development Of Animal Industry

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Abstract

Farm animal genetic resources are not only a source of food and animal protein, but also play a multi-functional role providing other commodities and services. As a result of evolution and environment factors over thousands of years we now have a vast array of species and breeds across the world. The genetic diversity among breeds and populations has been enhanced by the differences in the selection practices among countries and communities. Over the recent decades, however, this genetic diversity has become threatened. Indigenous and local breeds, which are often more adapted to the local environmental conditions and management systems, less prone to local diseases, require low maintenance and have unique qualities, are being replaced by a few high yielding specialised breeds or have their gene pool introgressed with genes from these breeds. The exotic breeds, which have been subjected to high intensity selective breeding, tend to have narrowed genetic base. Furthermore, in many developing countries the genetic diversity within the existing breeds is fast eroding as a result of mismanagement of breeding activities and failure to keep proper records. Genetic diversity is crucial for animals to adapt to changing environmental conditions and to survive in the face of disease outbreaks. It is also the resource for animal breeders to improve livestock productivity to meet current and future demands. The loss of genetic diversity among farm animals should be the concern of all as it affects food security, trade and livelihood of farmers. The stakeholders in the animal industry should realise that the sustainable development and increased productivity of the industry requires the conservation of genetic diversity and the sustainable utilisation and development of farm animal genetic resources.

Introduction

The animal industry has the vital role of providing food and animal protein. In addition, it also provides other commodities such as wool, hide, skin and antler velvet and services (Akila & Chander; 2010; Mburu *et al.*, 2012). The vast variety of animal genetic resources (AnGR) currently available for the industry is the outcome of the combined effects of nature over thousands of years and human activities since domestication. However, over the recent decades, the genetic diversity in animal genetic resources has been drastically narrowed. Commercialisation of the animal industry has resulted in specialised, high yielding breeds dominating some livestock sectors. Many indigenous and locally developed breeds have been neglected in favour of these.

This paper briefly highlights the reduction in animal genetic diversity, its importance, and the strategies that need to be adopted to conserve this for the development of the animal industry.

Animal genetic diversity

In 2010, the Commission on Genetic Resources for Food and Agriculture reported a global total of 8,054 breeds, of which 7,001 were local breeds and 1,053 were transboundary breeds (CGRFA, 2010). These breeds, which vary with respect to morphological traits, production and reproductive performances, and unique characteristics, are the outcome of evolution, mutation and natural selection. The varying climatic conditions across the world have caused animals to develop adaptive attributes for the local environment (Paterson and Coleman; 1982 Gaughan *et al.*, 1999). The genetic diversity has also been enhanced by the differences in the selection practices for economically and culturally important traits among countries and communities. These factors as well as genetic drift have also contributed to vast variations in genetic makeup among populations of the same breed at different locations.

In recent decades, with the rapid development of the animal industry and the accelerating demands from it, animal breeders, especially in developed countries, have been actively practising high intensity selection for fast growth and other economically important traits. Breeds have been developed to be specialised and high yielding with improved production efficiency and certain desired qualities specific for the livestock sector. With the adoption of intensive farming systems and mechanisation by large-scale livestock farmers, uniformity in the herd and flocks have become a requirement. With the ability to control the environment of the animals by housing them, adaptation and disease resistance traits have been neglected in the development of the breeds. A main focus has been high economic returns. As a consequence, a few breeds are dominating some sectors of the animal industry. However, the narrowed genetic base of these exotic breeds subjected to high selection pressures makes them vulnerable to environment stresses and diseases, and their management requires high quality feed and expensive management facilities.

Indigenous and local breeds are often more adapted to the local environmental conditions and management systems, less prone to local diseases, and require low maintenance. They harbour genes for unique qualities and functional traits. However, these breeds are economically undervalued. Thus in many countries, they are being replaced by the imported exotic breeds or have their gene pool introgressed with genes from the latter breeds as a result of crossbreeding in order to enhance the productivity of the animal industry (Hoffmann, 2010). Furthermore, in many developing countries, the erosion in genetic diversity is exacerbated by the mismanagement of breeding activities, indiscriminate crossbreeding, failure to keep proper records, and inbreeding. The 2010 report on the global survey on breed diversity classified 631 breeds as extinct, and 1,710 breeds (21%) as being at risk (CGRFA, 2010). This genetic erosion has become a global concern, especially with climate change, emerging diseases and increasing prevalence of resistance of pathogens and parasites to drugs, as it affects food security, trade and livelihood of farmers.

Genetic diversity is crucial for species and breeds to adapt to changing environmental conditions and to respond to market demands, socio-economic changes and changes in consumer preferences. It provides the buffering capacity for breeds or populations to survive disease outbreaks or dramatically emerging environmental challenges (FAO, 2007). The world population is increasing rapidly; it is anticipated to reach 7.7 billion by the year 2020 and near 10 billion by 2050 (UNDESA, 2011; USCB, 2012). Genetic diversity provides the genetic resources for animal breeders to design selection and breeding programmes to further enhance animal productivity and ensure food security. The rapidly dwindling animal genetic diversity threatens to jeopardise the ability of the industry to meet future challenges. These needs of the future and increasingly diminishing genetic diversity have gained global

attention and concern. Realising the need for consolidated intervention, the Global Plan of Action for Animal Genetic Resources was developed by the Food and Agriculture Organisation of the United Nations (FAO, 2007).

Sustainable Development of Animal Genetic Resources

Sustainable development of animal genetic resources according to the World Commission on Environment and Development (WCED 1987) is the management and conservation of animal genetic resources such that it meets the needs of the present and future generations. To achieve this, it has to be environmentally non-degrading, technically appropriate, economically viable and socially acceptable. Sustainable development of animal genetic resources is crucial in order to ensure food security and be able to meet the challenges to be faced by the animal industry in the future.

Sustainable development requires continued improvement in the production performance of the various livestock species, their husbandry and production processes, the quality of products and processing, and the marketing. Productivity of animal genetic resources has to be continuously enhanced in line with the changing production systems and environmental challenges. The quality of livestock products has to be developed in accordance with market demands and consumer preferences. Enhancing productivity through genetic improvement requires genetic diversity. Further improving the productivity of the high yielding commercial exotic breeds with narrow genetic base require introduction of new genes. Indigenous and local breeds are reservoirs of unexploited germplasm. However, these breeds are fast diminishing, and will soon be lost unless keeping them is profitable to the farmers. The indigenous breeds and locally developed synthetic breeds as well as the non-descript crosses require continuous improvement. The performance, genetic structure and genetic diversity of these genetic resources have to be evaluated. Genetic characterisation will identify unique traits and characteristics of these breeds which may be exploited so that values may be added to them (LPP *et al.*, 2010). Only with added value will there be sustainable utilisation facilitating the survival of these breeds in the future as part of the animal industry. In developing countries where low stress, high input farming systems as required by the high yielding exotic breeds is not possible, local breeds and locally developed synthetic breeds and non-descript crosses have to be developed to increase food production and provide economic resources to the farmers. Many indigenous breeds are known for their hardiness, resistance to diseases and parasites, and prolificacy. The genes associated with these beneficial traits may be transferred to the commercial breeds through appropriate breeding methods and gene technology.

Although the earlier part of this paper emphasizes the importance of local breeds, sustainable development of the animal industry cannot be achieved merely focusing to these. Focus should be on all available animal genetic resources in the country. The further development of the commercial exotic breeds will be taken care of by animal breeders in the countries that developed these. However, individual countries should be concerned about the indigenous and local breeds, the crosses developed through planned breeding programmes, the locally adapted imported breeds and the non-descript crosses.

Genetic variability within and among populations and breeds serves as an indicator of population dynamics, inbreeding, and level of admixture among populations (Li *et al.*, 2007; Wilkinson *et al.*, 2011). Evaluation of these will provide the valuable information necessary to decide on breeding strategies for individual breed development, and to identify the suitable production systems and conditions for the respective breeds (Hanotte *et al.*, 2005; Hanotte & Jianlin, 2006). Breeding programmes should be designed based on the production systems, economic needs of the farmers, and the current and future markets. It is pertinent that

selection based on genetic merit and correct breeding strategies are adopted; this requires proper data recording (Panandam, 1991). Optimal selection, sufficient breeding animals and alternative breeding populations are needed to avoid inbreeding. Biotechnology tools may be used to enhance the genetic merit of the breeds (Sellner *et al.*, 2007; Laible, 2009). Reproduction technologies should be adopted to disseminate the genes of high merit animals, increase the rate of selection response and avoid inbreeding (Cowan and Becker, 2006). Continued research is also crucial for conserving the genetic diversity and for the sustainable development of livestock productivity.

Conclusion

Local animal genetic resources are valuable assets of individual countries. They represent the germplasm pool that is vital for further improvement of livestock productivity, enabling the livestock industry to meet current and future challenges and to ensure food security. The rapid erosion of animal genetic diversity should be our concern and measures to reduce further loss should be adopted without delay. Local animal genetic resources have to be characterized; their performances, genetic diversity and unique qualities have to be evaluated and monitored. The above tasks which are vital for the sustainable development of the animal industry are both global and national responsibilities. Therefore, they have to be government-driven and government-supported. However, success may only be achieved through global and national cooperation and the concerted efforts of the various stakeholders in the animal industry.

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Gonadal and Extragenadal Sperm Reserves of Post Pubertal West African Dwarf and Sokoto Red Bucks in Their Native Tropical Environment

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Abstract

Six West African Dwarf and 6 Sokoto Red post pubertal bucks weighing between 4kg and 10kg were used in the determination of sperm storage capacity in the two genotypes. While gonadal sperm reserves were similar ($p>0.05$) between the genotypes, all extragonadal regions of the tract differed significantly between the breeds ($p<0.05$) in sperm reserves. The testes, epididymal portions and the ductus deferens contributed 29.80%, 8.51%, 4.55%, 53.31% and 3.83% respectively in the West African Dwarf breed, compared to 31.05%, 10.61%, 5.30%, 49.20% and 3.84% respectively in the Sokoto Red breed.

Introduction

Goats occupy a strategic position in the livestock economy and food security of developing nations in the warm wet humid tropics; especially in the West African sub-region. While the West African Dwarf (WAD) genotype is known to be the most prolific in the world, the Sokoto Red (SR) genotype became popular in Europe from the medieval period to date due to its provision of the fine quality Moroccan leather. These breeds, however, still remain unimproved and almost all available literature on the reproductive physiology of bucks of these breeds currently are either at the adult or pubertal stages only. Given the importance of the post pubertal phase as well as sperm storage in the reproductive physiology of the male, we undertook to provide information on gonadal and extra gonadal sperm reserves in post pubertal WAD and SR bucks in their native humid tropical environment.

Materials and Methods

The study was carried out at the *Small Ruminant Research* unit of the Teaching and Research Farm, University of Ibadan, Nigeria (Latitude 7° 20'N and Longitude 03° 50'E). Six WAD and 6 SR post pubertal bucks weighing between 4kg and 10kg were acclimatized, housed in dwarf walled pens and fed a basal concentrate diet *ad libitum* supplemented with forage, grasses, and cassava peels with cool clean water supplied always. All the bucks were sacrificed at the end of 7 weeks. Gonadal and extragonadal sperm reserves were determined as earlier reported by Bitto and Egbunike (2006b). Data were subjected to the analysis of variance (ANOVA) between regions of the tract and the Students 't' test between genotypes (SAS, 1999).

Results and Discussion

Table 1. Differences between Post Pubertal WAD and Sokoto Red bucks in Sperm Storage Capacity (mean $\pm$ sem)

Region of the Reproductive tract	Breeds		
	WAD	SR	Level of significance
Testis reserves (10^8)	1.71 $\pm$ 0.18 ^a	1.70 $\pm$ 0.08 ^a	p>0.05
% Contribution of gonads	29.80	31.05	
Caput reserves (10^8)	0.49 $\pm$ 0.06 ^b	0.58 $\pm$ 0.03 ^a	p<0.05
% Contribution of caput	8.51	10.61	
Corpus reserves (10^8)	0.26 $\pm$ 0.03 ^b	0.29 $\pm$ 0.04 ^a	p<0.05
% Contribution of corpus	4.55	5.30	
Cauda reserves (10^8)	3.06 $\pm$ 0.26 ^a	2.69 $\pm$ 0.29 ^b	p<0.05
% Contribution of cauda	53.31	49.20	
Ductus reserves (10^8)	0.22 $\pm$ 0.09 ^b	0.21 $\pm$ 0.08 ^a	p<0.05
% Contribution of ductus	3.83	3.84	
Total epididymal reserves (10^8)	3.81 $\pm$ 0.35 ^a	3.56 $\pm$ 0.36 ^b	p<0.05

sem = Standard error of mean, p<0.05 = significant, p>0.05 = not significant, a, b = values bearing different superscripts on the same row are significantly different, WAD = West African Dwarf Bucks, SR = Sokoto Red Bucks.

A summary of the results is presented in Table 1. Besides the similarity between the breeds in gonadal sperm reserves (p>0.05), all other regions of the tract differed significantly between the genotypes (p<0.05) in sperm reserves. While the SR was superior to the WAD in caput and corpus epididymal reserves (p<0.05), the WAD was superior to the SR in cauda, ductus and total epididymal reserves (p<0.05). The values of sperm reserves obtained in the present study are generally lower than values earlier reported in pubertal WAD bucks (Bitto and Egbunike, 2006b) and adult SR bucks (Bitto and Agam, 2012). These disparities appear to be due to the plane of nutrition, age and genetic factors. The relative contributions of gonadal and epididymal sections in the present study (at the post pubertal phase) however, followed a similar pattern with both pubertal and adult bucks of the breeds (Bitto and Egbunike, 2006b; Bitto and Agam, 2012). It is concluded from these results that even though bucks of both breeds may be relatively low in sperm storage capacity at the post pubertal phase, they could be used sparingly as sires and genetic resources for conservation and improvement.

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The Role of Biochar in Farming Systems Producing Food and Energy from Biomass

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Biochar as a component of integrated farming systems and resource material for research

A major challenge facing agricultural planners is in designing farming systems that combine production of food and energy with an overall negative carbon footprint. Biochar will almost certainly be an important component in this strategy.

Box 1.

The Chairman of Nestlé, at a recent International Conference in Sweden, stated that "the high price of food (which has intensified following the severe drought in the U.S. in the summer of 2012) was the result of biofuels that are grown in soil and water otherwise used for crops intended for human or animal consumption" and that "Biofuels compete with food production. This is unacceptable and cannot be justified."

Biochar is the product of the carbonization of fibrous biomass in a restricted flow of air and at high temperatures (500 to 1000°C). These are the conditions found in gasifiers be they updraft (TLUD) stoves or downdraft reactors producing gas for IC motors, turbines or simply process heat (as in brick-making). Thus from the outset, by using fibrous waste as feedstock, the gasification system, and the associated production of biochar, avoids the conflict of using natural resources of soils and water for biofuels instead of food (Box 1). Biochar is thus a by-product of the process of producing energy from non-edible biomass.

Growing of crops solely to produce biochar as a major tool for sequestration of atmospheric carbon dioxide, is not encouraged. Such proposals are

rightly criticized by environmentalists as being both undesirable and unnecessary.

The above criticisms can be largely avoided by ensuring that the farming system is geared to the needs and opportunities presented by small scale farms and rural communities that are best suited to utilize efficiently local resources, and to recycle wastes.

In tropical latitudes, the cropping systems best suited to integrated production of food, energy and biochar are rice, sugar cane and tree crops such as coffee, cocoa, oil palm and coconut. In all cases the primary objective is production of food or animal feed, while fibrous residues can be the feedstock for gasification.

Sugar cane for energy, feed and biochar

A model based on sugar cane, developed and used in Colombia over the past 8 years, is indicative of the potential of the small to medium scale of operation that can now be adapted to the needs of rural communities. In the prototype model, sugar cane stalks were crushed in a traditional 3-roll mill (as used for production of gur and panela) to yield sugar cane juice which is the basis of the feeding system for livestock (and as a sweetener for the family). The

crushed stalks (bagasse) were gasified to produce a gaseous fuel (for an engine-generator producing electricity) and biochar. Biochar produced from bagasse in this unit served as the basis of one of the earlier reported experiments on the synergism between biochar and organic fertilizer (biodigester effluent) in promoting growth of maize on infertile soils (Rodríguez *et al.*, (2009).

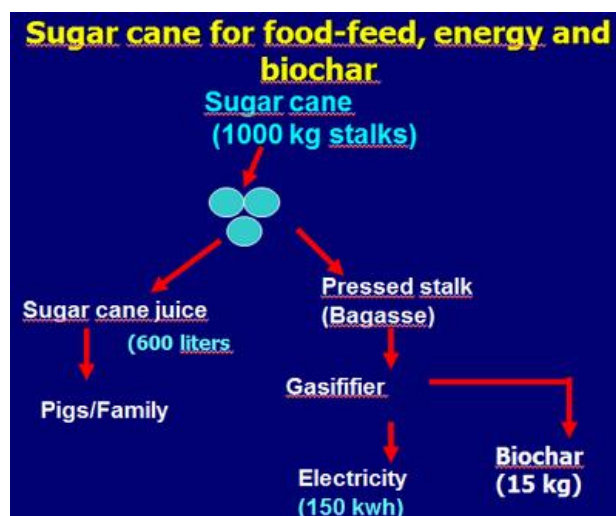


Figure 1: Integrated use of sugar cane for food/feed, biochar and electricity (Preston 2007, unpublished data)

Scaling up of this model to provide electricity, animal feed and biochar for a rural community of 50 to 100 families is now at the planning stage. In this model, the sugar cane juice is concentrated to “high-test” molasses (70% sugars) to ensure a stable product that can be stored and transported as replacement for cereal grains in animal feeds.

Energy, food and biochar from the rice crop

Presently, the production of biochar from the rice crop is almost exclusively from the use of rice husks as feedstock.

Cambodia is at the forefront in application of gasifier technology with an estimated 40 to 50 medium to large scale units (250 to 500 KVA) already operating in rice mills and rural communities. Increasingly, the biochar produced in these gasifiers, considered originally as a waste product, is being used as a soil conditioner for growing vegetables and flowers.

A recent development has been the re-designing in Vietnam of the updraft gasifier stove, developed originally in the Philippines (Belonia 2005) to use rice husks as fuel. This unit which is about to enter into large scale manufacture, has already served a valuable purpose as the means to facilitate use of biochar for research purposes in universities and research centers in Cambodia, Laos and Vietnam. Already more than 20 research papers have been produced in the region as a result of this initiative.

The next major objective is the densification of rice straw which is an essential step in order for it to be used as feedstock in gasifiers. The technology to do this is available. The need is to demonstrate its application. It can be estimated that if all the annual production of 40 to 50 million tonnes of rice straw produced in Vietnam were gasified, it could produce the balance of electrical energy needed to complete that from hydro and make the country a 100% clean energy producer. The associated production of biochar would be of the order of 5 to 6 million tonnes. The potential is enormous. Similar calculations can be applied to Cambodia and Lao PDR.

The role of biochar in farming systems

To date most of the emphasis given to biochar has been on its role as an amendment in soils and its potential to sequester atmospheric carbon. Recent research shows that its role is much wider with potential application in all components of farming system that involves microbial activities. In preliminary trials in Lao PDR (Leng *et al.*, 2012), biochar fed to cattle improved growth and feed conversion, with concomitant reduction in enteric methane emissions. In batch biodigesters, biochar increased biogas production by 30% with no apparent change in caloric value of the gas (Inthapanya *et al.*, 2012). After immersion in the effluent from biodigesters charged with pig manure, the stimulatory effect on growth of maize was increased (Southavong *et al.*, 2012).

Research priorities

Gasification versus pyrolysis

Competing claims are made for the virtues of biochar produced by pyrolysis compared with gasification. However, there is a lack of information on the respective merits of the biochar produced from the two processes as a component of farming systems. Comparative data from use of biochar produced by the two technologies is urgently needed. From the systems standpoint, gasification appears to have the advantage as the products can be used efficiently on-farm at all scales of operation. By contrast, the bio-oil that is a major product from pyrolysis will require refinement at some central facility before it can be used to replace liquid fuels. Producing electricity as the major output of gasification is facilitated by the ease of transporting it over existing transmission lines.

Long-term effects of biochar

A recent finding from Kenya indicates that the benefits from biochar on yield of grain sorghum were greater in the second year with no further biochar application (admittedly the quantities applied initially were very high – almost 100 tonnes/ha). The belief that biochar has mean residence times in soil, ranging from 1,000 to 10,000 years (Skjemstad *et al.*, 1998; Swift 1991), implies that there should be long term benefits in soils from application of biochar. This is in line with the observations of maintained fertility in **Terra preta** black soils in Amazonia (Glaser 2007). This feature of long term impact on soil fertility of the use of biochar has so far received little research attention.

Biochar in the farming system

Recent reports of beneficial effects from biochar on livestock productivity and equally important reduced emissions of enteric methane need to be verified under a wide range of farming systems.

Similarly, the potential role of biochar in enhancing biogas production and in purification (recovery of plant nutrients) of waste waters merits increasing attention.

Most reports on biochar as soil amender refer to effects on yield of biomass and its components. . The finding that in green mustard vegetable the crude protein percentage was increased, and crude fiber reduced (Chhay Ty *et al.*, 2012), implies that improvement in nutritive value of certain crops may be another virtue of soil application of biochar. Validation of these findings with other vegetables is another urgent research need.

The bottom line

The potential role of biochar as a means of sequestering atmospheric carbon has so far been the main focus of attention. However, its virtues are much wider with potential impacts on soil fertility, plant yield and quality and as an additive in livestock feed, biodigesters and other liquid waste disposal systems. More importantly, is the emphasis that biochar has given to the overall concept of the systems approach to utilization of renewable resources and recycling of wastes. Biochar makes most sense when it is derived from a process that aims to optimize the varied characteristics of biomass, to satisfy the major needs of humanity which are food, energy, shelter and a healthy environment.

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Effects of Different Protein and Energy Levels on Layer Performance under High Temperature

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Introduction

Heat stress is well known to cause lower egg production (Franco-Jimenez and Beck, 2007) and it is still not clear on how to solve the problem through nutrition (NRC, 1994). The purpose of this experiment is to understand how to solve the drop problem of egg production under heat stress.

Methods and Materials

In Trial 1, fifty four 113-wk old Hy-Line White Leghorn chickens were randomly allocated into a 3 (temperature: 14, 22 and 30°C) x 3 (CP levels: 18.8%, 15.1%, 12.5%, all diets with ME 2,900 kcal/kg) factorial arrangement according to their body weight with 6 replications per treatment. The birds were fed 80, 100 and 120 g of feed daily with *ad libitum* drinking water, 16 hr lighting. Feed intake and eggshell quality scoring were recorded daily. Besides initial body weight, the birds were weighed at the end of the trial. Behavior observation was conducted before the trial, on the 4th week and at the end of the trial. In Trial 2, eighteen 113-wk old Hy-Line breed White Leghorn layers were randomly allocated into 3 different treatments according to their respective body weight which were high protein treatment (18.8% CP, 2,900 kcal/ kg ME), high protein + 2.5% energy treatment and high protein + 5% energy treatment. The environmental temperature was controlled at 30°C, the birds were fed 80 g of feed daily, and management and data collection were similar as Trial 1. In Trial 3, twenty four 82-wk old Hy-Line breed White Leghorn layers were kept in 30°C and 22°C chambers under 16 hr lighting. In the calorimetric chamber, 24-hr heat production, emission of carbon dioxide and nitrous oxide were measured.

Results

The results indicated that in Trial 1, 30°C group had lower feed intake than 14°C and 22°C group; birds under 22°C had significantly better laying rate than those birds kept in low and high temperature conditions. For egg weight, eggshell strength and thickness, high temperature group was poorer than the other two treatment groups. High CP group (18.8%) and low CP group (12.5%) had significantly lower feed intake than moderate CP group (15.1%). A similar trend was noted on laying rate. For egg weight, high and low CP groups had significantly lighter eggs than moderate CP group. Moreover, high CP group had significantly poorer eggshell thickness. Besides abnormal eggs and soft shell eggs, significant environmental temperatures and dietary CP levels interaction effect was found. As environmental temperature increased, eating, drinking and panting frequency was significantly higher. As dietary CP content increased, eating behavior increased whereas

drinking and standing behavior was significantly reduced.

In Trial 2, as feed energy increased, feed intake was increased significantly and a similar trend was found on the laying rate. For egg weight and eggshell strength, 5% supplemental energy treatment birds were significantly better than other 2 trial groups. Comparing with high CP diet group, 2.5% and 5% energy supplementation increased cracked eggs incidences. Regardless of high protein or extra 5% energy supplementation, eating frequency was significantly higher, but extra 5% energy supplementation group had significantly lower panting frequency.

Results in Trial 3 indicated that heat production increased with the increase of the temperature, carbon dioxide emission increased in birds, but the results were not significant. Emission of nitrous oxide reduced significantly as environmental temperature increased.

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Oxidative Stress Management in Farm Animals: Opportunities and Challenges

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Abstract

This paper examines the role that oxidative stress plays in some physiological functions and we discuss the implications of antioxidant supplementation status on animal health and production. Oxidative stress is an active field of research in veterinary medicine and has been implicated in numerous diseases, however, studies in farm animals have been sporadic and mainly concerned with mastitis, pneumonia, and retained placenta. More recently, studies have been focused on environmental and physiological factors that affect animal production. Clarity in understanding of the pathophysiology of oxidative stress in farm animal will allow designing specific antioxidant interventions. The potential to increase production, health and reproduction has made nutritional manipulation of ruminants' diets a focus for research. Selenium and Vitamin E represents an ideal antioxidant supplement to improve animal health, production and reproduction. With this in mind, it is the goal of this paper to summarize the present knowledge of oxidative stress in animal production and to examine the basis of and evidence for the role of antioxidant supplementation in animal health and production. Future research on the use of antioxidants in animal nutrition should take advantage of the “omics” era and focus on the antioxidants and the animal. Moreover, considering the growing awareness among consumers of the benefits of antioxidant enriched foods, the livestock industries have the great opportunity to boost the production of antioxidant enriched products as functional foods. We propose thus, a new approach that explores the constitution and biological effect of different antioxidants, and then study relationships among complex system of antioxidants and other complex systems like genome, proteome, and metabolome in animal model.

Introduction

On farm animal husbandry practices are intrinsically linked with animal health, production and welfare. To deliver quality animal products and safe food efficiently, farmers must practice good animal husbandry and maintain their animals in peak condition. The very nature of farming means sound husbandry practices also deliver good animal welfare. However, the adoption of intensive methods of husbandry in farm animals for higher yields might compromise animal health and welfare and consequently increase the incidence of the metabolic and infectious diseases. Furthermore, the current climate change phenomenon represents an additional challenge for animal production as it reduces the availability of good quality and quantity of pastures and forage crops; also the more frequent occurrence of extreme temperatures might exacerbate the compromised health status and increase disease

incidence (Henry *et al.*, 2012). In addition, the present world food crisis is inducing animal scientists and farmers to reconsider the use of micronutrients for animal production. Consequently, interest in minerals and vitamins as potential natural alternatives for enhancing livestock productivity has increased. The livestock industry must continually seek and implement alternative animal nutritional strategies which comply with consumer desire for food products that are rich in micronutrients and produced in a clean, green and ethical manner. Therefore, the role and the activity of natural antioxidants not commonly present in the diets of ruminants warrants investigation. The supplementation of the diet with antioxidants has the potential to improve the health and production performances of farm animals by reversing the negative effects of oxidative stress. This paper will discuss the use of vitamin E and selenium as a management tool in farm animals with a particular focus on ruminants.

Oxidative Stress

Oxidative stress is commonly defined as an imbalance between pro-oxidants and antioxidants at the cellular or individual level (Lykkesfeldt and Svendsen, 2007). Oxidative stress is a disruption of redox signaling and control (Jones, 2006) which leads to damage of macromolecules such as lipids, proteins, DNA, and disruption of normal metabolism and physiology (Trevisan *et al.*, 1991) leading to loss of cell function, cell death or necrosis (Lykkesfeldt and Svendsen, 2007; Nordberg and Arner, 1991). Oxidative stress in veterinary medicine and particularly in ruminant health is a relatively young field of research (Celi, 2011a). Numerous and rapidly evolving methodologies for evaluating oxidative stress, each with its own distinct advantages and disadvantages, are available to clinicians and scientists. As oxidative stress is indicative of an imbalance between oxidants and antioxidants, methods for quantifying oxidative stress mostly include direct or indirect measures of oxidants and antioxidants (Celi, 2011b).

Pro-oxidants

Several definitions have been given to describe free radicals, however, in broad approach, a free radical is any species with one or more unpaired electrons (Halliwell and Gutteridge, 1989). The most abundant free radicals in biological systems are the oxygen-centred free radicals and their metabolites, usually referred as “reactive oxygen species” (ROS; Miller *et al.*, 1993). ROS are formed continuously as normal by-products of cellular metabolism and, in low concentrations, they are essential for several physiological processes, including protein phosphorylation, transcription factor activation, cell differentiation, apoptosis, oocyte maturation, steroidogenesis, cell immunity, and cellular defense against micro-organisms (Dröge, 2002; Miller *et al.*, 1993). However, when produced in excess, ROS can cause tissue damage by reacting with polyunsaturated fatty acids in cellular membrane, nucleotides in DNA and critical sulfhydryl bonds in proteins and harm cell functionality (Miller *et al.*, 1993). The plasma level of ROS is considered an indicator of free radical production. ROS are a collective term that includes not only oxygen-centred free radicals such as superoxide anion and hydroxyl radical, but also some non-radical derivatives of oxygen, such as hydrogen peroxide, and hypochlorous acid (Reilly *et al.*, 1991).

Antioxidants

Antioxidant can be broadly defined as any substance that delays, prevents or removes oxidative damage to a target molecule (Halliwell, 2007). The cellular antioxidant defence mechanism can be divided into at least three levels according to their function of quenching oxidants, repairing/removing oxidative damage or encapsulating non repairable damage

(Lykkesfeldt and Svendsen, 2007). As a first level of defense against the oxidants, the cell is equipped with so called antioxidant network. Antioxidants are the molecules which are capable of donating electrons to the oxidants and thus quenching their reactivity to make them harmless to the macromolecules. The antioxidants can also be classified as high molecular weight enzymatic antioxidants (superoxide dismutase, glutathione-peroxidase, catalase) and the low molecular weight non enzymatic antioxidants (Vitamin E, vitamin C and glutathione). It is assumed that whole antioxidant system is under homeostatic control however, when metabolic reactions are overloaded, accumulation of free radicals may lead to disturbance of redox homeostasis resulting in oxidative stress (Celi, 2011a) which has been implicated in various diseases and reduced animal performance. Several studies supporting the concept that oxidative stress increases the susceptibility of cattle to diseases (Bernabucci *et al.*, 2005; Castillo *et al.*, 2005; Sordillo and Aitken, 2009) have been reported recently. The changes in oxidative status in dairy cows (Celi and Raadsma, 2010; Celi *et al.*, 2011; Celi *et al.*, 2012; Pedernera *et al.*, 2010; Sharma *et al.*, 2011; Tanaka *et al.*, 2011), buffaloes (Dimri *et al.*, 2010) and small ruminants (Celi *et al.*, 2010; Rezapour and Taghinejad-Roudbaneh, 2011; Po *et al.*, 2012a, 2012b) underpin the importance of antioxidants for the ruminants during different physiological stages.

Endogenous antioxidants can be divided into three major groups (Miller *et al.*, 1993). The first group comprises enzymatic antioxidants including superoxide dismutase (SOD) and glutathione-peroxidase (GSH-Px), and represents the main form of intracellular antioxidant defense. Plasma GSH-Px activity contributes to the oxidative defense of animal tissues by catalysing the reduction of hydrogen and lipid peroxides (Halliwell and Chirico, 1993) and is also considered an indicator of oxidative stress (Tüzün *et al.*, 2002). GSH-Px functions in cellular oxidation–reduction reactions to protect the cell membrane from oxidative damage caused by free radicals (Flohe *et al.*, 1973). SOD catalyses the dismutation of superoxide to hydrogen peroxide (H_2O_2) and it is considered the first defense against prooxidants (Halliwell and Chirico, 1993). The second group includes non-enzymatic protein antioxidants that are primarily found in plasma. They are mainly represented by sulfhydryl (SH) groups of albumin and are considered a significant element of the extracellular antioxidant defense system against oxidative stress as are protein SH groups (Urban-Chmiel, 2006). The reducing properties of SH residue are known to be oxidised under oxidative stress and other physiological conditions (Di Giuseppe *et al.*, 2003, 2004). Total thiol groups of plasma represent the SH groups of albumin, L-cysteine, and homocysteine. Under physiological conditions, SH groups are the most chemically reactive sites and have strong reducing properties (Moran *et al.*, 1991; Soriani *et al.*, 1994). The third group is represented by the non-enzymatic low-molecular-weight antioxidants, and it is found mainly in plasma but also in other extracellular and intracellular fluids. The primary antioxidant capacity of serum is derived from non-enzymatic antioxidants such as glutathione, α -tocopherol, β -carotene, and uric acid (Halliwell and Gutteridge, 1989). In particular, GSH plays an important role in protecting cells against oxidative stress and toxic agents. It acts as substrate or co-substrate in enzymatic reactions and it also reacts directly with free radicals and lipid peroxides (Briviba and Sies, 1994). Similarly, vitamin E being the major lipid soluble antioxidant in all cellular membranes, plays a very important role in protection against lipid peroxidation by directly scavenging oxyradicals, superoxides and singlet oxygen, where as selenium, being an integral component of glutathione peroxidase, is important for decomposition of hydrogen peroxide and lipid peroxides (Machlin and Bendich, 1987).

Oxidative stress during the transition period, heat stress and growth

The transition from pregnancy to lactation is a crucial stage, during which dairy cows undergo substantial metabolic and physiological adaptations that are thought to contribute to the impaired inflammatory and immune responses of the host (Sordillo and Aitken, 2009). There is increased oxygen requirement to cope up with the physiological stress associated with growth of mammary gland, rapid differentiation of secretory parenchyma and onset of milk synthesis and secretions. This increased utilization of oxygen leads to the production of free radicals and augments the oxidant status of the animal (Sordillo and Aitken, 2009). Heat stress exacerbates the oxidative stress in transition dairy cows. Bernabucci *et al.*, (2002) evaluated oxidative stress in cows' calving during summer and spring and found higher levels of lipid peroxides and SOD activity in erythrocytes in the cows calving during summer months than spring. Recently, (Tanaka *et al.*, 2011) investigated the changes in the plasma concentrations of oxidative stress markers in periparturient dairy cows in hot conditions and suggested that oxidative stress is increased in cows after parturition under hot climatic conditions. In dairy goats also the redox homeostasis is impaired during the peripartum period (Celi *et al.*, 2010) as they experience moderate oxidative stress (Celi *et al.*, 2008) and the hot season rather than nutritional factors had a more pronounced effect on the oxidative stress markers (Di Trana *et al.*, 2006).

Environmentally induced periods of heat stress or hot environment impairs production (growth, meat and milk yield and quality), reproductive performance, metabolic and health status, and immune response of animals (Nardone *et al.*, 2010), decreasing productivity with devastating economic consequences to global animal agriculture (Bernabucci *et al.*, 2010). Heat stress induced economic losses, are not only associated with the declined milk production, but are also contributed by the poor health status, increased incidence of diseases and high mortality. The health status of the animals is believed to be affected because of the increased oxidative stress in the animals under exposure to heat stress (Bernabucci *et al.*, 2002; Mitchell and Russo, 1983). Recent studies in sheep exposed to heat stress in controlled climatic chambers, have demonstrated that heat stress induces oxidative stress and these negative effects can be ameliorated by supplementation of supraphysiological doses of selenium and vitamin E (Alhidary *et al.*, 2012a, b; Chauhan *et al.*, 2012). Therefore, manipulation of oxidative stress during the transition period by supplementation of ruminants' diets with antioxidants in periparturient ruminants under heat stress hold promise for improving the health and productivity and hence requires well designed and comprehensive research that will delineate more opportunities for vitamin E and selenium in this field.

Efficient animal production revolves on feeding balanced diets to meet the specific requirements of a particular class of animals. For example, supplementation of poultry diets with antioxidants and with selenium in particular, has been shown to have an important role in maintaining bird health and production (Surai 2002). During the production cycle, poultry can be exposed to environmental stressors that might result in oxidative stress, making the antioxidant supplementation a necessity. Growth is a trait that is affected by the intake of dietary antioxidants (Catoni *et al.*, 2008). The high metabolic rate of growing tissues produces large amounts of free radicals (Rollo 2002) that if they are not safely removed by antioxidants, may lead to oxidative stress. Therefore antioxidant supplementation may help to counter negative effects of oxidative stress associated with growth. Because growth is extended to several tissues, it is likely to be affected by the overall oxidative status of an individual.

Antioxidant supplementation in farm animals

Grazing may provide herbivores with health benefits from certain vitamins and minerals. Though fresh forages are typically considered capable of supplying adequate levels of antioxidants for dairy cattle, the availability of these compounds for lactating grazing cows is diminished when pasture availability is not adequate to meet their energy requirements. In this situation the gap between energy required for milk production and energy intake is often met by supplementing cows with conserved forages like silage. Silage is known for its poor content in antioxidants (Ballet *et al.*, 2000) and thus this might expose cows to oxidative stress. When sheep graze autumn pastures, wide spread subclinical vitamin E deficiency has been reported especially in weaner flocks (White and Rewell, 2007). The evaluation of oxidative stress in ruminants is significantly contributing to the understanding of the fundamental processes involved in metabolic disorders. Oxidative stress is believed to play an important role in the regulation of the metabolic activity of some organs and productivity in farm animals (Celi, 2011b). However, it is not clear whether or not the level of oxidative stress during the peripartum period could compromise animal performance. For example, several studies have reported variable levels of oxidative stress during the peripartum period in dairy cows (Bernabucci *et al.*, 2005; Castillo *et al.*, 2005; Pedernera *et al.*, 2010) and goats (Celi *et al.*, 2008, 2010a). However, it is not clear whether or not the level of oxidative stress during this period could compromise animal performance. It seems though, that reactive oxygen metabolites and antioxidants may be involved in some relevant physiological functions such as milk yield (Gabai *et al.*, 2004) and thus, the supplementation of cows' diets with antioxidants might result in an improvement of their oxidative status and productive performances.

Vitamin E and selenium supplementation

Vitamin E supplementation has been used in ruminants to improve reproductive performances (Ali *et al.*, 2009; Horn *et al.*, 2010), antioxidant (Bouwstra *et al.*, 2008; Dobbelaar *et al.*, 2010; Wang *et al.*, 2010) and immune status (Politis *et al.*, 1995; Spears and Weiss, 2008), to reduce the incidence of mastitis (Giadinis *et al.*, 2011; Smith *et al.*, 1984; Waller *et al.*, 2007) and to improve the productive performance (Wang *et al.*, 2010), either in combination with selenium (Brozos *et al.*, 2009; Lacetera *et al.*, 1996; Sathya *et al.*, 2007) or alone (Bouwstra *et al.*, 2009). Vitamin E and selenium supplementation in peri-parturient water buffaloes seems to be helpful in alleviating oxidative stress (Dimri *et al.*, 2010). Dietary vitamin E supplementation during heat stress has been shown to improve immune response (Niu *et al.*, 2009b) and performance (Panda *et al.*, 2008) and to reduce transportation stress in poultry (Ajakaiye *et al.*, 2010). Supplementation with vitamins E and C during pregnancy in sheep reared at high altitudes prevents oxidative stress and improves pregnancy outcomes (Parraguez *et al.*, 2011). Ali *et al.*, (2009) reported that vitamin E alone or in combination with selenium improved semen characteristics and reproductive performance of Awassi rams during the hot season. An improvement in acid base status and protection against heat stress has also been observed in Vitamin E supplemented goats (Sivakumar *et al.*, 2010), however further studies are required to fully elucidate the effects of increased levels of antioxidants supplementation in ruminants under heat stress, especially during the transition phase when animals are exposed to oxidative stress.

Supplementation of vitamin E can be achieved by the addition of synthetic (all-rac alpha-tocopherol acetate) or natural (RRR α -tocopherol acetate) form of vitamin E (Horn *et al.*, 2010), either in diet (Hidiroglou *et al.*, 1994) or by parental route (Morgante *et al.*, 1999). While it seems that the bioavailability of the RRR α -tocopherol acetate is higher than the synthetic form (Meglia *et al.*, 2006), no significant difference in reproductive performances

have been noted in beef cattle (Horn *et al.*, 2010). Higher concentration of α -tocopherol in cow plasma, colostrums, milk and blood neutrophils were observed after feeding RRR α -tocopherol acetate as compared to its synthetic form (Weiss *et al.*, 2009). Vitamin E supplementation results in different changes in oxidative status in blood, liver and milk, therefore when oxidative and vitamin E status are calculated on the basis of blood values alone need to be interpreted with caution and cannot be extrapolated to the whole organism. Considering that oxidative damage is likely to occur in only few tissues at the same time, high levels of oxidative stress biomarkers in the general circulation can be the consequence of a generalized increase in oxidative stress in most of the tissues, resulting in an increase of the biomarker concentration in blood proportional to the extent of the tissues damage; of the increase of oxidative stress just in a particular tissue that is the origin of the pathological dysfunction; or an increase of oxidative damage produced specifically in the circulatory system (Argüelles *et al.*, 2004). Even if several animal studies seem to suggest that oxidative stress biomarkers change toward the same direction in blood and tissues this needs to be fully evaluated in ruminants (Celi, 2011a,b).

Selenium is an essential element in the diet of animals and is important in host antioxidant defense and immune function (Rivera *et al.*, 2003). A severe selenium deficiency can lead to sudden death from white muscle disease (White and Rewell 2007) and a deficiency can result in ill thriftiness, reproductive losses, reduced reproductive efficiency, wool yields and reduced growth rate in young lambs throughout the growing period (Gardiner *et al.*, 1962; Rivera *et al.*, 2003; Robson 2007; Whelan *et al.*, 1994). Selenium is a component of the selenoenzyme, glutathione peroxidase (GSH-Px), which acts as an antioxidant and helps prevent tissue damage caused by free radicals. GSH-Px has been used as an indicator of selenium status in animals due to the high correlation found between dietary selenium and the activity of this enzyme in plasma and red blood cells (Andres *et al.*, 1999). Selenium status of sheep may affect incidence of clinical mastitis (Giadinis *et al.*, 2011) and also may influence the acquired immunity to parasitic infestation (Celi, 2010). A deficiency in selenium has been reported to cause delayed adult worm expulsion and increased egg production of established female worms in mice inoculated with the gastrointestinal parasite *Heligmosomoides polygyrus*, suggesting an impaired intestinal response in the mice (Smith *et al.*, 2005). No differences in the overall immune response to *Haemonchus contortus* infection have been observed in sheep given an intraruminal selenium pellet (Jelinek *et al.*, 1988). Selenium supplementation on helminthes burdens of marginally selenium deficient suckling Angora goat kids did not influence the level of parasitism (Fivaz *et al.*, 1993). It seems then that selenium supplementation may not offer a useful additional means of controlling internal parasites of Angora goat kids. However, other studies have demonstrated that both selenium and vitamin E are required for specific IL-4-related changes in intestinal physiology that promote host protection against gastrointestinal nematode parasites in mice (Au *et al.*, 2005; Smith *et al.*, 2005). In selenium-supplemented sheep lower fecal egg counts than the non-supplemented counterparts have been observed, which suggests the selenium status of sheep may influence the rate of acquisition of resistance to parasitic infection (Celi *et al.*, 2010b). The observed negative correlation between fecal egg counts and GSH-Px suggests that an increase in GSH-Px activity may reduce parasitic infection. However, as the correlation was not very strong it is likely that selenium status is not the only factor responsible for the development of resistance to gastrointestinal parasites in Merino sheep (Celi *et al.*, 2010b). Indeed, there are a number of other factors that can also play a role in the development of resistance and resilience to gastrointestinal parasites such as age, climatic conditions, genetics, nutrition, and grazing management (Burke, 2009; Van Houtert and Sykes, 1996). Further evaluation of the contribution of selenium to worm expulsion

should contribute to an understanding of the role of oxidative stress in the development of resistance to gastrointestinal parasites.

Supplementation of selenium is recommended in ruminants to avoid mortality in newborns, enhanced growth rate, improved milk and wool production and improvement of reproductive efficiency by increasing fertility and better seminal qualities in Se deficient regions (Harrison *et al.*, 1984; Hefnawy and Tortora-Perez, 2010). Comprehensive work has been done on the supplementation of selenium for improvement of reproduction (Ali *et al.*, 2009; Moeini *et al.*, 2009; Munoz *et al.*, 2008), increasing the concentration of Se in milk (Edwards *et al.*, 2011; Viero *et al.*, 2010; Walker *et al.*, 2010) and colostrums (Lacetera *et al.*, 1996; Swanson *et al.*, 2008). Quality work elucidating the role of selenium in immunomodulation (Finch and Turner, 1996; Kumar *et al.*, 2009; Spears and Weiss, 2008) has also been published. Selenium supplementation in sheep increased the levels of selenium in blood and colostrums, and in the blood and liver of their lambs with greater absorption of IgG (Rock *et al.*, 1991). When administering selenium at very high levels (2mg/day), higher amount of zinc supplementation is also advisable (Moeini *et al.*, 2011). However, there is not sufficient published work reporting the supplementation of selenium at higher levels during transition phase and its impact on the oxidative stress in ruminants.

Influence of selenium supplementation on HSP70 response of heat stressed and *Escherichia coli* challenged broiler chickens were investigated by (Mahmoud and Edens, 2004) and suggested that selenium supplementation imparted resistance to oxidative stress by improved redox status. Selenium supplementation has also been reported to improve the immune response of broilers (Niu *et al.*, 2009a) and quails (Sahin *et al.*, 2008) under heat stress. In goats the combination of selenium, Vitamin E and Vitamin C seems to reverse the negative effects of heat stress (Sivakumar *et al.*, 2010), however, more studies are needed to clarify the role of each individual antioxidant. Nano selenium seems to be utilized more effectively when compared to its inorganic or organic form (Shi *et al.*, 2011) in sheep, however, Monterrosa *et al.*, (2011) did not find any differences in absorption and digestibility with sodium selenite or selenomethionine included in the diet of lambs. Greater serum levels of selenium were observed in cows fed organic selenium and in their respective calves than those fed its inorganic form (Weiss and Hogan, 2005). An increase in whole blood, plasma and muscle tissue selenium concentration can be achieved by feeding higher levels of organic selenium (Heard *et al.*, 2007). In dairy cows organic selenium can be fed up to 20 times the NRC recommendation without any toxic effects (Juniper *et al.*, 2008). The appropriate levels of selenium to be included in ruminants' diet under heat stress still remains to be determined and needs to be investigated both in controlled and natural environmental conditions.

It is a well established fact that selenium and vitamin E act synergistically as preventive and chain breaking antioxidants and supplementation of one appears to be less effective when the other is lacking (Miller *et al.*, 1993). Their joint supplementation to dairy cows has resulted in reduced incidence of mastitis and retained fetal membranes and in an improved reproduction (Brozos *et al.*, 2009; Hogan *et al.*, 1993; Miller *et al.*, 1993; Moeini *et al.*, 2009; Pavlata *et al.*, 2004). Cows treated with sodium selenite and α -tocopherol acetate before calving, produced larger quantities of colostrum and milk however, the enhanced antioxidant status did not improve either passive immunity or calves' growth (Lacetera *et al.*, 1996). Parental administration of vitamin E and selenium during dry period has resulted in increased erythrocyte GSH-Px activity and blood neutrophils percentage in dairy sheep in subsequent lactation (Morgante *et al.*, 1999). A single treatment of α -tocopherol acetate and sodium selenite, 3 weeks before calving reduced the concentrations of plasma cortisol and erythrocyte peroxides (Gupta *et al.*, 2005) in crossbred dairy cattle. Selenium and vitamin E supplementation resulted in reduced still births or calf deaths with in 24hrs after birth in dairy

cows (Waller *et al.*, 2007) and reduced oxidative stress indices in dystocia-affected buffaloes (Sathya *et al.*, 2007). Alpha-tocopherol concentration of PMN was successfully elevated by supplementation of selenium and vitamin E during periparturient period that helped to negate the suppression of intracellular bactericidal action of PMN around calving (Smith *et al.*, 1997). Although there is a growing body of evidence for the beneficial effects of selenium and vitamin E supplementation above recommended levels on animal productive and reproductive performances, and immune function, the optimum levels of these antioxidants need to be firmly established in respect to the different physiological and environmental conditions that farm animals might be.

Conclusion

The study of the environmental and nutritional factors that affect the oxidative status in ruminants is an interesting area of research and there is a growing body of evidence underpinning the pathophysiological consequences of oxidative stress in farm animals. Despite oxidative stress has been associated with numerous conditions, there is a great deal to be discovered about its role in ruminant health and production. Clarity of understanding of the pathophysiology of oxidative stress in ruminants will allow designing specific antioxidant interventions. The potential to increase production, health and reproduction has made nutritional manipulation of ruminants' diets a focus for research. Selenium and Vitamin E represents an ideal antioxidant supplement to improve animal health, production and reproduction. The practical value of the use antioxidants in veterinary medicine is obvious and clear, however, a thorough scientific approach is needed to explain their success and effectiveness.

It seems clear that there are opportunities to improve animal production and health by supplementing vitamin E and selenium at higher levels than the recommended ones, however, further studies are required to provide more insights into the effects of selenium and vitamin E supplementation on the physiological responses in ruminants under both controlled and field conditions. Under normal physiological conditions, there is steady state balance between the production of oxygen-derived free radicals and their removal by the antioxidant systems however, physiological (growth, pregnancy and lactation) or environmental (heat stress) increased production of free radicals and/or decreased antioxidant activity may disrupt this balance leading to oxidative stress which can be corrected by supplementing supraphysiological doses of antioxidants like Vitamin E and selenium.

The field of oxidative stress in ruminant medicine is still in the early stages of development.. For example, if oxidative stress is a primary cause of pathologic change or a consequence of disease processes still remains to be determined. Clarity of understanding of the pathophysiology of oxidative stress in farm animals will allow designing specific antioxidant therapies. Future research should focus on the establishment of a reference panel of biomarker of oxidative stress to be used in veterinary medicine. Future research should also address the issue of standardization of techniques and methodologies to study oxidative stress (Celi 2011b). For example, tissue biopsy sampling techniques can be utilized only in particular cases in veterinary medicine, therefore a major challenge in veterinary oxidative stress research is to develop a set of blood biomarkers that can reliably reflect the tissue oxidative status in the individual animal.

With the development of the “omics” technologies, and the heritage and innovation of alternative medicine research, research on the use of antioxidants in animal nutrition should have a holistic approach. Considering the complexity of the animal body and of the possible interactions between antioxidants and the body, it is conceivable that holistic analyses of antioxidants-animal interactions are a prerequisite to reaching a full understanding of the

effects of selenium and Vitamin E supplementation in animal diets. By inference, the combination of different omics platforms will surely provide a deeper insight into the influence of antioxidants components and the mechanism of their actions. Such a combination is referred to as oxi-animalomics. Research on the use of antioxidants in animal nutrition should take advantage of the “omics” era and focus on the antioxidants and the animal. We propose thus, a new approach that explores the constitution and biological effect of different antioxidants, and then study relationships among complex system of antioxidants and other complex systems like genome, proteome, and metabolome in animal model. It is important that the oxi-animalomics approach studies the pharmacological effects, mechanism, safety, and compatibility of antioxidants using systems biology methods for the modernization and the innovative development of alternative medicine. A rigorous scientific development of the oxi-animalomics approach will provide a new theoretical platform to develop research on the use of antioxidants in animal nutrition.

The tactical use of particular antioxidants as well as nutritional manipulations is surely a major strategy in modern animal production. The demand for an omics-based approach will continue to grow in animal and veterinary science. The goals of oxi-animalomics research ranges widely, encompassing the discovery of new functionality, elucidation of the mechanisms of action, and safety issues. Although exhaustive analysis of one particular omics will help deepen our knowledge of the antioxidants -animal interaction, the combination of different omics data will provide more concrete information on what happens inside the animal in response to the consumption of antioxidants components. As a consequence, further cooperation of researchers with different backgrounds and expertise is required.

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Milk Fat and Protein Precursors Generated in the Rumen and Their Associations with Different Forage Combinations

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Abstract

Milk performance of dairy cows in most middle-to-small scale dairy farm in China is mainly maintained by incorporating high ratio of concentrate to forage in the total mixed rations, which resulted in low milk fat and a relatively high milk protein. Ryegrass hay with limited yield in China and alfalfa hay increasingly imported from USA are still regarded as luxury forage options in dairy feeding in China. Under high ratio of concentrate to forage, different corn-stover based forage combinations in the present study were compared with hay based forage combination in terms of their effects on milk yield, milk composition, rumen degradability and milk fat and protein precursors generated during the rumen fermentation. The results obtained in the present study suggested that milk yield and milk protein content was greater in dairy cows fed total mixed rations with forage combination of corn silage together with ryegrass hay and/or alfalfa hay than those in the rations with corn stover based forage combination, and this could be caused by relative high VFA production in the rumen and greater ruminal MCP flowed into small intestine in the ration with corn-silage based forage combination. The diurnal ratio of milk fat precursors (acetate plus butyrate) to lactose precursor (propionate) was contrary to diurnal VFA variation at different sampling time in a day in which dominant production of milk fat precursors mainly occurred before feeding, and dominant milk lactose production occurred mainly after feeding, especially in the rations with corn stover based forage combinations, and this could explained why milk fat content was greater in the rations with corn stover-based forage combination than the rations with corn silage based forage combination. Further phenolic acid profiles showed that ADL content in the corn stover based forage combinations was correlated with proportions of vanillic, ferulic and p-coumaric acids in total phenolic acids and the ferulic: p-coumaric acid ratio and in situ rumen degradation kinetics confirmed that ferulic and p-coumaric acids, especially in the rations with corn stover based forage combination would be the most important factors to inhibit fibre degradation in the rumen of dairy cows.

Introduction

In the last decades, the increase of milk production in China mainly relied on the increase of cow numbers, but the quality of raw milk as indicated by milk fat and protein contents has not been improved quite a lot as customer expected. Milk fat and protein contents in most middle-to-small scale dairy farms are still quite lower than those values in developed countries. In order to maintain a relative high milk yield, increasing concentrate to forage ratio up to 60:40 in the rations of dairy cows has been well accepted by these farms in China. The forage ingredients mainly include agricultural crop residues, such as grain bran, corn

stover and corn silage, etc. Ryegrass hay with limited yield in China and alfalfa hay increasingly imported from USA are still regarded as luxury forage options in dairy feeding in China. The ambitious objective of the present study is firstly to determine if there are any forage combinations without high-quality hay inclusion to maintain milk yield and milk composition, if not, what would be main limiting factor in corn stover based forage compared with hay included forage from a fibre degradation angle; the another objective attempt to explore milk fat and protein precursors generated in the rumen and their associations with different forage combinations based on a preliminary experiment trial finished recently.

Materials and Methods

Five nonlactating, ruminally cannulated Holstein cows (543 ± 25 kg) were used in a 5×5 Latin square design, balanced for residual effects, to investigate the effects of feeding cow five region-representative total mixed diets (concentrate: forage=60: 40) differing in forage combinations: 1) 100% corn stover (ration I: CS); 2) 50% corn stover plus 50% ensiled corn stover (ration II: CS+ECS); 3) 50% ensiled corn stover plus 50% Chinese wild ryegrass hay (ration III: ECS+CW); 4) 50% Chinese wild ryegrass hay plus 50% whole corn silage (ration IV: CW+WCS); and 5) Chinese wild ryegrass hay plus whole corn silage plus alfalfa hay in approximate ratio of 1:1:1 (Ration V: CW+WCS+AH). The surgical preparation of rumen fistulated cows was done 2 months before the start of the study at the College of Animal Science and Technology, China Agricultural University. Cows were confined by means of stanchions in 5 individual metabolism stalls in a monitor room with rubber-padded concrete flooring. The experiment was conducted under the approval of China Agricultural University Animal Care and Use Committee. During the experimental period, daily milk performance, milk composition, feed intake, urine volume and feces amounts of each cow were individually measured and recorded, rumen fluids and blood samples were collected for later analysis of rumen fermentation indexes and blood metabolites. The ratio of NFC to NDF in the five rations was calculated to indicate dietary carbohydrate structure. To determine microbial degradation characteristics of plant cell wall in the rumen and their relationships with phenolic acid profiles in fibrous feeds, bran and hull (corn bran, wheat bran, rice bran and rice hull), straw (corn stover, wheat straw and rice straw) and forage (alfalfa hay, reed hay, ryegrass hay, sudangrass hay) were chosen as target feeds and investigated.

Results

Effect of total mixed rations with different forage combinations on milk performance and milk composition

During whole experimental period, average milk production varied between 14.5-22.8 kg/d. Compared with the ration I, daily milk yield in rations II, III, IV and V were increased by 1.8%, 0.8%, 6.25%, 10.2%; Milk fat contents in ration I, II, III without any inclusion of corn silage and high quality hay were all higher than 3.5% above the 973 projects target value, and milk fat contents in both rations IV and V were above 3.4%, slightly lower than the rations I-III, but no significant difference was observed among these ration groups; The highest milk protein content occurred in the ration V, followed by ration IV, both higher than the 3.1% of 973 projects target value. The ration II with inclusion of ensiled corn stover presented the lowest milk protein content of 3.04%. Milk fat and milk protein content in milk showed a significant negative correlation with milk yield. In the case of milk fat composition, the corn stover plus ensiled corn stover ration II significantly increased the content of the C20 and

C22: 1 long-chain fatty acids in milk fat, while the ensiled corn stover plus ryegrass hay ration significantly decreased the contents of C20 and C22: 1 long-chain fatty acids in milk fat. Different rations did not exhibit differences for C8 to C18 long-chain fatty acids in milk fat.

Effect of total mixed rations with different forage combinations on rumen fermentation characteristics

Under the high concentrate ratio (60%) in rations, total mixed rations with different forage combinations did not alter average pH value in the rumen, and pH in all ration treatment was above 6.3. However, significant differences of rumen pH were observed among different sampling times within a day, and pH value peaked in the morning (7:00 am) and afternoon (7:00 pm) before feeding. After the feed, rumen pH decreased gradually to pH 6.1 in the afternoon (11:00-13:00) and pH 5.9 at night (23:00-01:00). The real-time Q-PCR population of three main cellulolytic bacteria including *Fibrobacter succinogenes*, *Ruminococcus albus*, and *Butyrivibrio fibrisolvens* in the rumen were decreased in the rations IV and V with inclusion of corn silage and ryegrass hay and alfalfa hay compared with corn stover based rations.

Total milk fat precursors, indicated as total volatile fatty acids (VFA) yielded in the rumen, did not significantly differ among five total mixed rations with different forage combinations. Diurnal mean VFA concentration in five rations were 146.8, 150.2, 149.1, 154.2 and 152.9 mM, respectively, in which the lowest VFA occurred in the ration I with single forage of corn stover inclusion, and the high VFA production was observed in the ration IV-V with the forage combination of corn silage together with ryegrass hay and/or alfalfa hay. Rumen VFA difference were also observed among the different sampling time within a day before and after feeding in the morning and afternoon. VFA production peaked 4 hrs after the morning feeding (11:00, 164.0 mM) and afternoon feeding (23:00, 163.0 mM), and it gradually decreased at 19:00 in the afternoon (131.3 mM) and at 7:00 in the morning (136.6 mM). The diurnal ratio of milk fat precursors (acetate plus butyrate) to lactose precursor (propionate) was contrary to diurnal VFA variation at different sampling time in a day in which dominant production of milk fat precursors mainly occurred before feed, and dominant milk lactose production occurred mainly after feeding especially in the rations with corn stover based forage combinations. Rumen fluids were sampled daily at final diurnal interval of 2 h, and microbial protein (MCP) concentration in rumen fluids did not differ among different time intervals ($P>0.05$), but it differed among five rations ($P<0.05$). The highest MCP concentration (1.217 mg/mL) occurred in ration III, and it was greater than those of rations I and V ($P<0.05$), but did not differ from those of ration II and IV ($P>0.05$). Allantoin, uric acid, total purine derivative (PD) in urine and microbial nitrogen (MN) and MCP flowed into small intestine increased significantly from rations I-V ($P<0.05$). Allantoin and uric acid in total PD excretion ranged from 83% ~ 92% and 8% ~ 17%, respectively. Allantoin ($y=50.44x+35.58$, $R^2=0.733$), uric acid ($y=27.22x-28.77$, $R^2=0.734$), and total PD ($y=77.67x+6.811$, $R^2=0.734$) excretion were linearly correlated with NFC/NDF value in the rations. Consequently, PD excretions in urine and MCP flowed into small intestine were greater in the ration with a roughage combination of Chinese wildrye hay + Whole corn silage+ Alfalfa hay than the other rations.

Effect of total mixed rations with different forage combinations on blood metabolites and hormone levels in the rumen

Triglyceride ($P=0.36$) and insulin ($P=0.20$) in the blood serum of ration III was the highest and lowest blood glucose concentration occurred in ration III, but the difference was not

significant among five rations, BHBA, NEFA, plasma urea nitrogen between each treatment group showed a significant difference ($P < 0.01$). And each treatment group BHBA, plasma urea nitrogen increased after feeding, feeding 4-6 hours after the highest, and then reduce; each treatment group, NEFA fluctuated over time points, the basic 4-6 hours after feeding to a minimum.

Progesterone in the rumen among treatments showed significantly difference ($P < 0.01$), but progesterone and gastrin content changes in the rumen showed a contrary order among treatments, estrogen and testosterone in ration V had the highest expression level, in others treated group, the content did not indicated the same regulation. In hormone variation at different time points, estrogen in the feed 1-2h reached a maximum value and then decreased to a minimum on 4-6h, but the variation of the pregnancy hormone, gastrin, and testosterone in each treatment were different.

Effect of phenolic acid profiles of plant cell wall in fibrous feeds and their relationships with microbial degradation characteristics in the rumen

Neutral detergent fibre disappearance rate with nylon bag technique decreased with lower dietary NFC to NDF ratio, but no significant difference was observed among five rations with different forage combinations. To deeply investigate microbial degradation characteristics of plant cell wall in the rumen and their relationships with phenolic acid profiles in fibrous feeds, corn bran, wheat bran, rice bran, rice hull, corn stover, wheat straw, rice straw, alfalfa hay, reed hay, ryegrass hay, sudangrass hay were chosen as target feeds for in situ rumen degradation. A rapid and sensitive reversed-phase method for the simultaneous quantification of protocatechuic (PRA), vanillic (VA), ferulic (FA) and p-coumaric (PCA) acids was developed and PRA, VA, FA, PCA and ADL of 13 feeds were determined. The result showed that ADL content was correlated with proportions of VA ($r=0.88$, $P<0.05$) (except tomato pomace), FA ($r=-0.95$, $P<0.05$) and PCA ($r=0.90$, $P<0.05$) in the summed phenolic acids and the PCA: FA ratio ($r=0.91$, $P<0.01$). It was assumed that VA, PCA and PCA/FA may be the most important factors to inhibit feed degradation.

There was no difference in degradation rate of cellulose among four bran/hull feeds, and the highest degradation rate of hemicellulose was rice hull ($c=0.063$). Effective degradability (ED) of DM, NDF, cellulose and hemicellulose in corn bran and wheat bran were all higher than rice bran and rice hull. PRA, VA, PCA and PCA/FA were the factors that may limit plant cell wall degradation in bran hull feeds, but FA did not show its limitation to feeds. Degradation rate of FA in corn and wheat bran were higher than PCA while lower than PCA in rice bran and rice hull. Among four phenolic acids, FA was the most easily degradable one but PCA was the most difficult degradable one. And there were no uniform degradation rule of PRA and VA in bran hull feeds.

Among crop stover or straw feeds, the highest degradation rate of cellulose was rice straw ($c=0.043$) while corn straw and wheat straw had no difference. And there was no difference in degradation rate among three straw feeds. ED of cellulose in wheat straw was significantly lower than corn straw and rice straw, while ED of hemicellulose in corn straw was significantly higher than wheat straw and rice straw. PCA had the significant positive relationship with ED of NDF and hemicellulose, but it showed depression on quickly degradable fraction (a) of cellulose. And FA showed significant positive relationship with the degradation of DM. PCA was most difficult to degrade in four phenolic acids. The degradation rate ranked: PRA (0.060) > VA (0.040) > FA (0.034) > PCA (0.018).

Among hay feeds, degradation rate of cellulose in sudangrass hay was highest ($c=0.062$) and there was no difference among alfalfa hay, ryegrass hay and reed hay. There was no difference in degradation rate of hemicellulose and ED of cellulose among four straw

feeds. And reed hay had the highest ED of hemicellulose and alfalfa hay had the lowest one. PCA was the most important factor to inhibit feed degradation. The degradation model of phenolic acids in alfalfa was most special and the digestibility of four phenolic acids in alfalfa were much higher than other three feeds. In hay feeds, the degradation rate of FA was higher than PCA. Meanwhile, FA was more easily degradable than PCA.

Conclusions

Under the high inclusion (60%) of concentrate in the rations, the results obtained in the present study suggested that milk yield and milk protein content was greater in dairy cows fed total mixed rations with forage combination of corn silage together with ryegrass hay and/or alfalfa hay than those in the rations with corn stover based forage combination, and this could be caused by relative high VFA production in the rumen and greater ruminal MCP flowed into small intestine in the ration with corn-silage based forage combination. The diurnal ratio of milk fat precursors (acetate plus butyrate) to lactose precursor (propionate) was contrary to diurnal VFA variation at different sampling time in a day in which dominant production of milk fat precursors mainly occurred before feeding, and dominant milk lactose production occurred mainly after feeding, especially in the rations with corn stover based forage combinations, and this could explained why milk fat content was greater in the rations with corn stover-based forage combination than the rations with corn silage based forage combination. Further phenolic acid profiles showed that ADL content was correlated with proportions of VA ($r=0.88$), FA ($r=-0.95$) and PCA ($r=0.90$, $P<0.05$) in total phenolic acids and the PCA: FA ratio ($r=0.91$, $P<0.01$), and degradation kinetics confirmed that VA, PCA and PCA/FA, especially in the rations with corn stover based forage combination would be the most important factors to inhibit fibre degradation in the rumen of dairy cows.

Inflammation Mediator Changes in The Plasma of Normal and Superovulated Rats

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Superovulation is carried out by administering exogenous gonadotropin to animals which subsequently induces small follicles on the ovaries to undergo rapid growth and ovulate. The selection of protocols to superovulate the animals is dependent on the species and the objectives of the studies. The objectives of this study are to determine the changes of inflammation mediators (IL-8, PGE₂ and NGF) in the plasma of normal and superovulated rats. Rats were divided into three treatment groups at random; control, sacrificed at 8 hrs post hCG and 18 hrs post hCG. Results shows that IL-8 concentration in rat at 8 hrs post hCG is significantly higher ($P<0.05$) than in control rats. This is probably due to the mRNA of IL-8 in granulosa luteal and stroma cells produce IL-8 proteins. The IL-8 concentration reduces in 18 hrs post hCG administration and this maybe an indication of the decreased expression of this mediator after ovulation takes place. The level of PGE₂ in rats increases at 8 hrs post hCG and reduced in rats at 18 hrs post hCG. However, the levels of circulating PGE₂ in control and superovulated rats were not significantly different ($P>0.05$). The results shows that blood plasma NGF is significantly higher ($P<0.05$) in rats at 18 hrs post hCG compared to 8 hrs post hCG. The CL was observed on ovaries of rats sacrificed at 18 hrs post hCG, which an indicator that healing is taking place after ovulation and NGF is also known as a vital component in tissue repairing and wound healing. These results indicated that the inflammatory mediators are expressed at different points of the ovulation process. However, IL-8 only increased in superovulated rats but not control rats. Therefore, further research on the circulatory level of this mediator should be carried out to understand the mechanism of this mediator and any problems encountered as a result of high level of circulating IL-8 when superovulation is carried out since PGE₂ and NGF concentrations were not altered in both superovulated and control rats.

Lead Paper 11

Ecogenomics of *Synergistetes* Bacteria to Facilitate Detoxification of Xenobiotics in Ruminant Livestock

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In the early 1980's, a major scientific and practical discovery was made by CSIRO when Raymond Jones identified, in a Hawaiian goat, the anaerobic bacterium *Synergistes jonesii* (leucaena bug) which could degrade toxic pyridinediol compounds from the fodder plant *Leucaena leucocelphala*. This was a significant achievement because (1) the bacterium was the first isolated representative of the phylum *Synergistetes* which was previously undescribed, (2) a paradigm shift occurred which recognised that discrete functional groups of gut microorganisms could be geographically segregated rather than broadly dispersed, and (3) the bacterium was introduced onto the Australian continent where it was postulated that the organism did not exist, and thus would protect cattle from leucaena toxicity. However the 'leucaena story' may not be as originally proposed based on our recent molecular ecology studies. In our taxonomic studies, we have found 16S rRNA gene sequences belonging to the species *S. jonesii*, recovered from both Australian cattle and wild indigenous herbivores in northern Australia, that differ from the *S. jonesii* type strain 78-1 which was released 20 years ago into Australian cattle. Recently we have also isolated from the bovine rumen a bacterium (strain MFA1) which belongs to the phylum *Synergistetes* and metabolizes fluoroacetate under anaerobic conditions (Davis *et al.*, 2012). It is clear that our understanding of the *Synergistetes* phylum in the ruminant animals is rudimentary but potentially important in nutritional physiology. The objective of the paper is to examine the distribution, function and ecology of rumen *Synergistetes* bacteria that ferment amino acids and their potential use to improve ruminant production.

Bacteria belonging to the *Synergistetes* phylum

The *Synergistetes* phylum has an interesting taxonomic history. *Synergistetes* have been found in a wide range of anaerobic habitats, including animal and insect gastrointestinal tracts, wastewater treatment systems, soils, oil wells and they also have been implicated in periodontal disease (Godon *et al.*, 2005). Despite this habitat diversity, isolates bear a striking physiological resemblance to one another in that they all ferment amino acids rather than carbohydrates and they have the highest average proportion of amino acid transport and metabolism genes in any bacterial phylum to date (Hugenholtz *et al.*, 2009). One possible explanation for this apparent physiological uniformity is that members of the *Synergistetes* have diversified by exploiting the same type of metabolic niche (amino acid fermentation) in different environments. The few cultured isolates from the phylum also display differing abilities to use xenobiotic compounds (dihydroxypyridine, fluoroacetate) as electron

acceptors to facilitate fermentation of amino acids which are their primary carbon source (Allison *et al.*, 1992; Davis *et al.*, 2012).

Molecular studies have shown that *Synergistetes* bacteria are especially associated with the digestive system of animals and humans (Godon *et al.*, 2005; Vartoukian *et al.*, 2007). Since the discovery of *S. jonesii*, the collection of *Synergistetes* 16S rRNA gene sequences has grown substantially to represent more than 12 distinct genera (Figure 1).

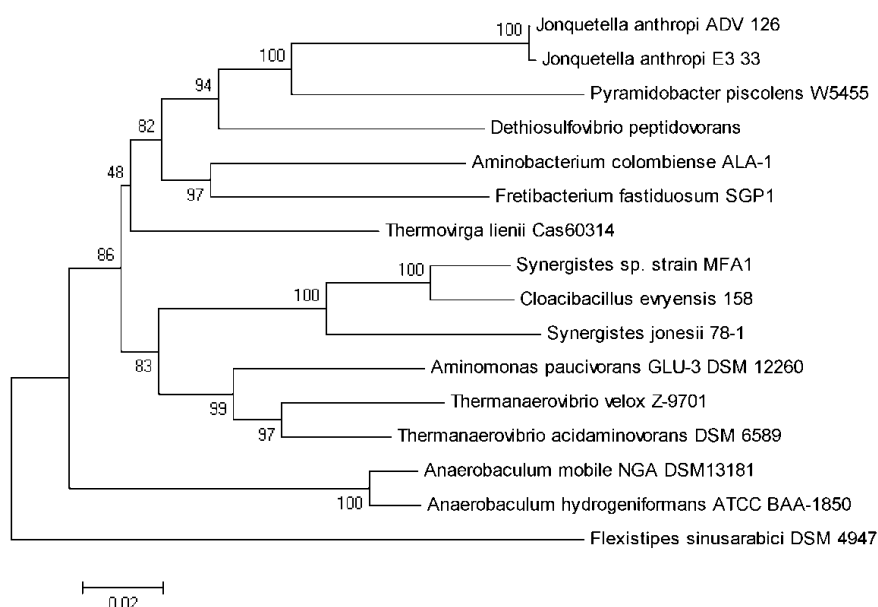


Figure 1. Phylogenetic tree of genera belonging to the *Synergistetes* phylum

Use of *Synergistes* bacteria in ruminant livestock production

Leucaena feeding

Leucaena (*Leucaena leucocephala*) is a highly productive tropical leguminous fodder tree. It is long-lived and drought tolerant and is a high-value feed for ruminant animals due to its palatability and excellent nutritional characteristics i.e. high crude protein content, high digestibility and non-bloating attributes (Jones, 1979). These productive traits consistently deliver excellent live-weight gains superior to other tropical forage systems (Shelton and Dalzell, 2007).

Leucaena does however contain a toxin, the non-protein amino acid mimosine. Mimosine and its primary rumen derivative 3-hydroxy-4(1H)-pyridone (3,4-DHP) are responsible for inhibiting animal production and the former compound may cause mortality (Peixoto *et al.*, 2008). In 1979, a rumen bacterium, later named *Synergistes jonesii*, was discovered that could degrade these toxins into harmless by-products (Jones, 1981a, Allison *et al.*, 1992). The bacterium was introduced into Australian ruminants in the 1980s enabling inoculated animals to achieve high dietary intakes of *leucaena* and display superior performance suggesting that *leucaena* toxicity was resolved (Jones and Megarritty 1983; Quirk *et al.*, 1988; Pratchett *et al.*, 1991). However, there have been consistent reports of continuing toxicity in Australian cattle herds even in those previously inoculated and therefore thought protected from DHP toxicity (Dalzell *et al.*, 2012). This producer survey involved extensive herd testing across Queensland, Australia and indicated that approximately 50% of the 44 herds tested displayed sub-clinical toxicity as indicated by high levels of DHP in urine. Toxicity may not always manifest itself as visible symptoms (Jones

and Winter, 1982) and subclinical toxicity often goes unnoticed while reducing animal performance and profitability. Despite lack of visible symptoms, Quirk *et al.*, (1988) showed that liveweight gain of cattle on leucaena pastures was doubled following inoculation.

The longevity and long-term efficacy of the *S. jonesii* inoculum is poorly understood and therefore a study was conducted recently to investigate the efficiency and persistence of inoculating *S. jonesii* into Australian cattle herds (Graham *et al.*, 2013). The experiments conducted in eight commercial herds showed (1) a very slow rate of degradation of DHP isomers; (2) frequent occurrence of high levels of 2,3-DHP in urine indicating partial toxin degradation, both before and after inoculation; (3) a low incidence of detection of *S. jonesii* in rumen fluid after inoculation based on PCR amplification of 16S rDNA sequence of the type strain 78-1 thus indicating low populations in rumen fluid (4) no evidence of DHP degradation post inoculation on one of two properties tested; and (5) loss of protection from subclinical toxicity on some properties after <4 months on alternative non-leucaena pastures (Graham *et al.*, 2013). It was concluded that while most herds showed some capability to degrade DHP due to some residual capability from previous exposure, they did not achieve the same rapid and complete DHP degradation reported in the 1980s.

Based on this information, our current hypothesis is that *S. jonesii* was broadly dispersed in Australia prior to the release of the imported strain but was phenotypically different in ability to degrade leucaena toxins which were not present in indigenous Australian plants. This is supported by the observation that detoxification of leucaena in ruminants has been documented on several continents other than Australia. We propose that the *S. jonesii* species are not geographically constrained but rather have evolved varying phenotypes for metabolism of xenobiotics based on the different habitats they occupy globally.

Fluoroacetate Poisoning

Globally, fluoroacetate is found in over 40 plant species (Harper *et al.*, 2003) and is responsible for intoxication of commercial livestock species (McIlroy, 1982). Due to this problem associated with fluoroacetate-accumulating plants, dehalogenase genes have also been used to develop transgenic rumen bacteria (Gregg *et al.*, 1994) which detoxify fluoroacetate within the gastrointestinal tract of ruminant livestock (Gregg *et al.*, 1998; Padmanabha *et al.*, 2004). Concerns over the release of these transgenic bacteria, and the lack of information on fluoroacetate-degrading anaerobes prompted us to search for naturally-occurring anaerobic microorganisms that could reduce fluoroacetate toxicity in ruminants. Despite the interest in the microbial degradation of fluoroacetate, there are few reports of fluoroacetate being degraded naturally under anaerobic conditions (Kim *et al.*, 2000).

We have recently isolated from the bovine rumen a bacterium (strain MFA1) which belongs to the phylum *Synergistetes* and metabolizes fluoroacetate under anaerobic conditions (Davis *et al.*, 2012). The growth characteristics of strain MFA1 indicate that the bacterium may gain energy via the process of reductive dehalogenation (dehalorespiration). In the course of our studies, we found four other fluoroacetate-degrading strains with a 99 % similarity of 16S rDNA sequence to the MFA1 bacterium in the gut of emus (*Dromaius novaehollandiae*), kangaroos (*Macropus* spp.) and other cattle. The occurrence of strain MFA1 and other related strains (98% similarity) from the gut of animals demonstrates that these members of *Synergistetes* may be widely distributed in the gastrointestinal tracts of herbivorous mammals. The fact that these sequences could only be detected using nested PCR indicates they are at low numbers, and possibly at the limit of detection for a PCR-based method.

Growth requirements and genomics of Synergistetes bacteria

Synergistetes species are anaerobic amino-acid fermenters, and this is reflected in their genome content, which has a greater abundance of amino acid transport and metabolism genes compared to other bacteria. These organisms are also known to utilise peptides for growth requirements (Allison *et al.*, 1992; Baena *et al.*, 1999). A better understanding of the nutritional and physiological requirements and genome content of bacteria in this phylum will provide insights into the ecology of these organisms in the rumen which could be managed to protect animals from toxicity. We have therefore examined the diversity of the peptidolytic systems of 15 *Synergistetes* bacteria at the genome level to identify the predominant genes involved in peptide and amino acid metabolism of rumen *Synergistetes*.

All of the *Synergistetes* examined possessed a conserved set of peptidase genes consisting of pepM, ggt, pepF, lap, dpp1, and pepP. Phylogenetically similar species were observed to cluster together based on their peptidolytic systems (Figure 2). *Synergistes jonesii*, strain MFA1 and closely related species (Cluster IA) were the only bacteria to contain endopeptidase O (pepO) and Proline iminopeptidase (pip) genes. Cluster II members were found to have a higher abundance of peptide transport systems compared to all other groups.

Conclusions

Rumen *Synergistetes* bacteria appear to have a preference for peptides compared to amino acids for growth. They also have distinctive enzyme systems for the metabolism of peptides of specific amino acid composition. Provision of diets that are optimised to provide nitrogenous nutrients specific for the *Synergistetes* bacteria may stimulate growth and abundance of these organisms in the rumen and provide greater protection against toxicity from leucaena and fluoroacetate and perhaps other plant secondary compounds.

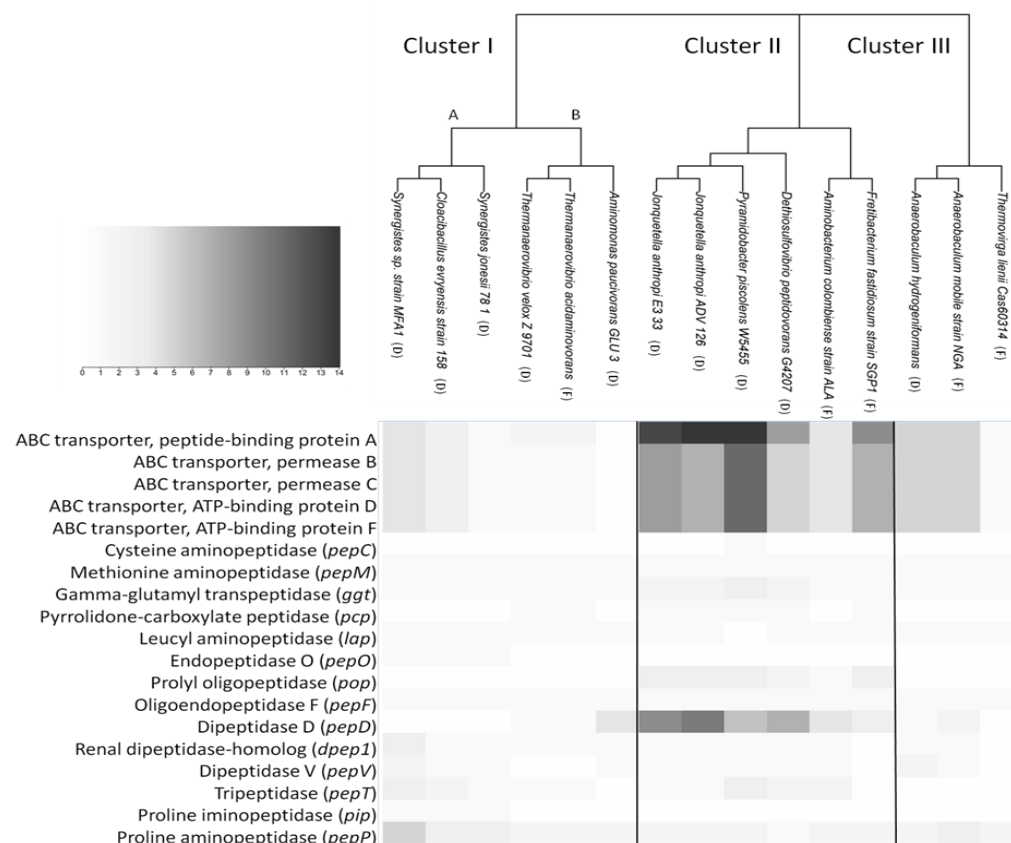


Figure 2. Heat map representing distribution of genes associated with peptidolytic systems among 15 *Synergistetes* species. Alphabet in the parentheses next to the species indicated the genomic sequencing status: D, draft; and F, finished.

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Sustainable Beef Production in Tropical Savannas of Northern Australia

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Introduction

In the tropical savannas of northern Australia, beef cattle production is the most widespread land use with cattle numbers in 2011 estimated at 6.7 million (ABARES, 2011). The production system generally involves continuous grazing of native pasture by large herds (hundreds) of *Bos indicus*/*Bos taurus* cattle in fenced paddocks with a single or multiple waters. Cattle are largely undisturbed throughout the year except for musters at the end of both the wet season and the dry season when animal husbandry activities occur, calves are separated from their dams and sale cattle are removed. Paddocks are typically large (50 to >100 km²) and heterogeneous, with diverse native vegetation that presents many spatial and temporal opportunities for selective grazing (Stobbs, 1975).

Cattle were introduced across the region over one hundred years ago. During this time the industry has changed markedly. Initially cattle were produced and sold opportunistically, but with big advances in infrastructure, northern Australia now supports a large live export market of cattle to Asia and beyond, with the number exported exceeding 500,000 in 2011 (ABARES, 2011). Markets have been the main driver of change in the industry and in cattle management. The current impetus is to increase production in northern Australia while maintaining or enhancing sustainability.

To manage cattle for sustainable grazing of native pastures, information concerning the interaction between intake and diet is needed (Oliviera & da Silva, 2007). For informed conservation and pastoral management, understanding the complexities of savanna dynamics is crucial (Sharp & Whitaker, 2003). Plant species response varies with different seasons and levels of use, which affects grazing choice and change in feeding value of vegetation types with season (Gordon, 2000). For sustainable production in the Victoria River District of the Northern Territory, grazing of approximately 21% of annual pasture production is recommended (Cowley *et al.*, 2007), but current utilisation levels of individual plant species and effects on pasture intake are not known.

This paper reports the results of an experiment that quantified and compared changes in intake and nutrition and related them to pasture defoliation patterns determined from individual plant measurements. The applied pasture utilisation levels were designed to exceed district averages in both a wet season and dry season pasture in order to understand effects of excessive use on pasture species.

Material and Methods

In the experiment, a 2 ha paddock was grazed with 10 cattle over 15 days in the dry season and 14 days in the wet season to remove around 60% of pasture biomass. By using this grazing down approach the dynamics of intake, diet selection, number of defoliation events for individual plants and species, and utilisation rates were determined.

Factors that limit cattle production in tropical pastures (Stobbs, 1975) were measured in November (the end of the dry season) and April (the end of the wet season). These were:

- Voluntary intake of pasture by individual animals, determined from changes to *n*-alkane concentrations in faecal samples collected daily, combined with dry matter digestibility (DMD) values from faecal near infrared reflectance spectroscopy (F.NIRS). *N*-alkanes were released into the digestive tract by alkane cattle capsules (Argenta®) administered to each animal five days before the trial. During each trial, *n*-alkanes were released at a constant rate for up to 20 days;
- Diet quality for individual cattle. Crude protein (CP), dietary non-grass (NG) and DMD were estimated from F.NIRS analyses of the daily faecal samples collected;
- Defoliation patterns. Height and basal area of individual plants within quadrats in the paddock were measured in each trial before grazing commenced and then repeated regularly during grazing. This described grazing patterns i.e. species selection, individual plant height and basal area grazed, and plant re-grazing sequences; and
- Pasture utilisation levels. This was calculated from removal levels recorded as part of the defoliation patterns.

The soil was a black vertisols. The pasture was a mix of native species dominated by perennial curly bluegrass (*Dichanthium fecundum*) and other C4 tussock grasses including *Panicum decompositum* (native millet), *Chrysopogon fallax* (ribbon grass) and *Aristida latifolia* (feathertop wiregrass), all highly variable in height and basal area. Forbs (39 plants in the dry season and 104 in the wet season) were scattered across the paddock as were trees and shrubs. Paddocks were not replicated. In the dry season trial the ten *Bos indicus*/*Bos taurus* heifers or steers had mean weights of 249 kg $\pm$ 6.9 kg and in the wet season, 249 kg $\pm$ 13.1 kg.

Results

Cattle consumed an estimated 48% of pasture in the dry season trial and 60% in the wet season trial, with no significant change in liveweight during both. Voluntary intake changed little in the dry season (4.8 to 4.4 kg/day), but declined after three days in the wet season from 6.6 kg/day to 5.2 kg/day (Figure 1). This decline appeared to be unrelated to available pasture biomass.

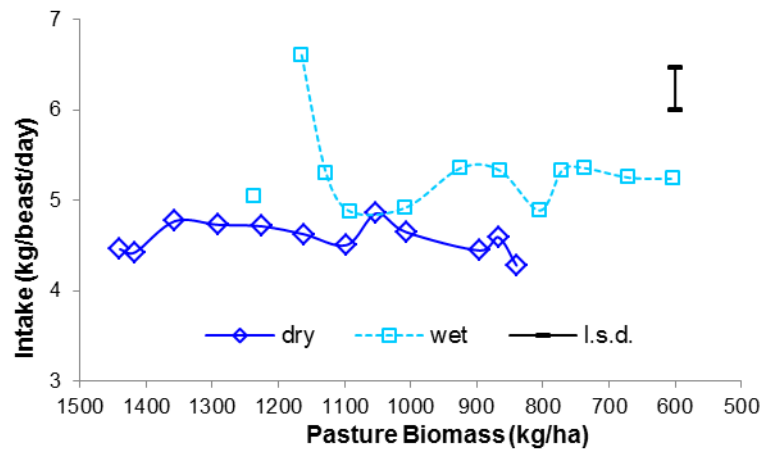


Figure 1 Pasture intake (kg/beast/day) (mean with average least significant difference (l.s.d. $P < 0.05$) relative to pasture biomass (kg/ha) in the dry and wet seasons.

As defoliation progressed dietary crude protein declined from 9 to 7% in the wet season and 6 to 4% in the dry season (Figure 2a). Dietary non-grass levels were greater in the wet season and declined more (49 to 32%) than in the dry season (28 to 20%) (Figure 2b); dry matter digestibility declined similarly, from 60 to 54%, and 51 to 48% respectively (Figure 2c).

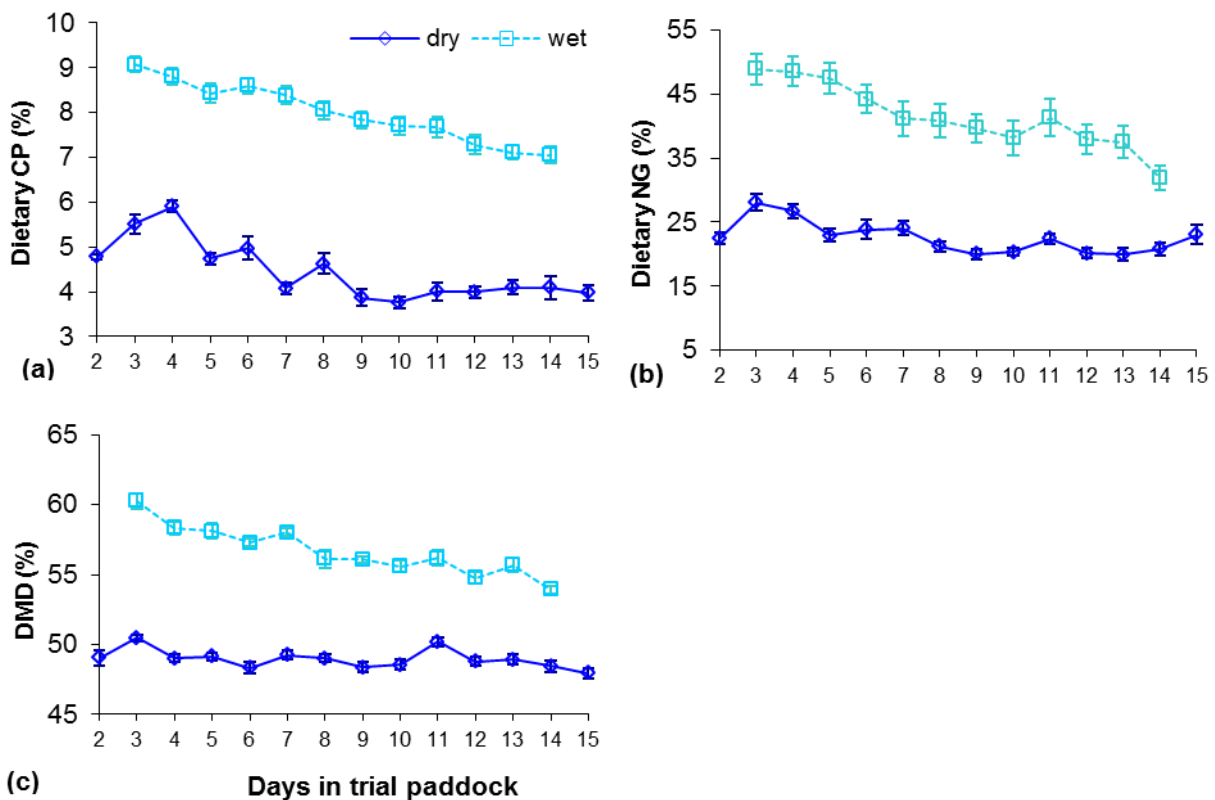


Figure 2 (a) Dietary crude protein (CP), (b) non-grass (NG) and (c) dry matter digestibility (DMD) (means $\pm$ S.E.) from F.NIRS predictions for the dry and wet seasons.

Plant measurements revealed different defoliation patterns for both species and season (Figure 3a and 3b), with species selection evident and different between seasons (Figure 3c and 3d). Re-grazing of individual plants also differed between species and season, with 49%

of *A. latifolia* plants being grazed more than twice in the dry season, (compared to 25% in the wet season), and 56% of *P. decompositum* plants in the wet season (compared to 29% in the dry season). In the dry season 21% utilisation was achieved during day five when 48% of *C. fallax*, 24% of forbs, 12% of *D. fecundum* and *A. latifolia* and 5% of *P. decompositum* volume had been removed (Fig. 3a). In the wet season 21% utilisation occurred at day six when 30% of *P. decompositum*, 25% of *A. latifolia*, 21% of forbs, 18% of *C. fallax* and 12% of *A. latifolia* volume had been removed (Fig. 3b).

Discussion

The dominant feature of the array of measurements taken from cattle grazing the same pasture in the dry and wet seasons was the great variability. Being unimproved native pasture, high levels of heterogeneity were displayed, with differences evident within plants of the same species and between species in their vertical structure, horizontal distribution and presence or size of plants temporally due to seasonal conditions. Grazing removed 48% and 60% of pasture biomass in the dry and wet seasons, resulting in significantly lower dietary CP, NG and DMD values at the end of each trial. The declines were smaller in the dry season, likely due to the predominantly senescent plant material on offer. Selective grazing occurred, observed through the dynamic defoliation patterns which were neither uniform nor consistent within a single plant, plants of the same species, between species or seasons (White, 2012). Voluntary intake was constant in the dry season but peaked at day three in the wet season, declined to day five and changed little for the rest of the trial. This decline coincided with the removal of around 14% of the volume of the preferred species prior to re-grazing of individual plants (White, 2012).

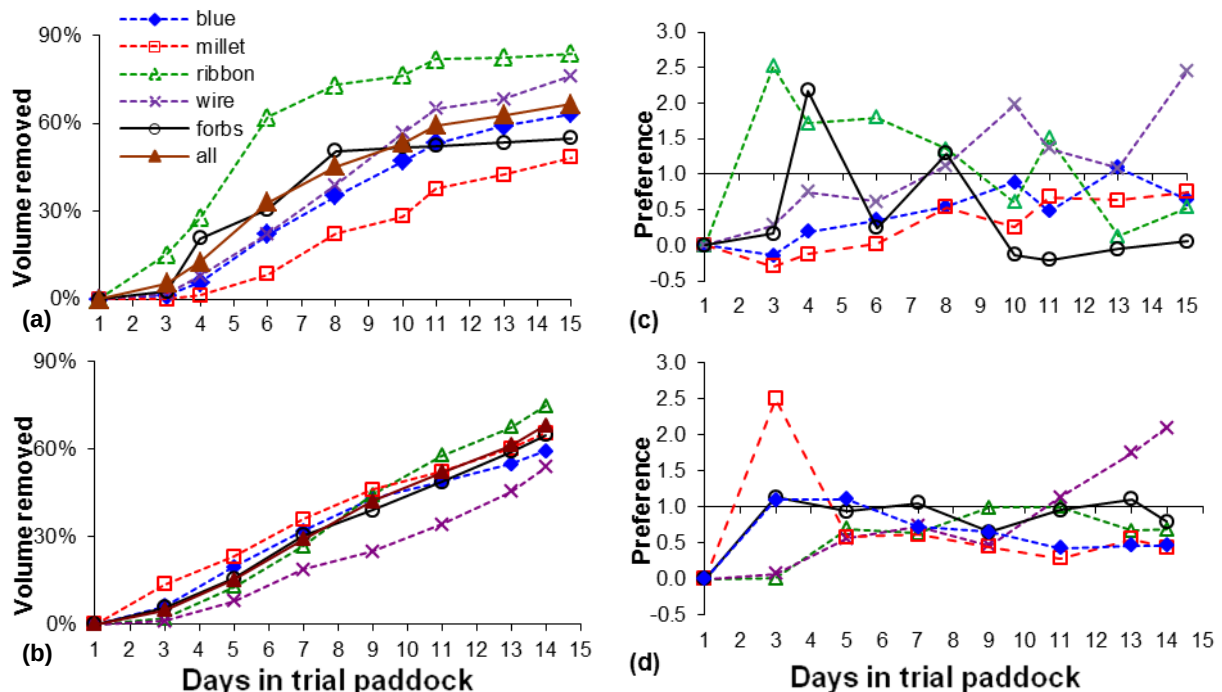


Figure 3 Defoliation patterns of individual species (blue: *D. fecundum*, millet: *P. decompositum*, ribbon: *C. fallax*, and wire: *A. latifolia*), vegetation groups (forbs) and all species combined, during the dry season (a) and wet season (b), revealing preference for grazing species (values >1; see Crawley, 1983) in the dry season (c) and wet season (d).

These findings are important in understanding: the response of the pastures to varying seasonal conditions; the changes in grazing that occur with season, pasture composition and degree of defoliation; and in managing plant/animal interactions. For example, if a rotational grazing system was used, in the wet season voluntary intake and nutrition levels (and presumably liveweight gain) would be better maintained if cattle were moved to the next pasture after three days. In the dry season rotational grazing would seem to confer little benefit. (Extrapolating trial results to commercial situations should be done with caution as the trial was undertaken in small paddocks over short periods with high stocking rates and utilisation levels).

Measurements of pasture height and basal area revealed distinct defoliation patterns in each trial. Species selection was apparent, with *C. fallax* and forbs preferred initially in the dry season, and *P. decompositum* in the wet season (Fig. 3c & d). Consistent in both seasons was leaf height removal at the first defoliation. For *C. fallax* and *A. latifolia* plants, 60 to 70% was removed, greater than for *P. decompositum* or *D. fecundum* plants where 45 to 53% was removed. Field observation of the grazing of *C. fallax* and *A. latifolia* suggested this was due to use of the tongue to grip the longer lamina (Gordon & Benvenuti, 2006), not evident with the other species.

Dry season pasture removal of 48% reduced perennial grass basal area and pasture biomass in the following wet season under this grazing system (White 2012). This indicates that pasture utilisation exceeding the recommended rate of 21% could prove to be unsustainable. At 21% defoliation, large variability in grazing was evident, with plants of the same species ranging from being not grazed, to some 100% defoliated, with no consistency between species. Similarly, large variability was evident in the number of plants grazed either once or multiple times, and for plant removal levels and species preference. This variability probably contributes to the sustainability of the grazing strategy without over-grazing.

The ability to restrict the frequency of plant defoliation is an important management factor in reducing the stress on individual plants and contributing to sustainable grazing (Gammon & Roberts, 1978; Heitschmidt & Walker, 1996). The data showed that, at 60% pasture removal in the wet season, most stress was placed on *P. decompositum*, 56% of plants being grazed more than twice, the most being six times. This suggests that *P. decompositum* is most at risk of over-grazing and multiple defoliations should be restricted to ensure its retention in the pasture.

The different seasonal intake and defoliation patterns highlighted in this study suggest that sustainability could be enhanced by adopting more flexible grazing management with a seasonal basis that responds to the variable seasonal conditions and is sympathetic to key pasture species responses. Being the first study of its type in the Australian tropical savannas, it provided a greatly enhanced level of understanding of the dynamics of the system while also highlighting where management would benefit from additional knowledge.

Acknowledgements

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Trade-offs Between Stocking Rate, Range Productivity and Livestock Performance in a Mediterranean Grassland

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Abstract

A long-term grazing trial was conducted on a Mediterranean grassland to study trade-offs between the multiple responses of pasture and livestock to higher stocking rates. Grazing commenced each year after early-season grazing deferment to allow for undisturbed pasture establishment. The treatments comprised two relatively high stocking rates of 0.55 and 1.1 cows ha⁻¹, and two grazing protocols of continuous grazing throughout the grazing season and split-paddock grazing which doubled the stocking rate in each half paddock and created an opportunity to study the effect of a very high stocking rate on the growth dynamics of the pasture. Under continuous grazing, the animals grazed throughout the growing season at both stocking rates but under the split-paddock protocol, the herd was stressed at the high stocking rate well before the end of the growing season and had to be moved to the un-grazed half of the paddock. In both protocols, heavier stocking reduced standing biomass at the end of the growing season and grazing duration during the subsequent dry season but increased the weaned live-weight production per unit area, the daily consumption of supplementary feed, and the number of grazing days per unit area. Quantification of these trade-offs can guide the management of stocking rate and grazing protocol of the herd within the economic context of the grassland-livestock system.

Introduction

Livestock management on Mediterranean rangelands is commonly determined by trial and error, by accumulated experience or by standards adopted by the herder. These methods are usually sufficient where the range is the only source of nutrition for the livestock during the grazing season. However, supplementary feeding has become increasingly common as a means of improving the productivity of rangeland livestock by buffering the availability and quality of the pasture vegetation during the grazing season. That adds a complicating factor to range management because even though it eliminates most nutritional deficiencies of the range vegetation, it also raises the possibility of increasing the stocking rate and changing the timing and duration of grazing.

With higher stocking rates, the impact of grazing on the pasture vegetation, the livestock and the scale of supplementary feeding, increases. Consequently, higher grazing pressure creates a complex management challenge because, in addition to the economic

consequences, it influences the growth dynamics, the botanical composition and nutritional quality of the pasture (Henkin *et al.*, 2011; Sternberg *et al.*, 2000). The constantly changing availability and quality of the pasture vegetation that determine both the nutritional intake of the grazing animals and the role of supplementary feeding, create trade-offs between the multiple responses of the vegetation, the livestock and the cost/benefit ratio of the grazing enterprise (Baron *et al.*, 2002). Quantifying the trade-offs can contribute to more effective enterprise management (Savory and Butterfield 1998).

In eastern Mediterranean grasslands that are dominated by annual species, the strongly seasonal pasture cycle is characterized by a mild, rainy winter-spring growing season and a hot and dry summer-autumn season. At the beginning of the rainy season (Nov.-Dec.), the biomass is too sparse to enable beef cattle to forage effectively on the predominantly annual herbaceous pasture vegetation. As the biomass increases, livestock ingest increasing amounts of forage. During the spring (Feb.-Apr.), there is a surge of growth that provides the abundant quality forage on which livestock production on the range is critically dependent. Peak biomass production at the end of spring is followed by a sharp reduction in amount and quality of the herbaceous vegetation caused by seed dispersal, followed by rapid desiccation and a gradual decline in the amount of dry herbaceous biomass.

Herbaceous plant production determines the carrying capacity of rangeland for livestock husbandry. It is difficult to determine over the large area required to maintain viable herds because it is influenced not only by the prevailing climatic factors but also by the vegetative composition of the range and the complex habitat characteristics (Seligman and Van Keulen 1989). Nevertheless, it is an essential factor in the analysis of herd management decisions, especially where supplementary feeding interacts with the other elements of the production system. Appropriate stocking rates under such conditions are dependent not only on productivity of the pasture vegetation and the supplementary feeding protocol but also on the response of vegetation and livestock to grazing pressure and timing (Gutman *et al.*, 1990).

As a rule, the amount of standing biomass in the pasture decreases with increasing stocking rate (Baron *et al.*, 2002). Change in the standing biomass of a growing sward depends on the balance between the rate of pasture growth and the rate of forage consumption by the grazing herd. Heavy grazing at the beginning of the growth season can prevent the increase of standing biomass and maintain the sward at a low equilibrium level at which the growth rate of the sward equals the forage consumption rate of the herd, which is then far below that required for adequate animal nutrition (Noy-Meir 1975). Deferment of heavy grazing at the beginning of the growing season has been shown to prevent a fall to a low stable equilibrium (Gutman *et al.*, 1999). The aim of the current study was to quantify the trade-offs in the multiple responses of pasture growth, performance of the grazing livestock and amount of consumed supplementary feed to relatively high stocking rates in a predominantly annual Mediterranean rangeland.

Materials and Methods

Study site and Experimental design

The experiment was conducted during the years 1994-2010 at the Karei Deshe experimental farm, located in the eastern Galilee in the north-east of Israel (long. 35°35'E; lat. 32°55'N; altitude 60 - 250 m a.s.l.). The topography is hilly and the landscape is covered with basaltic rocks. The soil is a fertile brown basaltic protogrumosol of variable depth, but seldom deeper than 60 cm. The area has a Mediterranean climate, characterized by wet, mild winters and hot dry summers. The average seasonal rainfall is 560 mm, falling mostly in winter and spring. The rainy season begins in October-November and ends in April. As a result, the vegetation

is green between November and April, but during May most plants mature, disperse seed and dry out.

The study included different grazing scenarios based on two stocking rates and two management protocols: continuous (C) grazing of a single paddock throughout the grazing season, and a split-grazing (S) protocol with animals being moved between multiple paddocks. The two stocking rates were moderate (M, 0.55 cows ha⁻¹) and high (H, 1.1 cows ha⁻¹). In the split-grazing protocol the paddock was divided into two equal sub-paddocks. Grazing began in one sub-paddock early (E) in the growing season after deferment of grazing since germination. The herd was moved to the second un-grazed sub-paddock later (L) in the grazing season when the amount of standing biomass was reduced to a level that subjected the herd to nutritional stress. The two stocking rates (M, H) and two grazing management protocols (C, S) constituted four main grazing treatments (MC, HC, MS, HS). The trial was maintained for 17 years to cover the wide annual variation in climatic conditions and pasture productivity. All treatments were replicated twice and were maintained without change. The area of the 8 main paddocks ranged between 21 and 35 ha.

Livestock and grazing season

The paddocks were stocked with mature, medium-frame Simford (Simmental × Hereford) crossbred cows, with about 20% blood from local eastern Mediterranean breeds with an average body weight of 432 ± 15 kg. The pasture year is basically divided into two seasons: a green and a dry season. The average date of the first effective rains (>20 mm) in Karei Deshe experimental farm during the years was November 4th. The herbaceous vegetation was usually well established within 14 days after the first effective rains, by which time the standing biomass (reported on a dry matter basis throughout) was *ca.* 10 g m⁻² (Svoray *et al.*, 2008). Grazing was deferred in all paddocks during the initial growth period to allow the herbage to reach a threshold beyond which the livestock could forage a substantial part of their daily requirement. The herds were introduced to the experimental paddocks at the end of the deferment period, usually during the latter half of January, when the standing biomass averaged 76 ± 5 g m⁻². In the summer, the herds remained in the moderately grazed paddocks till October – November, depending on the timing of the first rains. In the heavily grazed paddocks, the herds had to be removed towards the end of August. At weaning, the cows were weighed and in September the pregnancy of each cow was determined to calculate the conception rate of the herd. All calves were weighed at weaning and then removed from the paddocks.

Vegetation sampling, primary productivity and animal nutrition

The standing biomass in the paddocks was estimated by placing 25x25 cm quadrats at random along permanent transects that crossed all the experimental paddocks. All above-ground herbaceous standing biomass in the quadrat was harvested. At each sampling date, 20 samples were harvested in each of the paddocks. The harvested plant material was oven-dried at 65°C and weighed. The biomass was sampled every year at the beginning of grazing (January-February), at the peak of vegetation growth (April), at the end of the abundant dry pasture in early summer and the beginning of supplementary feeding (June), and at the conclusion of the grazing season towards the end of summer (August-September). We estimated primary productivity under grazing as the sum of the standing biomass at the end of the growing season and the assumed quantity of herbage that was ingested during the growing season by the cattle. During the green season and the beginning of the dry season, the pasture was the only feed source of the experimental herds. During the later dry pasture

period in summer the herds were given *ad lib* access to supplementary feed, mainly poultry litter, that provided a nitrogen supplement to the protein-poor pasture.

Statistical analysis

The distribution of explainable sum of squares of the biomass data among season, year, grazing treatment, replicates and interaction between season and treatment was calculated with a GLM procedure (SAS Institute 2002). For comparisons among the secondary treatments, the years were treated as independent nominal values and the standard deviations of the average biomass values over the years are given as an indication of the inter-annual variability.

Results

Duration of the grazing season

At the moderate stocking rate, the herds were on the pasture for almost 280 days of the year and at the heavy stocking rate, just over 200 days (Table 1). Grazing started at the end of the grazing deferment period and ended at the beginning of autumn when the dry pasture biomass was grazed down to between 55 and 116 g m⁻² (Figure 1). The variation in the number of grazing days per hectare in the different treatments is a function of the stocking rate and the duration of the grazing season in the different treatments (Table 1).

Table 1. Pasture utilization, supplementary feed consumed, live-weight and conception rate of herds in the experimental treatments (Average $\pm$ S.D.).

Treatment	MC	MS	HC	HS
Days in treatment paddocks	279 $\pm$ 19	277 $\pm$ 18	198 $\pm$ 26	205 $\pm$ 27
Grazing days per hectare	156 $\pm$ 10	168 $\pm$ 29	223 $\pm$ 28	233 $\pm$ 60
Supplementary feed (kg day ⁻¹)	4.4 $\pm$ 2	4.5 $\pm$ 2	7.9 $\pm$ 2	6.7 $\pm$ 3
Cow live-weight on entry (kg)	429 $\pm$ 30	448 $\pm$ 25	421 $\pm$ 19	430 $\pm$ 28
Conception rate (%)	73 $\pm$ 13	76 $\pm$ 13	70 $\pm$ 6	78 $\pm$ 5
Weaned calf production (kg ha ⁻¹)	46 $\pm$ 12	41 $\pm$ 7	89 $\pm$ 17	87 $\pm$ 17

Standing biomass and primary productivity

The average long-term green standing biomass when the herds entered the paddocks was between 71 and 84 g m⁻². Subsequently, the amount of standing biomass reflected the grazing pressure imposed on the different paddocks (Figure 1). The standing biomass in the continuously grazed paddocks was inversely proportional to the stocking rates in the MC and HC treatments. An estimate of primary productivity of the herbaceous vegetation in a grazed paddock requires an estimate of herbage consumption by the herd during the growing season. We were obliged to use the normative values of biomass consumed by cows in a beef herd. Adding the biomass consumption by the herd to peak biomass gave 17-year average primary production between 219 and 397 g m⁻².

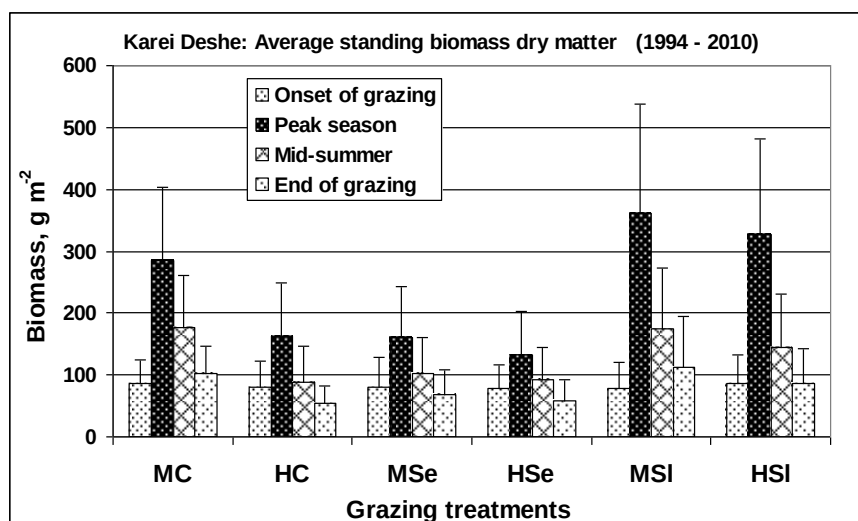


Figure 1. Annual cycle of standing biomass in the moderate and heavy continuous stocking rate treatments and in the sub-paddocks of the split paddock grazing protocol (Averages and standard deviations, 1994-2010). (Main treatments: MC – moderate continuous, MS – moderate split, HC – heavy continuous, HS – heavy split; Sub-paddocks: MSe – heavy early, HSe – very heavy early, MSI – heavy late, HSI – very heavy late).

Performance of the herd

The amount of poultry litter consumed was clearly related to the stocking rate and to the availability of dry pasture biomass during the late summer. Even though the animals at the heavy stocking rate were on pasture for a shorter period, the consumption of supplementary feed per head was 64% higher (Table 1). The live-weight of the cows and their conception rates were higher in the split grazing treatments but the differences were relatively small so stocking rate had an overwhelming, almost proportional effect on weaned live-weight per unit area of pasture: the weaned calf production was 87-89 and 41-46 kg ha⁻¹ at the high and moderate stocking rates, respectively (Table 1).

Discussion and Conclusions

Under continuous grazing the herd could be maintained on pasture from the end of the early season deferment period until the end of the growing season at both the moderate and heavy stocking rates. The biomass was lower under heavy grazing both at the peak of the growing season and at the end of the dry season (Figure 1). However, in order to enable grazing throughout the growing season, the stocking rate should not exceed 1.1 cows ha⁻¹. Nevertheless, the seed production dispersed early in the dry season was evidently enough to allow the pasture to become established in the following seasons, especially as early season deferment allowed undisturbed growth. Consequently, the differences in standing biomass between stocking rates at the onset of the grazing season were small (Figure 1). But, the length of the grazing season and the need for alternative supplementary feed sources are additional considerations that must be included in the evaluation of the treatments (Hooper and Hady 1970).

The live weight of the cows at weaning and the weaning rates were higher in the split paddock protocol. However, these are relatively small differences in comparison to the differences in stocking rate and are contrary to findings in other studies (Gutman *et al.*, 1990). The relative similarity in animal performance between treatments is related to the *ad lib*

access of the herds to supplementary feed when the dry pasture was insufficient to maintain the performance of the herd in summer. A consequence of this procedure was an almost doubling of the weaned live weight production in the heavy stocking rate treatments, albeit at a higher cost of supplementary feed.

When pasture is the mainstay of the herd and must supply feed for as long as possible during the year, both the grazing deferment period and the shorter grazing duration at the higher stocking rate exact a heavy cost in additional supplementary feed. The trade-offs between the larger herd required to increase stocking rates, the shorter grazing season and the heavier cost of supplementary feeding must be weighed against the higher animal production per unit area. Different combinations of stocking rate and grazing duration are possible with little effect on the persistence of the pasture vegetation. The practical implications of the trade-offs that were observed in this trial depend on a combination of the grazing strategy of the herd owner and economic context that includes the price of weaned live weight, the cost of supplementary feed and the fixed and variable costs related to rangeland ownership and management.

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Oral 1

Degradation and Carbon Loss From Crop Encroachment in Himalaya's Alpine Meadows, Northern Pakistan: Impacts and Mitigation Potential

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Introduction

Crop encroachment over pastures is a global issue that affected the sustainability of pastoral systems and the livelihood of nomadic herders at risk. In the Pakistani Hindu Kush Himalayas, the degradation of high altitude rangelands occurs as pastoralists till pastures on steep slopes to crop off-season potatoes and peas. While during the first year of cropping the reward is much higher than keeping livestock, soil loss due to the lack of terracing fosters a rapid yield decline (Khan et al., 2012; Harden, 1991). Resorting to evermore fertilizers as well as further reclaiming plots at higher elevation exacerbates pressure over pastures and herders who still keep livestock.

We analyse the socio-ecological impacts of crop encroachment in the mountain context of the Naran Valley in the Pakistani Himalayas and analyse a potential payment scheme compensating for the renouncement of cropping based on the REDD+ principles for avoided emissions (Tennigkeit & Wilkes, 2008). We posit that, by shrinking the available grazing area, crop encroachment leads to a reduction in herd size, changes in herd composition, and alterations of family labour divisions. It also compels sheep and goat herds to graze on higher elevation pastures and for longer durations. We further hypothesize that cropping over pastures reduces carbon (C) stores, and that avoided emissions from preventing the conversion of pastures into cropping fields may yield more C payment than conventional improved pasture mitigation activities.

Methodology

The study area located in the Naran valley (34.48°-34.55° North and 73.51°-74.02° East) of the Pakistani Himalayas receives an annual average of 819 mm of rain and 764 mm of snow. Average temperatures remain below 0°C from November to March while frost may occur all year round. A geographic information system (GIS) was used to assess the extent of crop encroachment since the last 25 years discriminating for the extension in time, elevation and slope inclination and by means of mapping global positioning system way points. A questionnaire was administered to 126 respondents previously selected using participatory rural appraisal and divided in four groups: Group A herding sheep and goats as the sole occupation, Group B herding sheep and goats with occasional labour service in cropping, Group C engaged both in cropping and herding, Group D engaged mainly in cropping with only a few cattle for homestead milk. A paired t-Test between the current and 25 years back

situations was used to assess the impact of crop encroachment on herd size, herd composition and herding labour allocation.

A total of 72 soil core samples were collected discriminating land use (cropping, pasture), aspect (North, South), elevation (low 3000, middle 3100, and high 3200 m.a.s.l.), and soil depth (shallow 0-10, deep 10-30 cm). Thirty six biomass samples were collected over the same independent variables (except for soil depth) using a 10x10x20cm steal box inserted in the ground for each sample. Above ground biomass and coarseroots were separated from the soil aggregate and oven-dried. Soil organic carbon (SOC) and biomass carbon (BC) were estimated through a potassium dichromate oxidation treatment. The samples were collected during the second week of October 2010 at the end of the grazing and cropping season and before the first snowfall. The data was statistically analyzed by means of a one-way analysis of variance.

Results

The GIS analysis shows that crop encroached on 3% of the grazing areas, mostly on prime pastoral niches. Cropping reduced herd sizes by at least 47%, halved the number of small ruminants, and shifted more than half of the family labour away from herding. Furthermore, sheep and goat herds increasingly have to graze at higher elevations for longer periods, despite a shorter plant growth period on those pastures. Although highly rewarding in the short run, crop encroachment endangers this pastoral system as the tilling of ever steeper plots causes the loss of soil and nurtures land abandonment.

Table 1. Distribution of crop encroachment by elevation and degrees of slope.

<i>Elevation classes (m a.s.l.)</i>	<i>Cultivated land</i>		<i>Distribution per slope category [%]</i>			
	<i>ha</i>	<i>Cropped area [%]</i>	<i>Gentle ≤16°</i>	<i>Medium 16-33°</i>	<i>Steep 33-44°</i>	
2980 - 3000	44.3	13.1	83.1	16.9	0	100
3000 - 3180	121.8	36.1	71.2	18.6	10.2	100
3180 - 3260	64.4	19.0	54.3	28.5	17.8	100
3260 - 3400	81.6	24.1	76.4	18	5.6	100
3400 - 3500	25.2	7.7	34.9	57.2	7.9	100
<i>All elevations</i>	337.3	100	68	23	9	100

The one-way analysis of variance on mean soil organic C shows that all variables taken separately have a significant effect ($P < 0.01$) ($n=72$) [g kg^{-1}]: (land use) crop/pasture 13.3/15.9, (aspect) North/South 16.1/13.2, (elevation) low/middle/high 10.9/16.2/16.8, (soil depth) shallow/deep 1.4/1.53. These preliminary findings suggest that preventing the conversion of pastures into cropping fields in the Naran valley avoids an average loss of 12.2 t C ha^{-1} or $44.8 \text{ t CO}_2\text{eq ha}^{-1}$ representing a foreseeable compensation of 672€ ha^{-1} for the Naran landless pastoralists who would renounce cropping.

Conclusions

Although highly rewarding in the short run, crop encroachment endangers this pastoral system as the tilling of ever steeper plots causes the loss of soil and nurtures land

abandonment. The ongoing study shall provide a complete picture for carbon payment integrating key aspects such as the rate of cropping encroachment over pastures per year, the methane leakage from the system due to livestock enteric fermentation, the expected cropping income vs. livestock income and the transaction costs of implementing the mitigation project, certifying it, and verifying carbon credits.

Acknowledgments

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Intensity of Climate Variation in Karamoja Sub-region, Uganda: Implications for Forage Availability

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Introduction

Considerable climate variability and change have been recorded in Africa over the last century (Trenberth *et al.*, 2007). In the Sahel for example, rainfall declined by 20-30% (Dai *et al.*, 2004) while temperatures rose by 1.3°C (Trenberth *et al.*, 2007). Meanwhile, significant increase in rainfall variability and seasonality, intensification of aridity conditions during the start and end of the wet seasons have been reported in eastern Sudan (Sulieman and Elagib, 2012) with wide ranging impacts including: decline in vegetation cover (Gonzalez *et al.*, 2012), changes in land use and degradation of grazing areas (Sulieman and Elagib, 2012). Within Eastern Africa, climatic variability is a fact (Thornton *et al.*, 2010). In Uganda in particular, variability in climate is most pronounced in the “cattle corridor”; a dryland belt. Despite this assertion, limited effort has been geared towards providing evidence of climate variability intensity. Therefore, this study aimed to fill this gap.

Materials and Methods

This study utilized two rainfall data sets. Historical data for Namalu Station in southern Karamoja covering 1947-1976 periods was used and the global daily climate data (1979-2009) provided by the National Centers for Environmental Prediction (NCEP) which is part of the broader NOAA reanalysis programmes. Correlation and regression method of the near next neighbor station was used to fill missing data, a fit $y = 0.8947x$ and $R^2 = 0.8348$ was obtained for Namalu and Katakwi weather stations. Data analysis was conducted in Excel spread sheet, Instat and Combined drought Index (CDI) Calculator software.

Results and Discussion

Rainfall trend in Karamoja: A positive trend in rainfall over the Karamoja sub-region is observable despite the existence of below normal rainfall; a similar pattern has been observed by Sarr (2012) in semi-arid region of West Africa. Rainfall generally increased by 0.7 mm this followed an increase in the MAM, SON and DJF rainfall by 66.7 mm, 31.7 mm and 45.7 mm respectively however, a decreased in JJA rainfall by 148.4 mm (1979-2009 period) was also realized. The return period of poor rains ranges from 4-7 years for the period 1979-2009 compared to 1-3 years earlier (1947-1976). In 1984, a major drought was experienced. The sub-region's intensity of rainfall variability is depicted by a very high inter-annual coefficient of variation (CV) at 138.3 % with all the sixteen stations having above 90% inter-annual

coefficient of variation. These observations are similar to those made by Ellis and Swift in southern Turkana (Ellis and Swift, 1988).

Onset and withdrawal of rainfall in Karamoja: Rainfall onset in Karamoja occurs around the 20th pentad with the first peak level quickly approaching around the 25th pentad and a withdrawal around the 31st pentad. The first withdrawal is short-lived that a second peak is observed around the 36th and 38th pentad. A second withdrawal occurs around the 54th pentad. Therefore, the first rains were very short, lasting approximately 20 days to the peak and 25 days to withdrawal. The rise is rapid and so is the withdrawal. Observably, rainfall onsets from various stations analyzed have reflected delays, but experience timely cessation. This finding is agreement with the findings of Mubiru *et al.*, (2012) when they characterized agro-meteorological climate risks and uncertainties in Uganda.

Temperature Trends in Karamoja: A general rise in minimum, maximum and mean temperature has been experienced for 1979-2009 period. Minimum temperature increased by 0.9°C (R^2 0.67), maximum temperature by 1.6°C (R^2 0.35) and mean temperature by 1.3°C (R^2 0.56). Within similar range temperature increase has been observed by Trenberth *et al.*, (2007) in the Sahel. Temperature in Karamoja (1979-2009) has undergone three phases rise and decline scenario although rising.

Conclusion

Based on the very high inter-annual coefficient of variation (CV) above 33% threshold, Karamoja is a highly non-equilibrium rangeland. By implication this will have effect on forage biomass and plant species composition. The oscillations in rainfall also predispose a continuous flux in forage resources. Therefore, this study offers relevant information vital for adapting to spatial and temporal climatic variability in particular monitoring vegetation performance.

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Hillside Rehabilitation With Indigenous Fodder Trees Can Contribute to Food Security and Societal Harmony in Pakistan Northern Mountains

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Introduction

In Northern Pakistan, collapsing traditional institutions that formerly managed communal hillsides and the inability of the new formal institutions to provide alternatives led to severe deforestation and hillside degradation during the last four decades (Rahim and Viaro, 2002). These hillsides were once covered with diverse native vegetation including a large variety of fodder trees and shrubs. Through social forestry projects, rapidly growing exotic species of *Eucalyptus camaldulensis*, *Pinus roxburghii* and *Robinia pseudoacacia* were planted to rehabilitate the overused mountain slopes. Forest cover was replaced with exotic species (Rahim and Viaro, 2002) and was perceived a negative development by its main user group, the nomadic pastoralists (Leede *et al.*, 1999). Due to their forced eviction and curtailed access to the so called rehabilitated hillside, the average herd size of the landless pastoralist decreased from 340 to 140 goats and sheep. Despite the increased tree cover, the societal disharmony and reduced livestock output were the negative side effects that reduced the acceptability of social forestry programs (Rahim and Viaro, 2002).

One approach to overcome the negative consequences of the rehabilitation campaigns is to include local communities in selecting species to be planted (Rueff *et al.*, 2008). By including indigenous fodder trees in the degraded hillsides, the interests of both landowners (tenure, rent) and landless herders (availability of fodder from trees and shrubs) can be achieved. In addition to hillside rehabilitation, plantation of these trees will have positive impact on food security and societal harmony. This study aimed to identify key indigenous fodder trees and shrubs, their nutritional values and distribution at different elevations.

Materials and Methods

For the identification of the major fodder trees and shrubs and their pattern of use, 195 local experts identified by the villagers were interviewed at different elevation and aspects in the study areas. Air-dried foliage of 15kg of each identified species was collected for nutritional evaluation. Samples were analyzed for dry matter (DM) and crude protein (CP) contents (AOAC, 1990), *in-vitro* dry matter digestibility (IVDMD) (Tilley and Terry, 1963) and Potential Intake Rate (PIR) (Atiq-ur-Rehman, 1995). The data for PIR was analyzed using analysis of variance in a group balanced block design (Gomez and Gomez 1984) and the means were compared by least significant difference (Steel and Torrie, 1982).

Results and Discussion

Fodder trees have a higher biomass than grass and enough protein to support growth and milk output in dry season (Long, 1997). Annual fodder yields vary from 20 to 400 kg fresh leaves per tree depending on age, species, lopping and management pattern (Devendra, 1989). For *Grewia oppositifolia*, *Zizyphus jujuba*, *Aesculus indica*, *Betula utilis* and *Corylus avellana*, the CP, IVDMD and PIR are all high making them of high value. Introducing these trees may contribute to stabilizing social relations among landowners and landless herders who are competing for fodder resources. Promoting these trees can enhance food security for communities of the mountains in Northern Pakistan and can efficiently substitutes to exotic tree in large scale afforestation programs.

Nutritional aspects of the indigenous tree leaves

Fodder plant	DM (%)	CP (%)	IVDMD (%)	PIRg/4 min	± SE*
<i>Ailanthus chinensis</i>	26.7	15.2	63.2	37	± 3.42 ^b
<i>Zizyphus jujube</i>	23.4	17.8	63.2	71.2	± 14.21 ^a
<i>Melia azedarach</i>	21.7	12.8	62.6	36.3	± 2.63 ^b
<i>Grewia oppositifolia</i>	27.3	19.9	62.2	72.8	± 16.35 ^a
<i>Corylus avellana</i>	22.6	20.7	61.3	69.5	± 14.57 ^a
<i>Aesculus indica</i>	28.6	18.7	60.6	67.8	± 15.12 ^a
<i>Diospyros lotus</i>	29.4	14.2	57.5	68.3	± 15.62 ^a
<i>Acacia modesta</i>	23.4	17.5	55.9	41.4	± 7.23 ^b
<i>Betula utilis</i>	28.2	19.7	54.4	70.8	± 12.17 ^a
<i>Morus nigra</i>	27.2	14.6	54.4	69.4	± 8.23 ^a
<i>Acacia nilotica</i>	22.7	18.1	54.3	43.5	± 8.44 ^b
<i>Ficus sarmentosa</i>	33.4	12.4	54.3	45.5	± 4.94 ^b
<i>Salix tetrasperma</i>	24.8	17.4	52.7	39.8	± 7.62 ^b
<i>Robinia pseudoacacia</i>	23.7	11.9	52.7	40.3	± 8.61 ^b
<i>Morus alba</i>	26.5	14.8	52.3	72.3	± 11.4 ^a
<i>Celtis australis</i>	23.7	10.7	49.3	69.8	± 7.66 ^a
<i>Olea cuspidata</i>	36.4	11.6	46.4	38.8	± 10.76 ^b
<i>Celtis caucasica</i>	32.2	10.1	46.3	67.5	± 20.87 ^a
<i>Quercus incana</i>	37.4	11.9	42.4	18.3	± 2.36 ^c
<i>Quercus dilatata</i>	38.6	12	41.9	13.2	± 1.92 ^d

*Each figure represents the mean (± standard error) of 4 samples. Subscript letters indicate significant differences (P < 0.05).

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Oral 4

Effect of Total Mixed Fiber (TMF) as Roughage Source on Rumen Fermentation in Lactating Dairy Cows

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Introduction

Agricultural crop-residues and by-products from agro-industry such as rice straw, sugarcane and corn husk are an important source of feed for ruminants and commonly used in cattle and buffalo diets in Thailand (Wanapat, 1999). Vinasses is a co-product generated by the fermentation of molasses to obtain alcohol (Fernández et al., 2009). Hadalga (2009) reported that vinasses has been used in liquidform in animal feeding. In most dairy cow feeding in Thailand, pineapple waste silage and leaves from baby-corn canning factories and sweet corn waste silage have been used (FAO, 2002). The objectives of this experiment were to determine the effect of feeding silage by-products as roughage source for lactating dairy cows and compare with other roughage sources on rumen fermentation.

Material and methods

Fifteen, 87.5% Holstein Friesian multiparous blood dairy cows in mid-lactation with an average 420.5 kg BW and 78 DIM were used in the present study. Group 1 was fed with rice straw and 1 kg of vinasses. Group 2 was fed with sweet corn waste silage (SCWS) and group 3 was fed with total mixed fiber (TMF). The study was conducted using Completely Randomized Design. The commercial concentrate was calculated based on NRC requirement (NRC, 1991). The TMF was composed of pineapple peel, corn husk, corn cob, bagasse and vinasses. The mixtures of all products were mixed and fermented for 30 days. The SCWS and TMF were analyzed for pH (Bolsen et al., 1992), water soluble carbohydrate (WSC) (Dubois et al. 1956). Rumen fluid samples were analysed for NH₃-N (AOAC, 1990) and volatile fatty acid (VFA) (Samuel et al., 1997).

Results and discussion

The values of pH and lactic acid in TMF were in the optimum range of silage (Catchpoole and Henzell, 1971). The TMF had higher WSC than those of SCWS. WSC is used as energy source for microbes in rumen to produce VFA (Aminah et al. 2004). The DM of roughage intake of cow fed rice straw with vinasses was significantly higher ($P < 0.05$) than cow fed TMF and SCWS, respectively. The pH of the rumen was similar among treatments and was in the normal range (Firkin, 1996). The average NH₃-N was 13.4-17.3 mg/d and was almost similar to the optimum NH₃-N (Wanapat and Pimpa, 1999). The VFAs were not significantly

($P>0.05$) different among treatments. Houtert (1993) reported that the concentration of VFAs highly differed among diets. It generally ranged from 60 and 120 mmol/L.

Conclusion

It is shown that the chemical composition of FBP was in the optimum range of silage. Cows fed with TMF had shown no negative effect of rumen pH, $\text{NH}_3\text{-N}$ and VFA and therefore suggests that it could be used as roughage source for lactating dairy cow.

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Oral 5

Total Carbon Storage in Himalaya Rangeland of Milke-Jaljale Area, Eastern Nepal

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Introduction

Rangelands occupy 51% of the terrestrial land surface, 23% total land of Nepal (Anonymous, 2012). It contains about 36% of the world's total carbon in above- and below-ground biomass (Solomon *et al.*, 1993). Rangelands can aid in the mitigation of rising atmospheric carbon dioxide concentrations via carbon storage in biomass and soil organic matter.

Materials and Method

A study on carbon stock on soil and vegetation at various altitudinal gradients in Milke – Jaljale rangeland area of eastern Nepal was made. The study was carried out at three altitudinal gradients (above sea levels): Milke (3000m), Gorujure (3500m) and Jaljale (4000m). This method required establishing a transect line. Sample points were located by pacing the appropriate distances from the point of origin at a transect line. To determine distribution and quantity of plant carbon and Soil Organic Carbon (SOC) 45 sample points were established and 15 points were sampled from each study site.

Results and Discussion

Total soil carbon was estimated as follows: 17.65 T/h at Milke, 17.27 T/h at Gorujure and 28.33 T/h at Jaljale. Similarly, total vegetation carbon was estimated 22.68 T/h at Milke, 29.79 T/h at Gorujure and. 42.54 T/h at Jaljale. Highest elevation study site with least external disturbance (Jaljale area), had high storage of carbon in both cases vegetation and soil.

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Determination of Rangeland Grazing Suitability Model by GIS (Case Study: Sarab Sefid Basin)

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Abstract

Livestock grazing in unsuitable land has increasingly grown in most part of rangelands of Iran due to population increase. It causes many irreparable damages such as soil erosion, water loss, and wealth loss. Therefore, it is important to identify suitable land for livestock grazing, quickly and accurately. Many ecosystem components affect land suitability for livestock grazing but due to time and funding restrictions, the most important and feasible elements were investigated. This paper adapted the Schematic model based on the concepts presented by the FAO on suitability analysis for livestock grazing in Sarab-Sefid Boroujerd rangeland of Iran in 2012. Affecting Factors on livestock grazing such as forage, soil and water which were in sub-models were determined and incorporated into the final model of rangeland grazing suitability. The main maps which were used in the study were DEM, slope, aspect, range condition, range trend, forage, soil erosion, water sources. Within the model parameters, three sub models including water accessibility, forage production and erosion sensitivity were considered. Suitable areas at four levels of suitability were determined using geographic information systems (GIS). This suitability modeling approach was adopted due to its simplicity and the minimal time required for transforming and analyzing the datasets. Results showed that of the 16 types of vegetation covered, none of them was in good suitability class (S1). About 3088.74 hec (52.67%) was in medium suitable class (S2), 1892.63 hec (32.28%) in poor class (S3) and 882.84 hec (15.06%) was in non-suitable class (N). Also the results determined that there was no limitation in water resource in the whole of the rangeland and the most and main important factor affecting suitability is soil erosion and slope due to the mountainous area. According to field data and comparing with the study data, the GIS technique is fast and accurate in monitoring and determining the suitability of areas in the rangelands.

Modified Indigenous Fermented Fresh Water Fish (*Anabas Testudineus Bloch*) Processed as a Viable Protein Source for Developing Countries

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Introduction

Fermentation of fish has been practiced for centuries especially in developing countries where these age old products are consumed widely either as condiments or as a side dish (Santo *et al.*, 2005; Taorem and Sarojanlini, 2012). Indigenous salted fermented fresh water fish (*Anabas testudineus Bloch*) is very popular in South Kalimantan society and is locally known as *Wadi Betok* (Petrus, 2009; Petrus 2012). This salted fermented fresh water fish has been used as a side dish in a limited amount due to the very salty taste, and therefore Petrus *et al.* (2012) reported that the addition of palm (*Arenga pinnata*) sugar (15%) and lime (*Citrus auriflora*) juice (6%) together with salt (15%) during fermentation improved the flavour and taste of the end product . However the protein content and amino acid profile of this modified fermentation product has not been reported. Therefore the aim of this study was to investigate the changes of protein content and amino acid profile of this product.

Materials and Methods

Samples were fresh water whole Betok (*Anabas testudineus Bloch*) fish with the same relative size after evisceration, descaling, washing in running tap water, draining and layering in a fermentation bowl and each layer was covered with coarse salt (15% w/w) and palm sugar (15% w/w) combined with lime juice (6% w/w) in the treatment group. Only coarse salt (15%w/w) was used as the treatment for the traditional indigenous fermentation process. Bags were sealed tightly before fermenting at ambient temperature for 7 days. A Completely Randomized Design was used as the experimental design for this study Two factors, namely concentrations of palm sugar: 0 (control), 5, 10 and 15% w/w and lime juice 0 (control), 2, 4, and 6% w/w respectively were used. The experiment replicated 3 times was carried out and the protein contents were measured. The protein content of Wadi Betok samples was determined according to the standard method of AOAC no 992-15 (AOAC, 2000). Amino acid profiles of fresh water Betok fish and indigenous and modified Wadi Betok were determined using HPLC following an OPA derivative method.

Results and Discussion

The addition of palm sugar (15%w/w) and lime juice (6%w/w) together with salt (15% w/w) increased the protein content of indigenous Wadi Betok from 13.84% up to 23.42%. In general an increased amount of amino acids in either indigenous and modified Wadi Betok was observed, however a slightly higher amino acid content was determined in modified

Wadi Betok compared to the indigenous one. It is interesting to note that lysine was the most abundant amino acid in both traditional Wadi Betok (2.16%) and modified Wadi Betok (1.95%), followed by leucine and arginine, whilst the major non essential amino acids in both traditional Wadi Betok (2.74%) and modified Wadi Betok (2.00%) were aspartic acid followed by alanine.

Conclusion

The addition of palm sugar (15% w/w) and lime juice (6% w/w) together with salt (15% w/w) during preparation of salted fermented fresh water Betok fish increased protein content of the end product. An increase in amino acid content was also found in indigenous salted fermented and modified salted fermented Betok fish compared to the fresh water Betok fish. Therefore the improved indigenous salted fermented Betok fish could be a good source of animal protein for people in developing countries.

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Oral 8

Synergism Between Biochar and Digester Effluent as Soil Amenders For Biomass Production and Nutritive Value of Mustard green (*Brassica juncea*)

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Abstract

A field trial was conducted in the dry season (February to March 2013) that involved ten treatments arranged in a 2*5 factorial arrangement with 3 replications. The first factor was level of biochar (0 and 4 kg/m²); the second factor was level of biodigester effluent (0, 25, 50, 75 and 100% of 10kg N/ha of biodigester effluent). The area of each plot was 1.6m² (2.0m length x 0.8m width) with spacing between each plot of 0.5m. The experiment lasted forty days. The biochar was obtained from paddy rice drier (combustion temperature with rice husks as feedstock was about 500°C). Increasing the application of biochar from 0 to 4 kg/m² and biodigester effluent (0, 25, 50, 75 and 100% of 10kg N/ha) led to linear increases in biomass DM yield (2.79 and 7.78 t/ha for biochar 0 and 4kg/m² and 1.65, 3.95, 7.12, 5.80 and 7.88 t/ha for 0, 25, 50, 75 and 100% of 10kg N/ha respectively). Soil quality improved after the forty days trial. The chemical composition of the leaves DM showed average increase in crude protein content with the increase in the levels of biochar (P<0.001) and levels of biodigester effluent (P<0.001). However, there was a tendency for an increase of crude fiber on increasing levels of biochar (P = 0.14), but crude fiber decreased as the level of biodigester effluent increased (P<0.001).

Oral 9

Effect of some heavy metals on the biochemical composition and their recovery in Indigenous Major Carps

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Abstract

Water pollution does not only greatly damage the aquatic ecosystems but the terrestrial organisms and ecosystems are also severely damaged and threatened. The natural resources of water for example, rivers, ponds, lakes and seas are polluted with a variety of solid and liquid wastes. Every waste is ultimately dumped or emptied in natural water. Most of our rivers have become noxious sewers due to haphazard and excessive pouring of industrial wastes into them and veritable death traps for aquatic life including fish which is highly nutritious, easily digestible and much sought after food. Studies were conducted to assess the effects of sublethal exposure of Mercury for 45 days on Indian major carps, *Labeo rohita*, *Cirrhinus mrigala* and *Catla catla*. Its treatments in general showed significant reduction in carbohydrate and lipid contents in muscles as well as in gills in all the three fish species. The reduction in carbohydrate and lipid level may be due to catabolic process induced by Mercury stress. The present studies suggest that *L. rohita* is more resistant towards mercury toxicity as compared to *C. mrigala* and *C. catla*, as both of these fish species require more time for complete recovery of biochemical constituents in muscles and gills. The fish *Catla catla* was found most susceptible for body carbohydrate reduction, while lipid reduced maximally in *Cirrhinus mrigala*. When fish were transferred to metal free water for 30 days, the level of carbohydrate and lipid contents improved considerably in all the three fish species. During the recovery period, the depleted tissue components were regained to a certain extent which might be due to the elimination of mercury from the body. It could be attributed to restoration of regulatory functions by the cells and tissues involved in body metabolism when fish were transferred to water free from metals. Finally, it may be concluded from the present investigation that significant alterations in biochemical constituents in mercury exposed fishes could be of vital importance, both to the human and pisciculture practices.

The Effect of Farm Size and Locality on Production Performance in Small and Medium Dairy Farmers

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Introduction

Small (SFG) and medium (MFG) scale farmers are the back bone of the dairy industry in Pakistan. Almost 40 million families are engaged directly or indirectly with the animal farming. Dairy sector will remain important source of nutrition for emerging population in the 21st century (Creamer *et al.*, 2002). The present study investigated the different production constraints faced by these farmers and to formulate strategies for sustainable rural dairy industry.

Material and Methods

Sixty randomly selected respondents were interviewed using a questionnaire on the different parameters of production status such as milk production, calving interval and age at first calving, length of dry period, feeding management, health facilities, cost of milk production and other economical factors related to these parameters. Statistical analysis of parameters was performed by descriptive statistics as well as inferential statistics. The significance of the parameters was measured by population proportion test at 5% level of significance.

Results and Discussion

The highest percentage (40%) of SFG was having the calving interval between 22-24 months in buffaloes. In case of MFG, 56.7% farmers were having calving interval of 16-18 months. In cattle, most of the (40%) respondents of SFG reported a calving interval between 13-15 months. In the case of MFG, 56.7% respondents indicated a calving interval of 13-15 months. Age at first calving in buffaloes was 43-48 months in 56.7% SFG and 53.3% in MFG. In cattle, the age at first calving was 43-48 months in 56.7% SFG and 53.3% in MFG. The average dry period in buffaloes was more than 115 days in 30% of SFG, but in most (33.3%) of MFG this period was 100-114 days. For cattle, these percentages were 40% in SFG and 33.3% in MFG. In buffalo, the average service period in most of the (46.7%) SFG was between 91-95 days. In MFG, most of (50%) the respondents were having SP between 76-90 days. The SP length in cattle was 91-105 days in most (46.7%) of the SFG, but in MFG most (50%) of the respondents were having SP between 76-90 days. In SFG 5-6 services per conception were required in most (46.7%) of the respondents. In MFG 3-4 services were practiced for 50% of the respondents. In cattle more than 4 services were needed by 63.3% respondents in SFG. Most (53.3%) of the farmers in MFG were having 3-4 services per conception. In SFG most (40%) of the respondents were having lactation length between 10-11 months in cattle and 12-13 months in buffaloes. In MFG the LL of cattle and buffalo were 10-11 months in 50% and 56.7% of cattle and buffaloes, respectively. The profit (net

income/liter) in SFG were \$.-0.03, -0.04/liter and in MFG were \$ 0.14 and 0.70/liter and differed significantly.

Conclusion

It was concluded that herd size and extension workers access to farmers significantly affected the production cost, animal performance and farm economics.

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An Analysis of Professionalism of Agricultural Officers to Cope With the Production and Livelihood in Khyber Pakhtunkhwa Pakistan

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Abstract

Professionalism is a matter of attitude and behavior which is useful to communicate better with farmers so that they adopt new technologies and improve their production. It embraces not just knowing how to do your job, but also demonstrating a willingness to learn, cooperate and get along well with others, showing respect, and living up to your commitments. It takes time to become professional and skilful in one's work as an extension man. Professionally competent agriculture officers play an important role in the development of agriculture in the country. A study was conducted in Khyber Pakhtunkhwa (Pakistan) on the assessment of Agriculture Officers (AOs) regarding professionalism which ultimately helps in improving production. Data were collected from all (111) of the AOs through mailed questionnaires. The study showed that the use of neat and clean dress and value/like extension work were top rank competencies while identification of professional agricultural-extension organizations and societies in Pakistan were the lowest competencies. With regards to trainings, the identification of professional organizations and societies were on top while viewing the extension work as life long career and the use of clean dress were on the bottom. Possessed and required levels of competencies were scaled from one to five on Likert scale. One was very low and five was very high. Among those associated factors, only two factors have statistical significance at 95% confidence level consisting of professional qualification (0.370) and family background (0.212). A positive relationship was found among the AOs who were highly qualified and having agricultural background.

Sustainable Commercial Maggotry for Animal and Aquafeeds in Rivers State, Nigeria

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Introduction

Good quality fish meal costs over \$2.1 per kg, about thrice the cost of soybean meal and four times the cost of groundnut cake (GNC). The development of non-conventional protein supplements such as insect larvae in commercial quantity appears to be possible alternative. House fly larvae meal has been found to be not only rich in limiting essential amino acids (Aniebo *et al.*, 2008a), but also highly available to poultry, pig and fish, save that it is not yet available in commercial quantity. Their use as protein sources have been widely reported only at experimental levels (Tegui 2005; Ogunji *et al.*, 2006). However, information on commercial models is lacking and has remained the only bottle neck in the exploitation of this tested feed resource. The objective of this study is to develop a commercial model for sustainable maggot meal production via conversion of abattoir and other plant wastes to feed.

Materials and Methods

Blood potential of Rumueme slaughter slab was based on the average weight of blood yield per cow/goat from three categories (A,B and C) of each of the animal species. Official record of all registered slaughter slabs and their slaughter figures were obtained from the Rivers State Ministry of Agriculture.

Twenty-five kg of whole undiluted blood (WUB) was mixed with five kilogram of each absorbent material namely wheat bran (WB), rice dust (RD) and saw dust (SD) and exposed for biodegradation for 48 hours in an open sided space of 4.32m² demarcated into three equal parts of 1.44m² each. House flies entered through the opened front screen, which was closed on the 2nd day. They laid eggs in the substrate which hatched into larvae and were harvested on the 5th day of substrate exposure. HFLM per quantity of blood was determined from the most efficient treatment. Based on the projected daily and annual slaughter figures in the state, HFL potential in Rivers State was determined. Sample collection for substrate mixture (medium for larvae production) was carried out thrice per month for 12 months. Proximate analysis by AOAC (2000) was used to determine the nutrient composition of blood and absorbent materials used in the substrate mixture. Data collected were subjected to analyses of variance (ANOVA) procedure (Steel and Torrie 1980) and means were separated using Multiple range test (Duncan 1955).

Table 1. Characteristics of Substrate Mixtures.

Treatment	Absorbent material	WUB
S1	5kg Wheat bran	25kg
S2	5kg Rice dust	25kg
S3	5kg Saw dust	25kg

Results and Discussion

The daily blood yield projection at Rumueme slab and Rivers State were 234.72kg and 6,744.2 – 6,897.5kg respectively. The total projected blood yield gave an insight on the actual volume of blood that is wasted on daily basis and the pollution load that is exerted on the surface water bodies adjoining slaughter houses in Rivers State. This is consistent with the findings of (Olanike 2002), that blood and gut contents were discharged directly into nearby water bodies where they constitute pollution threat to aquatic life. This supports the report that facilities for waste recovery, treatment and re-use are non-existent in most Nigeria abattoir (Aniebo *et al.*, 2008b).

Results of maggot production revealed that S1 yielded 7.16kg wet maggot (3.2kg dry maggot) which was significantly better ($P < 0.05$) than S2 and S3 that yielded 2.46kg and 0.13kg respectively. It showed that WB + WUB supported larval growth more efficiently than RD + WUB and SD + WUB. This could be due to better nutrient composition of WB than RD and SD (Sowande *et al.*, 2002). Microbial degradation of cellulose components of SD could have not been achieved within the 3 - 4 days metamorphic period of maggot, while high density of RD could have decreased aerobic conditions in the substrate mixture which ostensibly affected maggot development.

The Results from this investigation showed that state daily blood output of 6,744.2 – 6,897.5kg has the potential to yield 1,932–1,975.2kg wet maggot (863–883kg dry maggot), with an annual maggot potential of 705,012 – 721,155kg in the State. Therefore the mixture of WUB + WB is the best substrate for maggot production.

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Haemoparasites of Traditionally Reared West African Dwarf (WAD) Small Ruminants in the Tropical Humid Rainforest of Southeastern Nigeria

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Introduction

Small ruminant production is popular in Nigeria, with great economic potentials because of their high fertility and early maturity as well as their adaptability to the humid environment (Ademosun, 1988). Apart from producing hides, skins and other products, meat production is most important. The benefits derived from these animals however, are limited by low productivity from numerous factors of which the major one is disease (Akerejola *et al.*, 1979). For example, mortality rates of 34.12% and 36.20% have been reported, respectively for sheep and goats in the old Bendel State (ILCA, 1987) which is one of the close neighbouring states of Owerri. Most apparent are diseases caused by blood parasites. This work was designed to investigate and document the prevalence of blood parasites of these ruminants reared under traditional husbandry system in Owerri which is in the tropical humid rainforest of southeastern Nigeria.

Materials and Methods

This study investigated the prevalence of haemoparasites of West African Dwarf (WAD) small ruminants reared under traditional husbandry system in the tropical humid rainforest of Owerri southeastern Nigeria from June to August, 2011 that coincided with the rainy season. Blood samples were collected from 500 animals (260 goats and 240 sheep) and examined for haemoparasites, following standard procedures as described by Foreyt (1991). Data obtained were analysed, using simple averages and percentages.

Results and Discussion

Results showed that 160 (32.0%) of the animals were infected with blood parasites: 90 (34.6%) goats and 70 (29.2%) sheep. The rainy season when this study was carried out favoured the survival and proliferation of the arthropod vectors that were responsible for the transmissions of pathogenic organisms. This could be the reason for the relatively high prevalence of haemoparasites recorded among the animals examined. These animals are considered to be resistant to diseases such as trypanosomiasis under natural condition (Adejinmi *et al.*, 2004). *Plasmodium sp* recorded the highest (56.3%) prevalence in both sheep and goats, *Anaplasma* and *Eperythrozoon* (18.8%) each and *Trypanosoma sp* (6.3%). The prevalence of these haemoparasites in these animals had earlier been documented by Ukaga *et al.*, (2002). *Plasmodium*, the causative organism of malaria in man was commonly

encountered in these animals that may suggest that these goats and sheep could serve as reservoirs of infection in the areas studied. This could be true as these animals are housed in close proximity with their owners. Malaria parasitaemia in humans is widespread in this area (Egwunyenga *et al.*, 1996).

The high prevalence of blood parasites recorded in this study suggests that the economic gains accruable to the peasant farmers would be reduced, following the morbidity, mortality, reduced growth rate of the animals and subsequent disinterest in their production.

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Reproductive Management of Turkeys Among Small-Holder Farmers in Imo State, Nigeria

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Introduction

Turkey production in Nigeria has largely remained at the small holder level due to various reasons (Ojewole, 2002) including management. Reproductive management practices undoubtedly play an important role in improving turkey production efficiency. This study was therefore carried out to assess the reproductive management of turkey among small holder farmers in Imo state, Nigeria to identify constraints and problems that limit turkey production in the area.

Materials and Methods

The survey was conducted in Imo state. Imo State is situated in the Southeastern vegetation belt of Nigeria and lies between latitude 50 4I and 60 3I N and longitude 60 15I and 70 34I E. The agro-ecological characteristics of the area have been reported (Okoli, 2003). The state is divided into 27 Local Government Areas (LGA), which are further divided into three agricultural zones namely; Owerri, Orlu and Okigwe. One hundred (100) structured questionnaires were distributed among turkey farmers in the three agricultural zones, targeting their major towns. In Orlu zone, Orlu town, Mgbidi, and Mgbirichi were selected. In Okigwe zone, Amaraku, Okigwe town and Okwelle were selected, while from Owerri zone, Owerri Municipal, Nguru and Ahiara were selected. Smallholder turkey farmers who stocked at least ten turkeys were identified and selected for the study.

Ninety of the distributed questionnaires were laid. Data generated were analyzed using simple descriptive statistics such as frequency distributions, percentages and tables.

Results

Result of the study revealed that 83.33% of respondents reported a sex ratio of one male to five female while another 16.67% reported a sex ratio of more than one male to ten females in turkey breeding farms. Umesiobi (2000) had earlier reported that a stag can serve up to ten female turkeys.

Table 1. The distribution of sex ratio in turkey breeder farm.

Sex ratio	Frequency	Percentage
One male to five female	75	83.33
One male to ten female	0	0.00
More than one male to ten female	15	16.67
Total	90	100.00

50% of the respondents reported that the laying duration of turkeys wasn't specific. While 16.67% each reported that some lay for 3 – 4 months, 4 – 5 months and 5 – 6 months respectively. Umesiobi (2000) reported that the length of lay of a breeder turkey is 5 months in a year. The length of lay may be influenced by the management methods adopted by the turkey producers.

Table 2. The distribution of laying period.

Laying duration	Frequency	Percentage
2 – 3 months	0	0.00
3 – 4 months	15	16.67
4 – 5 months	15	16.67
5 – 6 months	15	16.67
Not specific	45	50.00
Total	90	100.00

Respondents were unable to say the number of eggs laid by each turkey in year a clear indication of zero or poor record keeping.

Table 3. Number of eggs per year.

Number of eggs	Frequency	Percentage
90 – 120	0	0.00
100 – 150	0	0.00
150 – 200	0	0.00
More than 200	0	0.00
Total	0	0.00

Results generally highlight a need for improvement in reproductive management among small-holder farmers to increase turkey production and reduce losses.

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New Extension Model for Small Holder Dairy Farmers in Pakistan

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Abstract.

The objective of the study is to demonstrate the effect of improved extension services on adoption rates of small holder dairy farmers in Pakistan. Preliminary results indicated significantly higher adoption rates when extension services were provided using the whole family approach compared to the simple approach after one year of both phases. In conclusion, this study indicates that improved extension services have a significant impact on adoption rates of small holder farmers.

Key words: Extension services, Dairy, Adoption rate, Small holder farmer

Introduction

Pakistan, like many developing countries, has an agrarian rural based economy. Livestock is a major contributor to the national (12%) and agricultural (50%) economy (Pakistan Economic Survey, 2006). It is estimated that around 70% of the dairy households in Pakistan still operate under conditions of subsistence by maintaining herds of three or four animals (Burki et al., 2005). The productivity of livestock is still lagging behind its potential level. In order to meet the requirements of a rapidly growing population, dairy production needs to be increased. This can be done by adopting modern techniques of dairy farming. New technologies developed by researchers are disseminated. Thus the major objective of this study is to demonstrate the effect of new extension model on adoption rates of small holder dairy farmers in Pakistan.

Materials and Methods

Australian Centre for International Agricultural Research (ACIAR) research project was commenced with the aim of increasing dairy production through improved extension services. Small dairy farmers having 4-10 (buffalo and/or cattle) for production were the main target group for this project. During the first phase of the project a simple approach of extension targeting male farmers was used. During the second phase of the project a whole family approach targeting all family members was utilized. A number of innovative ways of extension have been adopted including the use of video practices, demonstration plots, problem based learning, stage drama, radio and TV shows to improve the effectiveness of the program. Benchmark data were collected on whole farming systems from 228 farmers during the first phase and 292 farmers during the second phase of the project. Subsequently, at the

end of every year data have been collected to monitor the impact of these initiatives on the rate on the rate of extension message adoption.

Statistical analysis.

Adoption rates between the whole family approach and simple approach after one year of both phases were analyzed using a Chi-square test. Similarly, adoption rates of various modules at the start and after one year of project phase-II were analyzed using a Chi-square test.

Results and Discussion

To our knowledge this is the first report which clearly describes the effect of improved extension services on adoption rates of small holder farmers in Pakistan. Higher adoption rates were achieved when we introduced a whole family (male, female and children) approach compare to simple approach relative to the traditional male only approach to extension. An effective extension program with participation by the whole family is highly desirable to enhance farm productivity. Many organizations aiming at improving small holder dairying fail to appreciate this fact and ignore women and children in their training and skills development programmes. Women normally cannot leave their home and families for a few days to participate in training programmes and usually require female trainers for effective communication. Thus during the second phase of the project we arranged parallel sessions for women and children co-ordinated by women trainers. This approach, along with training of the male farmers resulted in higher adoption rates.

Conclusion

Preliminary results indicate that improved extension services have a significant impact on higher adoption rates of small holder farmers in Pakistan.

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Effectiveness of Public-Private Partnership Model in Improving Dairying in Developing Countries: Case study of Malawi

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Introduction

In quest to enhance and diversify income and nutrition among the rural small-scale farmers in Malawi, a dairy outreach programme was established in 2010 at the Lilongwe University of Agriculture and Natural Resources (LUANAR). The programme among others, aimed to ascertain the strength of Public-Private Partnership (PPP) model in increasing income and nutrition security as well as diversifying income of rural farming communities around Bunda Campus of LUANAR. This paper presents key outputs of the programme, two years after inception.

Materials and Methods

The first 24 beneficiaries constructed dairy cattle houses, planted pasture and received 26 dairy heifers (4 pure Holstein-Friesian, 19 Crosses between Holstein-Friesian and Local breed and a Jersey) in April 2011. Two breeding bulls were also distributed to the first beneficiaries in Mitundu and Mkwinda Extension Planning Area (EPAs). The bulls were distributed so that in the long run, some farmers would specialise in raising bulls and become a local sire service provider to complement the artificial insemination (AI) service. Prior to distribution of animals, Government extension workers and lead farmers from the aforementioned impact areas were trained in dairy technologies of pasture production, breeding, AI and record keeping. The extension workers in turn identified, organized and trained primary and secondary beneficiaries of the dairy cows in their respective EPAs. Extension workers and farmers attended similar workshops in order to build the capacity of the community and thereby ensuring the sustainability of the programme outputs and impacts. The trainings were conducted at the Dairy Learning Centre at LUANAR where there were established grass and legume pastures that were meant to be used for enhancing forage nutrition of dairy cows. The pasture plots at the centre comprised grass [Rhodes grass (*Chloris gayana*) and Napier grass (*Pennisetum purpureum*); and legumes [Centrosema (*Centrosema pubescens*) and Lucerne (*Medicago sativa*)]. Apart from using pastures for demonstration and feeding dairy cows, the pasture plots also provided seed for farmers including those under the outreach programme. Technical staff from LUANAR and Government extension workers conducted routine supervisory inspection on farms.

Results and Discussion

Adoption of technologies and feed conservation

Despite the fact that adoption of forage technologies is affected if the technology does not complement food crops (Gebremedhin *et. al.*, 2003), the majority (75%) of the dairy farmers in this outreach programme adopted pasture establishment. All the farmers who adopted the technology established the pastures in pure stand plots and/or fields. Eighty three percent of the farmers had *Pennisetum purpureum* plots while 11% grew *Centrosema pubescens* (Table 1). Hay conservation during the dry season was done by all farmers and groundnut haulms were the only legume hay conserved during the dry season. Likely farmers were feeding grass that was cut and carried from the wetlands during the dry season. The high adoption level of the pasture technology was attributed to farmers' attitude and interest. After three months of monitoring visits, the farmers organized themselves and conducted routinely monthly meetings where they shared experiences and advices. The venues of the meetings rotated amongst the farms of the first beneficiaries.

Table 1. Grass and legume pastures adopted and grown by dairy farmers (n = 24) under dairy outreach programme at LUANAR.

Species	Type of pasture	Percent growing
Napier grass (<i>Pennisetum purpureum</i>)	Grass	83.3
Rhodes grass (<i>Chloris gayana</i>)	Grass	5.6
Centrosema (<i>Centrosema pubescens</i>)	Legume	11.1

Productivity and Income

In terms of cow fertility, the program achieved 100 % conception rates; thus for 75% of the cows that had calved within one year of introducing dairy. The average number of services per conception was two. The calving intervals were within 12 to 13 months in cows that calved second time. The remaining cows (15%) were brought to farmers either young or had reproductive problems. For example, one farmer had a heifer with poor growth despite good feeding. On a test-day in 2012, farmers whose cows were in milk produced as high as 16 liters per day [mean 9 liters/day/cow (Standard Deviation = 3.7)] of which 83% of milk was sold and the balance was consumed at household. The selling of milk was one primary focus of the outreach, to diversify income sources. Consumption was another focus, to enhance dietary dairy intake of households. On the average, farmers received MK1000.00 (3USD) from milk sales per day, which translated to about MK30, 000.00 (85 USD) per month. Therefore, the programme fulfilled its objective in the short term.

Conclusion

The results from the first evaluation of the dairy outreach programme have demonstrated that PPP model could be sustainably effective in improving dairying, consequently the livelihood of rural communities, in developing countries such as Malawi.

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The Socio-economic Potential of Indonesian Native Cattle: Study on Smallholder Rambon Cattle Farming in East-Java

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Introduction

The Government of Indonesia has promoted a livestock development program targeting on self-sufficiency for meat in the year 2014. In order to achieve the target, the government will gradually reduce both the number of imported beef cattle and imported frozen meat as well as to improve the productivity of the native cattle breeds in Indonesia. Rambon cattle have been acknowledged as one of indigenous cattle breeds originated from Banyuwangi regency in East Java province. Up to present, there is scanty investigation on the desirable attributes of Rambon cattle and indigenous knowledge of the communities keeping the Rambon cattle has not been adequately documented. Therefore, the objectives of this study were to determine the socio-economic roles of Rambon cattle as well as to document farmers' indigenous knowledge in keeping of the Rambon cattle.

Materials and Methods

The study was carried out in the sub-district Glagah of Banyuwangi regency, East Java province. Sixty-five farmers were purposively selected as respondents and interviewed on socio-economic aspects of Rambon cattle keeping management using a structured questionnaire. A descriptive analysis was employed to analyze the collected data. The SPSS version 12.0 for Windows software was used for the statistical analyses program and $P < 0.05$ or $P < 0.01$ was considered significant.

Results and Discussion

Characteristic of the respondents

Characteristics of respondents showed that the majority of the household heads (95.38%) were categorized at a productive age. Productive age was directed to those with 15 to 64 years of age. Meanwhile, unproductive labor was addressed to those with less than 15 or those with more than 64 years of age (BPS, 2000). Respondents in the study area were less educated as indicated by most (69.23%) of respondents only accomplished the elementary school and 6.14% of the respondents did not complete elementary school or even never attended school at all. The study found that a large proportion of respondents (83.08%) worked in the farm. The result indicated that the average number of family labor was 3.53 ± 0.87 Adult Worker Equivalent (AWE) comprising husband, wife, and a child in productive age. Subagiyo (1996) stated that a person between 15 and 65 years of age was defined one AWE, meanwhile children aged 10 and 15 years as well as people over 65 were classified as 0.5 AWE. Another result showed respondents had more than 15 years of farming experience. Murray-Prior *et al.*, (1999) argued that farmers, who were likely more experienced farmers

and also tend to have lower levels of formal education, might be more reluctant to upgrade their farming skills because they were already satisfied with their level of skill.

Rambon cattle keeping management

The results showed that the majority of the respondents (63.07%) raised Rambon cattle as animal draught power to cultivate land. Saving was another motivation for respondents to raise Rambon cattle (32.92%). The form of saving meant that by selling cattle, respondents were able to enter the cash economy and this can be used to cover major expenses incurred in the household cycle such as to have a religious festivities meant to give thanks, to have a wedding feast, to build or renovate a house, to rent or buy new land, and to fulfill unpredictable moment e.g. medical expenses. The result found that on average, respondents had 1.61 Rambon cattle or similar to 1.09 Animal Unit (AU). This type of cattle ownership structure consisted of 1 mother and 1 calf. However, respondents who kept Rambon cattle for animal draught power to cultivate land purposes owned minimum a pair of females Rambon cattle. Another finding indicated that the majority of respondents (78.46%) owned their cattle and 12.31% of them kept Rambon cattle of other households (tenants). The cattle owners and tenants usually had a general agreement that the off springs would be shared on a fifty-fifty basis between the cattle's owner and the tenants. Since respondents had practically no access to grown pasture or common grazing land, the cut-and-carry feeding practice was very common in Kemiren. Most respondents (60%) were more likely to opt natural mating for several reasons. Firstly, natural mating service was inexpensive and easier to be accessed for 24 hours in the village rather than artificial insemination (AI) method. Respondents usually paid IDR 15,000 or paid in the form of forages to the bull owner instead of cash payment. Secondly, farmers had to take their animals to the bull owner who also lived in the same village. Thirdly, AI was more time consuming because they had to contact the AI officer who lived far in another village.

Economic value of Rambon cattle

By considering the fact that Rambon cattle kept by respondents were more likely to be secondary activity to support primary activities in growing crops, the efficient economic calculation were often neglected by smallholder farmers, particularly the use of production input. The study found that respondents had an average investment worth IDR 4,373,076.92 in the form of Rambon cattle. One US dollar was considered as equal to IDR 8,500 based on available currency rate in September 2012. Labor cost was not calculated since respondents were more likely to use their family member as labor in raising cattle. Meanwhile, feed i.e. forage was also not considered as production cost because respondents only utilized weeds or crops residue to feed their cattle. Rambon cattle could be sold in the livestock market or through middlemen living in the village by estimating the physical appearance of the cattle. The economic value indicated that the average income of the farmers gained from Rambon cattle keeping practice was IDR 1,699,606.80. Thus Rambon cattle have played an important role in supporting household family income at the micro level.

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Fatty Acids Profile of Buffalo and Cattle Meat Fed Ration Supplemented with Protected Fish Oil

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Introduction

Concentration and composition of fatty acids in meat can be influenced by feed consumed by the animals (Baer 1991). Supplementation of fish oil (*Sardinella longiceps*) into the ration can increase un-saturated fatty acids contents especially omega-3 fatty acids such as EPA (*Eicosapentaenoic acid*, C_{20:5(n-3)}) and DHA (*Docosahexaenoic acid*, C_{22:6(5-3)}). In the rumen, un-saturated fatty acids are saturated by hydrogenation process of rumen microbes if the fatty acids are not protected. This research was aimed to investigate the effect of protected fish oil supplementation on fatty acids profiles of buffaloes and cattle meat.

Materials and Methods

The experiment used 6 male swamp buffaloes with initial body weight of 218.66±16.28 kg and 8 male Ongole Grade cattle weighing 217.37±15.44 kg. The animals were fed grass (mixture of native grass and napier grass with the ratio 1:1) and concentrate in the ratio of 35:65% for 75 days. Protected fish oil was added at 45 g/kg concentrate.

After the experiment, all animals were slaughtered and meat samples for analysis of fatty acids were taken from *Strip Loin*. Parameters measured were: meat cholesterol (KIT Human LOT H116); concentration and composition of fatty acids (AOAC, 2005; IUPAC, 1988; and Gas Chromatography). The experiment was designed as a completely randomized design with factorial 2x2 with 3 replications for buffalo and 4 replications for cattle. The first factor was animals (buffalo and cattle) and the second factor was fish oil supplementation.

Results and Discussion

As it can be seen in Table 1, there was an interaction between animals and fish oil supplementation on the fat percentage and meat cholesterol content (P<0.05), and stearic acid (P<0.01) but not for miristic and palmitic acids. However, the concentration of miristic and palmitic acids was significantly higher in cattle compared to those in buffaloes. In addition, supplementation of fish oil reduced the concentration of palmitic and miristic acids.

There are 3 families of un-saturated fatty acids namely linolenic acid (omega-3), linoleic acid (omega-6) and oleic acid (omega-9). Amongst the omega-3 family, EPA and DHA are related to health. Table 2 revealed that the interaction between animals and fish oil supplementation did not affect essential fatty acids concentration. In addition, there was no difference of essential fatty acids in buffaloes and cattle, but the content of oleic acid, linoleic acid, EPA and DHA was significantly affected by fish oil supplementation. It is concluded that the supplementation of protected fish oil increases omega-3 content (EPA and DHA) in the meat of buffaloes and cattle.

Table 1. The Percentage of fat, cholesterol, miristic, palmitic and stearic acids of buffaloes and cattle meat supplemented with different level of sun flower seed oil.

Parameters	Fish oil	Animals		Average	Significance		
		Cattle	Buffalo		F	A	FxA
Fat (%)	Without	1.08	2.15	1.61	NS	NS	*
	With	1.89	0.52	1.20			
	SEM=0.93	Average	1.48	1.34			
Cholesterol (mg/100g)	Without	25.16	36.75	30.95	*	**	*
	With	26.45	52.59	39.52			
	SEM= 0.05	Average	25.80	44.67			
Miristic acid (%)	Without	3.12	2.93	2.65	**	**	NS
	With	2.60	1.36	1.98			
	SEM= 0.26	Average	2.86	1.78			
Palmitic acid (%)	Without	22.47	17.50	19.98	**	**	NS
	With	19.04	14.58	16.81			
	SEM= 1.20	Average	20.75	16.04			
Stearic acid (%)	Without	13.18	22.23	17.70	NS	*	**
	With	15.06	17.72	16.39			
	SEM= 1.87	Average	14.12	19.97			

Note: NS =not significant, SEM=standard error mean, * =(P<0.0%), **= (P<0.01), F = fish oil, A = animal

Table 2. Essential fatty acids (oleic acid, linoleic acid, linolenic acid, EPA and DHA) of buffaloes and cattle meat supplemented with different level of sun flower seed oil.

Parameters	Fish oil	Animals		Averag e	Significancy		
		Cattle	Buffalo		F	A	FxA
Oleic acid (%)	Without	18.02	14.08	16.42	*	NS	NS
	With	20.82	24.58	22.70			
	<i>SEM=1.92</i>	Average	19.42	19.71			
Linoleic acid (%)	Without	1.32	1.30	1.31	*	NS	NS
	With	1.60	1.81	1.70			
	<i>SEM=0.21</i>	Average	1.46	1.56			
Linolenic acid (%)	Without	0.36	0.47	0.42	NS	NS	NS
	With	0.38	0.44	0.41			
	<i>SEM=0.14</i>	Average	0.37	0.46			
EPA	Without	0.07	0.05	0.06	*	NS	NS
	With	0.30	0.39	0.35			
	<i>SEM=0.12</i>	Average	0.18	0.22			
DHA	Without	0.02	0.02	0.02	*	NS	NS
	With	0.08	0.05	0.07			
	<i>SEM=0.02</i>	Average	0.05	0.04			

Note: NS =not significant, SEM=standard error mean, * =(P<0.05), **= (P<0.01), F = fish oil, A = animal, EPA=Eicosapentaenoic acid. DHA=Docosahexaenoic acid

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Strategy of Empowering Farmers Capability at Integrated Farming Beef Cattle and Paddy Plant with Zero Waste

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Abstract

The aim of the study was to analyze a strategy for empowering farming capability in developing beef cattle which is integrated with paddy plant, to introduce a technology for adding a value of farming technique and to increase productivity of farming business.

The study used primary and secondary data. The source of primary data was provided by interview using a questionnaire, focus group discussion and in-depth study. Secondary data was provided by collecting relevant data from institutions. To determine a strategy for empowering capability of farmers, the data was analyzed using Analytical Hierarchy Process (AHP) by using soft ware program, which was Criteria Decision Plus.

Results showed that : 1) To increase capability of farmer in technology processing of rice straw as a beef cattle feed required a strategy in optimizing of implementing waste processing technology at farmer level (score is 0.558); 2) Increasing capability of farmer in waste processing technology of beef waste as a fertilizer could be achieved by implementing a strategy in increasing knowledge and skill of extension person for waste processing technology of rice straw (score is 0.443); 3) Increasing capability of farmer in beef waste processing as a biogas and developing extension material and method based on a farmers needs required a strategy in providing a supported facilities for implementing waste processing technology (score were 0.540 and 0.517, respectively). To optimize an extension person performance in implementing waste processing technology for farmers, it required implementing simultaneously all the strategies above.

Prospect of Small-Holder Beef Cattle Farming at East Java, Indonesia

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Introduction

Recently, the government of Indonesia has encouraged the increase in the number of cattle population in order to meet Indonesia's meat demand. East Java province plays an important role in providing more than half (45%) cattle farming in Indonesia. Beef cattle production systems were predominantly categorized as the mixed crop–livestock system. Thereby, working capital has a significant role in operating these enterprises (Amir and Knipscheer, 1989; Kadarsan, 1992; Bishop and Tassaint, 1997; Baker, *et al.*, 2002). In line with government policy, the development of cattle farming is likely to be addressed to enhance performance of small scale farmers to develop with promising prospects in the future. Therefore, it is interesting to investigate the prospect of the smallholder beef cattle farming on the basis of financial performance.

Materials and Methods

The research was held at Pakis village, Tambak Rejo Sub-district, Bojonegoro Province, East Java. One hundred and ten beef cattle farmers were obtained using purposive sampling methods based on the beef cattle ownership. Primary and secondary data were collected during one month from 1st October to 31st October 2012. These data were gathered by interview method with implementing structure questionnaire. Descriptive analysis using economic formulation involving revenue, profit, R/C ratio, and profit margin (Amir and Knipscheer, 1989; Downey and Erickson, 1987; Crawford, 1997; Erickson, *et al.*, 2002) was applied to analyse the data.

Results and Discussion

The Profile of Farmer

Most (37%) of farmer's age ranged from 41 – 50 years, dominated (48%) by primary school level education and only 15% has longer experience in raising beef cattle. Beef cattle farming were used as a secondary job (31%), while only 15% of them use its farming as a primary source of income. Most (93%) of beef cattle farming were wholly owned, whereas only small number (7%) were recognized as share owned farming.

Revenue, R/C ratio, Profit and profit Margin of Beef Cattle Farming

Table 1 reveals that the contribution of mature cattle was marginally higher (36.3%) than that from calves and young cattle (29.3% each). The ratio between revenue and cost depicted about 1.8 and it was considered as a high category. It can be interpreted that Rp. 100,000,- of cost invested in this farming will reach approximately Rp. 180,000,- of revenue and Rp. 80,000,- of profit. The cattle farming should be taken into account as work alternative with a promising prospect in the future.

Table 1. Profit, R/C ratio, and Profit Margin of Beef Cattle farming per year

No.	Variables	Rp/Farm	Rp/UT	Percentage
I	Revenue			
1.	Selling calves	3767500	2058743	29.33
2.	Selling young cattle	4400000	2404372	29.33
3.	Selling mature cattle	4679650	2557186	36.33
	Total	12847150	7020301	100
II.	Production Cost			
A.	Fixed Cost			
1.	Housing depreciation	370556	202490	5.18
2.	Housing tool depreciation	33587	18353	0.47
3.	Livestock depreciation	583333	318761	8.16
4.	Capital interest	130000	71038	1.82
	Total	1117476	610643	15.64
B.	Variable Cost			
1.	Purchasing cattle	5093280	2783213	71.26
2.	Forage	381240	208328	5.33
3.	Concentrate	127080	69443	1.78
4.	Vitamin	120000	65574	1.68
6.	Herbal Cost	150000	81967	2.10
7.	Electricity cost	20169	11021	0.28
8.	Labour	120000	65574	1.68
9.	Cost in kind	17848	9753	0.25
	Total	6029617	3294873	84.36
C.	Total Production Cost	7147093	3905515	100
III.	Profit	5700057	3114785	
IV	R/C ratio	1.80		
V	Profit Margin	44.37%		

Likewise, profit per year of beef cattle farming was Rp. 5, 700, 057, - per farm or Rp. 3,114,057,- per Animal Unit. From input side, farm's return has associated with the efficiency in the expenditure. So, the profit margin obtained was approximately 44.4%. This means that the development of smallholder beef cattle farming should take into account government policy since it has a promising prospect in the future.

Conclusions

It can be concluded that beef cattle farming who owned 1.83 Animal Unit (AU) has a promising prospect to be developed in the future on the basis of the following criteria: Production cost per year was Rp.7,147,093,- /farm or Rp. 3,905,515,-/AU, and it can obtain Rp.12,847,150,- /farm or Rp.7,020,301,- /AU of revenue with 1.80 of R/C ratio. Profit per year can reach Rp. 5,700,057,- /farm or Rp. 3,114,785,- /AU with 44.4% of profit margin.

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Key Factors for Success in Orgaware for Village Unit Cooperatives (KUD)

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Introduction

Development of a cooperative relationship between the company plays an important role in the successful implementation of business strategies. Implementation of cooperation in enabling businesses to create a higher individual performance as well as improve the performance of the group (Ladley, *et al.*, 2012). Some agricultural producers have formed New Generation Cooperatives (NGCs) in an effort to add value to their farm commodities (Stephanson (1995) in Carlberg, *et al.*, 2012). Three of the five most important factors come from that category. The strong local leadership in the beginning stages is recognized as the most important success factor and the related “steering committee” was identified as third most important (Carlberg, *et al.*, 2012). The cooperatives were successful because they followed the credit union philosophies and procedures meticulously. The credit union increased awareness of members by visiting branch offices, conducting meetings, discussions and keeping in touch through news letters (Pathak and Kumar, 2005).

Materials and Methods

This research was conducted at Garut regency area during June 2008 to December 2008. Garut regency area to represent successful in developed for KUD so they were chosen as area this research. Data were collected with a questioner at 10 KUDs.

The study aims to find the relationship and the influence of key factors orgaware component to the success of Village Unit Cooperatives (KUD). The study was conducted in the area Garut as one district that succeeded in the development of (KUD) at the national level. The data was collected through survey questionnaires in the field with the help of the ten best KUD. The object of research is orgaware component in the successful management of cooperatives. The data collected was analyzed using the Structural Equation Modelling (SEM) to find the amount of influence the key factors of success in the management of cooperatives especially orgaware components. Factors in orgaware components grouped into endogenous latent variables and exogenous latent variables. Analysis of the factors under study produced fifteen key variables on the endogenous latent variables of the nineteen variables were analyzed. While latent exogenous variables produce twenty three key variables of twenty-eight variables were analyzed. Key variables are recommended to be used as guidance in an effort to empower cooperatives towards independence.

Results and Discussion

Orgaware component analysis results showed the performance of the financial and operational performance was strongly influenced by the autonomy only work with their respective estimates 0.61 and 0.69. KUD is economic actors with different types of business activities (business department). Business activities are grouped into certain business units in accordance with its business. The business units have a firm job autonomy and each unit is managed by a manager, can thus achieve a good performance. The fact is evidenced by the Results of the analysis in Table 1 that work autonomy strong influenced the performance of the financial and operational aspect, consists of factors such as delegation of tasks and responsibilities, system of informal work and independence of work.

Table 1. Estimation and Value-t at the Component Model Measurements include Resources of orgaware

Components	Indicator Variables	Estimation	Value-t *
Autonomy within working system	1.Delegation of tasks and responsibilities	0.64	4.53
	2. System of informal work	0.88	6.39
	3. Independence of work	0.33	2.23

*Indicators in the table is selected indicators with real influence with the-t value>1.96

Conclusion

The results of this study showed that key factors of orgaware components are: the delegation of tasks and responsibilities, the system of informal employment, and independent work.

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The Grazing of Pampangan Buffaloes at Non Tidal Swamp in South Sumatra of Indonesia

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Introduction

Non Tidal swamp (*Lebak* in Indonesian) which is widely distributed in Indonesia is one of alternative areas to overcome food needs due to rising number of population and increasing conversion of land function every year. Pampangan Buffalo is one of Lebak Buffalo widely distributed in Indonesia, especially in South Sumatra. Farmers of Pampangan Buffalo have been utilizing lebak swamp since long time ago to produce meat and milk to prepare some traditional foods. Practically, the Pampangan Buffalo found in South Sumatra are not raised as source of primary income but as secondary activities. Buffalo farming is not conducted optimally, which can be seen from the low daily weight gain and low milk production. The population of pampangan buffalo tended to decline due to insufficient supply of food and inbreeding . This study is aimed to 1) investigate characteristics of Lebak swamp which is used as a grazing land of Pampangan Buffalo including water quality, soil physical and chemical properties, land use in Lebak swamp, and high of puddle; 2) find out botanical composition and vegetation consumed, nutrition value of forage in grazing land, and productivity of Pampangan Buffaloes.

Materials and Methods

Area of Land Grazing

Area of Lebak swamp used as a grazing land is investigated by GPS (Garmin's Oregon 400t gps) and plotting to map for each outermost point into the map by using the program ArcView 3.2 (ESRI, Redlands, California).

Height of puddle

Measurement of the height of puddle was done every 2 weeks from January until August, 2011, by using measurement of board. Height of puddle was measured from bottom to surface of swamp.

Water quality

Measurement of water quality was done twice, namely in January (high tide) and in August (low tide). In addition, the water pH measurement was done every month in the field by using pH Meter Hanna HI-98107.

Physical and chemical properties of the soil

The soil samples were analyzed in the laboratory at Soil Science Department, Faculty of Agriculture, Sriwijaya University to study the physical and chemical properties of the soil to represent the soil fertility (Center of Land Research, 2005).

All types of vegetation grown in land grazing were identified using procedures given by Biotrop (2009), Manetje & Jones (1992) and USDA (2010). Measurement of dominance of vegetation on grazing land was carried out by line intersection method. Observation of vegetation consumed was conducted by observing the species of vegetation that were consumed by Buffaloes (Hirata *et al.*, 2008 & Setianah *et al.*, 2004).

Chemical composition of the forage

Sampling of forage for the chemical composition were scheduled on May 19, 2012, with cutting the heading part of forage. This part of forage was dried in oven at 70⁰C for 24 hours and then analyzed in Laboratory of Feed Technology and Dairy Cattle Nutrition, Faculty of Animal Husbandry, Bogor Agricultural University. Measurement of fiber fraction content is done by using the Goering and Van Soest method, which included Neutral Detergent Fiber (NDF), Acid Detergent Fiber (ADF), cellulose, hemicellulose, and lignin. Besides, the contents of Ca, P, Mg, S, Cu, Zn Fe and Mn of the forage were also measured. The data obtained were analyzed using ANOVA and Duncan test to compare mean value between forage species.

Buffalo productivity

Determination of buffalo productivity was calculated by making direct measurement on body weight and milk production by interviewing the farmers on site. Buffalo sampling was determined by *purposive sampling* method at the most population of buffaloes and region that was easy to reach. Farmer sampling was based on those who had already raised buffaloes for 3 years and they have more than 10 buffaloes. Body weight was measured in April, June and August, 2012 on 13 males and 26 females buffaloes. milk was collected when the milking was done by farmer.

Results and Discussion

Status of soil fertility is indicated by low in pH with acidic condition, nitrogen in medium, and content of CEC, P Bray, Na, Ca, Mg ranged from very low to low criteria. Result of measurement of pH in the field indicated that the water pH is very acidic up to acidic condition. This resulted in high solubility of mineral Fe, Cu, Zn, Mn, but low mineral of Ca, P, and Mg contents.

Land use in Lebak Swamp

The Lebak swamp in the research area is also utilized by people to cultivate rice and vegetable which is planted once a year during low tide. Land mapping for the rice and vegetables cultivation amounting to 34.62 ha of swamp used as a grazing land are also used by people for rice and vegetables especially in the shallow and middle part of Lebak swamp. Practically, preparation of rice planting (land clearing and floating seeding) is carried out by farmers at the beginning of June, while harvesting was scheduled during August to September.

In addition to rice and vegetables cultivation, Lebak swamp is also used for grazing land and palm plantation. Fencing is done by farmers on the land of rice and vegetables areas with palm and rubber crops thus the buffaloes do not enter the land. This led to extensive

grazing mainly at the time of rice and vegetables planting in June and September.

Height of Puddle

As shown in other lebak swamp, grazing land of lebak swamp was located beside Batang Hari river which was affected by the high and low river water. The highest puddle in Lebak swamp occurred in March 2012, while the lowest puddle (point 0 meters) occurred in June to become lebak of Pematang (Shallow) and in July to become deepest Lebak. The highest puddle can reach 50 cm in Lebak of Pematang (Shallow), 101 cm in Lebak of Tengahan (Middle), and 167 cm in Lebak of Dalam (Deep), while the maximum depth of ground water taken placed in Lebak of Pematang (Shallow), Tengahan (Middle), and Dalam (Deep) occurred in September, which were 37.70, 77.70, and 87.70 cm, respectively. The low height of puddle will not only affect the growth and development of forage in grazing land, but also affect cropping pattern of farmers in the swamp land.

Botanical composition and vegetation consumed

Swamp vegetation which is found at the site of research amounted to 23 species. Type of grasses (*Poaceae*) are *Brachiaria muticum*, *Echinochloa stagnina*, *Hymenachne acutigluma*, *Ischaemum rugosum*, *Leersia hexandra*, *Oryza rupifogon* and *Saccharum spontaneum*; type of legumes (*Mimaceae*) are *Mimosa gigantea*, *Sesbania exasperata*, *Neptunia oleracea*, *Aeschynomene sensitiva*; type of *Cyperace* are *Scirpus grossus* L, *Scleria pterora* Presl, *Eleocharis dulcis*; type of *convulaceae* are *Ipomea aquatica* Forks, *Ludwigia hyssopifolia*, *Kylinga brevifolia*, *Polygonum barbatum* L, *Heliptropium indicum*, *Eichornia crassipes* S, *Hydrilla*, *Pandanus* sp, *Melaleuca leucadendron* *Ludwigia peruvial* dan *Ludwigia peploides*.

Vegetation that dominated on land with excessive grazing is *Oryza rupifogon* and *Eleocharis dulcis* with a composition of botany of 46.9 % and 46.1 %. Other vegetation found in this location is *Hydrilla* (3%), *Ludwigia peruvial* (1.1%), *Mimosa gigantea* (0.9%), *Ludwigia peploides* (0.82%), *Neptunia oleracea* (0.76%), *Ipomea aquatica* Forks (0.32%), and *Nymphaea amozanum* (0.1%). This is possible with the characteristic of *Oryza rupifogon* floating according with high the low of puddle. Result of observation of the grazing buffaloes showed that species of *Brachiaria muticum*, *Leersia hexandra*, *H. acutigluma*, *Ischaemum rugosum*, *Oryza rupifogon*, *Mimosa gigantea*, *Sesbania exasperata*, *Neptunia oleracea*, *Aeschynomene sensitiva*, *Scirpus grossus* L, *Scleria pterora* Presl,, *Eleocharis dulcis*, *Ludwigia peploides*, and *Nymphaca amazonum* were consumed by Buffaloes.

Chemical composition of the forage

The chemical composition of forage is different among species ($P < 0.01$). Crude protein content of the forage in these studies ranged from 60.40 g/kg (*Scleria pterora presl*) up to 280 g/kg (*Neptunia oleracea*). Crude protein content of grass on this research is not all lower than protein content of legumes such as forage in dry land (Evitayani *et al.*, 2006, Barnes *et al.*, 2006). Crude protein content on *H. acutigluma* is not significantly different ($P < 0.01$) with crude protein content on legumes *Mimosa gigantea* and *Aeschynomene sensitiva*. NDF content ranged from 610 g/kg (*Nymphaca amazonum*) up to 987 g/ kg (*Eleocharis dulcis*). Neutral Detergent Fiber content on legumes is lower ($P < 0.01$) in comparison to NDF content on other type of forage, except in *Leersia hexandra* and *Nymphaca amazonum*. Neutral Detergent Fiber content of swamp grass found on this research is ranging from 821g/kg (*Leersia hexandra*) up to 921 g/kg (*Brachiaria pycnanthemum*).

Content of Ca ranged from 0.31 g/kg (*Eleocharis dulcis*) up to 4.79 g/kg (*Neptunia oleracea*), P ranged from 0.11 g/kg (*Brachiaria pycnanthemum*) up to 2.14 g/kg (*Ludwigia peploides*), Mg ranged from 1.66 (*Eleocharis dulcis*) 23.48 g/kg (*Aeschynomene sensitiva*) and S ranges from 0.26 (*Oryza rupifogon*) up to 4,89 g/kg (*Eleocharis dulcis*). Content of Ca, Mg and P found on legumes is higher than on grass ($P < 0.01$), except on *Mimosa gigantica*. However, the concentration of Ca found in all of grass and cyperus is deficient, P concentration on all types of forage is deficient, Mg is found only deficient on *Eleocharis dulcis*, whereas deficiency of S concentration occurred on most of the forage, except on *Ischaemum rugosum*, *Aeschynomene sensitiva*, *Cyperus rotundus*, and *Eleocharis dulcis* respectively.

Content of Cu ranged from 10.00 up to 243 mg/kg (*Ludwigia peploides*) except on *Aeschynomene sensitiva* and *Ludwigia peploides* are in toxic levels in forage (McDowell *et al.*, 1993). Content of Fe was found ranging from 106 mg/kg (*Brachiaria pycnanthemum*) up to 10826,67 mg/kg (*Ludwigia peploides*). Moreover Zn content was obtained by about 26,67 mg/kg (*Eleocharis dulcis*) up to 206 mg/kg (*Ludwigia peploides*), whereas the content of Mn ranged from 33.3 mg/kg (*Eleocharis dulcis*) up to 1043,33 mg/kg (*Oryza rupifogon*). Refer to the requirement of micro minerals (McDowell *et al.*, 1993), the content of Fe, Zn and Mn exceeded a critical level, while the content of Cu and Zn in some species are deficient.

Buffalo Productivity

Daily weight gain of Pampangan Buffalos were lower compared to Murrah and Mediterranean Buffalos as stated by Camarao *et al.*, (2002) and Kandeepan *et al.*, (2009), but higher than daily weight gain found by Triwulaningsing & Praharini (2006) and Batosomma (2006).

Average of milk production collected from lactating Buffalo measured twice indicated that milk production found in Pampangan Buffalo was still low as $1,29 \pm 0,44$ liters per day (Camarao *et al.*, 2002 & Kandeepan *et al.*, 2009), but this result is not much different from the result obtained by Siregar *et al.*, (1998) in West Sumatra. Besides, on those two livestock productivity variables, reproductive variable of Buffalo observed on Pampangan is low, it is due to low quality feed and poor management (Putu *et al.*, 1995; Camarao *et al.*, 2002; Kandeepan *et al.*, 2009; Triwulaningsing & Praharini, 2006; Batosomma, 2006).

Conclusions

Conclusions of this study are 1) water quality and soil fertility found in lebak swamp grazed by Pampangan Buffalo are low with highest puddle occurred in March 2012, and lowest puddle taken placed in June and July, 2) existence of rice and vegetables cultivation are shown in low puddle season, as well as for palm oil plantation, causing conflict of interest between buffalo grazing efforts and agriculture activities, 3) 23 species of swamp land vegetation have been identified, 14 species are consumed by Buffaloes with the chemical composition varying among species, 4) high content of fiber fraction, low crude protein content, and presence of specific mineral deficiency and toxicity will result in low productivity of livestock of Pampangan Buffalos.

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Evolution of the Cattle Industry in Brazil During the Last Decade

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Introduction

Brazil is a leading player in beef, poultry and pork world markets. It is the world's largest meat exporter, second largest beef producer, and is home to the world's biggest commercial beef herd. For the past two decades, the cattle industry has moved toward the Midwest region, which is now home to one-third of Brazil's herd (Meyer *et al.*, 2013). This great change has occurred due to the continued availability of natural resources and a favorable exchange rate (Steiger, 2006). In order to understand the growth in the different regions, a study was conducted to evaluate the development of the Brazilian beef production from 1991 up to 2010.

Materials and Methods

Data were collected from official databases at Digital Databases "Sidra" (IBGE, 2010), from 1991 to 2010. Variables collected (per year and per state) were: bovine herd, number of slaughtered heads and total carcass weight. The number of slaughtered heads was divided by herd size to obtain the slaughter rate. Total carcass weight was divided by slaughtered heads to obtain the individual carcass weight. Brazilian states are aggregated in regions: North, Northeast, Southeast, South and Midwest. The annual average growth rate (%/year) was calculated using regression analysis, obtaining the slope between natural logarithm of each variable and the correspondent year. Then, the anti-logarithm of the slope minus 1 was taken, according to the following equation: $V_t = V_0 (1+r)^n$, where: V_t = growth at time t ; V_0 = initial growth; r = annual average growth rate; n = number of years. Slaughter rate/slaughtered heads ratio (SR/SH ratio) was calculated by the division of them. For example, if SR/SH ratio equals 0.6, it means that 60% of the slaughtered heads growth is due to increase in slaughter rate and 40% due to herd size.

Results and Discussion

All the results are shown in Table 1. In 1991, Brazil had approximately 176.4 million bovine heads and slaughtered 18.4 million heads (4.3 billion kg of total and 235 kg of individual carcass weight). In 2010, Brazilian bovine herd went up to approximately 209.5 million heads and almost doubled the slaughter up to 29.3 million heads (7.0 billion kg of total and 238 kg of individual carcass weight). From 1991 up to 2010, Brazilian bovine herd increased by 1.44%/year, the number of slaughtered heads by 5.32%/year and the slaughter rate by 3.83%/year, with a very small increase in the individual carcass weight (0.13%/year). Around 72% of the growth in slaughtered heads was due to increase in slaughter rate and 28% due to increase in herd size (SR/SH ratio = 0.72).

The North region encompasses the Amazon forest, representing an agricultural frontier, and accounted for the second largest bovine herd in 2010 (20% of the total). It

showed the highest growth in bovine herd (3.98%/year), in number of slaughtered heads (11.16%/year) and in slaughter rate (6.90%/year), with a decrease in individual carcass weight (0.65%/year). Around 62% of the growth in the number of slaughtered heads was due to the increase in slaughter rate and 38% was due to the increase in herd size (SR/SH ratio = 0.62). The Northeast region is the traditional region with ancient colonization, low social and economic development. It presented the 2nd highest growth in herd size (2.51%/year) and in number of slaughtered heads (7.31%/year) with the slaughter rate increasing by 4.68%/year. Around 64% of the growth in the number of slaughtered heads was due to increase in slaughter rate (SR/SH ratio = 0.64). The Midwest region is a traditional producer of beef cattle and grains, accounting for the largest bovine herd in the country in 2010 (34.63% of the total). It showed the third highest growth in herd size (1.06%/year), but the lowest growth in the number of slaughtered heads (3.55%/year) and slaughter rate (2.46%/year), but with the highest increase in individual carcass weight (0.57%/year). About 69% of the growth in the number of slaughtered heads was due to increase in slaughter rate (SR/SH ratio = 0.69). Recent cattle production has started to move north because of the expansion of soybean production raised land prices in the Midwest (Meyer *et al.*, 2013). Raising cattle in North is 10% more profitable than in other regions, because of lower land prices. Once timber is harvested, there is competition from other land uses such as crop production (Steiger, 2006). The Southeast region is the most technologically developed region. It used to have the second largest herd in Brazil in 2000, ranking third in 2010. Amongst the regions, it was the one with the lowest increase in herd size (0.07%/year), but most of the growth in the number of slaughtered heads (98%) was due to increase in slaughter rate (SR/SH ratio = 0.98), meaning that the region has become efficient in beef production and/or it slaughtered cattle imported from neighbor regions. The South is the region traditionally and strongly dominated by the European immigration. It showed the second lowest growth in herd size (0.10%/year), but the second highest increase in slaughter rate (5.27%/year). Most of the growth in slaughtered heads (98%) was due to increase in slaughter rate (SR/SH ratio = 0.98).

Table 1. Annual average growth rate of bovine herd, number of slaughtered heads, slaughter rate and individual carcass weight and slaughter rate/slaughtered heads ratio in different regions of Brazil from 1991 to 2010.

Region	Relative herd ¹ in 1991 (%)	Relative herd ² in 2010 (%)	Bovine herd ³ (%/y)	Slaughtered heads ⁴ (%/y)	Slaughter rate ⁵ (%/year)	Individual carcass weight ⁶ (%/year)	SR/SH ratio ⁷
North	15.46	20.09	3.98	11.16	6.90	-0.65	0.62
Northeast	13.27	13.72	2.51	7.31	4.68	-0.37	0.64
Midwest	35.03	34.63	1.06	3.55	2.46	0.57	0.69
Southeast	21.04	18.26	0.07	3.60	3.52	0.24	0.98
South	15.18	13.30	0.10	5.38	5.27	0.16	0.98
Brazil	100	100	1.44	5.32	3.83	0.13	0.72

¹ relative bovine herd in 1991 (% of Brazilian herd), ² relative bovine herd in 2010 (% of Brazilian herd), ³ annual average growth rate of bovine herd (%/year), ⁴ annual average growth rate of bovine slaughtered heads (%/year), ⁵ annual average growth rate of bovine slaughter rate, ⁶ annual average growth rate of individual carcass weight (%/year),

⁷ slaughter rate/slaughtered heads ratio.

Conclusion

The displacement of the cattle industry towards north has concerned the government, due to deforestation of the Amazon. Future livestock production, especially beef cattle may promote more intensive production systems and move to the Northeast region as well

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Assessment of Population Structure and Genetic Diversity of Tunisian Indigenous Rabbit Ascertained Using Molecular Information

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Abstract

Understanding the genetic structure of domestic species provides a window into the process of domestication. This study attempts to provide a comprehensive insight into the prevailing genetic status of Tunisian indigenous rabbit breeds using molecular markers.

Thirty-three microsatellite loci were used to provide a comprehensive insight into the genetic status and relationship among 12 indigenous rabbit populations in Tunisia. A total of 264 rabbits from villages of Tozeur and Kebili regions were studied. Population statistics were calculated within and between the 12 rabbit populations. The observed heterozygosity, unbiased expected heterozygosity, and the effective number of alleles were used to assess the genetic variation of each indigenous breed.

Results showed a high genetic diversity (observed heterozygosity ranged between 0.3 and 0.5), which implies that there is abundant genetic variation in the Tunisian indigenous rabbit breeds. Significant population differentiation was observed ($F_{st} = 0.11$), which means that most of the genetic variation resides within the breeds. The percentage of individuals correctly classified to their population was 85%. Breeds with more than one breeder origin were divided into subgroups, due to differences in gene frequencies between breeders, which in some cases created a genetic differentiation even higher than that observed between distinct breeds. The current study is the first detailed analysis of the genetic diversity of indigenous rabbit populations in Tunisia. The data generated here provide valuable information about the genetic structure of the 12 rabbit populations and this can be used for establishing priorities for their conservation.

Genetic Parameters for Birth Weight and Body Size in a Saanen Goat Population in Thailand

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Introduction

Birth traits are important traits related with factors affecting profitability. We could monitor farm management early by using estimated genetic parameters. Therefore, if we estimate genetic parameters of birth traits, it could be used to improve farm management and increase potential productivity. The objectives of this study were to estimate heritability, phenotypic correlations and genetic correlations for birth weight and body size at birth in a Saanen goat population under Thai environment condition.

Materials and Methods

All animals were raised on a commercial farm located in the western part of Thailand. Birth weight (BW), birth body length (BL), birth height (BH) and birth heart girth (BHG) were measured in 449 Saanen kids born between 2006 and 2008. All animals were raised under the same nutritional and management conditions. Bivariate analyses were carried out for all birth traits. Variance components were estimated with a linear mixed model using AIREML methodology implemented in the software package ASREML (Gilmour *et al.*, 2009). The environmental factors such as contemporary group, sex, parity and litter size were fitted in the model as fixed effects. Random effects fitted were direct and maternal genetic effects. Season of birth was formed by combining four months (February-May, June-September and October-January). Heritability estimates, phenotypic and genetic correlations were calculated from variance components.

Results and Discussion

Means and standard deviations of BW, BL, BH and BHG were 2.77 ± 0.77 kg, 30.32 ± 3.11 cm, 32.19 ± 3.38 cm and 32.72 ± 3.06 cm, respectively. Mean values of BW was higher than that reported by Kantanamalakul (2010); BW was 2.21 kg in Saanen goats from the south part of Thailand.

Table 1. Estimates of heritability (diagonal), genetic correlations (above diagonal) and phenotypic correlations (below diagonal) among BW, BL, BH and BHG.

Trait	BW	BL	BH	BHG
BW	0.38 ± 0.18	0.78 ± 0.23	0.55 ± 0.33	0.79 ± 0.18
BL	0.49 ± 0.04	0.31 ± 0.17	0.46 ± 0.42	0.99 ± 0.00
BH	0.49 ± 0.04	0.44 ± 0.04	0.27 ± 0.16	0.28 ± 0.46
BHG	0.66 ± 0.03	0.53 ± 0.04	0.42 ± 0.04	0.39 ± 0.19

Heritability estimates for BW, BL, BH and BHG were moderate; we can improve all of the birth traits by using suitable breeding programs. They ranged between 0.27 - 0.39 and were higher than those reported by Zhang *et al.*, (2008) in Boer goats (0.19 - 0.25). Genetic and phenotypic correlations among birth traits were high and positive, and they were in agreement with the results reported by Zhang *et al.*, (2008). Exception was for genetic correlation between BH and BHG which was moderate and positive. Therefore, selection for any of the birth traits could be used to improve the other birth traits.

Conclusions

Heritability values in this study may be classified as moderate. Genetic and phenotypic correlations among all the birth traits were high and positive, except for genetic correlation between BH and BHG which was moderate and positive.

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Genetic Polymorphisms of Caprine Growth Hormone (GH) and their Effect on Pre-weaning Growth Traits

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Introduction

The growth hormone (GH) gene could be considered as a candidate gene for weight because GH plays an important role in caprine growth and body development. Birth weight (BW) and weaning weight (WW) are economically important traits in goat breeding, and recording these is routine work and easy in Thailand. The establishment of significant correlation of BW and WW with the polymorphic sites at the GH gene could lead to the discovery of molecular markers which are useful in assisting selection programs. This information could be applied for selecting parental stock in the herd. The objectives of the study were to identify polymorphism of the GH gene by PCR-SSCP and to investigate the effect of the GH polymorphism on pre-weaning growth traits such as BW and WW in meat goats.

Materials and Methods

The 171 animals in this study were purebreds and crossbreds of Boer (BO), Thai native (TN), Anglo-Nubian (AN), and Saanen (SA) which were raised in a large commercial farm in southern Thailand. They were measured for BW and WW, using a digital weighing scale. Extracted genomic DNA were amplified for the GH gene using the forward primer 5'-CAGGACTTGGAGCTGCTTCG-3' and reverse primer 5'-ATCAGC GCCAGGATGCCTT-3' in the PCR technique. The genomic DNA (20 ng) was used in a 20 µl of reaction volume. The amplification was carried out using 40 cycles at 95°C for 30 s, 55°C for 30 s and 72°C for 30 s, followed by 72°C for 7 m. The amplified PCR products were approximately 225 bp. The PCR products were validated by the SSCP analysis after optimization of non-denaturing polyacrylamide gel concentration and other running conditions. Sequencing method was applied for detection of point mutations. The genotypic and allelic frequencies were estimated by the gene counting method. The R program version 2.11.1 (R program, 2010) was used to evaluate significance of fixed effects on BW and WW, and to analyze mean comparisons among genotypes.

Results and Discussion

The caprine GH gene revealed 4 patterns (AA, GG, AG and AC). The sequence analysis proved the difference in mobility, which had an A→G transition at nucleotide positions 1533 and 1551. The genotype AA was found to have the base A at both positions, but genotype GG was a mutated form with A→G substitution at both positions. The heterozygous AG and AC had base A at nucleotide position 1533. However, AG had base G and AC had base C at nucleotide position 1551. Genotypic frequencies of AA, GG, AG and AC were 0.38, 0.21,

0.39 and 0.02, respectively, and allelic frequencies of A, G and C were 0.58, 0.41 and 0.01. The AC genotype was rarely observed because goats with this genotype might have been culled. Mousavizadeh *et al.*, (2009) and Wickramaratne *et al.*, (2010) reported that the GH gene on exon 4 had several transitional mutations. Studying the effects of the gene on BW and WW considered the other fixed effects such as sex, contemporary groups and type of birth, regression of dam age, breed fractions of BO, TN, AN and SA that were included in the data analysis. Generalized linear model analysis demonstrated that effects of sex, contemporary group, type of birth, genotypes of investigated gene significantly influenced to BW and WW ($P < 0.05$). BW of animals with AA, GG, AG and AC genotypes were 2.48 ± 0.69 , 2.41 ± 0.48 , 2.50 ± 0.51 and 2.00 ± 0.01 kg and WW of each genotypic animal was 14.05 ± 4.51 , 13.89 ± 3.56 , 14.11 ± 3.29 and 12.17 ± 0.29 kg, respectively. Preweaning growth performance of animals with AG tended to be the highest. Animals with AC genotype had the lowest BW and WW ($P < 0.05$). Also, this genotypic animal should be culled in order to improve pre-weaning growth traits in this herd.

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Study of Four Microsatellite Loci in Crossbred Goats

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Introduction

Animal reproduction biotechnology includes embryo transfer, artificial insemination and cloning, which are technologies for genetic improvement of goat populations. However, these are complex methods and can involve mistakes such as inaccurate pedigree information, etc. Molecular genetic techniques, such as microsatellite analysis, can be used for accurate identification. Microsatellite technique targets short sections of the DNA where a simple motif, generally 1-5 bp long, is repeated up to about 100 times. Microsatellite markers are highly polymorphic, as well as abundant and fairly evenly distributed throughout the eukaryotic genome (Arif *et al.*, 2010). Microsatellite markers are commonly used for examining population structure, forensic purposes and individual identification. Therefore, the current study was carried out to evaluate primers of four microsatellite loci for use in identification in crossbred goats.

Materials and Methods

Sampling and DNA extraction

Fifty-one related and unrelated crossbred goats were selected from Nong Chok district. DNA was extracted from the blood sample of each goat by Genomic DNA mini kit.

Microsatellite markers, PCR condition and data collection

Four microsatellite loci were investigated: OarFCB304 (Mishra *et al.*, 2010), ILSTS30 (Dixit *et al.*, 2009), ILSTS082 (Verma *et al.*, 2010) and ILSTS058 (Mainguy *et al.*, 2005). The PCR amplification was conducted in 20 µL (total volume) reaction mixture containing 2.5 µL 10 X Buffer (Mg²⁺ plus), 1 µL forward and reverse primers, 2 µL dNTPs, 2 unit of *Taq* DNA polymerase and 100 ng/µL template DNA. PCR reaction condition included an initial incubation step of 95°C for 10 m, followed by 35 cycles of 95 °C for 45 s, 55°C to 60°C depending on the locus (as showed in Table 1) for 45 s and 72 °C for 1 m, followed by a final extension at 72°C for 5 m. PCR amplified products were analyzed in 3% agarose gel, stained with ethidium bromide, and observed under ultraviolet light to examine the size and quality of the product. Products were then analyzed in denaturing polyacrylamide gel for the separation of products with different sizes.

Table 1. Annealing temperature used for each microsatellite locus

Locus	Annealing temperature (°C)
OarFCB304	60
ILSTS30	55
ILSTS082	60
ILSTS058	55

Results and Discussion

All four microsatellite loci were successfully amplified; OarFCB304, ILSTS30, ILSTS082 and ILSTS058, which were polymorphism with > 4 alleles per locus, are shown in Table 2.

Table 2. Characteristics of the four microsatellite loci investigated for crossbred goats

Locus	Allelic size range (bp)	No. of alleles
OarFCB304	138-189	10
ILSTS30	156-178	7
ILSTS082	109-142	8
ILSTS058	164-184	8

Results of this study indicate that the four microsatellite loci showed successful amplification. Loci OarFCB304, ILSTS30, ILSTS082 and ILSTS058 were polymorphic with more than 4 alleles per locus. Thus, these four microsatellite loci may be useful for examining population structure, forensic purposes and identification of specific animal in crossbred goats.

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Molecular Diversity in ATP6 and ATP8 Genes in Dromedaries Camel Breeds of Pakistan

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Introduction

Camel (*Camelus dromedaries*) is of immense economic value providing mankind a useful product and services, e.g. milk, wool, meat and drought power. Camels have high forbearance ability adapted to a very harsh, severe and dehydration-prone environment (Schwartz, 1992). The aim of the current study was to analyze the genetic polymorphism of two mitochondrial genes ATP6 and ATP8 in eight camel breeds of Pakistan together with the evolutionary analysis of the selected camel breeds.

Materials and Methods

Blood samples were taken from different individuals belonging to eight selected camel breeds in their tracts of various geographical regions throughout the country. The DNA was extracted by a standard method and quantified through Nanodrop 2000/2000c. A set of primer CdATP8/6-F (AGCCATGACCCCTCCTTAGT), CdATP8/6-R (TGGTATGCGTGAGTCTGGTG) amplified both genes ATP6 (681 bp) and ATP8 (204 bp) was designed through online primer 3 software. Both genes are continuous with overlapping region of 43 bp between them.

Software analysis.

All of the sequences were aligned with the help of online software blast2 sequence (<http://www.ncbi.nlm.nih.com>) and the sequences analysis and polymorphism identification were detected using CodonCode Aligner. The UPGMA Phylogenetic Tree and Neighbor Joining Phylogenetic Tree were constructed from the final consensus sequences with help of MEGA program package, MEGA version 5.05 (Tamura *et al.*, 2011). DnaSP software package was used to identify the haplotype and nucleotide diversities and analysis of nucleotide polymorphism (Librado and Rozas, 2009).

Results and Discussion

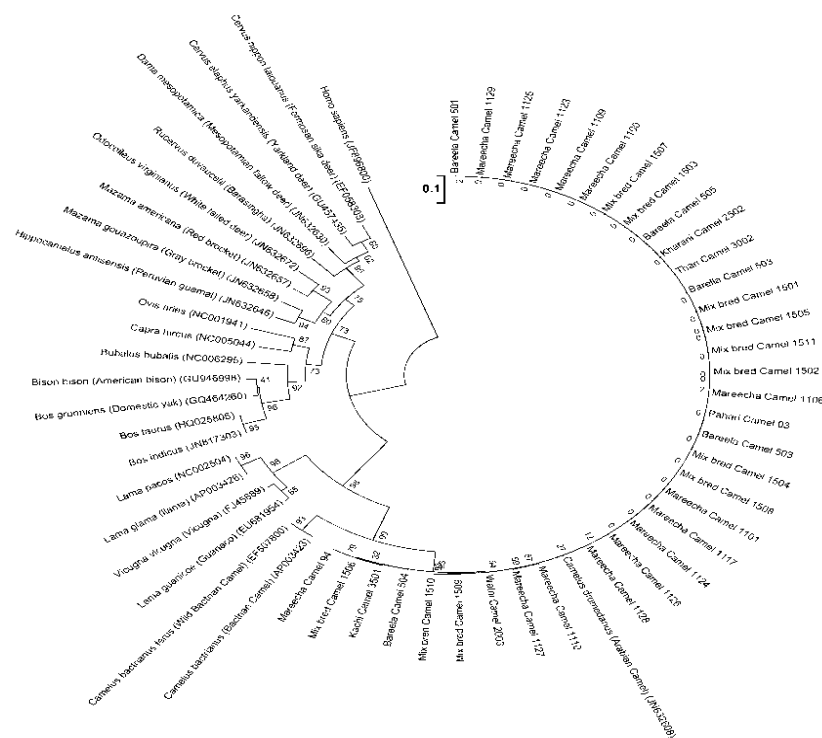
Genetic variation

After sequencing and alignment of a total 890 bp regions including both genes ATP6 and ATP8 in all eight camel breeds, results of the genetic analysis were obtained. No deletion/insertion was obtained. A total of 11 polymorphic sites were obtained, five sites were singleton variable sites at position 153, 202, 249, 374, and 572, while six sites 216, 290, 447, 593, 779 and 785 were found parsimony informative sites. A total of nine haplotypes were generated from all sequences in eight camel breeds. The haplotype (Hd) and nucleotide diversity (Pi) were 0.5290 ± 0.1010 and 0.00181 ± 0.00047 , respectively. Because all sequences were obtained from different geographical regions throughout the country, the Tajima's D value -1.33564 designated signature of population's expansion.

Phylogenetic analysis

The Neighbor- Joining phylogenetic tree was constructed between eight studied breeds of camel on the basis of sequences obtained from ATP6 and ATP8 genes. Support for individual branch of phylogenetic tree was assessed by Bootstrap percentages computed after 1000 replicates. The Sheep (*Ovis aries*) ATP8 and 6 sequence was selected as outer group. All single-humped camels of Pakistan (*Camelus dromedarius*) were grouped together along with one Arabian camel (*Camelus dromedarius*) sequence (NCBI GenBank accession no. JN632608). The two-humped camels (*Camelus bactrianus*) were also grouped together in another clade, confirming the genetic differences between two types of camel.

The present study is the first comprehensive study focusing on the phylogenetic relationships of some famous camel breeds of Pakistan which give some ideas about the genetic similarity and differences between different camel breeds of the country.



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A Random Regression Model for Estimating Different Heritability in Sheep

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Random regression model is of a great importance in evaluating repeated records of animal in different ages. The advantage of this model is that the different means and co-variances of the records over time are involved in estimating genetic parameters, result in increased accuracy. Data used included test day records of body weight of Moghani sheep, collected from 1995 to 2009. Fixed effects were: sex, birth type, dam parity, year-season of record and year-season of birth. Age of dam and age of the lamb at the time of recording introduced to the model as covariant variables. Data analyzed using IS-REML software. Body weight had an increasing trend from birth to 270 days of age, which it was faster from birth to 90 days of age and was steady from 90 days to 270 days of age. Direct permanent environmental and direct additive genetic variances increased from birth to the 270 days of age, the amount of increase was higher from 180 to 270 days for direct additive genetic variance. Maternal additive genetic variance and phenotypic variance had increasing trend, in spite of the decline in residual variance the declined from 180 to 270 days. Generally the heritability measures were low (0.002 - 0.069). It can be expressed that a set of reasons causes low heritability such as low diversity between records, more contribution of residual effects among management variations (in different nutrition systems, different weaning age of lambs). Direct heritability decreased at 90 days of age to the least amount then increased to 270 days of age. Maternal heritability decreased sharply after birth to 90 days of age and then increased as the age increased which is very important in the selection method based on the maternal ability. According to the high maternal heritability, breeding value of the dam should be considered in selection procedures. Proportion of direct permanent environment variables to phenotypic variance decreased after birth but then increased to the maximum rate at 270 days of age. Repeatability decreased after birth to the 180 days of age, thereafter increased to 270 days of age.

Alteration of body measurements of some native sheep of Iran

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Sheep industry has a growing trend and is an indispensable branch of animal production in Iran, where geographical structure is largely mountainous, agriculture is mainly performed under extensive conditions and pastures are not much efficient. Meat and skin production play great economic role in people's life of most parts of Iran. Body measurement is often used as an indicator in evaluating growth of animal but it does not indicate body composition. The increase in the prices of feedstuff, have made many sheep farmers to look for alternatives for body weight of animal so that they could select more prolific animals at the early ages. This study was conducted to determine body weight of 219 Shaal and 214 Fashandi native sheep using body measurements. Traits were: body weight (g), chest girth (cm), body length (cm), height-at-withers (cm) and hip width (cm). All traits had significant regression with body weight. Also sex age of dam and breed had significant effects on body weight. Sexual hormones, genetic and physical differences affected body weight which male sheep were heavier than female sheep. Older dams produced heavier lambs that influenced mature body weight of lambs. Fashandi sheep had higher body weight and body measurements. The correlation between body weight and measurements were highly positive and significant, otherwise body length had the lowest correlation. Hip width and height-at-withers were correlated with the chest girth which indicated that selection for bigger hip width and higher withers would result in bigger chest girth. Height-at-withers had the highest regression with the chest girth in Shaal sheep and it means that selection for one centimeter higher withers would result in one centimeter bigger chest girth, it could produce 0.73 g and 0.72 g more body weights, respectively. The body length had the lowest regression and it indicated that selection for this trait would not improve body weight of Shaal sheep. Height-at-withers in Fashandi sheep had the highest regression and it showed that one centimeter increase in this trait, results in 1.05 kg increase in body weight. Hip width had the lowest regression with body weight and is recommended to select Fashandi sheep according to the higher withers.

Organic Selenium from Selenium-Enriched Kale Sprout Increased Tissue Selenium Concentrations of Broilers

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Introduction

Selenium (Se) is an essential trace element in animals and as selenoproteins, play a vital role in the antioxidant systems of the body. Dietary Se is available in the inorganic or organic form. Currently, organic Se from yeast has been extensively reported to be more bioavailable than inorganic Se in poultry (Chantiratikul *et al.*, 2008; Krstic *et al.*, 2012). On the other hand, organic Se can also be synthesized by plants and has been used for human nutrition (Yoshida *et al.*, 2007). Kale sprout (*Brassica oleracea* var. alboglabra L.) grown hydroponically with sodium selenite supplementation HPSeKS) can provide an organic source of Se (Maneethong *et al.*, 2013). This study focuses on the availability of Se to broilers fed with HPSeKS.

Materials and Methods

Three hundred and sixty male broilers (10 day-old) were randomly assigned to 6 groups, with 4 replicates of 15 broilers each. Broilers were kept in evaporative cooling system housing. Internal light was provided for 24 h/d. The room temperature was 32°C at the first week and was gradually decreased to 25°C from d 30 until the end of the trial. The dietary treatments were T1: control diet, T2: control diet plus 0.3 mg Se/kg from sodium selenite (Na₂SeO₃), T3: control diet plus 0.3 mg Se/kg from Se-enriched yeast, T4, T5 and T6: control diet plus 0.3 mg Se/kg from HPSeKS. The control diet was formulated to meet the nutrient requirement of broiler (NRC, 1994), without Se supplementation. On d 42, 12 chickens from each treatment were randomly slaughtered. Afterwards, samples of liver, kidney, heart and breast muscle of broilers were collected for Se concentration determination by inductively coupled plasma mass spectrometer (ICP-MS model Elan-e, Perkin-Elmer SCIEX, USA). The data were analyzed according to Completely Randomized Design. The differences among means of each parameter were compared by Duncan's New Multiple Range Test.

Results and Discussion

Se supplementation increased ($p < 0.05$) Se concentrations in liver and kidney tissues of broilers when compared to that of birds on a control diet. Se sources did not alter ($p > 0.05$) Se concentrations in liver, kidney and breast muscle of broilers. However, Se content in heart tissue of broilers fed Se from Se-enriched yeast and HPSeKS was higher ($p < 0.05$) than that of

broilers fed Se from sodium selenite. Additionally, Se concentrations in liver, kidney and breast muscle of broilers increased ($p<0.05$) with increasing dietary Se level (Table 1). The present results are generally in agreement with other reports (Heindl *et al.*, 2010; Wang *et al.*, 2011; Krstic *et al.*, 2012). Moreover, the finding indicated that efficacy of Se from HPSeKS was comparable to that of Se-enriched yeast, which was higher than that of Se from sodium selenite. Based on the outcomes, it can be concluded that HPSeKS can furnish high quality organic Se to broilers.

Table 1. Selenium concentrations in tissues of broilers fed various selenium sources

Items	Dietary Treatments ¹						SEM
	T1	T2	T3	T4	T5	T6	
Liver (mg/kg)	0.49 ^c	1.40 ^b	1.41 ^b	1.67 ^b	3.46 ^a	3.20 ^a	0.23
Kidney (mg/kg)	0.60 ^d	1.52 ^c	1.79 ^c	1.54 ^c	3.71 ^b	4.64 ^a	0.31
Heart (mg/kg)	0.31 ^b	0.72 ^b	2.03 ^a	1.72 ^a	1.72 ^a	2.01 ^a	0.16
Breast muscle (mg/kg)	0.17 ^b	0.33 ^b	0.28 ^b	0.40 ^b	1.94 ^a	2.18 ^a	0.18

^{abcd} Means in the same row with different superscripts are significantly different ($p<0.05$).

¹T1 = control diet; T2 = control diet plus 0.3 mg Se/kg from sodium selenite; T3: control diet plus 0.3 mg Se/kg from Se-enriched yeast, T4, T5 and T6: control diet plus 0.3, 1.0 and 2.0 mg Se/kg from HPSeKS.

Acknowledgements

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Consumption of Fermented Cassava Tuber Wastes Lowers Glycaemic Indices and Loads in Pigs

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Materials and Methods

A solid substrate fermentation protocol was followed using a consortium of two lactic acid bacteria: *Lactobacillus delbrueckii* and *Lactobacillus coryneformis* and a cellulolytic fungus (*Aspergillus fumigatus*). Seven treatment diets were formulated from the fermented products. Twenty-eight (28) weanling pigs were fed with these diets for 10 weeks after which their glycaemic responses to the various diets were determined.

Results and Discussion

The results (Table 1 and Figure 1) revealed that all the cassava tuber waste (CTW) diets had lower glycaemic indices (GI) and glycaemic loads (GL) than the control diet. The lowest glycaemic index (45.73%) and glycaemic load (18.76%) were recorded on the naturally fermented starch residues (NFCSR) diet. The unfermented cassava peel (UFCP) diet elicited the highest pre-prandial blood glucose value (127.58g/dl).

It could be concluded that the use of these fermented CTWs may lower both the glycaemic indices and loads of feeds and hence mitigate the problems of hyperlipidaemia, cholesterolaemia and depot fat accumulation in pigs. Human subjects, by extension, could benefit from the consumption of foods with similar fermentation protocols which could help control incidence of hyperglycaemia and probably the prevalence of Type II diabetes in human population. These glycaemic responses could be used as predictors of cyanide toxicity in animals and human subjects.

Table 1. The glycaemic indices of microbially fermented CTW diets as determined from the postprandial glucose level of the experimental pigs.

Parameters	control	UFCSR	NFCSR	MFCSR	UFCP	NFCP	MFCP	± SEM
Preprandial glucose(g/dl)	97.20 ^{ab}	89.10 ^{ab}	93.20 ^{ab}	93.20 ^{ab}	127.58 ^a	68.85 ^b	97.20 ^{ab}	5.55
Postprandial 100g glucose(g/dl)	108.00 ^d	144.00 ^c	221.40 ^a	120.60 ^d	202.50 ^{ab}	101.58 ^d	188.33 ^b	20.96
Postprandial 100g feed(g/dl)	110.00 ^c	117.00 ^c	112.50 ^c	109.00 ^c	144.00 ^a	99.00 ^d	135.00 ^b	5.64
% rise due to pure glucose	18.51 ^e	56.82 ^{cd}	135.78 ^a	34.07 ^d	80.59 ^{bc}	58.33 ^{cd}	100.36 ^{ab}	20.11
% rise due to feed	7.98 ^e	21.43 ^{cd}	11.11 ^d	14.07 ^d	16.08 ^d	40.42 ^a	30.00 ^b	7.17
Glycaemic index(%)	91.67 ^a	73.13 ^b	45.73 ^c	81.34 ^{ab}	64.00 ^b	88.00 ^{ab}	64.52 ^{bc}	4.17
Glycaemic load (%)	45.62 ^a	28.23 ^c	18.76 ^d	32.70 ^{bc}	23.66 ^{cd}	35.89 ^b	28.33 ^c	2.67

^{a,b,c,d,e} = Means on the rows but with different superscripts are statistically (P<0.05) different. N = 28

UFCSR = Unfermented cassava starch residues, NFCSR = Naturally fermented starch residues, MFCSR = Microbially fermented cassava starch residues, UFCP = Unfermented cassava peel, NFCP = Naturally fermented cassava peels and MFCP = Microbially fermented cassava peels.

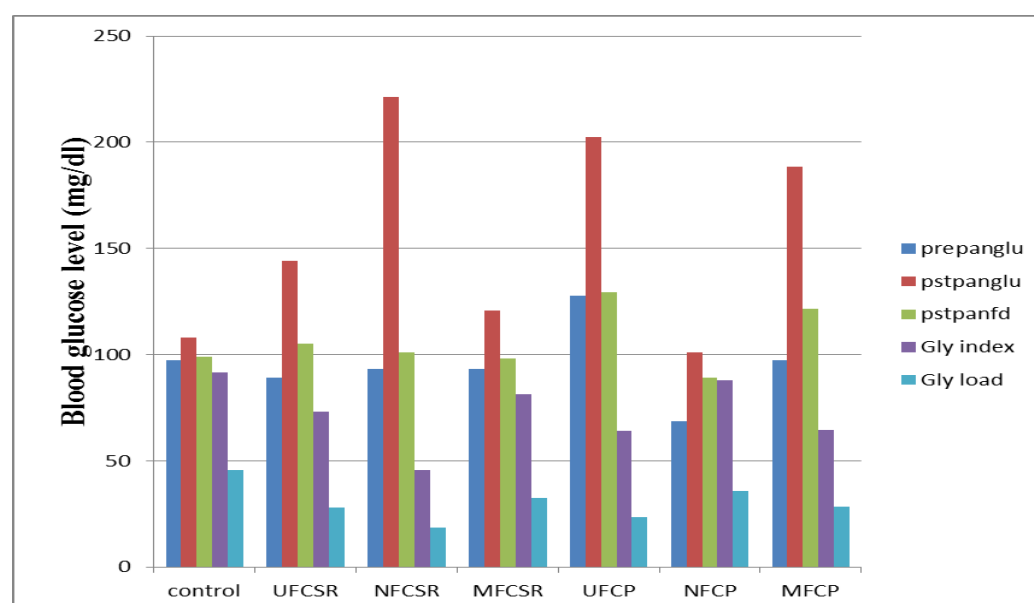


Figure 1. Glycaemic responses of cassava tuber waste (CTW) using pigs bioassay.

Prepranglu = preprandial blood glucose level, pstpanglu = postprandial blood glucose level to 100g of pure glucose, pstpanfd = postprandial blood glucose level to feed quantity that yields 100g equivalent of soluble carbohydrate, Gly index = Glycaemic index and Gly load = Glycaemic load. UFCSR = Unfermented cassava starch residues, NFCSR = Naturally fermented starch residues, MFCSR = Microbially fermented cassava starch residues, UFCP = Unfermented cassava peel, NFCP = Naturally fermented cassava peels and MFCP = microbially fermented cassava peels.

Characterization of Conjugated Linoleic Acid-Producing Bacteria Isolated from Chicken and Cattle

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Introduction

Conjugated linoleic acid (CLA) refers to fatty acids with 18-carbon and 2 conjugated double bonds in different positional and geometric configurations (C18:2). Dietary CLA intake by humans is too low to exhibit health benefits, such as anti-cancer, anti-inflammatory, anti-atherosclerosis, anti-obesity and modulation of immune system (Oh *et al.*, 2003). CLA could be obtained through the bioproduction by bacteria and the increase of consumption of CLA enriched products by humans. There is a need to conduct research on maximizing CLA production by probiotic bacteria. Animal performance has been improved with the use of probiotics. Two major CLA isomers are naturally found in ruminant products, and account for about 76-92% of total CLA in milk and dairy products of ruminant origin. CLA can be formed during incomplete biohydrogenation of dietary unsaturated fatty acids in the rumen by rumen bacteria (Chin *et al.*, 1992). Since CLA have been found in chickens, it is hypothesized that bacteria in the gastrointestinal tract of chickens are able to produce CLA. Therefore, the objectives of this study were to investigate the ability of bacteria isolated from ruminants, chicken, human milk and infant faeces to produce CLA, and to evaluate the probiotic characteristics of the bacteria isolated and the factors that affect the CLA production.

Materials and Methods

Isolation of lactic acid bacteria and anaerobic bacteria from ruminants, chickens, human milk, and infant faeces were carried out. Screening of CLA-producing bacteria was based on the method described by Barrett *et al.*, (2007). CLA production of the four highest CLA-producing bacteria was analyzed qualitatively by gas chromatograph (GC) and identified using 16S rRNA gene sequences. Probiotic characteristics of the four CLA-producing bacteria were evaluated using a series of tests, including the acid and bile tolerance tests, antibiotic susceptibility test, haemolytic test, antibacterial activity, production of bacteriocin, and lactic acid and acetic acid tests.

Ultra-violet spectrophotometry and the GC method were used to study the effect of the presence of oxygen, pH, temperature, substrate concentration and cell density to CLA production by washed cells of bacteria. For the GC method, lipids were extracted as described by Rodríguez-Alcalá *et al.*, (2011) and methyl esters of fatty acids (FAME) were prepared according to modified method of Zakaria *et al.*, (2007). FAME was quantified using a GC equipped with a flame-ionisation detector.

Results and Discussions

The four highest CLA-producing bacteria were isolated from chicken and cattle. They were identified as *Lactobacillus salivarius* strain P2, *Lactobacillus agilis* strain P3, *Enterococcus faecium* strain P1 and *Streptococcus equinus* strain C3, based on 16S rRNA gene sequences, and were found to produce CLA concentrations of 21.97, 31.08, 23.35 and 10.23 µg/ml, respectively. All bacteria tested were able to tolerate 0.3% bile salts and pH 2.5 acidic conditions. As compared to positive control (*Lactobacillus reuteri* ATCC 55739), *L. agilis* strain P3 and *L. salivarius* strain P2 showed better acid tolerance, resistance to only two types of antibiotics, higher antimicrobial activity, and ability to produce higher amounts of lactic acid. All bacterial strains showed no bacteriocin production. *Streptococcus equinus* strain C3 was resistant to four types of antibiotics and *E. faecium* strain P1 was haemolytic-positive. These characteristics have made these two strains (C3 & P1) not suitable as probiotic bacteria. The most efficient CLA production was obtained by 20% washed cell in citrate buffer, pH 5.5, containing 1.0 mg/ml LA which were incubated at 30°C for 48 h with shaking at 120 rpm under aerobic condition. Under optimal reaction conditions, washed cells of *L. reuteri* ATCC 55739 produced the highest concentration of CLA, 280.75 µg/ml reaction mixture, followed by *L. agilis* strain P3 with 109.78 µg/ml reaction mixture and *L. salivarius* strain P2 with 84.58 µg/ml reaction mixture. The CLA isomers formed were mainly isomer *c*9, *t*11 CLA and to some lesser extent, the isomer *t*10, *c*12 CLA. Taking into account the probiotic effect of bacteria, *L. salivarius* strain P2 and *L. agilis* strain P3 are more suitable to be used as probiotics for animals and to produce CLA extracellularly. The findings in this study warrant further studies to be carried out to investigate the ability of bacteria to produce CLA and their probiotic effects in animal models.

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Colonization and Proliferation of White Nile tilapia Testicular Cells Transplanted Into Black Nile Tilapia Triploid

Octavera, A.

The technology of fish testicular cells transplantation had been established to create a surrogate broodstock. This technology can also be utilized to generate YY-progenies that are useful to produce all-male fish. In this study, as a first step towards all-male tilapia production, white Nile tilapia testicular cells were transplanted into peritoneal cavity of triploid black tilapia larvae. A specific primer was designed to identify colonization and proliferation of transplanted cells in recipient fish using PCR method. Analysis of gonadosomatic index (GSI) was also performed to determine the transplanted cells proliferation in recipient gonad. The result of PCR analysis showed a specific DNA amplification product in the gonad of transplanted fish. The specific DNA donor was detected on the recipient gonad 90 dpt (days post transplantation) and it was not detected on 30 and 60 dpt. The GSI analysis showed that GSI recipient was increased and relatively similar with diploid non-transplanted Nile tilapia and it was higher than triploid non-transplanted Nile tilapia. These results showed that the donor cell could be colonized and proliferated in triploid black tilapia gonad. Thus, it is likely to obtain a broodstock that is able to produce donor-derived gamete in the near future.

Isolation of a Vaccenic Acid Hydrogenating Bacterium From Rumen of Dairy Cows

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Introduction

Optimization of the unsaturated fatty acid (e.g. conjugated linoleic acid, CLA) composition of ruminant milk and meat is desirable because they are beneficial for human health. The biohydrogenation process has long been known to occur in the rumen as the result of microbial metabolic activity. Vaccenic acid (trans-11 C18:1, VA) serves as a precursor for the synthesis of stearic acid in the rumen and of CLA at the tissue level. Thus, if ruminal biohydrogenation of unsaturated fatty acids, especially VA, can be controlled, it may be possible to increase CLA synthesis in milk. In the rumen, group B bacteria utilized VA as one of the main substrates with stearic acid being the end product. The only Group B bacteria identified for many years were *Fusocillus* spp. (Kemp and Lander, 1984) and *Butyrivibrio proteoclasticus* (Wallace *et al.*, 2006; Moon *et al.*, 2008). Nonetheless, recent DGGE data have shown that other bacteria may also play a role in the hydrogenation of VA (Kim *et al.*, 2002). The purpose of this study was to isolate and identify VA hydrogenating bacteria in rumen.

Materials and Methods

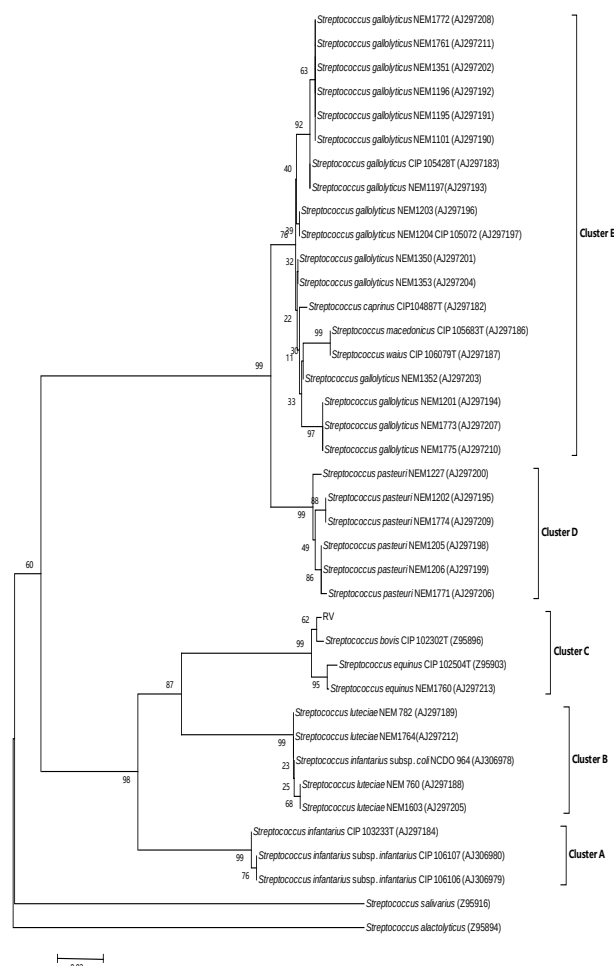
R Rumen samples were collected from Holstein dairy cows and inoculated into Hungate tubes in three triplicates with anaerobic basal medium containing VA (50 µg mL⁻¹) within an anaerobic chamber (Li *et al.*, 2012). After enrichment incubation at 39°C for 12h, 87 clones were isolated, picked by numerous transfers of spread plate cultivation (n≥5), at 39°C. The 87 clones were inoculated into the VA enrichment media, respectively. Samples were collected at 0 h and 12 h, and after centrifugation, fatty acid profiles of the supernatant were detected by gas chromatograph (Kramer *et al.*, 1997). The biochemical characterization of the isolated strain RV, the highest VA hydrogenation bacteria, was analyzed using the VITEK 2 compact system. The 16S rRNA and functional genes, *sodA* (Poyart *et al.*, 2002), *rpoB* (Drancourt *et al.*, 2004) and *recN* (Glazunova *et al.*, 2010), were sequenced and used for phylogenetic tree building using neighbor joining method.

Results and Discussion

The isolated bacterium was named RV. It was a strictly anaerobic, gram-staining-positive bacterium, globose or oval shaped, with an optimum growth at 39°C and pH 6.0-7.8. The carbon or energy sources of RV can be from D-xylose, D-maltose, D-cellobiose, D-galactose, lactose, etc. It contained some enzyme activities (e.g phosphatidylinosi phospholipase, β-

galactosidase, α -glucosidase and arylamidase) and resistant phylotype to bacitracin, novobiocin, polymixin B. The VA hydrogenating efficiency of RV was 82.1%. The 16S rRNA gene of RV had high identity to *Streptococcus equinus* and *Streptococcus bovis* (99%-100%). However, the phylogenetic tree of functional genes showed that RV weakly grouped with *S. bovis* (Fig 1), forming the sister group to *S. equinus*.

Fig 1. Phylogenetic tree of strain RV inferred from comparison of partial *sodA* gene sequences



Conclusions

One VA hydrogenating bacterium named RV, which is a strain from *S. bovis* was isolated from bovine rumen. To our knowledge, this is the first study showing that *S. bovis* has VA hydrogenating activity and this study would provide a strain for the research of biohydrogenation mechanisms in the future.

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Molecular Diversity of Rumen Protozoal Populations in the presence of Condensed Tannins

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Introduction

Methane production acts as the reservoir for the elimination of hydrogen within the rumen. The global issues on climate change and global warming have raised concern on carbon credit and the control of greenhouse gases production. Methane has been regarded as a potent greenhouse gas because of its global warming potential which is 25 times higher than that of carbon dioxide. Methanogenic archaea in the rumen utilize hydrogen for reducing carbon dioxide to methane. Methanogens that live symbiotically with protozoa may generate up to 37% of rumen methane emissions (Finlay *et al.*, 1994). Almost all the protozoa that inhabit the rumen are ciliated protozoa. Rumen ciliates are anaerobes and because they are much larger (15 to 250 µm) than the rumen bacteria, they can represent more than 50% of the total microbial biomass. Ciliates are involved in the metabolism and digestion of carbohydrate in ruminants. Ciliates also play a role in the rumen microbial ecosystem by producing hydrogen as a by-product of plant digestion. Removal of protozoa from the rumen (defaunation) has been shown to reduce methane emission by about 13% (Hegarty, 1999).

A plant secondary metabolite, condensed tannins (CTs), from *Leucaena leucocephala* hybrid-Rendang have been found to have the potential in the mitigation of methane production and to exert a change in the distribution of methanogen population (Tan *et al.*, 2011). CTs could be widely found in forage legumes. They are polymers of flavan-3-ols (catechins) and/or flavan-3, 4-diols (epigallocatechins or delphinidins), linked by carbon-carbon bonds, which are not susceptible to being cleaved by hydrolysis. Therefore, the focus of the current investigation is to analyze the molecular diversity of rumen protozoal populations in the presence of condensed tannins from *Leucaena leucocephala* hybrid-Rendang. In this study, the molecular diversity of protozoal populations due to the effect of condensed tannins was analyzed using molecular methods based on the 18S rRNA gene libraries.

Materials and Method

Extraction of CTs from *Leucaena leucocephala* hybrid-Rendang was carried out and purification of CTs was achieved using size exclusion chromatography. The control (0 mg CTs) and treatment (20 mg/500 mg dry matter of CTs) groups were used in the *in vitro* gas production system. After 24h of incubation, the rumen fluid was used for DNA extraction, cloning, and sequencing. The 18S rRNA gene sequences were then analysed using the

bioinformatics software MOTHUR and its suite of programs, including Libshuff, ACE, Chao1, Shannon-Weaver index and rarefaction analysis.

Results and Discussion

In the control 18S rRNA gene library, a total of 46 clones were examined. The sequences were related to nine genera, namely, *Ostracodinium*, *Anoplodinium*, *Dasytricha*, *Entodinium*, *Epidinium*, *Isotricha*, *Diplodinium*, *Eudiplodinium* and *Eremoplastron*. In the treatment library, the 41 clones examined were associated with protozoa from six different genera, namely *Epidinium*, *Dasytricha*, *Eremoplastron*, *Ostracodinium*, *Entodinium* and *Anoplodinium*. operational taxonomic units (OTUs) and diversity estimators were determined at 0.03 or 3% 18S rRNA gene sequence difference level by the MOTHUR program. Clones from control and treatment libraries were assigned to nine and six OTUs, respectively. Diversity estimators (ACE, Chao1 and Shannon-Weaver index) revealed that the control clone library exhibited higher diversity than the CT treatment clone library. Results from rarefaction analysis showed that a sufficient number of samples has been included in the analysis.

It was concluded that condensed tannins from *Leucaena leucocephala* hybrid-Rendang could alter the diversity of protozoa in the rumen.

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Estimates of Variances due to Direct and Maternal Effect for Body Weights in Barki Sheep

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Introduction

Genetic traits of farm animals are determined not only by animal's genetic potential for growth but also by maternal genetic and permanent and temporary environmental effects. Therefore, knowledge of genetic parameters for weight traits at various ages is needed in order to determine optimal breeding strategies to increase efficiency of sheep production. The aim of this study was to estimate direct and maternal genetic parameters among lamb weights at different ages of Egyptian Barki sheep.

Materials and Methods

A total of 1634 records for Egyptian Barki lambs progeny of 96 sires were used in this study. The data were collected over 23 years from Borg EL-Arab Research Station, Animal Production Research Institute, Agriculture Research Centre, Egypt. Traits analyzed were birth weight (BW), weaning weight (WW), 6 months weight (W6) and 12 months weight (W12), and pre-weaning daily gain (PDG). Weaning was at approximately 60 d. Ewes were first bred at an average age of 18 m. Mating was applied three times every two years. Dams were culled for infertility over consecutive two mating seasons. Rams were used for 2 breeding seasons and kept separated from ewes except during the mating season.

Statistical analyses. Variance and covariance components and genetic parameters were estimated using Restricted Maximum likelihood method (Meyer, 1998) by fitting 4 single-trait animal models. To identify the fixed effects to be included in the models, the General Linear Model Procedure (SAS, 2003) was used. The analysis of variance showed that fixed effects of season of birth, year and sex were significant for all traits. Consequently, these effects were included in four models for the body weight traits. But the effect of birth type was high for all traits except W12 and was excluded in models for W12. Random effects were direct and maternal additive genetic, maternal permanent environmental, and error. A log likelihood ratio test was used to choose the most suitable random effects model for each trait. When log likelihoods did not differ significantly ($p > 0.05$), the model that had the fewer number of parameters was selected as the most appropriate. All models included an additive direct effect, and this was the only random factor in model 1. Genetic correlations were estimated for a model with the same fixed effects and only additive genetic effects.

Results and Discussion

Log likelihood ratio test indicated the most appropriate model for BW, WW and W6 should include direct additive genetic effects as well as maternal additive genetic effects while the

most appropriate model for W12 and PDG had only the direct additive genetic effects. Direct heritability and maternal genetic estimates were 0.37 and 0.09 (BW); 0.34 and 0.09 (WW); 0.53 and 0.17(W6); 0.30 and 0.09 (W12); and 0.32 and 0.03 (PDG), respectively. Estimates of genetic correlation were 0.28 (BW with WW); 0.19 (BW with W6); 0.17 (BW with W12); 0.33 (BW with PDG); 0.68 (WW with W6); 0.49 (WW with W12); 0.94 (WW with PDG); 0.71 (W6 with W12); 0.61 (W6 with PDG) and 0.43 (W12 with PDG). The estimates of direct-maternal genetic correlations were negative and high for all traits studied (ranged from -0.70 to -0.95).

In general, no negative correlation was not found between lamb body weights considered. The highest direct heritability estimate was obtained for W6. Consequently, an effective breeding plan for improving the body weight of Barki sheep could be designed with respect to this trait. Selection for W6 is required to take into account the maternal genetic effects.

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Effect of Fig Fruit Extract and Storage Time on Native Chicken Semen Quality

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Introduction

Artificial Insemination is one of reproductive technology that is very efficient and effective in supporting genetic improvement programs of livestock. To support the efficiency of the AI program, sufficient quantity of good quality semen is needed to be available when required (Lukaszewicz, 1988).

Physiological NaCl is the basic medium of simple poultry semen diluter. Whereas, fig fruit extract is a material containing polyphenolics, i.e., flavanoids (Sirisha *et al.*, 2010) and α -, β - and γ -tocopherol (effective antioxidants to prevent oxidative stress) (Guvenc *et al.*, 2009). This study is to determine the effect of fig fruit extract in physiological saline and storage time on the quality of chicken semen stored at room temperature.

Materials and Methods

Preparation of fig fruit extract

Fig fruit extract was prepared by blending 5 g ripe canned fig fruit and 50 ml aquadest and the mixture was then filtered using filter paper and deposited to form the supernatant and precipitate. Supernatant (fig fruit extract) was stored in a freezer at -20°C until use.

Semen collection and fresh semen evaluation

Semen was collected from 4 cocks of native chicken (*Gallus gallus*). Semen was collected 2 times a week by dorso-abdominal massage. Ejaculates obtained from males were pooled and evaluated as one sample. Semen was collected 10 times from every male. After collection, the semen was evaluated for volume pH, concentration, sperm mass motility, individual motility, viability and morphology.

Semen dilution, storage and evaluation.

The selected semen was diluted with physiological NaCl-base diluent containing 0, 10, 20 and 30% of fig fruit extract. Semen was diluted in ratio of 1 semen: 5 diluent. Diluted semen was stored at room temperature (26-30°C). To determine the effect of level of fig fruit extract on the motility and viability of sperm, semen was evaluated after 0, 1, 2, 3, 4, 5 and 6 h of storage. Data were analyzed with ANOVA and Duncan's multiple range test (SPSS version 13.0).

Results and Discussion

Characteristics of fresh semen

Table 1 show that the characteristics of native chicken semen used in this study and they were normal.

Table 1. Characteristics of fresh semen used in the experiment (n = 10)

Parameter	Mean $\pm$ SD
pH	7.20 $\pm$ 1.03
Volume (ml/hd)	0.15 $\pm$ 0.052
Concentration (10^7 /ml)	319 $\pm$ 27.301
Individual motility (%)	75.50 $\pm$ 3.17
Viability (%)	85.71 $\pm$ 2.13
Abnormal sperm (%)	7.61 $\pm$ 2.92

Semen quality after storage

Table 2. Sperm individual motility and viability of native chickens following treatment with fig fruit extract after room temperature storage (n = 10; Mean $\pm$ SD)

Parameter	Storage time (h)	Level of fig fruit extract			
		0%	10%	20%	30%
Individual Motility (%)	1	65.00 $\pm$ 0.00 ^a	70.00 $\pm$ 0.00 ^b	63.33 $\pm$ 2.58 ^a	65.83 $\pm$ 2.04 ^a
	2	59.17 $\pm$ 2.04 ^b	63.33 $\pm$ 2.58 ^c	57.50 $\pm$ 2.74 ^{ab}	53.33 $\pm$ 6.83 ^a
	3	52.50 $\pm$ 4.18 ^b	55.83 $\pm$ 3.76 ^b	44.17 $\pm$ 2.04 ^{ab}	39.17 $\pm$ 4.92 ^a
	4	35.83 $\pm$ 6.65 ^b	44.17 $\pm$ 9.17 ^c	34.17 $\pm$ 2.04 ^{ab}	28.33 $\pm$ 5.16 ^a
	5	25.00 $\pm$ 8.37 ^b	33.33 $\pm$ 11.25 ^c	24.17 $\pm$ 4.92 ^{ab}	17.50 $\pm$ 11.12 ^a
	6	14.17 $\pm$ 11.14 ^{ab}	21.67 $\pm$ 13.66 ^c	16.67 $\pm$ 8.16 ^b	10.00 $\pm$ 5.47 ^a
Viability (%)	1	77.67 $\pm$ 2.81 ^a	81.67 $\pm$ 6.56 ^b	78.50 $\pm$ 5.05 ^a	77.67 $\pm$ 4.37 ^a
	2	70.67 $\pm$ 4.97 ^b	74.83 $\pm$ 4.12 ^b	67.67 $\pm$ 4.13 ^a	63.83 $\pm$ 5.19 ^a
	3	65.33 $\pm$ 3.14 ^b	68.17 $\pm$ 2.86 ^b	59.50 $\pm$ 1.87 ^a	54.83 $\pm$ 4.12 ^a
	4	50.50 $\pm$ 8.60 ^b	57.17 $\pm$ 9.95 ^c	50.33 $\pm$ 6.50 ^b	42.83 $\pm$ 9.66 ^a
	5	38.67 $\pm$ 6.12 ^b	50.33 $\pm$ 10.17 ^c	38.00 $\pm$ 3.69 ^b	30.00 $\pm$ 6.90 ^a
	6	25.33 $\pm$ 12.71 ^a	7.00 $\pm$ 19.91 ^b	25.33 $\pm$ 7.55 ^a	23.17 $\pm$ 8.38 ^a

^{a,b,c} Means in rows with different superscripts differ (P < 0.01)

Table 2 shows that the level of fig fruit extract significantly (P < 0.01) improved sperm individual motility and viability after storage at room temperature. In general, it was shown that 10% of fig fruit extract in NaCl-based diluent showed an optimal level for maintaining both the sperm motility and viability compared with the levels at 0, 20 and 30% fig fruit extract after 1, 2, 3, 4, 5 and 6 h time storage.

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Microencapsulation of Fish Oil Extracted From Local Trevally fish (*Selaroides spp*), Catchfish (*Clarias sp*) and Waste Canning Tuna Oil by Freeze and Spray Drying Technique on Omega 3, 6, 9 Content

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Abstract

Microencapsulation of fish oil extracted from *Selaroides spp*, *Clarias sp* and waste canning tuna oil were obtained by freeze drying and spray drying and the influence of various technique on level of omega-3,6,9 was evaluated. Experimental results showed that microencapsulated fish oil *Selaroides spp* and *Clarias sp* obtained by freeze drying was considered important for yield while mixing fish oil (*Selaroides spp*:*Clarias sp*) and waste canning tuna oil using spray drying method were found significantly affected omega-3 and omega-6.

Keywords: microencapsulation, fish oil, omega 3, 6, 9

Introduction

The availability of the omega 3,6,9 in the diet of humans is believed have a healthy beneficial. Since mammals, are unable to synthesize omega 3,6,9, it must be acquired from dietary sources. In general, fish oils could accumulate fatty acids including saturated and unsaturated fatty acids are present in *Selaroides spp*, *Clarias sp* and waste canning tuna oil of which omega 3,6,9 are predominant. Preliminary study showed that Travelly (*Selaroides spp*) fish oils contained omega-3, omega -6, approximately of 24.45 and 10.53%, respectively, while the Catfish (*Clarias sp*) fish oils contained 34.96% of omega 9 (Gobel, 2012). However, it is essential to protect fish oil against oxidation due to high susceptibility to oxidation. One of the methodology proposed for protection of fish oil is microencapsulation (Zuidam and Shimoni, 2010). Microencapsulation by freeze and spray drying techniques were most widely used in the food industry. The aim of this study was to compare of various microencapsulation techniques extracted from *Selaroides spp*, *Clarias sp* and waste canning tuna oil using freeze and spray drying on the of omega 3,6,9 contents.

Materials and Methods

Sample preparation

Two kind of non-economical fish such as Selar (*Selaroides spp*), Lele (*Clarias sp*) were obtained from sea water of Makasar or Tomini Gulf (Parimo Regency), Central Sulawesi Province and waste canning tuna oil from Bitung, North Sulawesi. These fish oil were extracted by wet rendering method (AOAC, 2005) and solvent method (AOAC, 2005). The extracted fish oil were analyzed its omega 3, 6, 9 using Gas Chromatography (GC) (SHIMADZU-FID). Maltodextrin, arabic gum, sodium caseinat was used as an additional

coating agent. Two types of samples were microencapsulated using spray drying and freeze drying methods.

Statistical analysis

This research was design using Completely Randomized Design, and continued with Tukey's HSD (Honestly Significant Difference) test (Steel and Torrie, 1993)

Results and Discussion

The results showed that mixed fish oil microencapsulated using freeze drying method contained the highest omega-3 content ($2.62 \pm 0.01\%$), omega-6 content ($0.03 \pm 0.01\%$), while it omega-9 found in spray drying method ($38.70 \pm 0.38\%$). It is interesting to note that freeze dried mixed oil had $25.97 \pm 0.72\%$ omega-9. In microencapsulated and emulsions, the matrix used to stabilize the oil influences the susceptibility of the oil to lipolysis. Moreover, the important parameter which distinguished the medium freezing process from the others was the mechanical stress applied to the emulsion during freezing in the extruder and could have led to damage of the casein structure (Heinzelmann et al., 2000).

Conclusion

Fish oil extracted from *Selaroides spp*, *Clarias sp* and waste canning tuna oil are capable of producing omega 3,6,9. Microencapsulated fish oil *Selaroides spp* and *Clarias sp* by freeze drying was considered the best method to obtain omega-9. While mixing fish oil (*Selaroides spp*:*Clarias sp*) and waste canning tuna oil using spray drying method were found significantly affected omega-3 and omega-6 content.

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The Capacitation Status of Ettawah Crossbred Sperms by α -tocopherol Supplementation in Extender during Cooling

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Introduction

Ram semen quality declined rapidly, due to the high rate of sperm capacitation (Ba'a, 2009). The occurrence of premature capacitation proficiency level, if passed will take place and when the acrosome reaction occurs outside the female's body, will fail in fertilization if inseminated. Continued in early capacitation acrosome reaction can occur because of damage to sperm membrane during the freezing process (dilution, chilling and freezing) (Cormier *et al.*, 1996). Damage can occur during this process by many factors, such as free radicals that attack lipid peroxide formed sperm membrane. This is related to the function of oxygen as an element in the process of oxidative metabolism producing metabolic waste products of oxidation behavior, such as hydrogen peroxide. Peroxide plays a key role in the aging process and shortens the vitality of spermatozoa, induces structural changes especially in the acrosome and motility decreases rapidly. Membrane damage caused by oxidation reaction during the freezing process can be minimized by the addition of anti-oxidants in the medium. One of the anti-oxidants is α -tocopherol or Vitamin E which has the ability to decide a variety of free radical chain reactions as a result of its ability to move the phenolic hydrogen on the free radical of the polyunsaturated fatty acids which have undergone peroxidation (Mayes, 1995). Hopefully the addition of α -tocopherol or vitamin E in the diluent Andromed[®] can minimize the effects of free radicals on sperm membrane so that the rate of premature ram sperms capacitation acrosome reaction is blocked.

Materials and Methods

Semen collecting.

Semen was collected from Ettawah crossbred rams kept at Sumbersekar Field Laboratory, Faculty of Animal Husbandry, Brawijaya University, Malang, Indonesia. The rams had an average age of 2.5 years and a minimum requirement of 70% individual motility. Semen was collected using an artificial vagina.

Semen processing.

Fresh semen was macroscopic and microscopic tested, and then divided into four parts. Semen was diluted with a suitable diluent treatment (P0: 0 g/100 ml; P1: 0.2 m/100 ml; P2: 0.4 g/100 ml and P3: 0.6 g/100 ml, stored in a refrigerator at constant temperature of 5°C for two hours (Anonymous, 2003).

Chlortetracycline staining.

The method of CTC staining (C-7889, Sigma) was used with 45 µl fresh or diluted semen and 45 µl CTC staining solution was added and mixed well by a vortex machine for 1m. And then, 8 µl CTC fixative solutions was added and mixed well by a vortex machine for 1m. Following that, 10 µl solutions were placed on a slide and 10 µl DABCO (D-2522, Sigma) solution was added and mixed well by a micropipette. After that, it was covered with a cover slip and pressed gently using palm paper. Each side of cover slip was closed by nail polish (Fraser and McDermott, 1992). The slide was observed using Epi-Fluorescence Microscope (Nikon Microscope OPTIPHOT-2 using Filter UV-2A consisting of Excitation Filter EX330-338, Diachronic Mirror DM440 and Barrier Filter BA435) (Sumitro and Susilawati, 1998). Capacitated sperm % was determined based on 100 sperms on a slide space. The data obtained in the study were statistically analyzed using a randomized block design (Gaspersz, 1991).

Results and Discussion

The percentage of capacitated sperms was $83.61 \pm 5.582\%$ and the acrosome reaction was $8.15 \pm 2.471\%$. The high value obtained was because the goat spermatozoa underwent capacitation early during the course of the male reproductive tract and the slight alleged level of fructose contained in seminal plasma (Rachmawati, 2002) which was about 250 µg/ml than in bulls which have been reported to range from 460 to 600 µg/ml (Garner and Hafez, 2000). These results are comparable with Rachmawati (2002) which showed capacitated fresh goat sperms underwent the acrosome reaction of $90.96 \pm 12.31\%$.

Based on the observations before freezing, the addition of α -tocopherol in a diluent could maintain the percentage of capacitation ($P < 0.05$) and reduced the percentage of acrosomal reaction ($P < 0.05$) in P2; dose of 0.4 g of α -tocopherol in 100 ml of diluent Andromed®. The addition of α -tocopherol dosage 0.6 g (P3) showed no significant difference compared with no addition of α -tocopherol (P0), or lower than the addition of α -tocopherol at dose 0.4 g (P2). This showed that excessive dosage of α -tocopherol could cause toxic effects. The belief that at a certain level, antioxidants can turn into pro-oxidants (which can produce ROS) (Donnelly *et al.*, 1999 and Parnes, 2009), was evident in this case as excessive doses of α -tocopherol was thought to cause changes in the nature of α -tocopherol of antioxidants becoming pro-oxidant.

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Genetic Polymorphism of Growth Hormone Genes in Indonesian Local Buffalo

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Introduction

Growth hormone (GH) is an anabolic hormone synthesized and secreted by lobe somatotroph cells in the anterior pituitary (Ayuk and Sheppard, 2006). The GH gene has important roles in prenatal growth, postnatal development, growth of tissue, lactation and reproduction. It also has key roles in metabolisms of protein, lipid and carbohydrate (Thidar Myint *et al.*, 2008). GH activation in the cells depends on its receptor, known as growth hormone receptor (GHR). GHR, as a transmembrane protein, binds GH with high affinity and specificity. Changes in GHR function, therefore, can be affected by the ability of GH binding and activity in targetted tissues (Di Stasio *et al.*, 2005). Another imporant gene affecting animal growth is the *pituitary transcription factor* (Pit-1). The Pit-1 gene is known as specific transcription factor, playing a key role in pituitary development and hormone expression in mammals.

Information on the genetic diversity of the growth hormone family genes in local swamp buffalo in Indonesia is still very limited. This study aimed to evaluate the genetic polymorphism of Pit-1, GHRH, GH and GHR genes in the Indonesian local swamp buffalo.

Materials and Methods

A total of 631 head of local swamp buffalo were used as samples in this study. These buffaloes originated from seven provinces or regions, i.e. from Aceh (83), North Sumatera (65), Riau (19), Banten (209), Central Java (75), West Nusa Tenggara (103), and South Sulawesi (107). DNA samples were extracted from blood and meat specimens using the phenol chloroform method (Sambrook and Russell, 1991) modified by Andreas *et al.*, (2010).

Amplification and genotyping of GHRH, Pit-1, GH and GHR genes were according to references, i.e. Moody *et al.*, (1995) for GHRH, Wollard *et al.*, (1994) for Pit1, Mitra *et al.*, (1995) and Balogh *et al.*, (2008) for GH, and Andreas *et al.*, (2010) for GH gene. The data were analyzed for genotype frequency, allele frequency, heterozygosity, and polymorphic information content (PIC).

Results and Discussion

As shown in Table 1, no polymorphism was detected for GH|*AluI*, GHR|*AluI*, and Pit-1|*hinfI* loci. All buffaloes observed had only one type of allele, i.e. the LL genotype at the GH|*AluI* locus, the AA genotype at the GHR|*AluI* locus, and the BB genotype at the Pit-1|*hinfI* locus. Polymorphism was found only in the GH|*MspI* and GHRH|*HaeIII* loci with allele frequencies

of 0.94 and 0.06 for GH|MspI (+) and GH|MspI(-), respectively, and 0.16 and 0.84 for GHRH|HaeIII (A) and GHRH|HaeIII (B), respectively.

Table 2 shows that most of the local buffalo populations which were polymorphic for the GHRH|HaeIII and GH|MspI loci had values of $H_o < H_e$. The exception was for the GH|MspI locus in North Sumatera buffalo, which had $H_o > H_e$. This indicates that the two loci had low levels of heterozygosity. The PIC values for the two loci for the buffalo from West Nusa Tenggara and Central Java were higher than those of the other provinces. The genetic diversity of Indonesian local swamp buffalo, therefore, is generally very low. This might be caused by the limited attention given to buffalo breeding programs.

Table 1. Frequency of alleles at Pit-1.GHRH.GH and GHR loci

Original province (n)	GHRH HaeIII		GH MspI		GH AluI		GHR AluI		Pit1 HinfI	
	A	B	(+)	(-)	L	V	A	B	A	B
Aceh (83)	0.00	1.00	1.00	0.00	0.00	1.00	0.00	1.00	0.00	1.00
North Sumatera (65)	0.15	0.85	0.89	0.11	0.00	1.00	0.00	1.00	0.00	1.00
Riau (19)	0.00	1.00	1.00	0.00	0.00	1.00	0.00	1.00	0.00	1.00
Banten (209)	0.13	0.87	0.99	0.01	0.00	1.00	0.00	1.00	0.00	1.00
Central Java (75)	0.31	0.69	0.85	0.15	0.00	1.00	0.00	1.00	0.00	1.00
West Nusa Tenggara (103)	0.32	0.68	0.88	0.12	0.00	1.00	0.00	1.00	0.00	1.00
South Sulawesi (107)	0.00	1.00	1.00	0.00	0.00	1.00	0.00	1.00	0.00	1.00
Overall	0.16	0.84	0.94	0.06	0.00	1.00	0.00	1.00	0.00	1.00

Table 2. Expected (H_e) and observed (H_o) heterozygosities, and polymorphic information content (PIC) for the GHRH|HaeIII GH|MspI loci

Original province (n)	GHRH HaeIII				GH MspI			
	H_o	H_e	PIC	F Statistics	H_o	H_e	PIC	F Statistics
Aceh (83)	0.00	0.00	0.00		0.00	0.00	0.00	
North Sumatera (65)	0.02	0.26	0.24		0.22	0.19	0.18	
Riau (19)	0.00	0.00	0.00	Fis = 0.001	0.00	0.00	0.00	Fis = 0.000
Banten (209)	0.17	0.23	0.22	Fit = -2.345	0.01	0.02	0.02	Fit = -.612
Central Java (75)	0.24	0.43	0.38	Fst = -2.369	0.05	0.25	0.23	Fst = -.622
West Nusa Tenggara (103)	0.31	0.44	0.39		0.17	0.21	0.20	
South Sulawesi (107)	0.00	0.00	0.00		0.00	0.00	0.00	

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Astraxanthin Extraction from Golden Apple Snail Eggs to Enhance Colors in Fancy Carps

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Introduction

Color is one of the most important quality criteria dictating the market value of koi. Because fish cannot synthesize carotenoids they rely on a dietary supply of these pigments to achieve their natural skin pigmentation (Gouveia et al., 2003; Paripatananont et al., 1999). Fish use carotenoids for pigmentation of their skin and flesh. Natural sources of carotenoids are usually composed of several carotenoids in various forms, and making their pigmentation efficiency complicated to interpret. In these studies we focused on astraxanthin extraction from Golden Apple Snail Eggs as it has become a serious calamity in agriculture around the world. It has been found that the egg and gonads of the apple snail contain a large amount of astraxanthin (Yi-Lung and Chin-Chang, 2008). Extraction from Golden Apple Snail Eggs would be beneficial to aquaculturists and private sectors who are interested to improve the quality of color of fancy carp or other ornamental fishes.

Materials and Methods

Astraxanthin extraction

Method for obtaining natural astraxanthin from fresh apple snail eggs was performed as described by Wu and Yang (2010).

Experimental diets

A herbivorous pellet diet containing 15.5 % of protein without added astraxanthin was used as a control diet (Tr1). For the experimental diets (Tr2) was 50 mg coated by spraying commercial astraxanthin and experimental diets (Tr3) to (Tr6) were coated by spraying astraxanthin extracted from golden apple snail eggs at 25 mg, 50 mg, 100 mg and 200 mg respectively.

Fish and rearing condition

The homogeneous red color fancy carp were fed with the control diet for 2 weeks with the length 3 inches, average 3 month of ages mixed male and female were randomly divided into 6 treatments of 60 fish each (6 treatments in triplicate) throughout the 25 days experimental period. The fish were fed the appropriate experimental pellet corresponding to 3–5% of their body weight. Weight was recorded and color (L* a* b*) was measured using colorimeter (miniscan EZ; Hunterlab) before and after the experiment. All data were subjected to a one-way analysis of variance (ANOVA) using the Statistical software to test the effects of the experimental diets.

Results and Discussion

Monoester-astaxanthin and diester-astaxanthin were extracted from golden apple snail eggs with 16.8g of wet golden apple snail eggs 1250g. The weight after 25 days rearing of all treatment were significantly different ($P < 0.05$). The result shown that a level of astaxanthin since 50 mg kg⁻¹ have an effect to the weight of carp according to the research of (Nakano et al., 1999) reported that astaxanthin supplement in fish feed had effected in the reduction of oxidative stress in salmon entailed and the growth rate of rearing salmon. The result of color enhancement after treatment by different level of astaxanthin concentration extracted from apple snail eggs presented that there were significant different ($P < 0.05$) among the treatment of experiments and these is inconsistent to the color variation in the pattern of L* and b* because astaxanthin was clearly visible only in all shades of red and not effected by the color L* and b* (Yavuz et al., 2010). In terms of red color enhancing (color a*), the effectiveness of astaxanthin to accelerate red color in carp after being fed 25 days showed that the results of red color was significantly different ($P < 0.05$) in all group, correlated to the amount of astaxanthin extract from apple snail eggs added. According to the data, 50 mg kg⁻¹ was the effective to accelerate red color in carp.

Conclusion

Monoester-astaxanthin and diester-astaxanthin can be extracted from apple snail eggs and used to enhance the red color in carp with equal capability as compared to a commercial astaxanthin at the same concentration. Nevertheless, it is not effective to accelerate other pigment in carp. The concentration at 50 mg kg⁻¹ was effective to be used according to the results of the experiment.

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The Influence of Complete Feed Based on Fermented Local Ingredients on the Exterior and Interior Quality of Pegagan Duck Eggs

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Abstract

The aim of this research was to find out the influence of complete feed based on fermented local ingredients to the exterior and interior qualities of pegagan duck eggs. Complete feed based on fermented local ingredients (RKBLF) with commercial feed was mixed every week in accordance with the levels of treatment. Feeds were arranged with protein content (18%) and metabolic energy (2900 kcal/kg) in accordance with the recommendations of the NRC (1994). Sixty Pegagan duck aged 4 months were used in the study. The experiment applied complete random design with 5 treatments and 4 replicates. Each replicate had 3 ducks and were kept for 3 months. The treatments consisted of: R0 (100% commercial feed), R25 (25% RKBLF + 75% commercial feed), R50 (50% RKBLF + 50% commercial feed), R75 (75% RKBLF + 25% commercial feed), R100 (100% RKBL). Providing complete feed based on fermented local raw materials resulted in significant ($P < 0.05$) increase in the value of egg index, yolk egg score, thickness of egg shell, and wholeness and cleanliness of the eggs. It is concluded that feeding complete feed based on fermented local ingredients can improve the egg index and yolk egg score, but caused reduction of the thickness of egg shell.

The Effect of Supplementation of Fulvic Acid on Body Weight, Internal Organs and Gastrointestinal Tract of Broiler Chicken

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Introduction

Fulvic acid is an organic acid that is formed naturally during the decomposition of organic matter called humus or humic compounds. Molecule structure of fulvic acid is very light and small and easily absorbed into the tissues and cells (Islam *et al.*, 2005). Fulvic acid has carboxyl levels three times higher than humic acid.

Fulvic acid influences enzymes secretion, hormones structure, and vitamin requirement. Fulvic acid can also absorb heavy metals and toxic pollutants. The use of humic acid as feed supplement was observed in broilers. KOMPIANG and SUPRIYATI (2007) reported that humic acid can improve broiler performance. The use of fulvic acid as supplement improved performance and immune system of broiler chickens that therefore produces good quality chicken and meat that is safe for consumption.

The purpose of this study was to evaluate the effect of fulvic acid in the ration on the weight of carcasses, internal organs, as well as total cholesterol of broiler meat.

Materials and Methods

This experiment was conducted using 375 CP-707 day-old chickens. The birds were randomly divided into 5 treatments with 5 replications. The birds were provided with feed and water *ad libitum*. The diets were formulated from corn, soybean meal, coconut meal, corn gluten meal, meat bone meal, wheat pollard, CPO, CaCO₃, dicalcium phosphate, salt, premix, DL-Methionine and L-lysine. The energy metabolism (EM) of starter and finisher were 3,050 and 3,200 kcal/kg, while the cruder protein contents were 21.6 and 20.0%, respectively. The levels of fulvic acid in the diet were 0, 0.25, 0.50, 0.75 and 1.0%.

The variables measured were live weight, carcass percentage, weight and percentage of internal organs (liver, heart, spleen, proventriculus, ventriculus, duodenum, jejunum, ileum, cecum, and bursa fabricius). The abdominal fat and total cholesterol were also measured. The experiments used a completely randomized design and the data were analyzed by ANOVA and Duncan's range test.

Results and Discussion

The effect of fulvic acid supplementation on live weight, carcass and digestive organ is presented in Table 1.

Live weight and carcass percentage: Final body weight of the chicken aged 5 weeks ranged from 1515 – 1590g. The supplementation of fulvic acid up to 1.0% tended to increase broiler final live weight. Supplementation of 0.5% fulvic acid in the ration decreased percentage of the carcass. Fulvic acid affected the percentage of feather weight of the broiler.

Internal organs: Supplementation of fulvic acid on the ration did not affect the weight of liver, hearth and spleen. Fulvic acid did not show negative effect on the internal organs. Meanwhile, the percentage of bursal fabricius weight was influenced by fulvic acid level in the diet. Chickens that received 1.0% supplementation of fulvic acid in the ration showed significant increase of weight of the bursa fabricius compared with the control.

Gastrointestinal tract: The weight of the gastrointestinal tract of broilers aged 5 weeks is presented in Table 2. The data showed that the supplementation of fulvic acid did not have significant effect on the gastrointestinal tract.

Table 1. Effects of fulvic acid on live weight, carcass and digestive organs of broiler

Variable		Level of Fulvic Acid (%)				
		0	0.25	0.50	0.75	1.0
Live weight	(g)	1515 ± 33	1539 ± 81	1558 ± 58	1590 ± 77	1528 ± 78
Carcass	(g)	1058 ± 46.6 ^{ab}	1034 ± 56.80 ^{ab}	1007 ± 55.78 ^b	1084 ± 56.5 ^a	1041 ± 48.6 ^{ab}
	(%)	68.4 ± 1.46 ^a	67.4 ± 1.38 ^{ab}	66.2 ± 1.99 ^b	67.6 ± 1.80 ^{ab}	68.8 ± 1.34 ^a
Liver	(g)	36 ± 2.7	35 ± 3.9	34 ± 3.8	37 ± 3.4	32 ± 2.7
	(%)	2.3 ± 0.14	2.3 ± 0.20	2.2 ± 0.19	2.22 ± 0.22	2.1 ± 0.17
Hearth	(g)	7.2 ± 0.57	7.0 ± 0.58	7.5 ± 0.60	7.8 ± 0.38	7.0 ± 0.36
	(%)	0.50 ± 0.04	0.45 ± 0.05	0.5 ± 0.04	0.48 ± 0.02	0.46 ± 0.03
Spleen	(g)	1.9 ± 0.94	2.8 ± 2.27	2.5 ± 1.57	1.86 ± 0.63	1.6 ± 0.71
	(%)	0.12 ± 0.06	0.11 ± 0.03	0.13 ± 0.04	0.12 ± 0.04	0.10 ± 0.05
Bursal	(g)	0.75 ± 0.25	0.80 ± 0.17	0.82 ± 0.18	0.68 ± 0.17	0.92 ± 0.15
Fabricius	(%)	0.05 ± 0.02 ^b	0.05 ± 0.01 ^{ab}	0.05 ± 0.01 ^{ab}	0.04 ± 0.01 ^b	0.06 ± 0.01 ^a

Table 2. Effects of fulvic acid on gastrointestinal tract of broiler

Variable		Levels of Fulvic Acid (%)				
		0	0.25	0.50	0.75	1.0
Proventriculus		6.65 ± 1.18	6.87 ± 0.56	7.32 ± 0.94	7.91 ± 0.74	6.96 ± 0.76
Ventriculus		23.65 ± 4.44	25.32 ± 4.34	28.14 ± 2.45	23.56 ± 3.91	27.94 ± 2.26
Duodenum		10.44 ± 1.25	11.29 ± 1.33	9.11 ± 1.26	10.42 ± 1.21	8.46 ± 0.99
Jejunum		20.42 ± 3.43	20.47 ± 2.09	19.98 ± 2.44	17.67 ± 2.40	17.10 ± 2.04
Ileum		16.28 ± 1.71	16.23 ± 2.01	15.12 ± 1.20	15.05 ± 2.50	14.73 ± 1.70
Cecum		5.20 ± 0.61	5.40 ± 0.88	6.04 ± 0.95	5.14 ± 0.93	5.79 ± 0.89
Colon		2.75 ± 0.48	2.40 ± 0.38	2.45 ± 0.22	2.26 ± 0.45	2.16 ± 0.34

Conclusion

The supplementation of 0.50% fulvic acid in broiler ration improved the efficiency of absorption of nutrients in the digestive tract of broiler chickens. The supplementation of 1.0% fulvic acid in broiler ration had no negative effect on the internal organs, but increased the levels of cholesterol in the meat.

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Effects of Phytogenic Feed Additive with Reduced Dietary Metabolizable Energy and Digestible Essential Amino Acids on Production Performances of Pekin Ducks

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Abstract

An experiment was conducted to study the effect of phytogenic feed additive with reduced dietary metabolizable energy and digestible essential amino acids on production performances of Pekin ducks. Ducks were of mixed sex and fed broken-rice-soy-based diets formulated to contain 0 (control), 100, 200 and 300 ppm of supplemental phytogenic feed additive (PFA; blend of essential oils from capsaicin, cinnamaldehyde, thymal and carvacol; Biomin[®] P.E.P) and 3 levels of reduced dietary metabolizable energy (ME) and digestible essential amino acids (DEAA) at 0 (control), 1.5 and 3.0% levels from the recommendation of NRC (1994) and INRA (2004). Starter diets were fed for the first four weeks of age and 5 to 8 weeks of age and 9 to 12 weeks of age were fed for grower and finisher diets. The experimental design was 4x3 factorial arrangements in CRD (completely randomized design) with 12 experimental dietary treatments and comprised with 4 replicates of 10 birds per each and all of nutrients excepted ME and DEAA were followed by the suggestion of NRC (1994) and INRA (2004). Birds were reared in open-side houses during June until September, 2012 in Thailand and temperature ranged between 28 to 33°C. Body weights and feed intake of birds were measured on weekly while mortality birds were recorded daily. The result showed that there were no interaction between PFA levels and dietary ME and DEAA. Body weight gain and feed intake were not significantly influenced by supplementation of PFA, however feed conversion ratio during the grower period (5 to 8 weeks of age) and overall period (1-12 weeks of age) was improved significantly ($P<0.05$) by the supplementation of PFA compared with the control diet. Throughout the experiment, body weight gain and feed intake of birds fed the reduced dietary ME and DEAA were significantly lower ($P<0.05$) when compared with the control group and treatments as supplementation with PFA. Meanwhile, mortality rate did not differ between all of treatments. In conclusion, reduced dietary ME and DEAA levels significantly affected growth rates. However, supplementation of the diets with PFA significantly improved feed conversion ratio, hence confirming a growth promoting effect of essential oils in Pekin ducks.

Fatty Acids Profile of Indigenous Chicken, Broiler and Spent Hen Meat in Manado, North Sulawesi

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Introduction

Meat and meat products are good sources of protein, fat, essential amino acids, minerals and vitamins especially in developing countries (Weirs *et al.*, 2010). Most of consumers prefer low fat chicken meat as consuming meat with high saturated fatty acids has a health risk. The saturated fatty acids content of chicken meat is in the range of 34.35 – 37.49% while unsaturated fatty acids is 62.51 – 65.66% (Jeffrey *et al.*, 1996; Supadmo, 1997). According to Khotimah (2002), most of Indonesian people prefer to consume meat from indigenous chicken, as they believe that this chicken with active scratching feeding habit has low fat content. Furthermore the moisture and fat contents of broiler are 71% and 10 – 25%, respectively, compared to indigenous chicken meat which usually slaughtered at older age contain 60 – 66% moisture and 7.6% fat. There is limited information on indigenous chicken, broiler and spent hen meat fatty acids profile, and none especially those chicken originated from Manado, North Sulawesi. Therefore the aim of this study was to determine the fatty acids profile of those meat from different breeds found in North Sulawesi.

Materials and Methods

The fat of fillet from leg and breast meat of indigenous chicken, broiler and spent hen were extracted using soxhlet method for laboratory analysis. These samples were esterified before analysis by gas chromatography for fatty acids profile determination.

Results and Discussion

The fatty acids profiles of indigenous, broiler and spent hen are presented in Table 1. It is interesting to note that broiler meat contained the lowest saturated fatty acid and the highest of either mono- and polyunsaturated. Hence, this type of meat could be considered as good source of omega 3, 6 and 9 fatty acids. The fatty acids profile of indigenous meat in this study was different than the one from Thai indigenous meat as reported by Wattanachant *et al.*, (2004) and this is possibly due to different species, feeding behaviour and diets.

Table 1. Fatty acids profile of indigenous, broiler and spent hen meat .

Fatty acids.	Indigenous chicken (%)	Broiler (%)	Spent hen (%)
Capric Acid (C10:0)	0.05 ± 0.03	0.04 ± 0.01	0.02 ± 0.01
Lauric Acid (C12:0)	0.45 ± 0.12	0.76 ± 0.11	0.60 ± 0.21
Myristic Acid (C14:0)	0.72 ± 0.04	0.94 ± 0.13	0.86 ± 0.06
Palmitic Acid (C16:0)	22.35 ± 0.41	21.95 ± 0.49	21.94 ± 0.43
Stearic Acid (C18:0)	8.70 ± 0.08	4.44 ± 0.12	6.20 ± 0.40
Anachidic Acid (C20:0)	0.46 ± 0.02	0.65 ± 0.04	0.39 ± 0.04
Behenic Acid (C22:0)	2.67 ± 0.04	0.51 ± 0.01	0.30 ± 0.02
Total saturated fatty acid	35.03 ± 0.86	28.99 ± 0.14	29.71 ± 0.47
Palmitoleic Acid (C16:1n-7)	3.99 ± 0.12	6.38 ± 0.17	3.50 ± 0.07
Oleic Acid (C18:1n-9)	38.97 ± 0.26	42.28 ± 1.15	43.85 ± 2.22
Total monounsaturated fatty Acid	42.97 ± 0.16	48.66 ± 1.31	47.35 ± 2.15
Linoleic Acid (C18:2n-6)	17.60 ± 0.10	19.01 ± 0.26	18.65 ± 0.87
Linolenic Acid (C18:3n-3)	0.19 ± 0.03	0.35 ± 0.05	0.10 ± 0.02
Total polyunsaturated fattyacid	17.79 ± 0.10	19.35 ± 0.31	18.75 ± 0.89

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Substitution Value of Beniseed (*Sesamum Indicum*) Meal for Soyabean Meal (*Glycine Max*) in Broiler Diets.

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Abstract

Two experiments were conducted to determine the substitution value of beniseed cake (BSC) for soya bean meal (SBM) in starter and finisher broiler diets. Mechanically expelled beniseed seed cake was used to formulate broiler starter and finisher diets such that in experiment 1 (Starter phase) beniseed cake replaced soya bean meal at 0%, 33.3%, 66.7% and 100% of the diets. In experiment 2 (finisher phase), the cake replaced soybean meal at 0%, 40%, 80% and 100% of the broiler diets. 28-day experimental trials were conducted in which the formulated starter and finisher diets were tested on control diet T₁ (0% beniseed seed cake). Average daily feed intake during the starter phase were 57.3, 79.3, 79.3 and 61.4g/bird respectively for birds fed the 0%, 33.3%, 66.7% and 100% SBM replacement diets. The average daily weight gains were 24.13g, 25.84g, 23.84g and 19.44g for birds fed the 0%, 33.3%, 66.7% and 100% SBM replacement diets respectively. The feed conversion ratio for birds on the treatment diets T₁, T₂, T₃ and T₄ were 2.38, 3.07, 3.33 and 3.16 respectively. The feed conversion ratio for birds on diets T₂ – T₄ were significantly ($P < 0.05$) different from birds on the control diets T₁. The cost of production (N/kg gain) decreased as the level of beniseed increased. The cost saving (%) increased suggesting that the replacement of soya bean meal with beniseed cake at the various treatment levels was economical. The live weight gain during the finisher phase was (1.83kg, 1.90kg, 1.87kg and 1.83kg/bird). The abdominal fat was high in birds on beniseed diets T₂ – T₄ (2.05, 2.94 and 2.20) % compared to T₁. The neck was almost similar (4.15%, 4.32, 4.33 and 4.43%) for T₁ – T₄. The average daily feed intake of the treatment groups were 123.4g, 128.7g, 120.8g and 107.4g respectively for birds fed diets T₁, T₂, T₃ and T₄. The average daily weight gain for the groups were 49.46g, 49.8g, 47.6g and 45.5g for birds fed diets T₁, T₂, T₃ and T₄ respectively. The average total body weight gain for the groups were 1385g, 1393g, 1334g and 1274g while feed conversion ratio for groups were 2.5, 2.59, 2.54 and 2.36 respectively. Birds on diets T₂ and T₃ differed significantly ($p < 0.05$) in feed conversion ratio from birds on diet T₁ (control) and T₄. The feed cost (N/kg) decreased (84.74, 71.76, 58.6 and 52.32). The cost saving (%) increased (15.3%, 30.83% and 38.24%). The results of study tend to suggest that beniseed cake could successfully replace 33.3%, 66.7% soya bean meal in broiler starter diets as well as 40%, 80% and 100% soya bean meal in broiler finisher diets.

Effect of Feeding Spice-treated Bovine Blood and Rumen Content Mixture on the Haematology, Blood Chemistry and Carcass Traits of Weaned Rabbits

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Introduction

Bovine blood and rumen content mixture (BBRCM) is an abattoir by product that offers a tremendous potential as a sustainable cheap and locally available alternative feedstuffs for livestock and large quantities of it is being wasted in abattoirs in Nigeria. Unfortunately, its usage has been encumbered by its obnoxious odor and low palatability. There is need therefore, to enhance the nutritive value and bio safety of this material by the incorporation of natural feed additives of plant origin like spices which are believed to be safer, healthier and less subject to hazards.

Generally, both the haematological and biochemical components of the blood are influenced by the quantity and quality of feed and also the level of anti-nutritional factors present in the feed (Akinmutimi, 2004). Kong *et al.*, (2006) reported that medicinal plants exert certain immunological consequences in animal's body. Based on this premise, this study was conducted to investigate the effects of feeding spice-treated bovine blood rumen content mixture on growth performance and economics of production of weaned rabbits.

Materials and Methods

Five experimental diets were formulated using bovine blood rumen content mixture such that diets 1 and 2 contained 0% and 20% BBRCM without spice supplementation. Diets 3, 4 and 5 contained 20% BBRCM supplemented with ginger, garlic and thyme respectively. Sixty (60) weaned rabbits were randomly assigned to the five (5) treatments in a Completely Randomized Design (CRD). Each treatment was replicated thrice giving 4 animals per replicate. The animals were housed individually in a cage. Feed and water were provided *ad libitum*.

At the 8th week, blood samples were collected from six (6) rabbits per treatment for the determination of the haematological and serum biochemical indices. Samples were collected from the ear vein of the rabbits by venipuncture using disposable needle (21 – gauge needle) and syringes. The blood were collected in sample bottles containing dipotassium salt of ethylene diamine – tetra acetic acid (EDTA – K²⁺) which served as anticoagulant for haematology while the bottles for serum biochemical indices were free of EDTA – K²⁺. The haematological indices determined were packed cell volume (PCV), haemoglobin concentration (Hb), red blood cell (RBC) count and white blood cell (WBC) count. Others such as mean corpuscular haemoglobin (MCH), mean corpuscular volume (MCV) and mean corpuscular haemoglobin concentration (MCHC) were obtained by calculation according to standard formulae (Jain, 1986). The other blood samples collected without anticoagulant

were used to determine the biochemical components such as albumin, total protein, cholesterol, globulin and glucose adopting the methods described by Uko *et al.*, (2000).

Six rabbits were randomly selected from each treatment for carcass evaluation. The rabbits were starved of feed and not water for 24 hours before slaughtering. They were slaughtered, eviscerated and the body parts and internal organs were weighed and expressed as percentages of live weight. The data obtained were subjected to analysis of variance as per Snedcor and Cochran (1989).

Results and Discussion

There was no significant ($P>0.05$) difference in the hematological indices of the rabbits among the treatments. The values of the PCV, Hb, WBC and RBC fall within the normal range for healthy rabbits as reported by Anon (1980). Feeding of spice treated BBRCM diets to weaned rabbits numerically increased the PCV, RBC, Hb and WBC of the rabbits. The numerical differences observed in the PCV, Hb and RBC of birds fed ginger and garlic supplemented diets suggest that the diets were better utilized and assimilated into the blood stream for use by the birds. This also suggests that the spices may have helped in boosting the immune system of the rabbits (Onu & Aja, 2011). The biochemical parameters evaluated did not differ significantly ($P>0.05$). The total protein, albumin, and globulin were not significantly different ($P>0.05$) among the treatment groups.

The carcass traits evaluated were not significantly ($P>0.05$) influenced by the dietary treatments and did not follow a definite pattern that can be attributed to treatment effect. The inclusion of BBRCM and spices did not affect the development of the organs. This implies that the test diets did not contain any appreciable toxin. The results suggest that spice-treated BBRCM has no adverse effect on immune responses and blood parameters of weaned rabbits.

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Carcass and Internal Organ Characteristics of Finisher Broilers fed Neem (*Azadirachta Indica*) Leaf Meal

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Introduction

The need for alternative sources of feeds has led to the exploitation of leaf meals of some tropical legumes and browse plants as ingredients in poultry diets. One of the tropical plants that has attracted attention of Animal nutritionists in recent time is neem (*Azadirachta indica*). The work of Obikaonu *et al.*, (2011b) on the haematological and serum biochemical indices of starter broilers fed diets containing Neem (*Azadirachta indica*) leaf meal suggested that Neem leaf meal can be included in the diets of broiler chicks up to 10% without any deleterious effect on their haematological and serum biochemical constituents. Internal organs have very significant role in body metabolic activities (Ogunlayi, 1999) and their characteristics are affected by internal and external factors.

The objective of this study is to evaluate the effect of Neem leaf on the carcass and internal organs of finisher broilers.

Materials and Methods

The study was carried out in the Poultry Unit of the Teaching and Research Farm of the School of Agriculture and Agricultural Technology and Animal Science Laboratory of the Federal University of Technology, Owerri, Imo State, Nigeria. Imo State lies between latitude 4°4' and 6°3' N and longitude 6°15' and 8°15' E. Owerri is about 100m above sea level.

Fresh green neem leaves used for the experiment were harvested within the University community, air-dried to become crispy to the touch and then milled to produce neem leaf meal (NLM) samples of the leaf meal were subjected to proximate analysis according to AOAC (1995). The neem leaf meal was included in the broiler finisher diets at 0, 2.5, 5.0, 7.5, and 10% levels designated as T₀, T_{2.5}, T_{5.0}, T_{7.5}, and T₁₀ respectively and all dietary treatments were iso caloric and iso protein. It was fed to groups of 30 broiler birds replicated three times in a Completely randomized design (CRD). Each replicate was housed in a pen measuring 1 ½ x 2m. Feed and water were provided *ad libitum* for 4 weeks.

At the end of the trial, 2 birds from each replicate were randomly selected, weighted and tagged making a total of 30 birds. They were starved for a day of feed sacrificed and carcass and internal organs were examined and weighed.

Data collected were subjected to analysis of variance (Steel and Torrie, 1980). Where analysis of variance indicated significant effects means were compared using Duncan's New Multiple Range Test (Steel and Torrie, 1980).

Results and Discussion

The carcass and internal organ weights are presented in table 1. The Neem leaf meal contained 18.10% CP, 15.56% CF, 2.50% EE, 5.26% ash and 58.25 NFE, live weights of birds and weight of blood were affected by the treatments as the level of neem leaf meal increased from T5-T10 ($P < 0.5$). the weights of thigh were not affected by treatments ($P > 0.5$). However, weights of wings were affected by treatment ($P < 0.5$). the weights of drumstick increased as the level of neem leaf meal increased. Hearts and liver weights were not affected by treatments ($P > 0.5$). Abdominal fat was also reduced as from T_{7.5} ($P > 0.05$). .

Table 1. Carcass and internal organ weights of finisher broilers fed neem leaf meal

Parameters	Dietary levels of the leaf meal inclusion					SEM
	T ₀	T _{2.5}	T _{5.0}	T _{7.5}	T ₁₀	
Live weight (g)	2575.03 ^a	2575.02 ^{ac}	2445.83 ^a	2666.67 ^c	2268.33 ^b	70.59
.Weight of blood (% of LW)	2.26 ^a	2.18 ^a	2.60 ^a	3.28 ^b	2.28 ^a	0.22
Weight of feathers (% of LW)	3.54 ^a	2.80 ^a	3.53 ^a	3.47 ^a	3.41 ^a	0.45
Dressed weight (g)	1854.33 ^a	1908.33 ^a	1854.33 ^a	1945.02 ^a	1350.01 ^b	75.21
Dressing percentage (% of LW)	72.02 ^a	73.68 ^a	76.24 ^b	72.65 ^a	73.79 ^a	0.87
Head (% of LW)	2.36 ^a	2.81 ^b	2.62 ^a	2.68 ^a	2.76 ^a	0.14
Neck (% of LW)	5.10 ^a	6.07 ^b	5.13 ^a	5.59 ^a	5.67 ^b	0.19
Wings (% of LW)	10.35 ^{ac}	10.96 ^a	9.51 ^{ab}	9.62 ^b	9.08 ^b	0.31
Thigh (% of LW)	12.86 ^a	13.24 ^a	12.20 ^a	12.97 ^a	13.09 ^a	0.36
Drumstick (% of LW)	11.17 ^{ab}	10.92 ^a	11.07 ^{ab}	12.71 ^b	12.21 ^b	0.31
Shanks (% of LW)	3.97 ^a	4.50 ^b	4.24 ^a	4.09 ^{ab}	4.12 ^a	0.16
Heart (% of LW)	0.33 ^a	0.41 ^a	0.36 ^a	0.30 ^a	0.44 ^a	0.03
Liver (% of LW)	1.37 ^a	1.19 ^a	1.58 ^a	1.48 ^a	1.62 ^a	0.33
Gallbladder (% of LW)	0.28 ^a	0.23 ^a	0.15 ^{bc}	0.12 ^{bc}	0.97 ^d	0.03
Gizzard (full) (% of LW)	3.75 ^a	3.15 ^b	3.00 ^b	3.59 ^a	3.16 ^b	0.20
Gizzard (empty) (% of LW)	1.97 ^a	2.41 ^b	2.11 ^a	2.43 ^b	2.20 ^a	0.12
Abdominal fat (% of LW)	1.65 ^a	2.03 ^b	1.60 ^a	1.18 ^c	2.14 ^b	0.15
GIT (% of LW)	3.98 ^a	4.57 ^b	3.95 ^a	3.89 ^a	4.67 ^b	0.20

^{a b c d} Means within the same row with different superscripts are significantly different ($p < 0.05$)

Conclusions

The results showed that the Neem leaf meal did not present any discernible nutritional problems that could clearly manifest in the organ and carcass weights.

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Fatty Acid Profile and Conjugated Linoleic Acid (CLA) Content in Thigh Meat of Native Chicken

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Introduction

CLA is a group of geometric and positional isomers of linoleic acid, an end product of fatty acid metabolism in bacteria. Ruminants synthesize and absorb CLA from digestive tract and incorporate these fatty acids into milk and fat tissue. CLA isomers are generated by heating linoleic acid in the presence of base. The CLA isomers linked to a multitude of metabolic actions, including reduced rates of fat accretion, increased saturation of fat, altered immune response, inhibition of carcinogenesis, and reduced serum lipids (Corino *et al.*, 2003 & Poulson *et al.*, 2004). Native chicken farmers rely on natural rearing systems. The survey of the number of poultry by livestock officers in Nakhon Phanom Province in 2010 estimated 1.25 million native chickens by headcounts. Most of them were raised by the small holders. Native chickens were more popular for the consumers due to their low fat, low cholesterol content and were more flavorsome. Moreover, native chickens had better survival rates and resistance to disease, having adapted well to the local environment. . The objective of this study was to determine the fatty acid profile and CLA content in thigh meat and a possible effect of gender on these traits.

Materials and Methods

One hundred and ten of native chickens (approximately 5 months old) were selected from 9 demonstration farms by of Department of Livestock officers in Nakhon Phanom province. Native chickens were fed rice and water. Females and males were slaughtered after attaining average weights of 955 and 1,050 grams respectively. Thigh meat samples were analyzed by gas chromatograph y (Christie, 1991 & Folch *et al.*, 1975) for fatty acid profiles and concentration. Means of all data were analyzed for analysis of variance and fatty acid concentrations were compared between genders using group t-test with the program SPSS version 16.05.

Result and Discussion

The SFA in thigh meat of Thai indigenous chicken raised by natural farming system showed the higher concentration of C18:0 for both male and female. The lowest fatty acids found in both male and female were C12:0 and C22:0 respectively. This was similar to those reported by Tathong (2009) who showed a major of fatty acid profile in the chicken meat were C18:0 and C16:0. The C4:0, C6:0, C8:0 and C12:0 were the found only in male thigh. The MUFA in thigh meat of Thai indigenous chicken raised by natural farming system showed that the highest concentration of fatty acid of male thigh was C22:1n9 while in female thigh was

C18:1n9c. The lowest fatty acid found in male thigh was C22:1 while in female thigh was C14:1. The PUFA in thigh meat of Thai indigenous chicken raised by natural farming system showed that the highest concentration of fatty acid in male and female thigh was C20:3n3 while the lowest concentration fatty acid was C18:2n6c in male thigh and C20:2 in female thigh. The C20:2 of fatty acid were not found in the male thigh. The CLA in thigh meat of Thai indigenous chicken raised by natural farming system showed that the trans10cis12 CLA was the highest isomer in male thigh while cis9 trans11 was the highest isomer in female thigh. The total fatty acid in thigh meat of Thai indigenous chicken raised by natural farming system showed that MUFA and PUFA in female thigh had higher concentration than male thigh ($P<0.05$) however the CLA in male had higher concentration than female ($P<0.05$) while SFA was similar ($P>0.05$) between both gender. Wanichapichard *et al.*, (2003) and Wattachant (2008) reported the SFA in thigh meat of Northern native Thai had approximately 40.48% of total fatty acid. However; the MUFA and PUFA showed similar concentration with this research.

Conclusion

Thai indigenous chicken raised under natural farming systems showed, without significant differences between sexes, that C18:0 was the highest SFA and C18:1, C20:3 and CLA isomer at trans10, cis12 was the highest in all samples. The concentration of CLA was higher in males than females ($P<0.05$) but registered lower MUFA and PUFA values ($P<0.05$).

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Reproductive Performance, Cholesterol and Progesterone Status of Garut Ewes Fed With Ration Containing Different Levels of Sun Flower Seed Oil

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Introduction

Garut ewes are prolific animals, producing two or more lambs every birth. However, in the small farmers the litter size is still low ($\pm 120\%$) with high embryonic mortality in pre-natal (30%), and pre-weaning period (20-70%). Essential fatty acids are important in the ration because it functions as membrane compound and precursor of prostaglandin synthesis which is required for growth, lactation, and reproduction (Palmquist, 2010). Fatty acids supplementation in ruminant ration can improve fertility and embryo development (Cerri *et al.*, 2009) and accelerate lambs ability to suckle milk after birth (Capper *et al.*, 2006). The objective of this experiment was to evaluate reproductive performance, blood cholesterol, and progesterone concentration of Garut ewes fed ration containing different levels of sun flower seed oil as a source of essential fatty acids.

Materials and Methods

Thirty two Garut ewes (BW 22.12 ± 1.69 kg) were allocated into a completely randomized design with 4 treatment rations containing different levels of sun flower seed oil namely: R0 (0%), R1 (2%), R2 (4%) and R3 (6%). All rations were formulated isoprotein (20%), with grass and concentrate ratio of 30:70. Estrus synchronization was conducted by injecting PGF_{2 α} (Noroprost[®]) hormone intramuscularly twice (day 1 and 12th before natural mating).

Blood samples were taken before mating and at early pregnancy, while for progesterone, the blood samples were taken at day 25th, 28th, and 31st after mating. Blood cholesterol was analyzed using Kit No. AKL 20101803460, while serum progesterone analysis was conducted using the method of Progesteron [¹²⁵I] RIA KIT (Ref:RK-460M) (IZOTOP, 2012). Number of embryo was detected using Ultrasound on day 18th – 20th after mating.

Results and Discussion

Garut ewes fed ration containing 4% sun flower seed oil produced 12.5% higher pregnancy rate compared to those of control. The litter size of ewes given sun flower seed oil was also higher than control. Pour (2011) reported that fatty acids are important in improving progesterone concentration to stimulate follicle to bring about pregnancy and maintaining pregnancy.

Garut ewes fed ration containing 4% sun flower seed oil increased the ratio of male to female (3:1) and higher than those of other treatments. Green *et al.*, (2008) reported that increasing polyunsaturated fatty acids in ewes ration could increase the ratio of male at 13th days after mating. The mortality of neonate lambs was still high (>20%). This may be due to the reason that the reproductive organ is not optimum yet as the ewes used in this experiment experienced the first birth. In addition, the ewes may have limited mothering ability.

The inclusion up to 6% of sun flower seed oil in the ration did not elevate cholesterol and progesterone levels of pregnant ewes. The availability of cholesterol is closely related to hormone status because cholesterol is the precursor of steroid hormone synthesis such as progesterone, cortisol, corticosterone, and estradiol (Fall, 2008).

Table 1. Reproductive performance of Garut ewes fed ration containing different level of sun flower seed oil

Parameters	Treatment			
	R0 (n = 8)	R1 (n = 8)	R2 (n = 8)	R3(n = 8)
Pregnancy rate (%)	87.5	75	100	75
Number of embryo*	1.80 ± 0.41	1.67 ± 0.56	2.25 ± 0.46	2.14 ± 0.38
Litter size (%)	133	225	225	200
Male:Female ratio	58:42	37:63	75:25	56:44
Mortality (%)	0.0	55.6	22.2	16.7

* = Ultrasound result

Table 2. Cholesterol and progesterone hormone of Garut ewes fed ration containing different levels of sun flower seed oil

Parameters	Treatment			
	R0	R1	R2	R3
Cholesterol pre-mating (mg dl ⁻¹)	78.92 ± 17.70	95.38 ± 22.76	96.79 ± 14.25	88.93 ± 20.68
Cholesterol early pregnancy (mg dl ⁻¹)	68.24 ± 23.82	106.98 ± 12.82	94.18 ± 20.99	96.36 ± 24.14
Progesterone on day 25 th (ng ml ⁻¹)	33.28 ± 2.94	35.32 ± 3.33	36.37 ± 6.75	33.95 ± 6.05
Progesterone on day 28 th (ng ml ⁻¹)	31.15 ± 7.13	30.07 ± 7.94	31.50 ± 4.55	29.30 ± 3.48
Progesterone on day 31 st (ng ml ⁻¹)	24.617 ± 4.30	29.317 ± 6.24	28.56 ± 9.98	30.08 ± 3.02

The addition of sun flower seed oil into the ration provided long chain unsaturated fatty acids such as linoleic acid which is the precursor of progesterone hormone synthesis that function in maintaining pregnancy. Garut ewes consumed ration containing 4% sun flower seed oil produced lambs as many as the number of embryo detected using ultrasound. This indicated that the addition of sun flower seed oil can better maintain pregnancy. Based on the results, it is concluded that the inclusion of 4% sun flower seed oil into Garut ewes ration can improve reproductive performance (litter size and sex ratio) and cholesterol concentration.

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Feed Supplement Evaluation of Pineapple Rind and Micro Mineral as Antioxidant Source to Rumen Fermentation of Etawah Dairy Goats

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Introduction

The animal in optimal conditions will change the balance of microbes in the rumen. Therefore supplementation of feed containing antioxidants is needed for microbial protein synthesis. Some antioxidants such as flavonoids, saponins, vitamins and minerals play a role in the metabolic processes and synergistically enhance rumen digestibility of feed in the rumen. Mardalena *et al.*, (2011) reported that pineapple rind containing saponins of 5.29%. Wina *et al.*, (2005) have reported that saponin substances have potential to suppress growth of protozoa and affected fermentation in the rumen. The increase in digestibility of feed, will increase the content of total VFA (acetic acid, propionic acid and butyric acid), which is a source of energy for animals.

Materials and Methods

The purpose of this study is to evaluate the effects of pineapple rind and mineral as the antioxidant sources in the *in vitro* rumen fermentation.

Experiments were carried out *in-vitro* using a factorial completely randomized design 3 x 3 with 3 replications. Factor I consists of: P1: pineapple rind 5 mg / kg, P2: pineapple rind 7.5 mg / kg, P3: pineapple rind 10 mg / kg. Factor II consists of: M1: Mineral Zn-vitamin E as much as 60 ppm-10 ppm, M2: Mineral Cu-vitamin E as much as 15 ppm-10 ppm, M3: Minerals Se-vitamin E as much as 0.15 ppm-10 ppm.

The parameters observed were gas production, pH, N- NH₃ concentrations (mM), number of rumen bacteria (CFU / ml), dry matter digestibility (%), organic matter digestibility (%), total volatile fatty acid and partial concentration (mM). Data were subjected to one-way ANOVA using SAS program. Difference among treatment means (P<0.05) was distinguished.

Results and Discussion

The results showed that there were an interaction between pineapple rind and mineral on dry matter digestibility (P<0.01) and total VFA (P<0.05) but not for gas production, pH, NH₃, bacteria, organic matter digestibility, acetate, propionate and butyrate concentration of Ettawah dairy goats rumen. However, NH₃, bacteria number, total VFA, acetate and butyrate were higher significantly (P<0.05) in pineapple rind 5 mg / kg cattle compared to pineapple rind 7.5 mg / kg and pineapple rind 10 mg / kg. Higher significant level was observed at P<0.01 for gas production, dry matter digestibility, organic matter digestibility and propionate concentration in factor 1. Gas production, organic matter digestibility, acetate and butyrate concentration recorded differences at P<0.05 in M1 (mineral Zn-vitamin E) as compared to M2 and M3 but higher significance at P<0.01 to dry matter digestibility, volatile

fatty acid total and propionate concentration. From this research, it was found that antioxidant pineapple rind by 5 mg / kg with minerals antioxidant Zn-vitamin E can be used as a food supplement in Etawah dairy goat ration.

Table 1. Effects of feed supplement on gas production, pH, NH₃ and rumen bacteria count

Parameters	Pineapple Rind	Mineral			Average	Significance		
		M1	M2	M3		P	M	P x M
Gas Production (mg/kg BW)	P 1	18.67	18.33	17.17	18.06	**	*	NS
	P 2	18.33	17.67	16.67	17.56			
	P 3	16.70	14.67	11.67	14.35			
	Average	17.90	16.89	15.17				
<i>SEM = 1.83</i>								
pH	P 1	6.52	6.52	6.51	6.52	NS	NS	NS
	P 2	6.49	6.50	6.59	6.53			
	P 3	6.53	6.55	6.59	6.56			
	Average	6.51	6.52	6.56				
<i>SEM = 0.42</i>								
NH ₃ (mM)	P 1	5.63	5.33	4.47	5.14	*	NS	NS
	P 2	5.47	5.57	5.04	5.36			
	P 3	4.87	4.81	4.83	4.84			
	Average	5.32	5.24	4.78				
<i>SEM = 0.58</i>								
Bacteria (x10 ⁹ CFU/ml)	P 1	2.45	1.85	1.18	1.83	*	NS	NS
	P 2	1.74	1.32	1.23	1.43			
	P 3	1.12	0.85	0.84	0.94			
	Average	1.77	1.34	1.08				
<i>SEM = 0.60</i>								

Note: NS = not significant, SEM = standard error mean, * = (P<0.05%), ** = (P<0.01) P = pineapple rind, M = mineral

Table 2. Effects of feed supplement on VFA, acetate, propionate and butyrate concentration

Parameters	Pineapple Rind	Mineral			Average	Significance		
		M1	M2	M3		P	M	P x M
Total VFA (mM)	P 1	54.45	54.14	51.68	53,42	*	*	*
	P 2	53.85	53.55	52.22	52,21			
	P 3	54.42	53.78	52.18	53,46			
	Average	54,24	53,82	52.03				
<i>SEM = 0.79</i>								
Acetate (mM)	P 1	27.1	25.8	24.3	25.73	*	*	NS
	P 2	26.8	26.3	25.6	26.23			
	P 3	26.7	16.4	15.8	19.63			
	Average	26.87	22.33	22.40				
<i>SEM = 0.77</i>								
Propionate (mM)	P 1	17.4	16.5	16.5	16.80	**	*	NS
	P 2	16.5	16.3	15.1	15.97			
	P 3	15.6	15.2	14.9	1.23			
	Average	16.50	16.	15.50				
<i>SEM = 0.69</i>								
Butyrate (mM)	P 1	10.2	10.3	8.2	9.57	*	*	NS
	P 2	10.6	9.9	9.3	9.93			
	P 3	10.3	9.4	9.3	9.67			
	Average	10.37	9.83	8.97				
<i>SEM = 0.83</i>								

Note: NS = not significant, SEM = standard error mean, * = (P<0.05%), ** = (P<0.01) P = pineapple rind, M = mineral

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Encapsulation of Carotenoid Extract by Several Polymers and its Degradation in the *in vitro* Rumen Fermentation

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Introduction

Carotenoid especially beta carotene is an important compound for dairy cows. It has several functions such as the precursor of vitamin A, antioxidant and effects on fertility (Arechiga *et al.*, 1998). The requirement of carotene in dairy cow is usually fulfilled by the consumption of green forage. During the dry season, carotene deficiency may be a problem because of the lack of green forage. Small dairy farmers in developing countries do not pay much attention on daily carotene requirement for their cows. This experiment was aimed at extracting the carotenoid from leguminous leaves and to encapsulate the carotenoid by different polymers to prevent rapid degradation by rumen microbes in an *in vitro* fermentation.

Material and methods

Carotenoids were extracted from dried milled *Calliandra calothyrsus* leaves. The extraction was conducted using single solvent (hexane, ethyl acetate and acetone) and compared to the standard AOAC method (1984). Several polymers: chitosan, alginate, mixture of chitosan and alginate, casein were used to encapsulate carotenoid extract. The concentration of chitosan was 0.2%, alginate concentration 0.06 and 0.2% and casein concentration was 0.2%. The particle was made by reacting the polymer with sodium tripolyphosphate for chitosan, CaCl_2 for alginate and dextran for casein. The particle size of all products was measured using particle size analyser. *In vitro* degradation of encapsulated carotenoid was done by putting 5 ml of encapsulated carotenoid in polymer solution to the *in vitro* tube containing 1 gram corn cob as the substrate in 100ml buffered rumen liquor. Samples (5ml) were taken at 1, 3, 6, 12 and 24 hours of incubation.

Results and Discussion

Acetone was chosen to extract as it gave higher concentration of carotenoid than other solvents and the crude extract has a very strong green colour (Table 1).

Chitosan with 0.2% concentration has various particle size below 300nm in the range of 115-259nm (Table2). Encapsulation by chitosan and Na-tripolyphosphate has shown that it gave lower particle size with lower concentration of chitosan with previously should be dissolved in low pH to avoid precipitation (Fan *et al.*, 2011). Addition of alginate to chitosan polymer will increase the particle size. Alginate encapsulation yielded much bigger range of particle size compared to chitosan encapsulation and when concentration of alginate increased, the particle size was bigger. Lower particle size caused rapid degradation in the rumen (3-6h of incubation, Fig 1A) and bigger particle caused slower degradation (12h of incubation, Fig 1B). Rumen microbes have many different enzymes which easily degrade chitosan, alginate or casein. It takes longer time for rumen microbes to degrade these

polymers when the particle size of encapsulated carotenoid was bigger. As it has been encapsulated, the reduction of carotenoid concentration during storage was not as sharp as the carotenoid extract without encapsulation. This shows the importance of encapsulation. In conclusion, encapsulation of carotenoid should be done to prevent rapid degradation both outside the animal and in the rumen and the particle size of the product should not be too small.

Table 1. Carotene, xanthophylls and total carotenoids contents in Calliandra leaf meal by different solvent extraction

	Carotene	Xanthophyll	Total carotenoids
	mg/kg DM leaf meal		
Hexane	410.14 c	578.92 d	989.06 c
Acetone	1113.4 a	1529.39 a	2642.78 a
Ethyl acetate	925.44 ab	982.34 c	1907.79 b
AOAC method	765.29 b	1322.16 b	2087.44 b
sem	59.68	53.57	94.49

Table 2. Range and average of particle size of encapsulated carotenoid made of different polymer

Product of encapsulation	Range of particle (nm)	Average particle size (nm)
Alginate (0.06%)	172-1005	325±108
Alginate (0.2%)	450-2600	620±230
Chitosan (0.2%)	115-259	152±20
Chitosan+alginate (0.2% and 0.06%)	197-1151	354±120
Casein (0.2%) dextran	300-2980	800±410

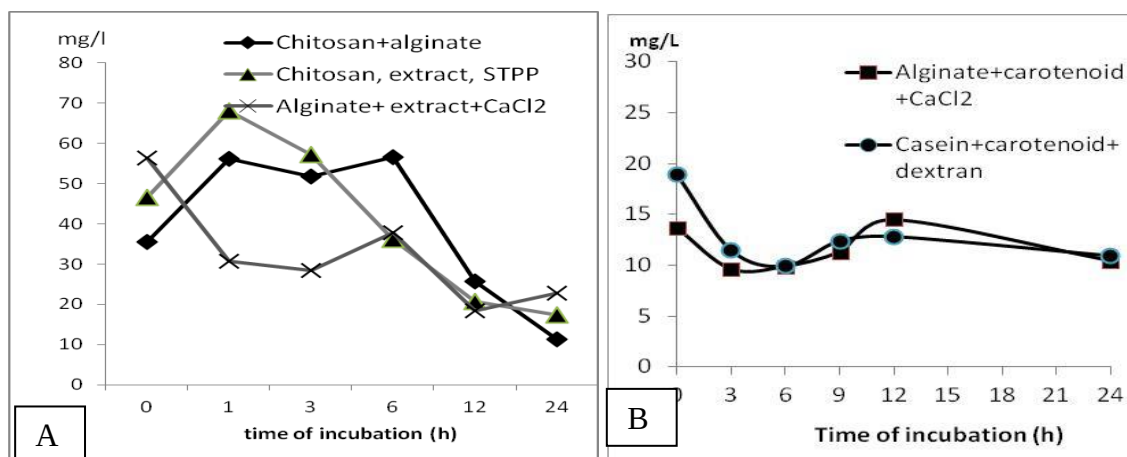


Figure 1. *In vitro* degradation of encapsulated carotenoid incubated in rumen buffer for 24 h. the encapsulated products were made of different polymer A) chitosan concentration of 0.2% and alginate concentration of 0.06%; B) alginate and casein concentration of 0.2% each.

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Blood Hematology and Lipid Profile of Ongole Crossbreed Beef Cattle Fed with Lerak Extract Based on High Forage Ration

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Introduction

Production of local beef cattle in Indonesia is low because farmers usually feed the animals with high forage diet of low nutritive values particularly low crude protein content. Defaunation using saponin is one of strategies to modify rumen fermentation in order to increase microbial protein. Lerak extract (*Sapindus rarak*) containing high saponin (81.5%) could reduce the growth of protozoa as shown in *in vitro* and *in vivo* studies (Wina *et al.*, 2006; Suharti *et al.*, 2011). The use of lerak extracts in cattle feed could optimize rumen fermentation and increased their average daily gain (Suharti *et al.*, 2010). Lerak extracts containing saponins can also lower blood cholesterol. Matsui *et al.*, (2009) reported that tea saponin induced decrease of cholesterol and triglyceride levels, while cholesterol fecal was increased. Kim *et al.*, (2003) also reported the decreasing of total and LDL cholesterol levels in human blood plasma of hypercholesterolaemic patients who received *Yucca schidigera* and *Quillajia saponaria* extracts that contain saponin. Oral administration of saponins may stimulate the immune system (Cheeke, 2000). Due to the limited information concerning the effect of saponin on cholesterol and blood profiles of cattle, a study was conducted to evaluate the effect of Lerak extract on serum cholesterol and blood profiles of beef cattle with high forage ration (70%).

Materials and Methods

Experimental Design, Animals and Management

The experiment was carried out at the Field Laboratory, Departement of Nutrition and Feed Technology, Faculty of Animal Science, Bogor Agricultural University, Indonesia. A total of 12 male Ongole Crossbreed beef cattle with initial body weight (BW) 187.5 ± 13 kg, were assigned to three dietary groups, each consisting four animals. All groups received similar basal diet consisting of native grass and concentrate mixture in the ratio 70:30. The design of experiment was block randomized design with 3 treatments and 4 replications as follows: basal diets + 0mg lerak extract (control), basal diets+ lerak extract 100mg/kg BW, and basal diets + lerak extract 200mg/kg BW. The lerak extracts was administered as a meal, prepared by mixing with concentrate mixture. All animals received ration with total DM of 2.8-2.9% of body weight during feeding for 90 days.

Plasma Cholesterol and Blood Profile Analysis

Whole blood samples were obtained and drained through coccygeal vein on 90th days of treatment and collected into tubes containing lithium heparin to obtain plasma. Total plasma trygliseride, cholesterol, HDL-cholesterol (HDL-C) was determined enzymatically using commercial assay kits (Dya-Sis). The concentration of red blood cells (RBC), white blood cells (WBC) and lymphocyte percentage in the leucocytes were counted by using microscope.

Statistical Analysis

All data were analyzed by ANOVA using the GLM procedures (SPSS 13.0 for windows, 2004). The differences among treatments were separated by Duncan's multiple range test that was used to compare the means of the treatments.

Results and Discussion

Blood Profile

The addition of Lerak extract up to 200 mg/kg BW during the ninety days feeding treatment did not affect the blood hematology profiles (Table 1). The number of RBC and WBC, packed cell volume (PCV) and haemoglobin (Hb) level were equal between treatments. This indicates that the use of Lerak extract containing saponins up to 200 mg/kg BW (equivalent to 160 mg of saponin) does not interfere with the health of the cattle depicted on the hematological profile.

Table 1. Blood Hematology and Lipid Profiles of Ongol Crossbreed Beef Cattle That Received Different Level of Lerak Extract for 90 days Feeding Treatment

Parameter	Level of Lerak extract (mg/kg BW)			
	0	100	200	SEM
RBC, $\times 10^6/\text{mm}^3$	7.59	6.87	7.11	0.22
PCV, %	31.33	31.83	29.00	1.56
Hb, g%	12.16	11.74	10.67	0.49
WBC, $\times 10^3/\text{mm}^3$	12.85	10.01	9.05	1.18
WBC Defferentiation (% WBC)				
Neutrofil	33.67	29.33	40.00	3.51
Lymphocytes	61.67	66.67	56.75	3.45
Monocytes	3.67	2.67	2.50	0.62
Eosinofil	1.50	1.33	1.00	0.16
Triglyceride, mg/dl	44.67	32.75	34.50	2.77
Cholesterol Total, mg/dl	146.67	143.50	140.00	7.56
LDL cholesterol, mg/dl	28.10	23.98	28.20	1.39

These results are in contrast with previous studies that evaluated the effect of whole Lerak fruit in the meal (saponin of 11%) on blood profile of beef cattle for 60 days feeding treatment and showed that the administration of whole Lerak fruit meal at the level of 1000 mg / kg (40 mg saponin) in the ration reduced WBC significantly (Astuti *et al.*, 2009). This indicated that whole Lerak fruit given in the form of meal and improper doses had a negative effect on the immune system. However, whole Lerak fruit given in the form of methanol extract was relatively more secure on the health of the beef cattle.

Blood Lipid Profile

The used of Lerak extract up to level of 200 mg/kg in the beef cattle diet did not affect the concentration of triglycerides, cholesterol and LDL (Table 1). In this study, the administration of saponin Lerak extract could not reduce the levels of blood triglycerides and cholesterol. This is due to saponins being quickly broken by bacteria and loses its sugar group and converted into other compounds such as sarsapogenin or episarsapogenin in the rumen (Flaoyen *et al.*, 2002). This may be a reason that saponin could not act as anti-cholesterol in ruminants because they lose their sterol-binding activity.

Conclusion

The used of Lerak extract up to level 200 mg/kg BW until 90 days feeding treatment did not affect the blood hematology profiles and blood lipid profile (triglycerides, cholesterol and LDL cholesterol). This indicates that the use of Lerak extract containing saponins up to 200 mg/kg BW (equivalent to 160 mg of saponin) does not interfere with the health of beef cattle.

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Profile and Antibacterial Activity of Whole Corn Silage Juice Against *Escherichia Coli* and *Salmonella* sp. isolated from Scouring Calves

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Introduction

Coliform bacteria mainly *Escherichia coli* and *Salmonella* sp. are normal inhabitants of the intestinal tract of many animal species and are usually in low number. However, in diarrheic calves, the fecal numbers of coliform exceed lactic acid bacteria (Abu-Tarboush et al., 1996; Krehbiel et al., 2003).

Ensiling is a preservation method of crop based on natural lactic acid fermentation whereby lactic acid bacteria (LAB) utilize water soluble carbohydrate (WSC) in a mixture of acids mainly lactic and volatile fatty acids. Antimicrobial compounds are produced during ensilage such as: acid fermentation products and bacteriocins (McDonald et al., 1991; Gollop et al., 2005). The aim of this research was to study the juice profile of whole corn ensiled for ten weeks and its antibacterial activity against *Escherichia coli* and *Salmonella* sp. isolated from scouring calves.

Materials and Methods

Whole Corn Silage Fermentation and Juice Analyses

Whole corn crop with half milk line was harvested and chopped into 1-2 cm length without wilting. Chopped whole corn was then mixed thoroughly and filled into 0.35 mm double-lined plastic bags and vacuum-packed without additive treatment and ensiled for 10 weeks at ambient temperature (25-28°C). Silage dry matter (%) was then evaluated. The juice of whole corn silage was obtained by hydraulic pressing. The pH was measured by pH meter (sensIONTM). The concentration of formic, acetic, propionic, butyric and lactic acid in juice was measured by HPLC (AOAC, 2002). Lactic acid bacteria of the juice was plated on MRS agar and incubated at 37°C for 24 h.

Antibacterial Activity Assay

Antibacterial activity in the juice of whole corn silage against culture of 13 *Escherichia coli* and 9 *Salmonella* sp. which was isolated from scouring calves was undertaken using agar well diffusion with two replications (Ham et al., 2003). Commercial antibiotic Vita Tetra-Chlor[®] (each capsule contains 50 mg tetracycline HCl and 10 mg Erythromycin) was used as control with 50 µg/ml of concentration. Each suspension of test organism was adjusted to McFarland 0.5 (1-2x10⁸ CFU/ml). Means were compared by t-test (P<0.05).

Results

The Profile (means $\pm$ std.dev) of whole corn ensiled for ten weeks (n=10) is shown in Table 1. The acid concentration of the juice was dominated by lactic acid (7.71 mg/ml) ranging from 6.41 to 9.10 mg/ml. High lactic acid concentration was followed by acetic acid (1.48 mg/ml) ranging from 1.04 to 2.12. Formic, propionic and butyric acids were found at low concentration with 0.49 ± 0.14 mg/ml; 0.04 ± 0.04 mg/ml and 0.11 ± 0.03 mg/ml, respectively. In addition, high lactic acid bacteria number (10.32 ± 9.84 log₁₀ CFU/ml) has contributed to the low pH (3.87 ± 0.26) found in this study.

Table 1. The profile of whole corn ensiled for ten weeks

Item	Mean $\pm$ Std.dev
Whole corn dry matter content (%)	16.71 ± 1.24
pH	3.87 ± 0.26
Lactic acid (mg/ml)	7.71 ± 0.73
Acetic acid (mg/ml)	1.48 ± 0.45
Formic acid (mg/ml)	0.49 ± 0.14
Propionic acid (mg/ml)	0.04 ± 0.04
Butyric acid (mg/ml)	0.11 ± 0.03
Lactic acid bacteria number (Log ₁₀ cfu/ml)	10.32 ± 9.84

The juice of whole corn silage in this study showed antibacterial activity against all test organisms isolated from scouring calves (Table 2). Inhibition zone in juice of whole silage was greater than in Vita Tetra-chlor® for *Salmonella* sp. This is in contrast to the antibacterial activity in juice against *Escherichia coli* which was lower than in Vita Tetra-chlor®

Table 2. Antibacterial activity of the juice of whole corn ensiled for ten weeks and Vita Tetra-chlor® against *Escherichia coli* and *Salmonella* sp. isolated from scouring calves

Test Organism	Inhibition Zone of Diameter (mm)	
	Juice of whole corn silage	Vita Tetra-chlor® (50µg/ml)
<i>Escherichia coli</i>	$3.0 \pm 1,1^b$	$5.7 \pm 1,1^a$
<i>Salmonella</i> sp.	$4.7 \pm 1,7^a$	$2.6 \pm 0,7^b$

^{ab} Means in rows with different superscripts differ significantly (p<0.05).

Conclusion

It can be concluded that the juice resulted from well preserved whole corn silage contained high lactic and acetic acids. Moreover, the juice is effective in inhibiting *Escherichia coli* and *Salmonella* isolated from scouring calves.

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Methane Production and Fermentation Rate of Local Sheep Rumen-fluid Fed *Indigofera* sp. and Mung Bean Sprout Waste Using RUSITEC

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Introduction

Legume could be used as an alternative protein sources for local sheep feeds. Introduction of *Indigofera* sp. in some areas have fulfilled the availability of forage, while the exploration of unconventional feedstuffs have been tried to develop mung bean sprout waste. For fattening sheep concentrate has to be added for proper ration. Legume has lower methane producing potential than grass when consumed (Archimède, *et al.*, 2011) and high concentrate ration will reduce methane production (Grainger & Beauchemin, 2011). Mung bean sprout waste had a potential as fiber source (13-14% CP, 49.44% CF) (Rahayu *et al.*, 2011). The aim of this study was to quantify methane production and fermentation rate of local sheep fed complete ration containing 30% *indigofera* sp. or 30% mung bean sprout waste using Rusitec.

Materials and Methods

Eight growing sheep, a Rusitec unit with eight vessel tube using 3% h⁻¹ of saliva flow and methane analyzer were used to support this experiment. The complete rations were pelleted containing 30% *Indigofera* sp. plus 70% concentrate (IS) and 30% mung bean sprout waste plus 70% concentrate (MBS).

The animals were kept in individual metabolic cages with ration and water was given *ad libitum*. After three months their rumen fluid was taken off from the rumen for analyzing using Rusitec. Each incubated ration contained 15g (dry matter bases) and wrapped into 10 x 20 cm polyester bag (50 ± 10 µm porous) and fermented for 48 h in vessel. Every 24 hours, the incubated bags were replaced with new batch and the result goes to 105°C oven overnight for dry matter and organic matter degradation determination. At the same time methane production and pH were measured. Data were analyzed using t-test. Methane production, pH effluent, dry matter and organic matter degradation rate using regression.

Result and Discussion

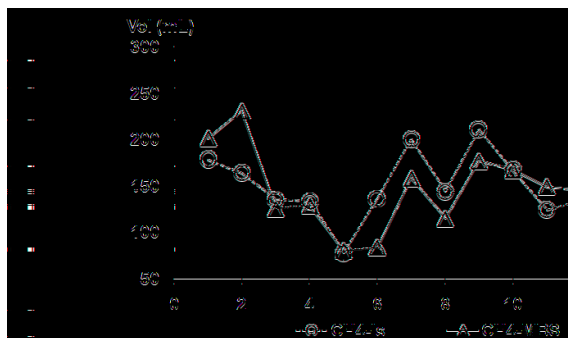
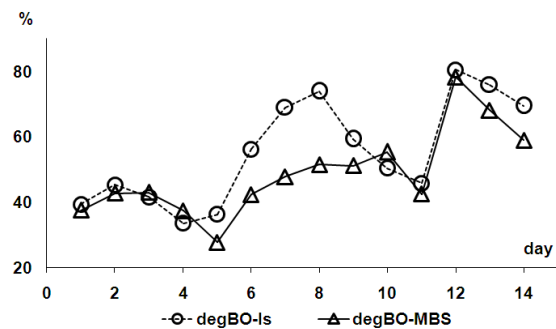
Methane production and pH value were not significantly different between treatments (Table 1). Jayanegara, *et al.*, (2009) reported that NDF and ADF were positively correlated with methane concentration. Our experiment showed that NDF percentage of IS has not significantly affected methane production. It was due to the ration has high soluble carbohydrate (52.27%). The fact was supported by dry matter and organic matter degradation of IS which was significantly higher (p<0.01) than MBS ration.

Table 1 Fermentation parameter of IS and MBS ration using Rusitec.

Ration	Methane (mL h ⁻¹)	pH	DM deg (%)	OM deg (%)
IS ration	164 ± 6.06	6.76 ± 0.08	52.35 ± 1.35	55.48 ± 2.62
MBS ration	153 ± 22.15	6.81 ± 0.04	44.75 ± 1.92	48.88 ± 1.94

Note: DM deg (dry matter degradation), OM deg (organic matter degradation)

Methane production rate, pH, dry matter and organic matter degradation were fluctuating by day and have cubic regression curve. Methane equation for IS was $Y_{(CH_4-IS)} = -0.003X^3 + 1.476X^2 - 16.21X + 181.7$ with $R^2_{(CH_4-IS)} = 0.49$, while for MBS was $Y_{(CH_4-MBS)} = -0.366X^3 + 10.11X^2 - 78.21X + 295.3$ with $R^2_{(CH_4-IS)} = 0.49$ (Figure 1). Organic matter degradation value of IS was $Y_{(degBO-IS)} = -0.013X^3 + 0.279X^2 + 1.233X + 36.64$ with $R^2_{(degBO-IS)} = 0.52$, while organic matter degradation value of MBS was $Y_{(degBO-MBS)} = -0.047X^3 + 1.248X^2 - 6.877X + 47.68$ with $R^2_{(degBO-MBS)} = 0.64$ (Figure 2).

**Figure 1.** Methane production pattern on rusitec fermentation**Figure 2.** Degradation of organic matter pattern on rusitec fermentation

It is concluded that there were no significant difference for both rations in sheep rumen fermentation to produce methane, but IS has DM and OM higher than MBS ration.

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Influence of Concentrate Containing Probiotics on Fermentation Characteristics and *in vitro* Methane Production of *Pennisetum purpureophoides*

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Introduction

Methane (CH₄) production from ruminant does not only cause a substantial loss in efficiency of animal production, but also contributes significantly to global warming. Recently, there is an increasing interest in research to evaluate the potential of probiotics as feed additives instead of chemical compounds *i.e.* ionophores and antibiotics as manipulators of rumen fermentation to decrease CH₄ production. In a previous study, Mwenya *et al.*, (2004) reported that adding yeast culture containing 21% of *S. cerevisiae* reduced CH₄ production by 10% in sheep as compared to the control sheep. In *in vitro* study, Lila *et al.*, (2004) concluded that *S. cerevisiae* stimulated mixed rumen fermentation with decreased lactate, and a small decrease of methane and hydrogen. Therefore, the objective of the present study was to evaluate the effect of different concentrate containing probiotics on fermentation characteristics and *in vitro* methane production.

Materials and Methods

The concentrates were mainly formulated from agricultural and food industry by-products *i.e.* tofu waste, cassava waste, sago waste and rice bran. Two LAB strains *i.e.* *Lactobacillus plantarum* and *Lactobacillus acidophilus*, and one yeast strain of *Saccharomyces cerevisiae* were used as probiotics. The LAB and yeast were mixed with sago gelatin, ZnSO₄7H₂O, CoCl₆H₂O and urea as catalytic supplement. Four type of concentrates namely I. Concentrate containing *L. plantarum* and *L. acidophilus* 2% (w/w); II Concentrate containing *L. plantarum*, *L. acidophilus* and *S. cerevisiae* 2% (w/w); III. Concentrate containing *L. plantarum* and *L. acidophilus* 4% (w/w); IV. Concentrate containing *L. plantarum*, *L. acidophilus* and *S. cerevisiae* 4% (w/w). Six treatments tested were (A) *P. purpureophoides* as control; (B). *P. purpureophoides* + concentrate without probiotic; (C) *P. purpureophoides* + concentrate I; (D) *P. purpureophoides* + concentrate II; (E) *P. purpureophoides* + concentrate III; (F) *P. purpureophoides* + concentrate IV. The ratio of *P. purpureophoides* and concentrate was 70 : 30 on DM basis. The samples were incubated in syringes containing rumen liquor-buffer mixtures at 39 °C for 48 hours. Variables measured were CH₄ production, and ammonia-N and volatile fatty acids (VFAs).

Results and Discussion

CH₄ production was reduced by 60.3% in grass substrate with concentrates (B, C, D, E and F) compared to grass alone (A). Addition of probiotics in concentrate reduced CH₄ production

by 18.8% compared to concentrate without probiotics. Methane production was significantly lower ($P<0.05$) in treatments D and F than treatments C and E. The reduction could be due to increasing utilization of hydrogen by ruminal acetogenic bacteria (Chaucheyras *et al.*, 1995). Total VFA concentration was higher ($P<0.01$) in grass substrate with concentrate (B, C, D, E, F) than grass alone (A). Concentration of propionic acid decreased ($P<0.01$) in grass substrate with concentrate than grass substrate alone, whereas concentration propionic acid increased ($P<0.01$) in grass substrate combined with concentrate. Addition of *L. plantarum*, *L. acidophilus* and *S. cerevisiae* in the concentrate increased ($P<0.05$) propionic acid concentration. This result was supported by Lila *et al.*, (2004) that increasing concentration of *S. cerevisiae* caused a linear increase in the proportion of propionate. Chamberlain (1987) revealed that lactic acid that produced by *Lactobacillus* could be converted to propionic acid by *Megasphaera elsdenii* in the rumen.

Conclusion

Addition of probiotics, strain of *L. plantarum*, *L. acidophilus* and *S. cerevisiae* in concentrate increased propionic concentration and decreased *in vitro* CH₄ production.

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Growth Performance of Local Sheep Fed with Mung Bean Sprouts Waste

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Introduction

There are two distinct types of local sheep in Indonesia, thin-tailed and fat tailed, with some strain differentiation within each, particularly the thin-tailed group (Sodiq and Tawfik, 2004). Jonggol and garut sheep are thin-tailed, with growth performance better than other breeds within group (Sumantri *et al.*, 2007; Sodiq and Tawfik, 2004). Growth performance is also influenced by nutrient content of feed. Mung bean sprouts waste is unconventional feedstuff which has been tested on local sheep. The waste contained 49.4% crude fibre and 13-14% crude protein (Rahayu *et al.*, 2011). The aim of this experiment was to evaluate the performance of growing local (jonggol and garut) male lambs fed with pellet ration containing 30% mung bean sprouts waste.

Materials and Methods

Eight local growing male lambs consisting of four UP3-jonggol and four garut (7-8 months of age and average body weight $\pm$ 15 kg), were used in this experiment for three months. The complete ration was pellet containing 30% of mung bean sprouts waste with 87.7% dry matter (DM), 16.7% crude protein, 24.5% fiber, 3.7% extract ether and 72.2% total digestible nutrient (TDN). The animals were reared in individual cages with water and feed *ad libitum*. Feed consumption was measured daily and body weight gain monthly. Parameters measured were average daily gain (ADG), daily feed consumption (FC) and feed conversion ratio (DFC/ADG). Data were analyzed by using t-test between the two breeds.

Results and Discussion

Average daily gain (ADG), daily feed consumption and feed conversion ratio were not significantly different between breeds (Table 1). Sumantri *et al.*, (2007) reported that UP3-jonggol sheep was produced from crossbred jonggol sheep and garut sheep, therefore both sheep breeds had a similar growth performance. The ADG (jonggol : 127.0 g/d and garut : 153.3 g/d) fed with 30% mung bean sprouts waste were higher than javanese thin-tailed sheep (107.9 g/d) (Herianti and Prawirodigdo, 2010), garut sheep (117.7 g/d) (Handiwirawan *et al.*, 2004) and other local sheep (95.0 g/d) (Dulджaman, 2004). Meanwhile, feed conversion ratios of jonggol (6.9) and garut (6.7) fed with 30% mung bean sprouts waste were better than javanese thin-tailed (7.2) (Herianti and Prawirodigdo, 2010).

Table 1. Growth performance of local sheep fed with Mung bean sprouts waste.

Parameters	Jonggol sheep (JS)	Garut sheep (GS)
ADG (g/day)	127.0 ± 21.3	153.3 ± 23.6
Feed consumption (g/day)	859.3 ± 65.4	997.0 ± 151.0
Feed conversion ratio	6.9 ± 1.0	6.7 ± 1.9

Note: ADG (average daily body weight gain), Feed conversion ratio (Feed consumption/ADG).

Growth performance of jonggol sheep (JS) and garut sheep (GS) changed during the three months experiment (Figure 1). At the beginning, ADG of garut sheep was higher than jonggol sheep, but gradually decreased, and at the end of the experiment, both garut and jonggol sheep showed similar ADG (a). Meanwhile, the daily feed consumption of garut sheep was higher than jonggol sheep (b). The feed conversion ratio of jonggol sheep tended to be higher than that of garut sheep at the beginning, but the ratio for garut sheep increased at the 2nd month and then decreased at the 3rd month, and finally both breeds showed similar feed conversion ratio (c).

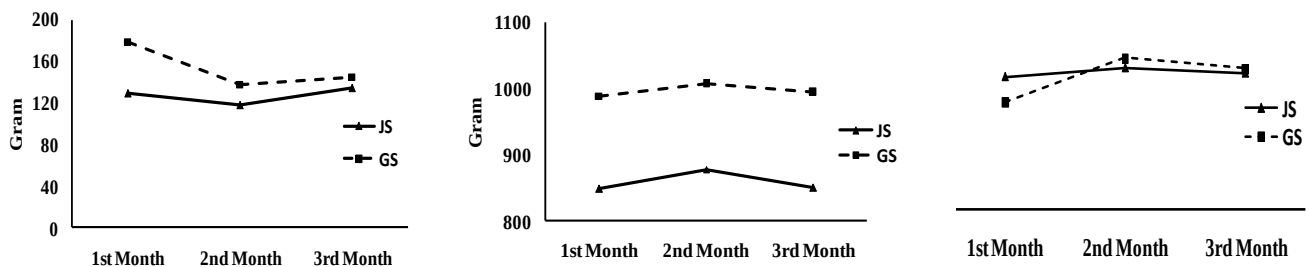


Figure 1. The average daily gain (a), daily feed consumption (b) and feed conversion ratio (c) of local sheep (jonggol and garut) during three months experiment.

It is concluded that there were no significant differences in growth performance between jonggol and garut breeds fed 30% of mung bean sprouts waste.

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Nitrogen Utilization of Treated Cocoa Pod-Based Ration in Steers: Prediction from Metabolic Parameters

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Introduction

Insufficient supply of forage may limit the potential production of ruminant. Accordingly, some agro-industrial by-products may constitute alternative feedstuffs to overcome such limitation, among them cocoa pod. Cocoa pod is a by-product of cocoa (*Theobroma cacao*) plantation from some areas in Indonesia. However, high concentration of cell wall limits its utilization although its pre-treatments may improve utilization (Saili *et al.*, 2010). Previous works have been focused to improve fiber digestibility of cocoa pod although there is still limited information on N utilization. The aim of this study was to investigate N utilization of treated cocoa pod-based ration fed to steers. Metabolic parameters were tested as predictive index of dietary N utilization.

Materials and Methods

Cocoa Pods (CoP) were obtained from PTP XII Rajamandala, Bandung, West Java). Prior to utilization, the raw material was treated as follow: (CTR) control (U) treated with 1.5% urea, (M) fermentation with 3% molasses, (RC) fermentation with 3% rumen content, and (M+F) fermentation with 3% molasses and fungi (*P. chrysosporium*). Treated and untreated CoP were then included (35% DM, basis) into total mixed rations (TMR) formulated to be iso-energy and iso-protein, (i.e. 65% total digestible nutrient and 17% crude protein respectively). Five Friesian Holstein steers were fed the experimental rations following a 5 × 5 Latin square design. Trial lasted for 30 d, 20d for diet changeover and 10 d for experimental measurements Parameters measured were average daily gain (ADG). N digestibility (ND) and retention (NR) together with rumen NH₃ concentration and microbial yield (MPS) based on urinary allantoin excretion (UA), Data obtained were statistically analyzed (statistical package) using the Duncan's test to detect treatment differences (P<0.05). Multiple linear regression analyses were used to predict NR and NPU (n = 25 data).

Results and Discussion

Rations containing 35% of cocoa pods treated with Urea (U) molasses (M) and 3% molasses + *P. chrysosporium* (M+F) improved NH₃ (P<0.05) concentration into the rumen compared with steers feed with CTR diet (Table 1). However, only the latter treatment M+F) increased MPS over CTR (P<0.05); the respective result was confirmed by the UA data since rumen microbial protein is excreted as allantoin in urine (Carro *et al.*, 2012). The patterns of ND, NR and NPU showed similarities and treatment rations improve such parameters in relation to CTR. The response was further reflected in ADG parameter, in which rations U and M

resulted in higher ADG than those of other rations ($P<0.05$). Apparently, better access of rumen microbes on the plant cell wall of cocoa pods due to ammoniation or fungal treatment stimulates the microbes growth efficiency and in turn N- efficiently.

Table 1. Nitrogen utilization of cocoa pod (untreated or treated) when fed to steers at 35% inclusion level in a total mixed ration

Parameter	A	B	C	D	E
Rumen NH_3 (mM)	4.69 ^a	6.30 ^b	4.18 ^a	4.84 ^a	5.90 ^b
MPS (g/d)	253 ^a	299 ^a	318 ^a	331 ^a	520 ^b
UA (g/d)	3.32 ^{ab}	3.98 ^b	3.69 ^{ab}	2.85 ^a	5.10 ^c
ND (%)	41.8 ^a	51.9 ^{ab}	42.8 ^a	44.3 ^a	55.2 ^b
NR (g/kg $\text{BW}^{0.75}/\text{d}$)	1.06 ^a	1.45 ^b	1.12 ^a	1.16 ^a	1.60 ^b
NPU (%)	40.6 ^a	50.1 ^{ab}	41.4 ^a	43.0 ^{ab}	53.0 ^b
ADG (kg/d)	0.76 ^a	1.56 ^b	0.94 ^a	0.75 ^a	1.46 ^b

Various superscripts within the same row showed significantly different at $P<0.05$.

A, control; B, ammoniation with 1.5% urea; C, fermentation with 3% molasses; D, fermentation with 3% rumen content; E, fermentation with 3% molasses and fungi *Phanerochaete chrysosporium*.

MPS, microbial protein synthesis; UA, urine allantoin; ND, nitrogen digestibility; NR, nitrogen retention; NPU, net protein utilization; ADG, average daily gain.

In relation to predicting N utilization NR and NPU, correlate with ADG, metabolic body mass (MBM), rumen NH_3 concentration, ND and UA. Multiple regression equations for predicting NR and NPU showed a significant correlation (R^2), i.e. 0.99 and 0.85, and the respective equations are presented below:

$$\text{NR} = 3.75 + 1.09 \text{ ADG} - 0.04 \text{ MBM} + 0.01 \text{ NH}_3 + 0.94 \text{ ND} + 0.54 \text{ UA}, R^2 = 0.99$$

$$\text{NPU} = 141.2 - 5.03 \text{ ADG} - 3.06 \text{ MBM} + 1.35 \text{ NH}_3 - 0.68 \text{ ND} - 1.01 \text{ UA}, R^2 = 0.85$$

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Effects of Enzyme Addition in Oil Palm Frond Silage Based Rations on Rumen Microbial Population of Adult Male Goat

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Introduction

Oil palm frond (OPF) is the most abundant by-product produced from oil palm plantation and had a potential value as source of roughage for ruminant. Several processing techniques have been developed to improve feeding values of OPF. OPF silage together with concentrate in total mixed ration (TMR) has proved to improve intake through better palatability.

Materials and Methods

The experiment was conducted using twenty four post-weaning males Thai Native x Boer crossbred (aged between 9-12 months) with an initial weight 11-18 kg. An experimental TMR containing (g/100 g DM; Table 1) was supplemented with an enzyme mixture produced by *Aspergillus* spp. BCC 274 (approximately) 1×10^7 , 9×10^6 , 2×10^6 , 1×10^6 and 2×10^6 unit/kg dry weight for xylanase, β -glucanase, cellulase, mannanase and amylase, respectively, were supplemented at 0, 2, 4 and 6 g/kg DM of the TMR.

Results and Discussion

Table 1. Chemical composition of experimental diets (% on DM basis).

Items	Level of enzyme (g/kg DM of TMR)			
	0	2	4	6
DM	95.85	95.92	96.07	96.21
OM	92.07	91.47	90.39	92.85
CP	11.44	10.80	11.84	10.99
NDF	59.95	51.81	53.70	59.04
ADF	36.62	35.48	37.02	36.48

The treatment of enzyme supplementation on the diet affected significantly ($P < 0.05$) the bacteria population at before feeding time (0 h) and the trend was cubic ($P < 0.01$) by increasing the level of enzyme. Meanwhile, the total population of protozoa at 4 h after feeding was significantly different ($P < 0.01$) between treatments. It also happened to the population both of holotrich ($P < 0.05$) and entodiniomorphs ($P < 0.01$) at the same time. The detail results are shown in Table 2.

Table 2. Effect of enzyme supplementation in TMR on rumen microbial population of goat

Items	Level of enzyme (g/kgDM of TMR)				SEM ¹	Contrast ²		
	0	2	4	6		L	Q	C
Total direct count								
Bacteria (x10 ¹⁰ cell/ml)								
0 h, post-feeding	1.48 ^a	1.68 ^a	1.05 ^b	1.48 ^a	0.12	ns	ns	*
4 h	1.07	1.22	1.22	1.61	0.15	ns	ns	ns
Mean	1.27	1.45	1.14	1.55	0.16	ns	ns	*
Total Protozoa (x10 ⁶ cell/ml)								
0 h, post-feeding	1.66	1.71	3.48	1.88	0.59	ns	ns	ns
4 h	1.10 ^c	1.49 ^b	2.07 ^{ab}	2.73 ^a	0.25	**	ns	ns
Mean	1.38 ^b	1.60 ^b	2.77 ^a	2.30 ^{ab}	0.60	*	ns	ns
<i>Holotrich</i> sp. (x10 ⁵ cell/ml)								
0 h, post-feeding	1.41	1.20	2.31	1.16	0.49	ns	ns	ns
4 h	1.75 ^b	2.78 ^b	3.24 ^{ab}	6.25 ^a	1.00	**	ns	ns
Mean	1.58	1.99	2.78	3.70	0.95	*	ns	ns
<i>Entodiniomorphs</i> sp. (x10 ⁶ cell/ml)								
0 h, post-feeding	1.51	1.59	3.25	1.75	0.56	ns	ns	ns
4 h	0.92 ^c	1.21 ^{bc}	1.74 ^{ab}	2.10 ^a	0.17	**	ns	ns
Mean	1.22 ^b	1.40 ^b	2.49 ^a	1.92 ^{ab}	0.42	*	ns	ns
Fungal zoospores (x10 ⁶ cell/ml)								
0 h, post-feeding	3.75	4.06	3.69	3.97	0.36	ns	ns	ns
4 h	5.74	5.82	5.81	6.93	0.82	ns	ns	ns
Mean	4.74	4.94	4.75	5.45	1.01	ns	ns	ns

¹SEM: standard error of the means²Contrast effects (L = linear, Q = quadratic, C = cubic)^{a-c}Means with different superscript within the same row was significantly different P<0.05

* P<0.05; ** P<0.01; ns: not significantly different (P>0.05)

According to Table 2 the population of ruminal microbes at 4 h after feeding was greater than before feeding. The trend of total bacteria at 0 hr among the treatments was cubic. The amount of bacteria at 4 g/kgDM of TMR was the lowest number (P<0.01). Usually, the increase in number of bacteria reflected the increase in ruminal digestibility especially for fiber digestion. Silva *et al.*, (1987) cited by Chen *et al.*, (2008) reported that the rate of fiber degradation depends on the extent to which the rumen environment allows an adherent cellulolytic microbial population to develop.

Conclusion

Increasing of level of enzyme enhanced protozoa population, reducing probably the rumen fermentation efficiency. Treatment enzyme at 2 g/kgDM of TMR showed the low ciliate population but the greatest titres of bacteria.

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Yak Grazing Behaviour and Energy Expenditure Under Extensive Grazing Conditions

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Introduction

The yak is a unique bovine that has survived on the Tibetan plateau for centuries under harsh alpine environmental conditions and under extensive grazing management all the year round. Because of the long period of negligible or zero plant growth each year (7-8 months) and year-round grazing management, yaks have to always go through such a cycle in one year, eating full in summer, getting fat in autumn, losing fat in winter, becoming exhaustible or dead in spring (Ding *et al.*, 2007). This situation has been exacerbated in recent years because of rangeland degradation, which has reduced the amount and quality of the herbage available, especially in the winter. However, such deterioration of pasture affects yak productivity throughout the year because of the high energy requirement for maintenance due to severe climatic conditions (long-term cold in winter, and increased temperature in summer), and the requirement to walk long distances in steep terrains to reach their pastures.

Material and methods

The experiment was conducted in Tianzhu Tibetan Autonomous County, Gansu Province, northwest China. The same twelve 4- to 8-year-old dry female yaks were used throughout the experiment selected from a farmer's large yak herd (80 yaks). The experimental yaks were integrated within a larger yak herd and subjected to traditional management, which was carried out on open pastures without fencing. Measurements of grazing behaviour were determined using solid-state behaviour recorders (IGER-Recorder) (Rutter *et al.*, 1997). Heat production was measured by using the HR method as described by Brosh *et al.* (2004), which is based on the measurement of HR and then relating it to the HP by calculation of O₂P through short simultaneous measurements of oxygen consumption (VO₂) and HR.

Results and discussion

The total grazing time of yaks is higher in grass growing season than in non-growing season (Figure 1). Total ruminating time was higher in late summer. The bite rate was significantly higher in early summer, which is up to 68 bites per minutes. The results showed that yaks adapted their foraging behaviour in response to changes in sward conditions. In the dry periods or seasons, the yaks did not extend their grazing time because of the low quality of

forage. In the grass germinating season (May), the yaks increased their bite rate and total grazing time as a response to reduced bite mass. As a result, the yaks extended much higher time for grazing and to grasp much more new germinated grass.

The average traveling distances calculated from the GPS data in December and May was shown in Figure 2. In December yaks traveled between 1000 and 1900 h, with a minor peak around 1200 h and a major peak around 1730 h. In May, yaks started to travel at about 0530 h and continued until 2400 h, but with two peaks of activity at around 0830 and 1830 h. The total daily distance traveled in December was significantly lower than in May (3.2 vs. 5.3 km). These results indicate that free-range yaks exerted much more energy for traveling in grass germinating period. The increased walking activity in May, in spite of the shortage in energy reserves of the yaks, was almost certainly motivated by the combination of high quality forage and low herbage mass.

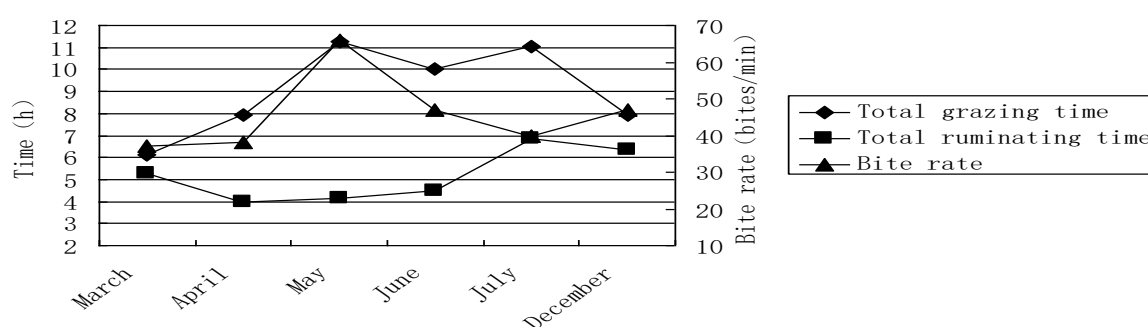


Figure 1 Total grazing and ruminating time, bite rate of free-range yaks in different months over 24 h

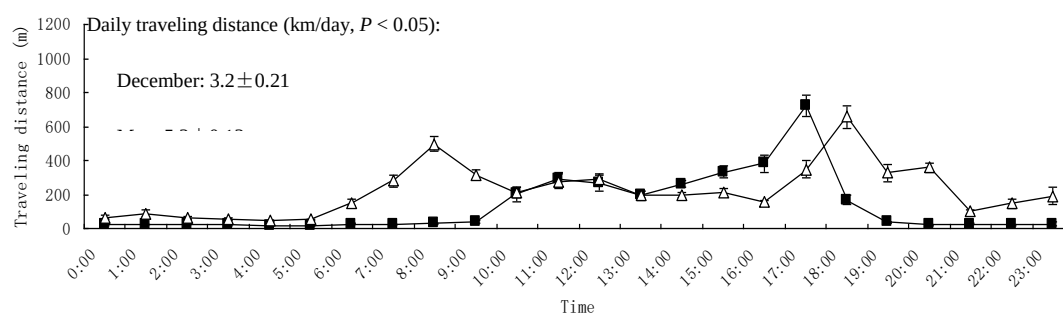


Figure 2. Mean distances traveled ($\pm$ S.E. bars) by free-ranging yaks within each hour of the day during May ($\triangle$, $n=30$) and December ($\blacksquare$, $n=22$).

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Effect of Feeding *Orpinomyces joyonii* on Rumen Fermentation, Digestability and Microbial Populations in Indian Murrah Buffaloes

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Introduction

In India, livestock subsist on low quality roughage and other fibrous feeds, poorly digested in the rumen. Several attempts to enhance the digestibility of low quality roughages by addition of rumen fungi as a source of lignocellulolytic enzymes have been reported, although there were none on the administration of *Orpinomyces joyonii* in buffaloes (*Bubalus bubalis*). This study evaluates the effect of *O. joyonii* administration on nutrient digestion, N retention and rumen fermentation characteristics of Indian Murrah buffaloes.

Materials and Methods

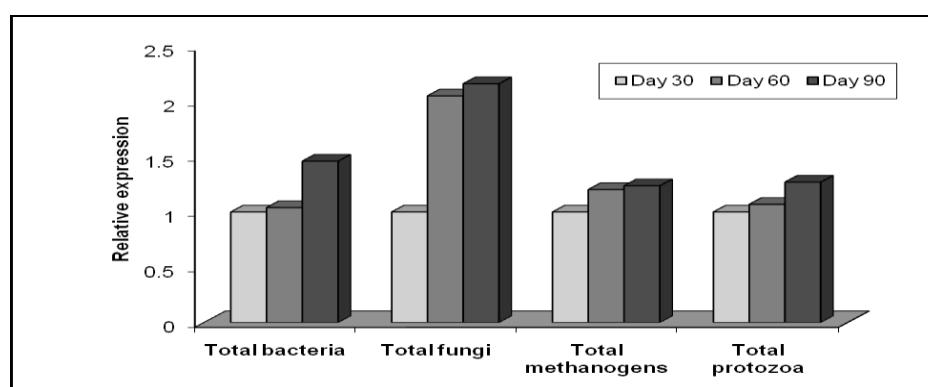
Three fistulated Murrah buffaloes (BW 526 ± 5 kg) fed a mixed diet (concentrate: roughage 40: 60) were selected for the trial. Roughage portion consisted of wheat straw ad libitum along with 1 kg (animal/d) green fodder. Animals were adapted to the diet for 21d followed by 7d digestibility trial. Thereafter, animals were administered 250 ml broth containing 10^6 tfu/ml of *O. joyonii* twice weekly for 30 days. Digestibility trials and rumen samplings were performed on d30, 60 and 90. Proximate, chemical and VFAs analysis were performed as per AOAC (1995), Erwin *et al.*, (1961) and Van Soest *et al.*, (1991). Quantitative real-time PCR was performed to investigate the abundance of the rumen bacteria, fungi, methanogens and protozoa before, during and after supplementation. Moreover, microbial counts in rumen liquor were estimated also by anaerobic roll tube technique and protozoa were recorded by optical microscopy.

Results and Discussion

Supplementation of *O. joyonii* resulted in increase in dry matter intake, nutrients digestibility and propionate levels in Murrah buffaloes. Total rumen bacteria and total fungi showed >2-fold increase on d60 and d90. Supplemented fungus was able to establish and survive in treated animals even after discontinuation of supplementation (on day 90) as indicated by higher digestibility coefficients, propionate levels and higher microbial populations. Our findings indicate that *O. joyonii* may be utilized for enhancing the fibre digestibility under Indian livestock production system..

Table 1. Effect of feeding *O. joyonii* on DM digestibility and fermentation parameters.

Parameters	DAY		
	30	60	90
DMD	67.58 ± 2.31	73.27 ± 2.79	74.96 ± 0.05
DDMI (kg/d/head)	6.26	8.28	9.47
TDN %	58.04	65.11	68.09
TVFA (mM)	16.02	12.18	16.03
Propionate (mM)	5.43	9.37	7.19
NH ₃ -N (mg/100 ml)	19.09	15.54	16.47
Total bacteria (×10 ¹¹)	2.7 ± 0.3	6.7 ± 0.2	6.0 ± 0.1
Total fungi (×10 ⁵)	4.37 ± 0.6	49.7 ± 2.1	16.2 ± 1.3
Total protozoa (×10 ⁴)	8.16 ± 0.3	8.08 ± 0.08	8.4 ± 0.08

**Figure 1.** Effect of *O. joyonii* supplementation on rumen microbial groups in Murrah buffaloes as determined by Real-Time PCR.

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Effect of Different sources of Biochar and Bentonite on Methane Production in a Rumen in vitro Incubation

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Introduction

Earlier studies in our laboratory (Leng *et al.*, 2012a) showed that incorporation of biochar prepared by carbonization of rice husks in a gasifier stove reduced methane production *in vitro* and also *in vivo* (Leng *et al.*, 2012b). We hypothesized that the action of biochar in rumen ecosystems was as a potential improved location for biofilm microbial consortia to facilitate microbial activity, including oxidation of methane by methanotrophic organisms.

The capacity of biochar to act as a functional site for improved biofilm formation is thought to be related to the large surface to weight ratio ($>30\text{m}^2/\text{g}$), creating opportunities for adsorption of both micro-organisms and nutrients. Bentonite clays are also characterized by their high adsorptive capacity and have been demonstrated to improve microbial protein availability in sheep (Fenn and Leng, 1970).

Materials and Methods

Treatments and experimental design

The design was a completely randomized block with eight treatments and 4 replicates. The fermentation was over a total period of 24 h with measurements of gas production and content of methane in the gas at 3, 6, 12 and 24 h. At the end of the 24 h fermentation the DM mineralized was determined by filtering the contents of the fermentation bottle. The treatments were: Bentonite clay powder from Australia (Ben-A) and Vietnam (Ben-V); two commercial samples of biochar from Australia (Bio-AL and Bio-AM) and two from Lao PDR (Bio-LPN and Bio-LPO); one commercial sample of activated charcoal from Colombia (AC); control with no additive (No-bio). The substrate contained cassava root meal, cassava leaf meal and urea. The *in vitro* system was that used by Inthapanya *et al.*, (2011). The biochar samples from Lao PDR (LP-N and LP-O) were produced by carbonizing rice husks in a top lit updraft (TLUD) gasifier stove (Olivier, 2010) at estimated temperatures in the range 700-900°C.

Results and discussion

The percentage methane in the gas increased with a curvilinear trend as the fermentation time was increased (Figure 1). The relative effect of the various additives in decreasing methane production appeared to improve as the fermentation time (and the production of methane) increased.

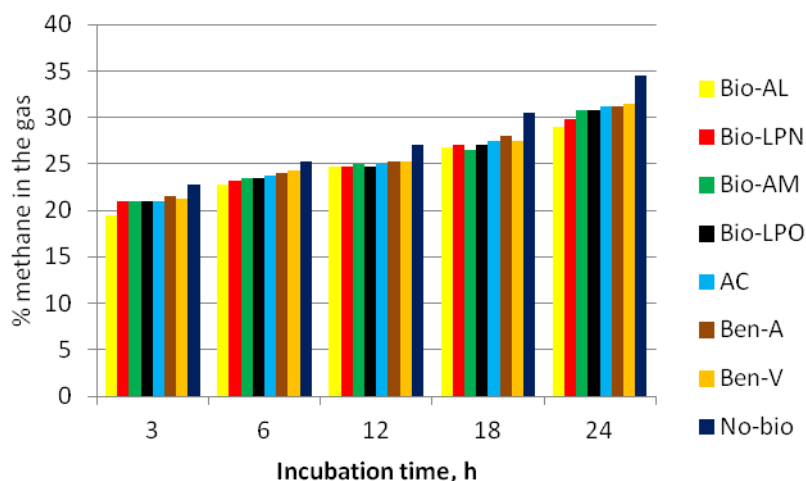


Figure 1. Effect of incubation time and sources of biochar and bentonite on methane content of the gas in a rumen *in vitro* system with substrate of cassava root, cassava leaf and urea

Acknowledgement

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Some Differences in Protein Nutrition in Swamp Buffaloes

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Introduction

The final meeting of the joint FAO/IAEA (2002) for development, standardization and validation of nuclear based technologies for estimating microbial protein supply in ruminant livestock for improving productivity (purine technique) concluded that buffaloes have much lower (and more variable) urinary excretion of purine derivative (PD) per unit DOMI than cattle. Urinary PD excretion in buffalo is not related to lower supply of microbial cells from the rumen, or to absorption of purines from the small intestine, but to differences in tissue metabolism for which mechanisms are not fully understood. Thus this is the reason why buffaloes differ from cattle with respect to PD excretion and the mechanism for this difference should be investigated.

Materials and Methods

NPN supplement (feeding urea-molasses cakes)

The urea-molasses cakes (UMC) were processed with the composite: molasses: 30%; urea: 10%; rice bran: 50%; lime powder: 8%; salt: 1%; premix: 1%. The mixture was mixed well and then put in the wood molds, strong pressed then dried at 60°C for 18 hours. The study used 27 female swamp buffaloes (*Boss bubalus*), mean body weight average was 320 kg, with age range from 20 to 27 months, and 27 female local yellow cattle (*Boss indicus*) mean body weight was 200 kg with age range from 20 to 25 months. The rice straw fed at a rate of 2% (DM) of animal body weight. Animals were fed at 5 pm, frequently checking if the cakes fell out or not. Uneaten feed was collected for calculation of intake at 7 am the next morning.

NH₃ concentration in rumen fluid

Forty two swamp buffaloes (30 females and 12 males) with mean body weight 330 kg and 42 local yellow cattle (30 females and 12 males), mean body weight 210 kg were selected. The animals were grazing half time per day in the same pasture (the grass with composition of DM: 29.6%; ash: 9.3% and CP: 10.9%) and half time kept under indoor feeding of rice straw (80.9% DM; 6% CP and 12% ash) fed 1% (DM) of animal body weight for 10 days without any addition, with unlimited water drinking supplied from buckets. Rumen fluid samples were collected at 5 am, before grazing; with syringes connect to the tubes. In the process of rumen fluid sampling, tubes were moving in the rumen to obtain fluid from different locations in the rumen then analyzed for NH₃ in the laboratory with Kjeltex 2200 analyzer.

Results

Results in Table 1 for showed that buffaloes were less interest in the cakes given to them than cattle. The amount of UMC consumed by the buffalo on the first day was 34% of the cattle. After 10 days, the consumption was increased in both types of animals, but buffaloes was still lower ($P < 0.001$), on average the amount of cakes consumed was 57% of the cattle.

Table 1. Intake of urea-molasses cake

Animal	1st day(g)	10th day(g)
Buffalo (n = 27)	41.11	287.04
Cattle (n = 27)	121.85	501.11
SE	15.6	9.3
P	0.001	0.001

The results for the NH_3 concentration in rumen fluid showed that the rumen fluid NH_3 is significantly higher in buffaloes ($P < 0.001$) (Table 2). It was only 58% in yellow cattle compared to buffaloes.

Table 2. Rumen fluid NH_3 concentration

Animal	Buffalo (n = 42)	Cattle (n = 42)
Mean(mg/L)	129.02	74.18
Minimum(mg/L)	73.36	26.04
Maximum(mg/L)	272.16	138.13
SE mean	7.09	4.17
SE	5.8	5.8
P	0.001	

Discussion and Conclusions

NH₃ supply requirement

Buffaloes consumed less UMC than cattle. This result agrees with our previous work when rice straw were sprayed with 0, 0.5, 1 and 2% of UMC and given *ad libitum* to the animals, the results showed no significant differences on intake, feed digestibility and purine derivative (PD) excretion in the urine of the buffaloes. Maybe buffaloes have the ability to recycle nitrogen back to the rumen as an ability to adapt to the conditions with low N in feed resources.

NH₃ concentration in rumen fluid

We have previously reported higher ruminal NH_3 in buffaloes then cattle when the animals were fed by rice straw supplemented with different levels of urea (Thanh 2012). In this experiment, we tested on farm animals and again obtained similar results which clearly showed that the rumen fluid NH_3 in buffaloes was significantly higher than cattle. This may indicate that buffaloes may have the ability to recycle urea to the rumen as well as PD to meet the nitrogen required by rumen microbes. This is important for their development and feed fermentation activities and provides the microbial protein source for the host animal. That could be the reason why the PD excretion in buffalo urine was lower than cattle and they need less crude protein in their roughage diet than cattle, because they are physiologically adapted to efficient recycling of urea as well as PD.

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Effect of Agro-Industrial By-Products as Roughage Source on Growth Performance of Fattening Steer

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Introduction

Agro-industrial by-products such as bagasse, vinasse, sweet corn and pineapple peel can be used for feed in its fresh state, or in ensiled form chopped and made a silage bag when forages are in short supply. Nonetheless, using only the materials to produce silage are usually limited in the nutrients, palatability, feed digestibility and shelf life. Vinasse can be used for animal feed ingredient (Cavani and Manfredini, 1979; Stemme *et al.*, 2005) as a source of nutrition and minerals for animal feed such as pigs, poultry and ruminant animal. Bagasse was high in quantity from industry. However, bagasse is the highly fibrous residue remaining after sugar cane is pressed to remove sucrose and contains low proteins and high cellulose. Therefore, bagasse and vinasse mixed (BV) with another agro-industrial by-product such as corn cob, corn husk and pineapple peel which can enhance each other in nutrient composition and palatability may produce a better silage. The aim of this study was to evaluate silage produced from BV mixed with sweet corn husk and cob and pineapple peel on silage quality and chemical composition. In addition, feed intake and growth performance of fattening steer will also be investigated.

Materials and Methods

Animal and diets

Forty eight steers with 50% Brahman 50% Thai native blood were used in the present study. All steers were 18 month old with an average body weight of 263.96 ± 37.74 kilograms. All animals were randomly allocated to three treatments and allowing 14 days of adjustment period before the data were collected. Treatment 1 was fed with concentrate, rice straw and molasses (control). Treatment 2 was fed with concentrate and bagasse vinasse mixture with sweet corn husk and cob silage (BS) while Treatment 3 was fed with concentrate with bagasse vinasse mixture with pineapple peel silage (BP). For silage management, the bagasse and vinasse mixture (BV) was developed using bagasse from sugar industry by-product and vinasses from the ethanol plant. Bagasse and Vinasse Mixture was mixed at the ratio of 70% vinasse and 30% bagasse. BV was then further mixed with sweet corn husk and cob silage and considered as BS for T2 and mixed with pineapple peel mashed silage and considered as BP for T3. All feed groups were opened and samples were collected and analyzed for chemical composition and fermentation characteristics. In addition, all groups were given 13% CP of commercial concentrate feed with twice a day feeding. They were fed *ad libitum* on roughage and supplemented with rice straw and molasses. The feed consumed by all steers in each group were calculated based on nutrient requirement for maintenance and production (NRC, 1991).

Measurements and Statistical analysis

The procedures described by AOAC (1990) were used to determine the chemical composition of all feeds. The Neutral Detergent Fiber (NDF), Acid Detergent Fiber (ADF) and Acid Detergent Lignin (ADL) in feed samples by the method of Goering and Van Soest (1970). All data were analyzed as a Completely Randomized Design (CRD) with three replicates. Data were analyzed by analysis of variance (ANOVA) of the Statistical Analysis System (SAS, 1996). Duncan's New Multiple Rang Test was used to test different among treatment means (Steel and Torrie, 1980).

Result and discussion

The chemical composition of bagasse before mixing with vinasse was low in protein but high in crude fiber, acid detergent fiber, neutral detergent fiber and cellulose. The crude protein contents were enhance from 2.02 to 7.80 by mixed with vinasse. The dry matter of BS and BP found to be 27.45 and 25.60 % respectively. Crude protein content of BV, BC and BP were 7.80, 8.74 and 9.10 %, respectively. Moreover, nitrogen-free extract in BVM+PAW was higher than all groups. The pH levels in BV, BS and BP were found to be significantly different ($P<0.05$). In addition, acetic and butyric acids in BS were higher than BP ($P<0.05$). For growth performance of fattening steer, the total DMI of feed intake and body weight of total DMI in the T1 (9.77 ± 0.38) was higher than T3 (8.12 ± 0.43) and T2 (7.00 ± 0.43) respectively ($P<0.05$). In this study, dietary treatment had significant effect on body weight gain. Steers fed with BP (T3) had higher weight gain (35.65 ± 4.42 kg) than the T1 and T2 ($P<0.05$). Feed conversion ratio of steer in T3 (6.89) was lower than T1 (10.55) and T2 (7.82) respectively ($P<0.05$).

Conclusion

The BV could be used to mix with sweet corn husk and cob and pineapple peel mashed to produce silage. The protein content of BS was higher than BP and contained around 25% dry matter for both silages. The fermentation characteristic of BS and BP were in the optimal range. Steer fed with BP tended to yield the highest average daily gain and feed conversion ratio among all treatments.

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Fertility and Hatchability Characterization of Three Strains of Egg Type Chickens

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Abstract

The fertility and hatchability characteristics of three popular strains of egg type chickens in Nigeria, namely ISA Brown, Alpha (Improved native) and the local strain (Pure native) chickens were studied. They were compared from twenty weeks of age using 15 hens and 3 cocks from each strain. The parameters recorded were egg production, egg weight, percent fertility and hatchability. The experiment was replicated three times. The data obtained showed that the improved native strain produced more eggs followed by the exotic strain and lastly, the pure native strain. ISA Brown strain and improved native strain were similar in egg weight; but performed better than pure native and the other strains. The ISA Brown recorded mean egg weight of 59.27 ± 0.02 g, Improved native recorded mean egg weight of 53.10 ± 0.02 g and the pure native recorded mean egg weight of 41.00 ± 0.02 g. Conversely, fertility was highest in the pure native strain (86.04%) followed by improved native strain (83.08%) and the exotic strain recorded the least percent fertility of (68.21%). Hatchability was highest in the improved native strains (77.33%), followed by the pure native (73.55%) and ISA Brown (exotic) which recorded the lowest level of hatchability (61.24%). From the findings, the improved native strain performed well in all the parameters investigated and has enough room to carry out selection for improvement.

Effect of Introducing Different Breeds of Chicks to Scavenging System at Different Ages on Growth, Survival and Adaptation Traits in Malawi

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Introduction

The population of indigenous chickens in Malawi is dramatically increasing (Chintsanya, et al, (2004) with average flock size of 10 – 15 chickens per household (Gondwe, 2004). The majority of Indigenous chickens are kept by smallholder farmers in rural communities, mostly in free-range systems but their productivity is very low in terms of meat and egg production. The Malawi Government instituted a Smallholder Village Poultry Improvement Program (SVPIP) aimed at improving meat and egg production of indigenous chickens through cross-breeding with the Black Australop (BA). BA breed was chosen for its dual-purpose functions and its ability to survive harsh tropical conditions. Hyline is the only breed in Malawi used for egg production under intensive system. This study was done to determine the effect of introducing local BA and Hyline chicks to scavenging system at different ages on growth, survival and adaptation traits.

Materials and Methods

The study was done on farm at Nsabwe village and Chisemphere village in Lilongwe, Malawi. Three breeds; Hyline, BA and indigenous chicks were used in the study. These chickens were brood under intensive system and thereafter distributed to 16 farmers. The chicks were distributed at 2, 4, 6 and 8 weeks of age. The farmers raised the chicks under scavenging system. Data was collected on weight gain, mortality rate, incidence of disease and distances covered when scavenging. Indigenous chickens were considered as the control group of the study since most Malawi farmers raise poultry under scavenging system. Data management and analysis was done using a Statistical Package for Social Scientist (SPSS).

Results and Discussion

The results showed that although the BA had higher weight gain compared to BA and Hyline chicks (25g per day), they presented high mortality rates of more than 80 %, due to coldness, Pneumonia, coccidiosis, coryza as well as nutritional problems. Hyline performed better in terms of mortality rate which was 20%. Although they had some problems of coccidiosis, they were responding well to treatments. In terms of scavenging ability indigenous chickens and Hyline were scavenging at a radius of more than 100 meters from the chicken houses while BA was scavenging within a radius of less than 100 meters from the dwelling houses. Hylines had good scavenging ability since they were not scavenging very far from dwelling house and they were able to be protected from predators. The observed high predation rate in local chickens was associated with long distances of more than 200m away from dwelling house. The observed high performance of Hyline in terms of mortality rate is in

agreement with Chikuse et al., (2005) who reported that Hyline performed better under semi scavenging conditions in terms of survivability and egg production. Black Australop performed better in terms of growth rates under scavenging systems which agree with Gondwe (2004) who indicated that performance of local chicken was not significantly different from that of BA under scavenging conditions but it had higher mortality.

Conclusion

The results of this study showed that Hyline performed better under scavenging system in terms of performance and survivability when released for scavenging from six week old than the other breeds. Therefore Hyline breed would be recommended for village conditions after the age of six weeks.

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Effect of Extender on Quality of Native Chicken “Luang hang kao” Spermatozoa

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Introduction

Chicken semen shows a limited ejaculated volume, and this characteristic provides a limitation for artificial insemination (AI). Therefore, the extension of neat semen with proper diluents is required prior to AI and storage. The extender has to provide an energy source for spermatozoa, and maintain pH and the osmolarity level of diluents. In addition, it should be compatible with the biochemical composition of chicken semen (Donoghue *et al.*, 2000; Siudzinska & Lukaszewicz, 2008). Moreover, the pH and osmotic pressure of diluents can affect the motility, metabolic rate and morphology of spermatozoa. Several experiments have indicated that chicken sperm can tolerate a pH range of 6.0 to 8.0 and osmolarities ranging from 250 to 460 mOsm/kg (Donoghue & Wishart, 2000; Siudzinska & Lukaszewicz, 2008). There is a need to develop a more effective extender for chicken sperm preservation. The aim of this study was to determine the effect of extenders on the quality of native chicken “Leung hang kao” spermatozoa.

Materials and methods

Luang hang kao cocks of 1.7 years old and 74 weeks old Isa Brown hens were used in this study and kept in individual cages at Suranaree University of Technology Farm, Nakhon Ratchasima, Thailand. Sperm was routinely collected two times a week by dorso-abdominal massage (Burrows & Quinn, 1937). Sperm with a motility percentage higher than 75 was used for preservation. Pooled semen was diluted with three extenders (modified extender, Beltsville Poultry Semen (BPSE) (Sexton, 1977) and Lake's diluted (Lake, 1978), at a ratio of 1:3 (sperm: extender). Fresh semen, which diluted with 0.9% NaCl and 0.2% glucose, was used as a control. The diluted milts were stored at 4-5 °C for 24 h. After 24 h of storage, Sperm motility percentage and velocity parameters (curvilinear velocity (VCL), average path velocity (VAP) and straight line velocity (VSL) were determined by image J program. The dye eosin-nigrosin was used to evaluate sperm viability. The fertility percentage was determined by egg candling at day 10 of incubation. The data percentages were subjected to arcsine transformation prior to analysis. Analysis of variance (ANOVA) at $\alpha = 0.05$ using SPSS for Windows was used to analyze the differences between treatments. Significant differences between treatments were compared using Duncan's New Multiple Range test.

Results and Discussion

Sperm diluted with the control extender yielded the highest motility percentage (79.88%) but it was not significantly different from Lake's diluent (74.08%; $P>0.05$). Furthermore, the motility percentage of sperm diluted with Lake's diluent was not significantly different from the Modified extender or BPSE ($P>0.05$) (Table 1). The VAP, VSL and VCL analyses indicated that the sperm diluted in control had the highest velocity in VAP (143.36 $\mu\text{m}/\text{sec}$) and VSL (109.59 $\mu\text{m}/\text{sec}$) ($P<0.05$). The sperm diluted with control was not fertile which may be the result of sodium chloride having a harmful effect on the characteristic changes of spermatozoa (Wales and White, 1957). Moreover, the sperm diluted in Lake's diluents yielded the highest VCL (387.03 $\mu\text{m}/\text{sec}$), but it was not significantly different from the modified extender (312.57 $\mu\text{m}/\text{sec}$) ($P>0.05$). Furthermore, the sperm diluted in Lake's diluent had the highest viability percentage (92.60%) ($P<0.05$). Lake's diluent includes polyvinylpyrrolidone, which can prevent sperm cell damage at low temperature. Lake's diluent and BPSE yielded a good fertility compared to the other treatments. These showed that the best results are obtained from those extenders that have a higher hyperosmolarity than the seminal plasma of native chicken "Luang hang kao" sperm ($306 \pm 2.65 \text{ mOsm}/\text{kg}$) because the hyperosmolarity of the extenders did not cause adverse morphological changes in the sperm morphology in relation to forms with bent neck. In addition, Wales and White (1957) reported that the spermatozoa can retain their fertilizing capacity better in hypertonic than hyperosmotic media. Nevertheless, sodium chloride in modified extenders causes damage to sperm cells. Therefore, this substance yielded low fertility.

Table 1. Effects of extender on motility, velocity parameters, viability and fertility of native chicken "Leung hang kao" spermatozoa (mean $\pm$ S.E.)

	Control	Modified Extender	BPSE	Lake's diluent
Motility (%)	79.88 $\pm$ 2.15 ^a	65.47 $\pm$ 2.47 ^b	68.61 $\pm$ 4.40 ^b	74.08 $\pm$ 3.14 ^{ab}
VAP ($\mu\text{m}/\text{sec}$)	143.36 $\pm$ 9.26 ^a	124.04 $\pm$ 4.98 ^b	66.96 $\pm$ 2.04 ^c	117.50 $\pm$ 3.35 ^b
VCL ($\mu\text{m}/\text{sec}$)	312.57 $\pm$ 6.77 ^b	339.26 $\pm$ 5.29 ^a	264.64 $\pm$ 11.02 ^c	387.03 $\pm$ 8.12 ^a
VSL ($\mu\text{m}/\text{sec}$)	109.59 $\pm$ 9.52 ^a	71.39 $\pm$ 3.70 ^b	41.43 $\pm$ 2.24 ^c	80.1 $\pm$ 2.96 ^b
Viability (%)	85.40 $\pm$ 1.86 ^b	83.80 $\pm$ 2.37 ^b	86.60 $\pm$ 1.57 ^b	92.60 $\pm$ 1.57 ^a
Fertility (%)	0.00 $\pm$ 0.00 ^c	45.49 $\pm$ 9.95 ^b	78.73 $\pm$ 3.24 ^a	72.13 $\pm$ 6.84 ^a

^{a, b, c} Mean with different superscripts in each row are significantly different at $P<0.05$

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Effect of Temperature and pH on Activity of Purified Enzyme of *Aspergillus flavus*

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Abstract

In view of the fact that temperature and pH play key roles in the activity of fungal cellulases, this experiment was designed to assess the effect of temperature, and pH on activity of the purified enzyme from *Aspergillus flavus* derived from rotten wood. The characterization of the purified cellulase enzyme of *Aspergillus flavus* was carried out using Carboxymethyl cellulose, Filter paper and Cotton wool assays. The maximum and optimum temperatures were 90⁰C and 70⁰C respectively, and optimal pH values were between 5 and 8. The enzyme retained above 50% of its original activity at 100 ⁰C for 1h and up to 80% at 80 ⁰C for 1h. It was stable over a pH range of 5-8, and retained up to 40% of its original activity at pH 9. The study carried out showed that the purified *Aspergillus flavus* cellulases demonstrated useful properties among which include; high optimum temperature, increased thermal stability at both acidic and alkaline pH. They also offer additional advantage as they are more rigid than meso enzymes and moreover, are more resistant to thermal and chemical denaturation. Hence *Aspergillus flavus* cellulases are remarkable tools for developing commercial biotechnologies and for studying protein stability.

Effect of Levels of Deep Stack-Broiler Litter on Chemical Composition and Rumen Degradability of Commercial Concentrate Diets

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Abstract

The objective of the experiment was to investigate the chemical composition and rumen degradability of the diets containing different levels of deep stacked broiler litter. Broiler litter was collected from a commercial broiler houses in Khartoum North, Sudan. Deep stack was prepared in an underground silo pit (2*2*2 m) for a period of month. Four concentrate rations were formulated compromising deep stacked broiler litter at a rate of 0, 15, 30 and 45 % of ration in addition to other feed ingredients of molasses, sorghum, ground nut cake, wheat bran, ground nut hulls, limestone and salt. Chemical composition of the four diets showed no differences ($P>0.05$). There were significant ($P<0.05$) differences in the slow degradable fraction among four diets, but for other kinetic fractions there were no significant ($P>0.05$) differences found. Degradability of dry matter increased for the diets ($P<0.05$) during incubation in the rumen of fistulated buffalos from 24.05% at 3 h of incubation to 56.49% at 96 h, from 27.05% to 46.33% and from 26.7% to 47.58% for B, C and D, respectively. In conclusion, there is a possibility of incorporating deep stacked broiler litter into animal feeds hence reducing the cost of production of feed and consequently reducing the unit cost of animal products.

Effect of Linseed Oil Supplementation on Growth Performance and Blood Parameters of Beef Steers

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Introduction

Fat content, fatty acid composition and cholesterol level in meat are of major importance for consumers health due to their importance for meat quality and nutritional value (Orellana *et al.*, 2009). A high blood cholesterol level is a major risk factor for atherosclerotic coronary heart disease (CHD). Williams (2000) reported that unsaturated fatty acids have cholesterol lowering effects. Linseed oil is a ready, natural source of α -linolenic fatty acid, and it may afford polyunsaturated fatty acids (PUFAs). It is also a precursor of eicosanoids, which play an important antithrombotic and anti-inflammatory role (Palmquist, 2009). In general previous studies reported the effect of different linseed form and concentration on performance and on FA composition of muscle and adipose tissue in beef cattle (Mach *et al.*, 2006). Thus, the objective of this study was to determine the effect of linseed oil supplementation on growth performance and blood parameters of beef steers.

Material and Method

Fifteen fattening steers, averaging 337 ± 43 kg live weight (LW) and approximately 2 years old, were stratified and randomly assigned in completely randomized block design. All steers were fed approximately 4 kg/d of 14% CP concentrate with *ad libitum* fresh grass (*Pennisetum purpureum* x *Pennisetum americanum*) and free access to clean water and were individually housed in a free-stall unit. The treatments were 1) control concentrate plus 200 g/d of palm oil; 2) control concentrate plus 100 g/d of palm oil and 100 g/d of linseed oil; 3) control concentrate plus 200 g/d of linseed oil. Data measurements were analyzed by ANOVA for a completely randomized design using the Statistical Analysis System (SAS, 1996). Significant differences among treatments were assessed by Duncan's new multiple range test. A significant level of $p < 0.05$ was used (Steel & Torrie, 1980).

Result and Discussion

Animal performance and blood parameter data are summarized in Table 1. In the present experiment, they were not affected by the dietary treatments ($P > 0.05$). In conclusion, the present experiment revealed that oil supplement had no negative effect on the growth performance and blood parameters of beef steers. Daily total DM intake (DMI) across the treatments was similar because total energy consumption was balanced. These results suggest that considerable amounts of triglyceride-rich lipoproteins were secreted into the lymphatic system and eventually reached the general circulation via the thoracic duct. Similar increases

in cholesterol and lipoprotein cholesterol in blood plasma of cows fed fat have been reported by others (Dai *et al.*, 2011)

Table 1. Effect of treatment on dry matter intake (DMI) and blood parameters of beef steers.

Item	Treatment ¹			SEM	Pr>F ²
	PO	MO	LO		
DMI (kg/d)	9.31	9.24	9.56	0.16	
Initial live weight (kg)	336	338	338	11.17	0.9983
Final live weight (kg)	402	409	402	10.91	0.9566
ADG (kg/d)	0.9	1.0	0.9	0.06	0.7835
Cholesterol (mol/L)	255.5	192.5	203.5	18.33	0.4090
Triglyceride (mol/L)	41.5	34.0	30.5	2.62	0.2442
LDL (mol/L)	9.5	7.0	12.5	1.52	0.4219
HDL (mol/L)	181.5	153.5	162.5	8.16	0.4544
VLDL (mol/L)	64.5	32.0	28.5	11.92	0.5010

¹ Treatments were: 1) PO = control concentrate plus 200 g/d of palm oil; 2) MO = control concentrate plus 100 g/d of palm oil and 100 g/d of of linseed oil;. 3) LO = control concentrate plus 200 g/d of linseed oil.

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Fermentation of Indigofera-based Rations in Rusitec fermentors: Methane Production

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Introduction

Effort to increase the productivity of dairy goats in Indonesia is often hampered by the poor feed quality, so milk production in goats averaged less than 1.5 L/goat/ day. Farmers give concentrate to fulfill requirements of the animals. However, concentrate is expensive especially for small-holder farmers. Certain leguminous species (e.g. *Indigofera zollingeriana* (CP: 28-31% DM) with high protein content may be a potential alternative to concentrate.

Indigofera has a rapid growth, adapted to low fertility soil, easy and inexpensive maintenance with high biomass production (up to 51 tons of DM/year/ha), (Abdullah and Suharlina, 2010). Fed to dairy goats, Indigofera increased milk production (up to 26%) and increased feed efficiency (15-23%) (Abdullah *et al.*, 2012). This study aims to investigate the effect of Indigofera on rumen fermentation and methane production using a Rusitec fermentor system.

Materials and Methods

Raw Indigofera was sun-dried, followed by oven-dried at 70 °C for 3 h. The dried plant was included in rations at different levels of inclusion: R1: 80%, R2: 60% ;, R3: 40%, R4: 20% of dry Indigofera, and R5: was the CTR diet without Indigofera. Diets were then pelleted (4 mm) and subjected to an *in vitro* study by using RUSITEC (Czerkawski and Breckenridge, 1977). Variables observed were dry matter and organic matter digestibility, methane emission, protozoa and bacteria populations, and volatile fatty acid (VFA) concentrations. The data were analyzed using analysis of variance (ANOVA), followed by least significance difference (LSD) test among treatment means when ANOVA results showed significant difference at $P < 0.05$.

Results and Discussion

Higher levels of Indigofera inclusion increased crude protein (CP) contents of the rations. *In vitro* dry matter (IVDMD) and organic matter digestibility (IVOMD) of the rations were modified by the experimental treatment ($P < 0.05$). Higher values of IVDMD and IVDMO were obtained on R1, R2, R3 and R5 compared to those of R4 (comparison must be done with the control R5 diet) ($P < 0.05$); Rations containing 40% to 80% Indigofera showed similar digestibility than commercial rations containing 28% soybean meal. This suggests that Indigofera may have the potential to partially substitute soybean.

Higher inclusions levels of Indigofera reduced CH₄ production (Figure 1); methane productions from incubation of R1, R2 and R3 were significantly lower than that of R4

($P < 0.05$). The respective results were associated with data on protozoa population; higher levels of Indigofera resulted in the higher CH_4 production and lower protozoa population. This is in agreement with the fact that some methanogens are living symbiotically with protozoa (Morgavi *et al.*, 2010). Apart from that, lower methane production by increasing levels of Indigofera addition may relate to fiber content. Overall, this study showed the potential of Indigofera to improve nutritional quality of ration and at the same time, to mitigate methane emission resulting from enteric fermentation.

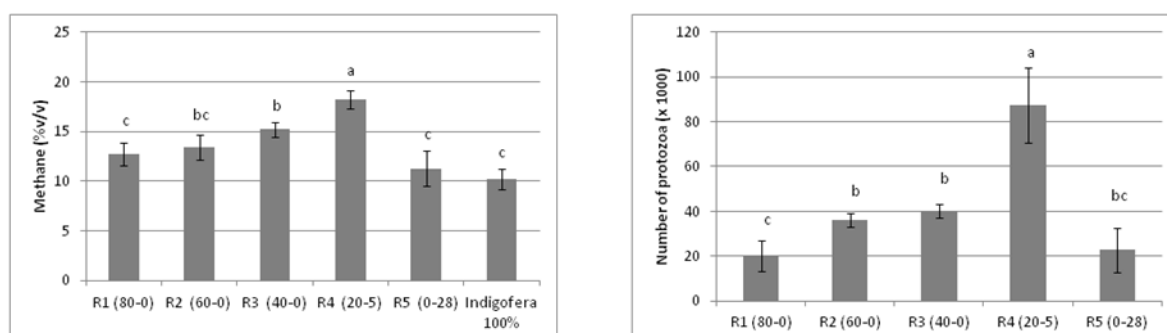


Figure 1. Methane production and protozoa population *in vitro* of Indigofera-based rations when incubated in RUSITEC.

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An Epidemiological and Economic Analysis of HP-PRRS Vaccination in Vietnam

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Introduction

Highly pathogenic porcine reproductive and respiratory syndrome (HP-PRRS) is one of the most significant infectious diseases currently affecting swine worldwide. Since 2007, the Vietnamese pig farming sector has been affected by HP-PRRS. Pig farming is a major income source for many farmers in Vietnam and HP-PRRS has damaged their livelihood seriously.

Vaccination is recommended for HP-PRRS control. However the HP-PRRS vaccine is expensive so only a small proportion of commercial pig farms have used this vaccine, as determined in a field survey by the authors in 2012 (Zhang *et al.*, [13]). It can be hypothesized that if the vaccination usage was higher, the economic damage due to HP-PRRS outbreaks would be less. The economic benefit of the vaccination program should outweigh the cost of it. To test this hypothesis, the purpose of this study was to investigate the most economical and epidemiologically efficient HP-PRRS vaccination coverage in Vietnam.

Methods

Epidemiological data were collected in previous research (Zhang *et al.*, [13]). A field survey was conducted on September 2012 in Hue, Vietnam, where HP-PRRS outbreaks were severe. In that survey, interviews were conducted with local veterinarians and experts in agricultural economics.

This study follows the approach of Dijkhuizen *et al.*, [4], to develop a framework for economically and epidemiologically analyzing the efficiency of HP-PRRS vaccination. This framework includes two sub-models (epidemiological model and economic model). The epidemiological model was applied to estimate the epidemiological efficiency of alternative levels of vaccination coverage and economic model was designed to evaluate the economic benefit of HP-PRRS vaccination.

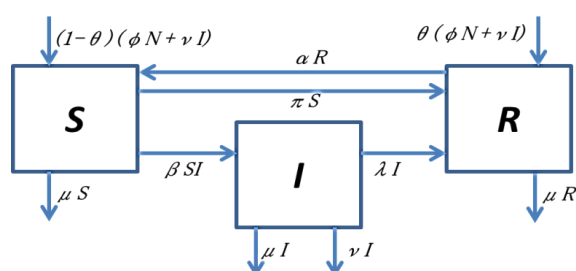


Figure. 1 Flow diagram of the SIR model for HP-PRRS control

We developed a variation of the classic infectious disease epidemic models (Susceptible Infected Recovered (SIR) Model) of HP-PRRS transmission among individual pigs. This model is based on Lanzas *et al.*, [5], with modifications specific to HP-PRRS outbreaks in pig farms. In an SIR

model, we study a population which is composed of three groups of individuals: susceptible (S), infectious (I), and recovered (R). The dynamics of state transitions are illustrated in Figure 1.

Cost Benefit Analysis (CBA) is an economic model for comparing the costs and benefits of an HP-PRRS vaccination program. This approach has been widely used for evaluating animal disease control programs. Given the result of the epidemiological model of HP-PRRS vaccination, the economic model calculates the costs and benefit of an HP-PRRS vaccination program. The costs are the costs of vaccination. The benefit of the vaccination program is the reduction of disease-associated loss attributable to vaccination.

Results

According to our SIR model the **basic reproduction number: R_0** in HP-PRRS outbreaks in Hue province is 1.3 and the optimal vaccination proportion is 26%.

If the optimal vaccination proportion (26%) was applied the additional costs of vaccination would be 582 million VND. However the modeling indicates that the number of culled pigs would be decreased from 2,441 head to 78 head, representing a calculated saving of 4,499 million VND. Therefore with the cost of this extra vaccination program being 582 million VND and the benefit being calculated at 4,499 million VND the B/C ratio is 7.73. That means the benefit of the vaccination program is 7.73 times larger than the cost of running the program (Table 4).

From a governmental perspective if vaccination decreases number of culled pigs from 2,441 to 78 there would be a saving of 2,959 million VND in subsidy provision (Table 4).

Discussion

The calculated optimal vaccination proportion of 26% is considered achievable. HP-PRRS vaccine is available but expensive. To conduct HP-PRRS vaccination and achieve 100% coverage in developing countries where small farms are major, costly complete vaccination program is not feasible. Therefore, we have to find out the most economically and epidemiologically efficient HP-PRRS vaccination proportion. According to our estimation, incomplete vaccination program with a vaccination proportion of 26% is epidemiologically and economically efficient. This vaccination proportion is much easier to achieve than complete vaccination in developing countries.

Investment in HP-PRRS vaccination is beneficial. Although the vaccination program is costly both government and pig farmers can gain benefit from an optimal vaccination proportion. Government can save the budget of providing the subsidy for culling infected pigs. For pig farmers vaccination could decrease the number of infected pigs to be culled. In Vietnam about 80% of pig farms are small-scale and pigs are a major income source. The small-scale farms' livelihood has been damaged by HP-PRRS infection. Governmental support for HP-PRRS vaccination will benefit both government and pig farms.

Excellent animal disease surveillance is necessary. According to the present study, a vaccination coverage of 26% can effectively suppress an HP-PRRS outbreak in the study area. However, this vaccination proportion may not be effective for HP-PRRS outbreak control in other areas of Vietnam because of variability in the quality of animal disease surveillance. In Hue province surveillance is effective (Zhang *et al.*, [13]). Animal disease

surveillance is very important in the control of HP-PRRS. According to our SIR model, if the surveillance system is not excellent, and the infected pigs are identified and culled more than 2 weeks after infection, even 50% vaccination coverage cannot control an HP-PRRS outbreak.

More importantly, vaccination alone cannot control HP-PRRS. Combined with vaccination other animal disease control measures such as surveillance, cleaning and disinfection on farms also have to be enhanced for controlling HP-PRRS outbreaks.

Prevalence, Bacterial Causes, and Antimicrobial Susceptibility Profile of Mastitis Isolates from Cows in Large-Scale Dairy Farms of Northern Ethiopia

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Abstract

The study was undertaken to determine the prevalence of bovine mastitis, isolate mastitis causing bacteria, assess the association of some risk factors, and determine the antibiotic resistance pattern of bacterial isolates in cows in large-scale dairy farms of Northern Ethiopia. A total of 305 lactating and non-lactating cows were included in the present study. The overall prevalence of clinical and subclinical mastitis was 3.6 and 33.8 %, respectively. The quarter level prevalence was 15.4 %; from which, 11.9 and 1.1 % were subclinical form and blind teat, respectively, while the remaining 2.4 % were of clinical form. *Staphylococcus aureus* accounted for 36 % of the isolates followed by *Escherichia coli* (27.3 %). Risk factors including age ($p < 0.001$), parity ($p < 0.001$), and lactation stage ($p = 0.02$) showed significant association with the occurrence of mastitis. Higher prevalence was observed in both groups of older cows (i.e., 6–9 years (odds ratio (OR) = 4.65, 95 % confidence interval (CI) = 2.74–7.89) and >9 years (OR = 3.63, 95 % CI = 1.42–9.25)), cows with four to seven calves OR = 3.39, 95 % CI = 2.06–5.60), and cows in late lactation stage (OR = 3.79, 95 % CI = 1.64–8.75). In multivariable logistic regression analysis, age ($p = 0.005$) and lactation stage ($p = 0.027$) showed statistically significant association with the occurrence of mastitis. The antimicrobial susceptibility pattern showed high susceptibility of *S. aureus* to nalidixic acid (82.4 %) followed by chloramphenicol (58.8 %); however, these species were resistant to the rest of the antimicrobials tested. Highest resistance was observed against clindamycin and ampicillin. Coliform bacteria (*E. coli* and *Klebsiella pneumoniae*) showed resistance to most of the antimicrobials used. Detailed investigation is needed to identify the interplay of managemental and environmental risk factors to design appropriate control measures.

Antibacterial Activity of Alma, *Emblica officinalis* Against Bacteria Isolated from The Fish, *Poecilia Sphenops* for Fish Health Management

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Abstract

Fisheries play an important role in the world food economy. Fish is the primary source of protein for some 950 million people worldwide and represents an important part of the diet and human nutrition. Globally, fish provide about 16% of the animal protein consumed by humans, and are valuable source of minerals and essential fatty acids. Fish is the primary source of omega-3 fatty acids in the human diet. However, the problem with diseases is a crucial factor which inhibits the expansion of aquaculture. Moreover, the bacterial infections are considered the major cause of mortality in aquaculture. The use of herbal plants in aquaculture is gaining success. Recently, it is considered as an alternative to the use of antibiotics and chemicals in fish health management. Therefore, the current investigation was undertaken to investigate the antimicrobial properties of herbal extracts against bacterial pathogens isolated from infected black molly (*Poecilia sphenops*). The tissue samples were aseptically collected from the infected fish and the bacterial diversity was screened and identified up to species level. All identified bacterial strains were selected for sensitivity study on the herbal extract from *Emblica officinalis*. The bacterial growth inhibitory effect was found to be dependent on the specific herbal extracts. A suspension of freshly cultured experimental bacteria was prepared and 100µl of the suspension was spread over the nutrient agar plates. The extract of herb was inoculated in wells made through cork borer on the plate to detect the response. Result showed that the herbal extract of *E. officinalis* is most effective and poses antibacterial properties. It shows inhibitory effect against all isolated bacteria and maximum zone of inhibition against *A. hydrophila* i.e. 18.62 mm was observed.

Factors Affecting on Farm Revenue of Male Duck Fattening at East Java, Indonesia

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Introduction

With over 248 million people, Indonesia is the world's fourth most populous country and home to the world's largest Muslim population. It is the largest economy in Southeast Asia. Indonesia has self-sufficiency goals for poultry and beef (USDA, 2013). Indonesia ranked 15 in the world for duck production. In 2009, Indonesia imported 758 mt of duck meat, decreased to 6.38 mt in 2010 (FAOSTAT, 2013). Increased of duck productivity in Indonesia was reflected by increasing numbers of duck farmers. This increasing was caused by the assumption of higher revenue in particularly fattening duck farming. In fact, the revenue of this farming has varied among duck farmers. Raising duck management was inefficient and it leads to the production less optimal. Many factors challenged for the duck farming, for instance breeding and productivity of duck farms (Holdings, 1991), capital, feed, and selling price. Therefore, the objective of this research was to determine the factors affecting the total revenue of duck farmer.

Material s and Methods

The research was held at Branggahan Sub-district, Regency of Kediri, East Java. Twenty four (30) duck farmers were involved using purposive sampling methods based on the duck ownership. Primary and secondary data were collected during one month from 22nd June to 22nd July 2012. These data were gathered by interview method with implementing structure questionnaire. The data was analysed using linear regression to obtain the value of each factor that affected to farmer's revenue (Amirand Knipscheer, 1989).

Results and Discussions

Duck farmers were characterised by aged between 30–40 years (28%) with primary education (53.3%) and longer experience in raising duck (97%). Regression linear analysis showed four out of ten variables significantly influenced duck farmer's revenue with 99.5% of adjusted R square. It can be interpreted that duck farmer's revenue was influenced by 99.5% of observed variables, while it has only associated with 0.5% of unobserved variables.

Selling price, farmer's experience in duck farming and the number of male ducks has a positive association with duck farmer's revenue, whereas fixed capital has a negative influence on its return. The increase of 10% on the following variables namely selling price of fattening male duck, number of male duck and farmer's experience in raising duck will rise about 0.45%, 11.2%, and 4% of duck farmer's revenue, respectively. On the other hand, farmer's return will decrease to 1.14% when fixed capitals incline to 10%.

Table 1. The result of regression linear analysis.

Parameter	Estimation
Education	-0.034
Farmer's work	0.022
Fixed capital	-0.114 ^{*)}
Working capital	-0.134
Fixed cost	0.087
Variable cost	0.255
Finisher weight	-0.024
Selling Price	0.045 ^{*)}
Number of male duck	1.120 ^{***)}
The experience in Raising duck	0.040 ^{*)}
F Table	613.326
R Square	0.998
Adjusted R square	0.995
Sign. F	0.000

^{*)} P < 0.1; ^{***)} P < 0.000

Conclusion

Duck farmer's revenue was positively associated with selling price (0.045), the experience in raising duck (0.040), and the number of male ducks (1.120). However, it was negatively influenced by fixed capital (0.114).

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Housing, Feeding and Milking Management Practices of Dairy Buffaloes in Udaipur District of Rajasthan, India

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Introduction

Buffalo rearing provides economic stability to farmers through the sale of milk and animals due to uncertainties associated with crop farming in dryland/rainfed area, which constitutes 70% of grazeable land of India. Buffaloes are also important source of draft power, meat, fuel, skin, bones and organic manure (Gandhi and Sharma, 1991). Involvement in animal production is a potential means of raising the living standard of the small and marginal farmers and landless agricultural workers. Rajasthan state has about 1.24 crores cattle and 1.12 crores buffaloes and form about 6% and 10.5% of India's total cattle and buffalo populations and contributes around 10% total milk production of country. The Udaipur District of Rajasthan is predominantly rural in character as 81% of total population lives in rural areas. The low milk production in Udaipur district even with a large bovine population, opportunities for growing green fodder round the year along with man power, possibly indicates either the animals are genetically poor, inadequate nutrition, diseases and management and technical inadequacies. Therefore, the present study was undertaken to find out the lacuna to improve production of buffaloes in Udaipur District of Rajasthan.

Materials and methods

The study was conducted in the tribal and non-tribal areas. Buffaloes reared by the selected households were categorized by breed and sex. In Udaipur district, four tehsils were selected for sampling under rural areas which included tribal and non-tribal villages. Sixteen villages (8 tribal and 8 non-tribal) were selected in each tehsil. Tribal villages were those where farm families do not supply milk to dairy organization through dairy cooperative society and the milk was utilized for home consumption including making of milk products. Non-tribal villages were of those farm families who supply milk to dairy organization through dairy cooperative society or the milk was being utilized for home consumption and preparation of milk products. An interview schedule was developed. The six major aspects studied were: personal information of the respondents family and his background, feeds and feeding (green and dry fodder, concentrate and drinking water) in different categories of animals, management practices (housing, milking and health practices). For the buffalo profile, the number of buffaloes owned per household during rainy season, which was the mid of three seasons of study period was included. In case of male animals the categorization was made as up to 6 months of age (calves) and above 6 months of age (bulls) and the castrated bullock kept for ploughing purposes. In female animals, the categorization was made as below six months of age (calves) heifers, milking and dry buffalo. The data were analyzed as per statistical treatments used by Snedecor and Cochran (1980).

Results and Discussion

The percentage of total family members involved in dairy farming was 57.2%. The involvement of female to the dairying activity was higher at 45.6% as compared to male (39.1%). 57.8% of the total persons involved in dairying consisted middle age group. The literacy rate among the tribals was 46.6 and non-tribals was 53.8%. The average number of buffaloes per household was 5.1. In terms of percentage, the distribution of milking buffalo, dry buffalo, female calves, heifers and bullocks were 21.2, 24.3, 13.0, 17.4 and 26.9, respectively. Percentage of Surti breed was 35.1% and the non-descripts were 64.9%. Most of the households (60.1%) had herd size of less than two milking animals.

Feeding management

Large number households fed their animals in group (81.3%) without any tying facilities. Feeding was done once (95%) daily in the evening (Table-1). Group feeding seems to be more common in the area and shows the availability of forages and concentrates in abundance, along with more number of unproductive animals, which we mainly housed in groups. From the animal welfare perspectives and efficiency of nutrient utilization, increased feeding frequency is beneficial. Feeding twice or thrice daily was just sufficient and economical (Thomas and Sastry, 1991).

Wheat straw (74.65%) was most common dry fodder followed by sorghum stover (20%) and *jowar kadbi* (6.25%). The concentrate mixture was prepared by mixing 60-70% home grown grains (barley/wheat/maize plus 30-40% oil cakes (cotton seed/mustard cake) plus 1% salt. In Udaipur District, mineral mixture was not fed to buffalo by most farmers (99.7%). Handa and Gill (1989) observed that none of the farmers used mineral mixture in Ludhiana District. Singh (2002) observed that very few respondents were feeding mineral mixture to their animals. Feeding of common salt was also not a regular practice, a finding in consonance of Singh (2002). Majority of households (89.8%) did not chaff the fodder. Very few households (11.3%) care of their pregnant buffaloes. The percentage of households producing adequate quantity of dry and green fodder was 96.7 and 46.2%, respectively.

Housing management

All the households followed semi-intensive system of housing buffalo (Table-2). The results obtained were not in line with the reports of Gupta (1988), who indicated that the buffalo in plain areas were mostly kept under stall fed condition. The practice of semi-intensive system was possibly associated with the availability of grazing land and forest areas in tribal and non-tribal areas of Udaipur district. The chance grazing also occurred after the harvest of *rabi* and *kharif* seasons crops. In all the sub-divisions, every household had access to the near by jungle for grazing their animals for 7 to 9 hours during day time. The availability of grazing land coupled with the prevailing situations of chance grazing after harvesting of crops and availability of dense forest areas were the main reasons for following the semi-intensive housing system in the area. These findings are in agreement with observations of Singh et al. (1988a) and Joshi (2002) who observed that loose housing open type system with kutcha house was most prevalent system of housing dairy animals in tribal belt.

Majority of the sheds (70.9%) had katcha floor, which was in agreement with the report of Dhiman et al. (1990). Malik and Nagpaul (1998) and Singh (2002) reported that most of the houses were pucca. Sufficient floor space was provided per animal while slope was not provided in majority of the houses (77.8%). Similar finding were also reported by Joshi (2002) and Singh (2002). Earlier the need of drainage system was well documented by Garg et al. (2005).

Table1. Distribution of households according to feeding practices

Areas	Households (Respondents)	Dry Fodder		Green fodders			Top Feeds		Type of Manager			Practice chaffing		of Feeding mineral mixture			Feeding of salts		Specific ration during calving		given	Enriching fodder feeding	
		Yes	No	Cultivate d	Natura l grown	Neithe r	Yes	No	Pucca	Kachha	Wood leg	Yes	No	Always	Some times	Never	Yes	No	Yes	No	With urea molasses	By chaffing	
Tribal	(240)	240 (100.00)	00 (0.00)	34 (14.16)	206 (85.83)	00 (0.00)	217 (90.41)	23 (9.58)	23 (9.58)	30 (12.50)	113 (47.08)	97 (40.41)	25 (10.41)	215 (89.58)	00 (0.00)	73 (30.41)	167 (69.57)	20 (91.66)	29 (12.08)	211 (87.91)	00 (0.00)	140 (58.33)	
Non-tribal	(240)	240 (100.00)	00 (0.00)	181 (75.41)	59 (24.58)	00 (0.00)	240 (100.00)	00 (0.00)	158 (65.83)	49 (20.41)	33 (13.75)	72 (30.00)	168 (70.00)	220 (91.60)	20 (8.33)	00 (00.00)	208 (86.66)	32 (13.33)	38 (15.83)	202 (84.16)	39 (16.25)	201 (83.75)	
Overall	(480)	480 (100.00)	00 (0.00)	215 (44.80)	265 (55.20)	00 (0.00)	458 (92.20)	23 (4.80)	188 (39.16)	162 (33.75)	130 (27.08)	97 (20.20)	383 (79.80)	220 (45.83)	93 (19.37)	167 (34.79)	228 (47.50)	252 (52.50)	67 (13.95)	413 (86.04)	39 (8.12)	341 (71.04)	

Figures in parenthesis indicate percentage

X = 4.761*

* Significant P<0.05

Table 2. Distribution of households according to housing of animals

Areas	Households (Respondents)	Housing of animals			Sloping of house		floor Clean of cattle shed		Stage stop milking	of pregnancy		Practice of weaning		Age of male calf		of castrase	
		In a shed	Open area	Any other place	Yes	No	Daily	Alternatively		One month before calving	Two month before calving	Don't stop	Yes	No	With 6 months	in 6-12 month	Within After one year
Tribal	(240)	62 (25.83)	151 (62.91)	00 (0.00)	198 (82.50)	42 (17.50)	66 (27.50)	125 (52.08)	49 (20.41)	120 (50.00)	120 (50.00)	00 (0.00)	00 (0.00)	240 (100.00)	00 (0.00)	158 (65.83)	82 (34.16)
Non-tribal	(240)	89 (37.08)	103 (42.91)	75 (31.25)	234 (97.50)	6 (2.50)	198 (82.50)	42 (17.50)	00 (0.00)	33 (13.75)	207 (86.25)	00 (0.00)	65 (27.08)	175 (72.91)	00 (0.00)	181 (75.41)	59 (24.58)
Overall	(480)	151 (31.50)	254 (52.90)	75 (15.60)	432 (90.00)	48 (10.00)	264 (55.10)	167 (34.80)	49 (10.20)	153 (31.90)	327 (68.10)	00 (0.00)	65 (13.50)	415 (86.58)	00 (0.00)	339 (70.60)	141 (29.40)

Figures in parenthesis indicate percentage

X = 4.247*

**

Significant

P<0.05

Milking management

No separate milking parlour was provided in any of the households studied (Table-3). Jana and Mishra (1985) reported that it is desirable to do the milking within the stall. There were very few high yielding animals among the households studied. These results are in consonance to the findings of Joshi (2002). Very few milkers (20%) appeared dirty at the time of milking. Majority of the farmers washed udder before milking. Dhiman et al. (1990), Singh et al. (1998b), Malik and Nagpal (1999) and Singh (2002) also reported that majority of farmers practiced washing of udder and teats with water before milking. Hazarika and Anand (1984) also found that majority of the farmers followed hygienic steps in pre-milking. All the households studied allowed the calf to suckle their dam before and after milking as was also reported by Verma and Malik (1993). However, Dubey and Kumar (1981) found 70.5% respondents allowed the calf to suckle their dam for milk let down. Although the system of marketing of milk through cooperative was regarded poor, the two axis low pricing of milk fixed by the cooperative hindered their popularity among the farmer. Thomas and Sastry (1991) reported that the best method of drying off the cow is by cutting down the concentrates in the ration which was followed by only 17.5% households. More than 79% households did not provide concentrate to their buffaloes during milking.

Conclusion

On the basis of the study, it can be concluded that the constraints such as farmer's poor educational background, inadequate follow up of improved management practices of dairying and irregularity in feeding of the milk buffalo can be overcome by streamlining the activities by adopting planned strategies in the respective fields for enhancing the productivity of buffalo in the tribal and non-tribal areas.

Table-3 : Percentage distribution of housing management practices :

Parameters	Tribal	Non-Tribal	Whole district
(A) System			
Intensive	—	—	—
Semi intensive	100	100	100
(B) Type of house			
Part residential	75.75	83.60	80.25
Separate	20.50	13.90	17.25
(C) Orientation			
N-S	55.30	47.80	51.95
E-W	43.10	50.89	46.95
(D) Type of floor			
Kachha	55.80	48.10	71.50
Pucca	43.25	50.75	28.80
(E) Slope in floor			
Yes	34.25	9.10	21.90
No	64.60	90.20	77.25
(F) Wall			
Kachha	78.25	55.75	66.80
Pacca	20.75	43.00	31.90
(G) Types of roof			
(i) Thatched / Kachha	83.75	82.50	83.00
Tin	15.20	16.25	16.00
(H) Manger			
Kachha	60.00	80.00	81.25
Pucca	15.00	19.50	18.75
(I) Water trough			
Provide	3.00	13.25	8.25
Not Provide	96.90	85.80	91.75

(J) Ventilation in Shed			
Poor	23.50	10.75	17.00
Fairly good	55.75	42.25	48.80
Good	19.25	45.75	34.20
(K) Cleanliness of stall			
Dirty	17.75	21.00	18.75
Clean	24.75	11.00	16.25
Fairly clean	57.50	68.00	64.00
(L) Disinfectant			
Used	4.00	7.25	5.50
No used	36.00	92.75	94.50
(M) Positon of Manure Pit			
Adjacent	29.00	28.50	28.25
Distant	71.00	71.50	71.75

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Reproduction and Economic Potential of *Kacang* Goats in East Nusa Tenggara – Indonesia

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Introduction

The growth of goats in the Eastern part of Indonesia is relatively low and reproduction potential is not fully exploited by small farmers. In the villages, goats complement other parts of the agricultural system, e.g., they consumed crop residues and weeds, added stability to farmers' income and consumption, provided liquidity, had high value for ceremonies and were a store of wealth, family security and insurance similar to the results of other studies (Knipscheer, et.al., 1987; Eik, 2008). Large proportion of meat in the future is expected to come from the small ruminant, although the economic value of goats is still considered low. There is little published information on goat farming systems in which they are kept, and on their role, productivity, reproduction, including economic potential, limitations and opportunities for development.

Materials and Methods

One year-long study of village goat rearing was conducted in East Nusa Tenggara (NTT) regions, followed by an in-depth monitoring study, involving 26 goat rearers out of 120 selected farmers from the survey study. The selected farmers were chosen randomly within the three locations representing 3 agricultural system, i.e. Rice and Mixed Garden (RMG), Garden and Grazing (GG) and Dry field, Grazing and Forest (DGF) areas. They were interviewed, based on written questionnaires, direct observations made and data recorded on reproduction, mortality, sales, health problems, economic variables and management practices. Population change during the study period was recorded this was estimated from the number of breeding females in the flock, the number of kiddings, the number of animals entering the flock, kid mortality and off take rates over the period.

Results and Discussions

The overall results of reproduction characteristics (Table 1) showed the low performance of goats at the three sites. The no of kiddings was 1.5 kids/doe/year.

Table 1. Reproductive performance and kid mortality of goats at three village sites

Attribute	RMG			GG			DGF		
	N	Mean	SE	N	Mean	SE	N	Mean	SE
Age at 1st kidding (m)	26	13.08	0.34	16	14.75	0.48	16	13.06	0.41
Kiddings/year	26	1.48	0.07	16	1.31	0.09	15	1.40	0.09

Kids (no/doe/year)	26	1.44	0.09	16	1.47	0.10	15	1.53	0.08
Kid mortality (%)	10	29.00	0.49	13	18.00	0.35	17	16.00	0.48
Age at culling (male,y)	10	5.50	0.31	3	5.00	0.58	10	5.80	0.33
Age at culling (female,y)	15	5.53	0.26	4	5.64	0.40	11	5.27	0.14

N = Number of farmers; m = month; y = year

Averagely, the ratios of males to females was 1:7, suggested adequate opportunities for does to be mate, as bucks and does generally ran together all year round. The average age of females at first kidding was about 13.6 months, the no of kids produced was 1.48/doe/year. Overall kid mortality from was high (21%), mostly caused by malnutrition after birth, and diseases. An effective disease control and health management are recommended and need to be done regularly, in reducing kid mortality and improved reproduction rate.

Most goat owners sold bucks or wethers and does before 3 years of age, only few farmers sold bucks and does at 5-6 years old, determined by size and/or condition. Assuming each farmer sold 8% kids, 8% growers and 4% finishers, thus, the average gross income from goats was US\$ 3.518/farmer/year. The average gross capital values of goats held in the villages was US\$ 23.202/year, thus, the gross return on capital received from goats was 15%. Middle-men or local traders who buy goats from farmers at the time of low prices and then resell them to consumers when prices are higher (e.g. Ramadan) have an important role in goat marketing in these villages. According to Eik (1987), village goats as had important economic contribution to household welfare and food security. Farmers stated that costs of goat rearing were very low, as only family labour and local feed and material were utilized.

Table 2. Capital invested in goats at the three sites (RMG, GG and DGF).

Age structure of goats	Average stock held	Price/head (Rp)	Capital (Rp)
Starters	306 (26%)	150.000 (US\$15.54)	45.900.000 (US\$.4.756)
Growers	448 (38%)	250.000 (US\$.25.90)	112.000.000 (US\$.11.606)
Finishers	165 (14%)	400.000 (US\$.41.45)	66.000.000 (US\$. 6.839)
Breeding stock	142 (12%)	Not sold	
Replacement stock	119 (10.%)	Not sold	-
Total no. of goats	1.180 heads		

Conclusion

Factors affecting the low reproduction performance of local kacang goats in the village sites, including limited genetic potential; inefficiency in breeding systems, ineffective feeding and health management; and poor marketing strategies. Economically, goats may have significance contribution to the cash income received by village farmers. However, lack of capital and credit facilities; and unavailability of reliable goat markets may have contribution to farmers income and limit the benefit to village farmers from goat enterprises.

To increase inputs to and income from goat enterprises, provision of improved management on breeding, feeding and health management; provision of credit facilities for farmers to purchase good breeding stock, improvement of veterinary services and establishment of reliable markets available in villages are considered essential.

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Strategic Supplementation with Urea Molasses Block to Improve Production and Reproductive Efficiency in Straw based Diet Cows

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Introduction

Seasonal scarcity of green fodder both in quantity and quality is an acute problem in tropical countries. Variations in supply of feeds at different seasons significantly affect the milk yield and quality, growth rate and reproductive performance, especially under smallholder farms in the tropics. Low quality straw based diet of insufficient and unbalanced nutrients in feeds affect production and income. In smallholder production system, a major constraint to milk production is the seasonality forced on cow by inadequate feeding during dry season in Bangladesh. Live weight loss can be avoided by feeding a small amount of protein or non-protein supplement which improve the utilization of straw based diets. Therefore, it necessary to develop and practice cost effective strategic supplementary feeding system for poor quality roughage based cattle production in Bangladesh. Urea molasses block (UMB) supplementation may be an appropriate technology to solve the nutritional inadequacy, especially during dry season by improving nutritional value of low quality roughage based diets (Hendratno, 1999). Supplementation with UMB has shown a beneficial effect on milk yield, growth and reproductive performance (Miah *et al.* 2000). The aim of the study was to investigate the potential of feeding UMB as supplementary feed during the dry season under existing feeding system of smallholder farmers in Bangladesh.

Materials and Methods

Sixty crossbred (Holstein Friesian x zebu) lactating cows of 31 smallholder farms were studied to evaluate the effectiveness of UMB during dry (November to April) and rainy season (May to October). Cows were stall-fed, reared on rice straw with seasonal cut and carry grass. Cows of one group received basal diet (roughage + concentrate) kept as control (-UMB) and other group received UMB @ 500g/d/cow treated as supplemented group (+UMB) in both seasons. Rice straw and green grass was given at the ratio of 4:1 in dry season and 2:1 in rainy season. UMB was prepared by cold method (Sansaucy, 1990).

Results and Discussions

The intake of straw and other nutrients, milk production, FCM, weight gain of calves and reproductive intervals improved in supplemented cows in both seasons (Tables 1, 2 & 3) with more improvement in the dry season.

Table 1. Nutrient intake in dry and rainy season

Ingredients	Dry season		Rainy season		SEM	Significance ¹
	-UMB	+UMB	-UMB	+UMB		
Straw (kg/d DM)	6.79 ^b	7.99 ^a	6.39 ^b	7.16 ^{ab}	0.35	*

Total DM (kg/d)	9.69 ^b	11.76 ^a	9.02 ^b	10.43 ^{ab}	0.49	**
CP (g/d)	650.00 ^b	900.80 ^a	610.70 ^b	810.30 ^a	41.83	***
ME (MJ/d)	72.13 ^b	90.47 ^a	67.80 ^c	80.67 ^{ab}	3.82	**

* = p<0.05, ** = p<0.01, *** = p<0.001 and NS = non significant

Table 2. Effects of UMB on milk yield, body weight changes of cows and weight gain of calves at different seasons

Parameter	Dry season		Rainy season		SEM	Significance
	-UMB	+UMB	-UMB	+UMB		
Average milk yield (kg/d)	4.75 ^b	6.29 ^a	4.84 ^{ab}	5.57 ^{ab}	0.45	*
3.5% FCM (kg/d)	4.93 ^b	7.17 ^a	5.16 ^b	6.45 ^{ab}	0.54	**
Body weight changes of cow (g/d)	18 ^b	135 ^a	22 ^b	50 ^b	29.54	*
Calves weight gain (g/d)	146 ^b	206 ^a	144 ^b	185 ^a	13.23	**

Table 3. Effect UMB supplement on reproductive performance of dairy cows

Parameter	Dry season		Rainy season		SEM	Significance
	-UMB	+UMB	-UMB	+UMB		
Calving to 1st estrus interval (d)	166	135	157	138	20.23	NS
Calving to conception (d)	233	173	231	188	21.24	NS
Calving interval (d)	515	455	511	471	21.11	NS
Service per conception (No.)	2.3	2.0	2.4	2.0	0.23	NS

Conclusion

UMB supplementation may be recommended for improvement of production and reproductive efficiency of cows during dry season feed scarcity in the tropical countries.

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Household Budget and Calorie Consume of Livestock Products: Evidence from Indonesia

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Abstract

This study intends to capture the household budget of livestock products consumption and its calorie consume in six provinces of Java Island in Indonesia. An empirical analysis is made by employing simple Engel model and the descriptive analysis. The result suggested that both household in urban and rural area spent their income for meat higher than that of egg and milk. In other words, as income increase consumption of meat responds much faster than consumption on egg and milk. The calorie consume from meat, egg and milk consumption are still low, under government's recommendation.

Key words: Household Budget, Calorie Consume, Livestock Products

Introduction

Livestock products such as meat and dairy products have higher responsiveness than do cereals (Hutasuhut et al, 2002; Ariningsih, 2004, Warr, 2005; Bond et al, 2007). Low consumption of animal protein in Indonesia is due to high price of animal protein compare with that of vegetable protein. In other words, purchasing power is the main factors of animal protein consumption (Martianto, 1995; Hermanto et al., 1996; dan Erwidodo et al., 1998). There is positive relationship between level of income and the consumption of livestock product, with the consumption of meat, milk and eggs increasing at the expense of staple foods (WHO).

Materials and Methods

Materials.

Household Expenditure Survey (SUSENAS) data were used in this study. The 2008 SUSENAS data involve sample household in whole Indonesia, but in this study we used data from six provinces in Java. Households were dividing into two categories; low, middle and high income in rural and urban area.

Method

Engel model analysis was used to examine expenditure pattern of households i.e. $\log w_i = \alpha_i + \beta_i \log(Y) + \varepsilon_i$, where w_i is expenditure on i th commodity, Y is household income, α_i and β_i are coefficients regression, and ε is an error term. This model specification allows luxuries ($\beta > 0$), necessities ($\beta < 0$), and inferior goods. The model has the advantage of being valid for all income groups; and the implied elasticity behavior is a slow

decline with differences between elasticities remaining constant, which is quite plausible (Leser, 1963, and Yoshihara, 1969). Household calorie consume were calculated from six main livestock products

Results and Discussion

Expenditure share on livestock product was lower than that of other food category. Most of rural household spent their income on livestock product is lower than that of either cereal or other food category, except DI Yogyakarta and DKI Jakarta province. Each of the livestock products is significantly correlated with various income groups in urban area. As observed, meat, egg and milk in urban area is correlated positively and significantly with income for low, middle and high income group. As shown by positive income parameter in the Engel function, the proportion of expenditure on meat, egg and milk will increase with an increase in household income. This suggests that as total income increase, expenditures for livestock product in urban area may increase more rapidly than expenditures for livestock product on rural household. The calorie consumption pattern from livestock product DKI Jakarta province is higher in all categories of livestock products while East Java province has the lowest ones.

Conclusion

This study revealed household in urban and rural area, household will spent their income for meat higher than that of egg and milk. In other words, as income increase consumption of meat responds much faster than consumption on egg and milk. The calorie from from livestock products consumption was still low from the recommendation

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***Trigona laeviceps* Foraging Activity and Colony Growth in Polyculture and Nutmeg (*Myristica fragrans*) Monoculture Plantations**

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Introduction

Sustainability of plant pollinators has become one of the world topics because our food availability depends on it. *Trigona* stingless bee is one of the universal pollinator and *T. laeviceps* has a wide dispersal. Understanding *T. laeviceps* behavior and colony growth in certain environment is necessary for its conservation and culture. It produces propolis, beepollen, and honey from plant resin, pollen, and nectar. Nutmeg (*Myristica fragrans*) tree provides resin which is the most necessary ingredient for *Trigona* bees. This experiment aimed to study and compare *T. laeviceps* foraging activity and colony growth in polyculture and monoculture plantations of nutmeg, as well as to find out the environment factors that suit them.

Materials and Methods

The polyculture plantation (2 ha) and nutmeg monoculture plantation (3.5 ha) were in West Java, Indonesia. Six *T. laeviceps* colonies were divided into polyculture (3 colonies; mean = 66.67 g) and nutmeg monoculture plantation (3 colonies; mean = 83.33 g). Number of bees that entered and left the hive was measured daily for ten minutes every hour from 06:00 until 17:00 hour. At the same time, temperature, humidity, and light intensity were taken. Colonies weight were measured every week for three months to obtain weekly colonies weight gain. The data were analyzed by ANOVA and Student t-Test at $p < 0.05$.

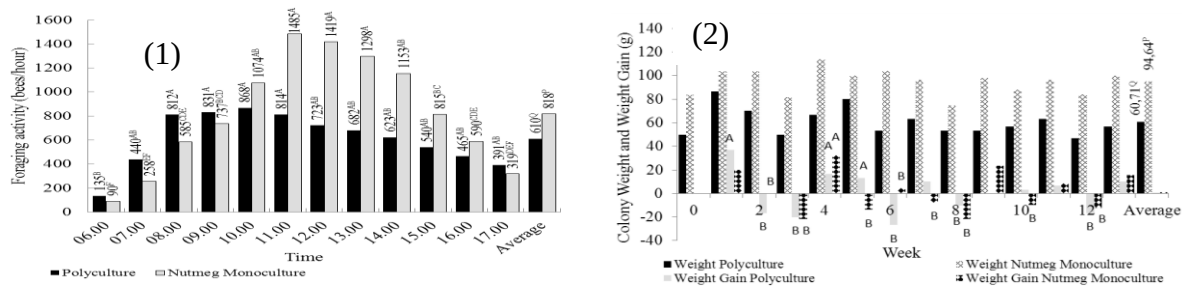
Results and Discussion

Foraging activity

Trigona laeviceps bees involved in daily foraging activity in nutmeg monoculture plantation were significantly higher ($p < 0.05$) than in polyculture (818 vs. 610 bees/hour; Figure 1.1), due to its larger initial colonies weight (83.33 vs 66.67 g), thus they had more worker bees and needed more feed (Inoue *et al.*, 1985). Foraging activity in each plantation also fluctuated significantly by hour ($p < 0.05$) and peak activity in nutmeg monoculture plantation occurred later (11:00-13:00) than in polyculture (08:00-11:00, Figure 1.1). This was due to differences in hour when the sunlight was shining through the canopy of trees in both plantations. When the hives received sunlight directly, both temperature and light intensity increased sharply and reached *Trigona* bees optimum requirement. The ambient temperature reached 26-30.75 °C, humidity around 66.39%-80.75%, and light intensity 21,331-140,460 lux at those times. When the ambient temperature is warm, resin takes a not too solid form that is more easily taken up by the bees (Wallace and Lee, 2009).

Foraging activity in polyculture plantation had a highly positive *correlation* with ambient temperature ($r = 0.912$, $R^2 = 0.832$), while in nutmeg monoculture plantation the

correlation was with light intensity ($r = 0.919$, $R^2 = 0.845$). This phenomenon suggests that foraging activities were related to environmental factors, but the most influential factor may vary (Heard and Hendrikz, 1993).



A,B,...,F = different superscript on the same plantation means significantly different value ($p < 0.05$)

Figure 1. *T. laeviceps* Foraging Activity (1) and Colony Weight and Weight Gain (2) in Polyculture and Nutmeg Monoculture Plantation.

Colony weight and weight gain

The colonies in nutmeg monoculture plantation (94.64 g vs. 60.71 g; Figure 1.2) were heavier, but it is because of their heavier initial weights with more bees engaging in foraging activity (Figure 1.1). Colonies weekly weight gain in both plantations fluctuated and was significantly affected ($P < 0.05$) by the time of the study (Figure 1.2), but not by plantation type. *Trigona* colonies weight gain in this study seemed to be more determined by its initial weights than bee activity and the ambient factors as shown in Table 3. Coefficient of determination (R^2) of bees foraging activity, temperature, humidity, and light intensity on colonies average weight gain were very low, i.e. 0.198, 0.177, 0.323, 0.305 respectively in polyculture and 0.351, 0.438, 0.375, 0.187 in nutmeg monoculture plantation.

Conclusion

Trigona bee foraging activity in the polyculture was lower than in nutmeg monoculture plantation, but colonies weight gain was not significantly different in both plantations. Temperature determined foraging activity in nutmeg polyculture, but light intensity had greater influence in monoculture.

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Mechanism of Arbuscular Mycorrhizal Fungi in Enhancing Productivity, Nutritional Quality and Drought Tolerance of *Paspalum notatum* Grasses

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Introduction

Arbuscular-mycorrhizal (AM) fungi are important in sustainable agriculture because it can improve plant water relations and thus increase the drought resistance of host plants (Christopher, 2008). When the AM symbiosis is established the fungus receives carbon molecules from the plant, and the plant receives nutrients (especially phosphorus) and water from the fungus (Gosling *et al.*, 2006). This research was conducted to study the mechanism of arbuscular Mycorrhizal Fungi in enhancing productivity, nutritional quality and drought tolerance of *Paspalum notatum* grasses.

Materials and Methods

The study used a completely randomized design with four treatments: D₀ (Well watered), D₁ (with AMF), D₂ (draught) and D₃ (with AMF in draught) and four replications and each replication consists of 2 unit plants. The measured parameters were: (a) soil moisture content, (b) leaf water potential using the WP4 potentiometer, (c) relative water content of shoot (RWC), (d) shoot and root dry weight, (e) proline, (f) soluble sugars, (g) crude protein, (h) gas production and (i) organic matter digestibility. Analysis of variance (ANOVA) was conducted and the differences between treatments were analyzed with Duncan Multiple Range Test.

Result and Discussion

Draught stress significantly ($P < 0.05$) decreased water moisture in soil. Draught causes water becoming unavailable for absorption by plants causing it to wilt (Karti, 2004). The leaf water potential determined at the end of the drought period was similar in plants treated with and without AMF cultivated under well-watered conditions (Table 1). Drought stress decreased leaf water potential, but the decreased was significantly ($P < 0.05$) larger in plants without AMF (-8.49 Mpa) than in AMF plants (-7.35 Mpa) in 48th day. Porcel and Ruiz-Lozano (2004) reported that the leaf water potential was also higher in stressed AMF plants (-1.9 MPa) than plants without AMF (-2.5 MPa).

Draught stress significantly ($P < 0.05$) decreased leaf relative water content, but inoculation with AMF can enhance about 32.6%. Porcel and Ruiz-Lozano (2004) reported that RWC was significantly higher in AMF plants than plants without AMF. Shoot dry weight significantly ($P < 0.01$) decreased in all treatments (D₂ and D₃) as a consequence of draught, except in plants inoculated with AMF was higher than without AMF about 21.8%. Draught significantly ($P < 0.05$) increased the concentration of proline especially in plants colonized by AMF can reduced this osmotic regulator. In this study, the proline content was greater in draught-stressed (D₂) plants than in well-watered plants (D₀). The beneficial effect of AM

symbiosis under draught-stress conditions increased root water absorption (Auge, 2004). Draught stress significantly ($P < 0.05$) enhanced water soluble carbohydrate. Inoculation with AMF under stress, reduced water soluble carbohydrate compared with non-AMF. Mycorrhizal colonization and draught interact in modifying free amino acids and sugar pools in roots and a greater osmotic adjustment has also been reported in leaves of mycorrhizal plants than in plants without mycorrhizal during a lethal drought period (Kubikova *et al.*, 1991)

Table 1. Effect of drought and addition of AMF to Parameters of *Paspalum notatum*

Variables	Treatments			
	D0	D1	D2	D3
Soil moisture (%)	34.71 $\pm$ 1.77 ^a	34.93 $\pm$ 1.76 ^a	22.91 $\pm$ 0.68 ^b	23.43 $\pm$ 1.95 ^b
Leaf water potential (Mpa)	-1.41 $\pm$ 0.1 ^a	-1.15 $\pm$ 0.17 ^a	-8.49 $\pm$ 0.57 ^c	-7.35 $\pm$ 0.17 ^b
Leaf relative water content (%)	70.16 $\pm$ 4.4 ^a	74.63 $\pm$ 2.95 ^a	29.55 $\pm$ 3.39 ^c	43.82 $\pm$ 1.2 ^b
Shoot dry weight (g/pot)	121.85 $\pm$ 20.32 ^A	141.00 $\pm$ 18.42 ^A	49.60 $\pm$ 2.39 ^C	63.45 $\pm$ 3.99 ^B
Root dry weight (g/pot)	35.45 $\pm$ 17.54	39.25 $\pm$ 7.96	23.60 $\pm$ 8.44	32.65 $\pm$ 10.69
Proline (μ g)	55 $\pm$ 3.4 ^B	45 $\pm$ 4.33 ^A	1255 $\pm$ 7.37 ^D	1025 $\pm$ 94.6 ^C
Water soluble carbohydrate (mg/200gDM)	8.8 $\pm$ 1.2 ^a	8.5 $\pm$ 1.2 ^a	42.5 $\pm$ 3.8 ^c	35.3 $\pm$ 2.2 ^b
Gas production (ml/200g)	20.7 ^a	21.02 ^a	19.3 ^b	20.86 ^b
Organic matter digestibility (%)	43.02 ^{ab}	43.57 ^a	42.66 ^b	42.86 ^{ab}
Crude Protein (%)	11.98 ^b	13.7 ^a	7.68 ^d	8.8 ^c

Description: D0 (Well watered), D1 (with AMF), D2 (drought), and D3 (with AMF in drought).

Total gas production in drought plants was lower ($P < 0.01$) than the watered plants. Inoculation with AMF under stress can enhance gas production. High gas production on those forages was related to nutrient content, rumen microbial metabolism and percentage of digestibility (Astuti *et al.*, 2011). Organic matter digestibility showed that the AMF treatment (D1) had the highest value, whereas the drought treatment (D2) was low and no different with D3. Crude protein content of *Paspalum notatum* significant ($P < 0.05$) influenced by the addition of Arbuscula Mycorrhizal Fungi (AMF).

Drought stress significantly ($P < 0.05$) decreased in soil water moisture, leaf water potential, shoot and root dry weight, crude protein, gas production, organic matter digestibility, and enhanced proline and soluble sugar. Inoculation of AMF under drought stress significantly enhanced shoot and root dry weight, crude protein, gas production and digestibility of organic matter and decreased leaf water potential, proline and soluble sugar. The drought tolerance mechanism of *Paspalum notatum* is by accumulating prolines and soluble sugars.

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Effect of Local Silage Additives on Fermentation Efficiency of *Leucaena* Silage

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Introduction

Leucaena leucocephala is a leguminous plant, commonly found in tropical countries. The nutritive value is comparable to alfalfa (Angthong et al., 2007). However, ensiling forage legumes has always been difficult because of low water soluble carbohydrate and high buffering capacity. These conditions result in low lactic acid and high pH and acetic acid production. These notwithstanding, the fermentation characteristics of the tropical forage silage should be understood before the ensiling process can be manipulated to achieve a desirable product (Fleischert et al., 1996). Therefore, the objective of this study was to improve the fermentation efficiency and quality of leucaena silage by applying local sources of carbohydrate and inoculants.

Materials and Methods

Leaf and stem (<1.5cm of diameter) of leucaena was harvested in November and then chopped into 2-3cm length. The 3x3 factorial in CRD with 2 replications was applied: carbohydrate sources including none, sugar cane molasses (1% fresh basis) and brown sugar (1 % fresh basis) and microbial inoculants including none, EM (effective microorganism, 1 % fresh basis) and bio-extract (1% fresh basis). EM was commercially used by farmers as silage additive. Bio-extract was prepared by mixing water, sugar brown and pineapple peels at the ratio of 10:1:3 (w/w) and applied for the study at the fourth day of fermentation period (the highest of lactic acid bacteria (LAB) at 2.9×10^8 cfu/ml). All silage additives were added at the time of ensiling in the laboratory silo (nylon and plastic bag containing 10 kg of ensilage). The physical characteristics of silage, pH, LAB, yeast and mold were observed at 7, 14, 21 and 30 days after ensiling. The data were analyzed by using the GLM procedure of SAS (SAS, 1998).

Results

There was no different among the groups in colors and textures of leucaena silage. Compared to none group, carbohydrate source and microbial inoculate groups had high frequency of sour smell of the silage throughout the storing periods. These relate to the pattern of pH of the silage shown in Table 1.

Sugar cane molasses, brown sugar, EM and bio-extract reduced pH throughout the fermentation periods compared to control group, especially high efficiency in brown sugar and bio-extract groups at 30 days after ensiling. Moreover there was the interaction between carbohydrate sources and microbial inoculants in pH of luucaena silage. The mixture of brown sugar and bio-extract showed the most efficiency to decrease the pH into 4.82.

There was small effect of silage additives on LAB. Bio-extract group was low in LAB compared to none and EM groups at 7 days after ensiling. Yeast and mold were high at 30 days of ensiling compared to none and bio-extract groups.

Table 1. Effect of silage additives on pH, LAB (lactic acid bacteria) and yeast and mold in leucaena silage at different duration.

Traits	Carbohydrate sources			SEM	Microbial inoculants			SEM
	None	Molasses	Brown Sugar		None	EM ¹	Bio-extract	
pH								
7 d	5.87 ^a	5.36 ^b	5.15 ^b	0.09	5.66 ^a	5.46 ^{ab}	5.25 ^{bc}	0.09
14 d	5.63 ^a	5.19 ^b	5.11 ^b	0.03	5.48 ^a	5.36 ^a	5.08 ^b	0.03
21 d	5.46 ^a	5.08 ^b	5.04 ^b	0.06	5.37 ^a	5.16 ^b	5.04 ^b	0.06
30 d	5.48 ^a	5.09 ^b	4.98 ^c	0.03	5.34 ^a	5.23 ^b	4.98 ^c	0.03
LAB (log cfu/g)								
7 d	7.38	7.33	7.37	0.05	7.41 ^a	7.44 ^a	7.23 ^b	0.05
14 d	8.45	8.21	7.90	0.31	8.47	8.15	7.94	0.31
21 d	7.97	7.43	8.28	0.32	8.45	7.59	7.64	0.32
30 d	7.22	7.69	7.49	0.25	7.55	7.39	7.41	0.25
Yeast & Mold (log cfu/g)								
7 d	7.26	7.21	7.06	0.07	7.25	7.12	7.15	0.07
14 d	7.84	8.22	8.36	0.25	8.14	8.44	7.84	0.25
21 d	7.28	7.19	n/a	0.30	7.48	7.89	n/a	0.30
30 d	7.48	7.45	7.87	0.24	7.37 ^a	8.18 ^b	7.25 ^a	0.24

^{abc} The letter difference means different between groups in each trait and period ($p < 0.05$), ¹ EM = Effective microorganism, SEM = Standard error of the mean

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Crude Extract Red Rice (*Oryza sativa* L.) Bran Of Minahasa, North Sulawesi as a Potential for Natural Antioxidant Sources

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Introduction

Rice bran is a waste product of paddy milling that contained protein, carbohydrate, dietary fiber, ash, fat, vitamin, mineral and natural antioxidant compounds (Chen *et al.*, 2008; Saenjum *et al.*, 2012). Rice bran also contains some phytochemicals compounds in a significant amount and these compounds have been considered as natural antioxidant. According to Xu and Godber (1999) and Chen *et al.* (2008), rice bran oil contained 95.6% saponified lipid such as glycolipid and phospholipid and 4.2% unsaponified lipid such as tocopherol, tocotrienol, γ -oryzanol, sterol and carotenoid.

Antioxidant activities of paddy variety contains colour pigments such as red Thai, black rice, red brown and dark purple that had been intensively studied by Muntana and Prasong (2010) and Yodmanee *et al.* (2011) who reported that rice with no colour pigment contained lower phenolic content and antioxidant activities.

The objective of this study was to determine the phytochemical compounds and antioxidant activities and assess its potential as natural antioxidant sources.

Material and Methods

The phytochemicals analysis were carried out following the procedures for phenolic, flavonoid, alkaloid, steroid, triterpenoid and saponin test (Harborne, 1987) and antioxidant activities test of crude extract of red rice bran used free radical-scavenging DPPH assay (Lee, 2006). While the IC₅₀ value was calculated from inhibition percentage and absorbance value of linear regression of some concentrations of crude extract of red rice bran samples.

Results and Discussion

The phytochemical analysis results of crude extract of red rice bran samples are persented in Table 1. Inhibition percentage from some crude extract of red rice bran samples increased as the crude extraction used also increased and in opposite ratio with absorbance value at 517 nm wavelength which decreased due to colour changes from purple to yellow as the uncoupled electron and DPPH radical coupled with hydrogen of crude extract of red rice bran to form a reduced DPPH.

Linear regression of inhibition percentage of some crude extract of red rice bran samples concentration with its absorbance value is as follow: $Y = 1.581 x$ and $R^2 = 0.980$.

Hence, the IC₅₀ value of crude extract of red rice bran was 31.62 mg/ml. The lower the IC₅₀ indicated the stronger capability of samples to catch free radical of DPPH.

Table 1. The phytochemicals analysis of crude extract of red rice bran samples.

Secunder metabolites	Test results
Phenolic	+
Flavonoid	
HCl 2N + Mg	-
H ₂ SO ₄ 2N	-
NaOH 10%	+
Alcaloid	
Mayer	+
Wagner	+
Dragendorf	+
Hager	+
Steroid	-
Triterpenoid	+
Saponin	+

Conclusion

As crude extracts of red rice bran samples contained phenolic, flavonoid, alcaloid, triterpenoid and saponin compounds and its IC₅₀ value was 31.62 mg/ml. It can be concluded that crude extract of red rice bran is a promising natural antioxidant source.

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Identification of Phenolic Compounds and Its Antioxidant Activity from Lignin and Palm Oil Frond Fermented with *Phanerochaete chrysosporium*

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Introduction

Lignin is natural phenolic polymer which is commonly found in cell wall of plants. Lignin is a limiting factor in animal feed due to its low digestibility. However, considering the structure of lignin that comprise of phenolic compounds, lignin may be beneficial as antioxidant. Degradation of polyphenol from lignin can be done through biodegradation using enzyme from white root fungi such as *Phanerochaete chrysosporium* which has ligninase and mangan peroxidase enzymes (Martinez., 2004). Polyphenol has been well known as effective antioxidant on lipid (Shaidi et al., 1992). This research was conducted to determine the optimum fermentation time of lignin and palm oil frond fermented with *Phanerochaete chrysosporium* based on the amount of phenolic compounds produced and its antioxidant activity.

Materials and Methods

The experiment was conducted in several steps: 1) lignin extraction from palm oil frond (Salanti et al., 2010); 2) biodegradation of lignin and palm frond; 3) identification of phenolic compounds by Gas Chromatography-Mass Spectrometry (GC-MS); 4) antioxidant activity test of lignin and palm oil frond fermented products using the method of α,α -Diphenyl- β -Picrylhydrazyl (DPPH) (Khalaf et al., 2008). All test and analyses were run in duplicate and the means values were tested by Duncan's Multiple Range Test. Butylated hydroxytoluene (BHT) (Sigma Chemical Co.) was used as reference antioxidant.

Determination of Optimum time for Lignin and Palm Oil Frond Biodegradation

Palm oil frond and lignin were inoculated with *P. chrysosporium* and incubated at room temperature for 0, 4, 8, 10 and 12 days. For each incubation time, two replications were employed. At the end of incubation, the samples were centrifuged at 1200 rpm for 5 minutes. The phenolic compounds in the supernatant will be determined by GC-MS.

Results and Discussion

The antioxidant activity showed that the longer incubation time (up to day 10) of palm oil frond increased the percentage of inhibition (Table 1) and the antioxidant activity was declining at 12 days incubation. Similar pattern was obtained from fermented lignin. This may be due to the increase phenolic compound produced by *P. chrysosporium*. Lignin is more effectively degraded by white-rot fungi through polymer oxidation to produce aromatic radicals. Phenoxy radicals may form lignin polymer again if it is not oxidized into phenolic compounds (Martinez et al. 2005). High antioxidant activity was also influenced by the amount and types of phenolic compounds produced (Nenkova et al., 2011). Phenolic compounds produced during fermentation of lignin and palm oil frond are presented in Table

2. Based on the results, it is concluded that lignin degradation with *P. chrysosporium* produced phenolic compounds that show antioxidant activity, with the optimum incubation time is 10 days and percentage of inhibition 89.41% for fermented palm oil frond and 92.11% for fermented lignin.

Table 1. Antioxidant concentration and inhibition percentage of fermented lignin and palm oil frond with *P. chrysosporium* at different fermentation time.

Fermentation Time (Days)	Palm Oil Frond Fermentation		Lignin Fermentation	
	Inhibition (%)	Concentration (ug/ml)	Inhibition (%)	Concentration (ug/ml)
0	74.820 ^d	629.655 ^d	24.015 ^c	0 ^d
4	84.012 ^b	11102.049 ^b	73.909 ^b	47.24 ^c
8	89.410 ^a	16466.110 ^a	75.731 ^b	127.72 ^c
10	89.411 ^a	16467.150 ^a	92.108 ^a	850.95 ^a
12	78.778 ^c	5947.646 ^c	87.680 ^a	655.39 ^b

Table 2. Identified monomer compounds from lignin and palm oil frond fermented with *P. chrysosporium* at different fermentation time.

Compounds	Lignin Fermentation					Palm Oil Frond Fermentation				
	Fermentation time (days)					Fermentation time (days)				
	0	4	8	10	12	0	4	8	10	12
Hidroxy benzoic acid	0.88	3.96	3.61	0.98	0.67	0.52	2.72	3.64	4.04	8.51
Hidroxy phenil acid	0	2.63	0.64	0.87	0	0	0	0	0	0
Methoxy Phenol	0	2.65	4.32	1.32	0	3.2	3.56	6.78	4.57	3.27
2,6, dimethoxy phenol	0	0	0	15.46	7.49	0	0	0	0	0
Vanilic acid	0	0.73	0.86	7.94	5.47	0	0.90	1.24	2.61	0.87
Hidroxy Benzaldehyd	0	0	2.54	1.61	1.75	0.59	0.73	2.89	6.3	0
Syringic acid	0.59	0.73	0.59	2.39	0.49	0.78	2.49	0.48	15.65	3.69
Syringic aldehyd	0	0	0.9	2.61	1.24	2.38	2.91	3.30	4.15	2.75
Coumaric acid	0	0	0.90	4.57	3.27	0	0.47	0.59	2.39	0.49
Ferrulic acid	0	3.96	1.62	2.14	1.12	0.59	1.96	6.65	3.3	6.6
Vanilin acid	0	0	2.38	3.30	3.3	0	0.90	1.24	2.61	0.87
Benzene dicarboxylic acid	0	0	0	2.91	0.57	0.98	0.64	3.52	3.65	0

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Study on Technology and Microbiology of Dahi: An Indigenous Dairy Product From Eastern Nepal

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Abstract

A survey was carried out to document the traditional practice of *dahi* preparation in Eastern Nepal. A questionnaire pertaining to definition and origin, ingredients and functions, preparation procedure and method of preparation, utensils, cooking fuel, desirable quality characteristics and factors influencing them, production and marketing, occasions of use, nutritive and therapeutic value and storage of indigenous *dahi* were used to collect the required information. A total of 236 respondents belonging to different ethnicity, religion, age and sex groups of different districts of Eastern Nepal were involved in the survey study. Morphological, cultural, physiological and biochemical characteristics were employed to identify *thermophilic lactic acid bacteria*, *Lactococci* and *Leuconostoc* isolated from thirty nine indigenous *dahi* samples collected from different districts in eastern Nepal. These comprised of *Lactobacillus delbrueckii* sub-sp. *bulgaricus*, *Lactobacillus fermentum*, *Lactobacillus casei*, *Lactobacillus brevis*, *Lactobacillus helveticus*, *Streptococcus thermophilus*, *Lactococcus lactis* sub-sp. *lactis* and *cremoris*, *Lactococcus lactis* sub-sp. *lactis* biovar. *diacetylactis*, *Leuconostoc mesenteroids* subsp. *cremoris* and *Leuconostoc mesenteroids* sub-sp. *mesenteroids*. Additionally, organisms like yeasts, moulds, coliforms, salmonella, *S. aureus* and total bacterial count were also determined. The initial high levels of contamination with pathogens in indigenous *dahi* are critical issues for the safety of fermented foods.

Native and Fermented Breadnut (*Artocarpus camansi*) Flour as a Natural Edible Fiber Source in Chicken Sausage Production

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Introduction

Chicken sausage is a popular side dish in Indonesian menu and according to Clara and Kusharto (2006), however this commercial sausage contains no dietary fiber. Saiwan (2009) also reported that dietary fiber content in sausages was very low and therefore he reported that the addition of rice bran or sticky (berry) rice bran could be improved significantly in its dietary fiber content. Breadnut fruits which are abundantly found in East Java have been used for centuries as a vegetable or substitution material in deep fried shredded meat/ meat floss in Indonesia. This fruit contained about 2.1% dietary fiber (Morton, 1987), while according to Amusa et al. (2002) the fermentation process could increase the dietary fiber content up to 4.0%. The objective of this study is to investigate the potential of local breadnut fruit as a natural edible fiber source.

Material and Methods

Breast chicken fillet of broiler of 4 weeks old and young local breadnut fruit (3-4 months) were used as raw materials in chicken sausage preparation. The breadnut flour was fermented using *Lactobacillus plantarum* for 72 hours at 37° C and redried using vacuum drying for 4 hours at 55° C following the method of Amusa *et al.* (2002) before added to chicken sausage batter. The native and fermented breadnut flour were added into chicken sausage batter in the amount of 0(control), 3, 5 and 7% (w/w) respectively. Total Dietary Fiber (TDF), Soluble Dietary Fiber (SDF) and Insoluble Dietary Fiber (IDF) were measured using the method of AOAC (2005). Data obtained were analysed using two ways ANOVA and differences among means were determined by Duncan Multiple Range test using SPSS version 15 (Chicago, Illinois, USA), and the 95% confidence level was used as the indicator for statistical significance.

Results and Discussion

Total Dietary Fiber (TDF) of chicken sausage without breadnut flours addition was $0.94 \pm 0.09\%$, while the highest amount of TDF ($2.59 \pm 0.37\%$) was observed in chicken sausage added with 5% w/w fermented breadnut flour during preparation. The Soluble Dietary Fiber (SDF) of chicken sausage without addition of breadnut flour was $0.10 \pm 0.09\%$ and the highest amount of SDF was $0.71 \pm 0.28\%$ found in samples added with 5% w/w fermented breadnut flour. Whilst the lowest Insoluble Dietary Fiber (IDF) was observed in chicken sausage without addition of breadnut flour ($0.78 \pm 0.05\%$) and if during preparation the sausage batter was added with 5% w/w fermented breadnut flour the IDF content increased up to $1.81 \pm 0.55\%$. According to Yilmaz (2004) the addition of 5 – 20% rye bran in meatball batter could increase the dietary fiber content and decreased fat content of the end product.

Conclusion

It can be concluded that especially fermented breadnut flour if added in the amount of 5% w/w into chicken sausage batter will increase the TDF, SDF and IDF of the end product.

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The Extraction of Fucoxanthin from Fresh Leaf, Thallus and Whole Part of *Sargassum Filipendula* from Madura Islands

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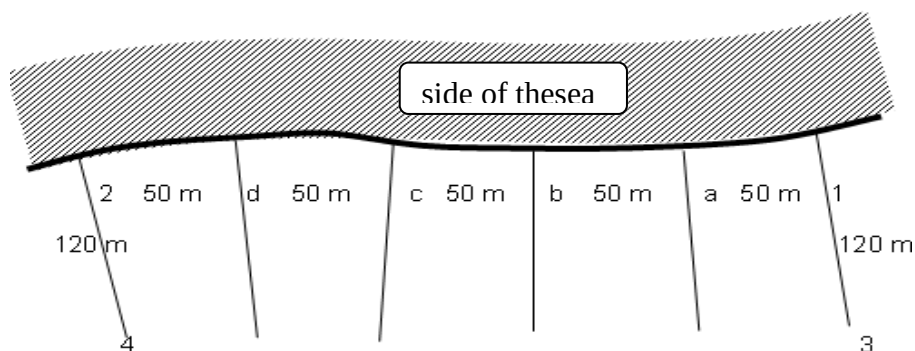
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Introduction

Seaweed has been popular especially in Japan, China and Korea as one of the main components in the diet (Sachindra et al, 2010.). Brown seaweed contain carotenoid pigments are attractive as a source of antioxidants and anti-cancer as reported by Mori et al. (2004). *Sargassum* sp. contains a large amount of dye that is fucoxanthin and other substances that act as anti-obesity agent (Ruperez and Calixto, 2000), antioxidants (Dounporn et al., 2007; Pangestuti et al., 2007), anticoagulants (Cumashi et al., 2007), anti-diabetes (Maeda Tsukui et al., 2008), anti-cancer (Pangestuti, et al. 2007), anti-tumor and colon cancer (Okuzumi et al., 1990; Liqun et al., 2008). Fucoxanthin as the major part of the carotenoid in the brown seaweed has certain alenic bond, in which 5,6 - monoepoxida plays an important role in the structure of fucoxanthin (Haugan et al, 1995 and Matsuno, 1991).

Materials and Methods

The sampling method used a GPS (Global Positioning System) in order to determine the location coordinates of the point were observed (113.94444°E - 7.08795°S, 113.94231°E - 7.08913°S, 113.94548°E - 7.08911°S 113.94347°E and - 7.08999°S). To obtain a homogeneous sample of seaweed species *Sargassum* sp, from the coastal boundary lanes 1 and 2 are determined by the sampling interval distance of each other lanes = 50 m, perpendicular to the beach, sampling each lane was taken at a depth of 1 m to 1.5 m as much as 3 kg of wet seaweed, so that from 6 lanes obtained 18 kg of wet seaweed



Lay out the sampling of seaweed on the beach of Padike village, Talango district. Seaweed after collected from the sea was washed with fresh water to remove impurities (such as sand, rocks and mud) to clean and drained. Wet weight was weighed and put in black plastic and stroed in the cool box then brought to Malaysia

Results and Discussion

Mass spectra analysis of samples shows that the chemical compounds in the samples with the following characteristics: there are three molecular ion fragments with the highest abundance (base peak) of these fragments is 658.77 m / z are also suspected as Fucoxanthin molecular weight compounds (Table 1).

Table 1. Fractions Fucoxanthin ion molecule compounds contained in the *Sargassum fillipendula*.

No.	Ion mass (m/z)	Allegations of molecular ion fragments
1.	682,87	$C_{42}H_{58}O_6-Na$
2.	681,23	$C_{42}H_{58}O_6-Na$
3.	658,77	$C_{42}H_{58}O_6$
4.	640,80	$C_{42}H_{56}O_5$

From the image data obtained that the first peak is the molecular weight of 658.77 fucoxanthin with m / z while the second peak is the molecular weight of 640.80 m / z which is thought to occur dehydro fucoxanthin removal of water and a third peak 681.23 m / z is the moment analysis there is the addition of Na ions (which is attached to the ion H-). And the fourth peak of Na atoms there is an abundance of isotopes with a molecular weight of 682.87 m / z (Kardono, et al 2010).

The results were analyzed by LCMS fucoxanthin extraction as for the data obtained:

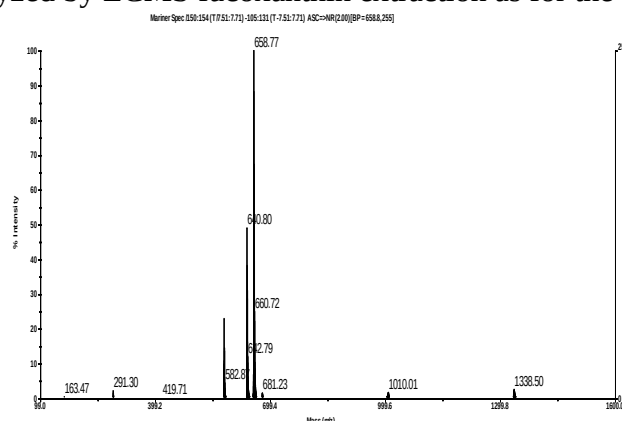


Figure 1. Adducts or Pseudomolecular Ion Formation

$M^+ = 658,77$ $M+Na = 681,23$
 $BM = 658,77$ $2M + Na = 1388,50$

The method of ionization and LC / MS Interfaces (L Ruth, 2005; Sangeetha Ravi Kumar et al., 2009) was used in this study. Our results show that pure fucoxanthin can be detected using LCMS m/z which contained molecular weight = 658.1. Garside and Riley (1968) reported a molecular weight measurement by mass spectrophotometer fucoxanthin showed pure compounds having a molecular weight of 658 consists of a group of molecules acetyl and two hydroxyl groups.

Fucoxanthin pigment content of brown algae *Sargassum filipendula* was calculated by the equation of Gross et al., (1997) was 0.1957 ± 0.0173 (mg/g sample).

Table 2. Calculation of molecular weight fukosantin ($C_{42}H_{58}O_6$) with LCMS chromatogram.

No	Element	calculate	Result	Analysis

			m/z	m/z
1.	C	12,000000 x 42	504,00000	
2.	H	1,007825 x 58	58,45385	
3.	O	15,994915 x 6	95,96949	
Total			658,42334	658,7682
Margin calculation			658,7682 - 658,42334 = 0,34486	

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Natural Antioxidant Properties of Functional Drink Prepared by Combination of Local Honey and Red Ginger Extract

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Introduction

Honey is known to be rich in both enzymatic and non-enzymatic antioxidants, including phenolic acids (Baltrušaityte *et al.*, 2005). Currently, ginger is a common interest of society with high potentially developed as health drink. Combining honey as other antioxidant is one of the ways to maintain ginger drink product in consequence of thermal processing. Antony *et al.*, (2000) reported the addition of up to 15% honey inhibited the development of oxidative compounds in cooked turkey meat, with little further inhibition observed compared to 20% honey, while according to Sikora *et al.*, (2008) some plants or specific combinations of herbs in formulations may act as antioxidants by exerting superoxide scavenging activity or by increasing superoxide dismutase (SOD) activity in various tissue sites. The objective of this study is to find out the potential of different kind of honey as natural antioxidant if combined with extracts of thermal processed red ginger (*Zingiber officinale* var. Rubra) rhizome to produce functional drink.

Materials and Methods

The thermal processing of 6 minutes and boiling at 100°C was carried out as described by Jaya (2008). Honey were obtained from three nectar source, namely kapok, mango and cashew trees which are taken in second harvest approximately on May-June. The amount of honey used were 15 mL and water ginger extract were 25 mL on the report of Purnomo *et al.*, (2009). Determination of DPPH radical-scavenging activity was measured as described by Khalaf *et al.*, (2008), while determination of total phenolics content was determined by the Folin-ciocalteu method of Miliauskas (2006). Identification and in order to elucidate its structure of antioxidant compounds in functional drink was accomplished by using gas chromatography-mass spectrometry (GC-MS) with computerized integrated data processing and descriptively discussed based on literature. Analysis of variance (ANOVA) followed by Duncan Multiple Range Test at a level of $P < 0.01$ if there was significant differences between samples. Organoleptic test analyzed following non-parametric statistical method by Friedman test of Steel. and Torrie (1994).

Results and Discussion

The result of organoleptic evaluation on taste score combining 25 mL water red ginger extract and concentration of 15 mL different kind of honey (kapok, mango and cashew) using hedonic scale scoring test by 25 panelists were ranging from 6.04-6.32. The best kind of honey was kapok, as most of the panelists could accept the pungent of ginger and sweetness of honey. Free radical scavenger activity of functional drink was 35.51 ± 0.19 and total phenolic was 3.12 ± 0.018 mg GAE/g; a taste score of 6.32; colour score of 5.96; and aroma

score of 6.44 by the hedonic scale scoring of 1-9. The analysis with GC-MS identified geranyl acetate (11.60%), ar-curcumen (20.69%), zingiberene (17.77%), alpha-farnesene (13.28%) and beta-sesquiphellandrene (14.77%) as dominant and antioxidant agents. Kruawan and Kangsadalampai (2006) reported that the main compounds of Japanese ginger isolated by solvent extraction and vacuum steam distillation using GC-MS were geranyl zingiberene (35.3%), beta-sesquiphellandrene (19.7%) and beta-bisabolane (6.7%).

Conclusion

It was proven that the functional drink produced by the combination of 15 mL kapok honey in 25 mL of water red ginger water extracts had been organoleptically accepted by the panelists.

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Biochemical Characteristics of Lactic Acid Bacteria with Proteolytic Activity Isolated from Local Goat Milk

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Introduction

Lactic Acid Bacteria (LAB) is a gram-positive, non-sporing, catalase-negative, devoid of cytochromes, of nonaerobic habit but aerotolerant, fastidious, acid tolerant and strictly fermentatation (Khalid, 2011). LAB are generally associated with habitats rich in nutrients, such as various food products (milk, meat, vegetables) and are important in dairy products. Fermented dairy products have been the major part of the diet of people around the world, where LAB are used in making starter culture. *Lactobacillus plantarum* and *Lactobacillus fermentum* have been reported to be the most commonly associated LAB species with spontaneous lactic acid fermentation (Jacobsen and Lei, 2004). The aim of this study was to isolate from local goat milk LAB with spontaneous fermentation and their classification based on the morphological and biochemical characterisistics and determine their potentials as proteolytic activity and ability in fermentation of local goat milk.

Materials and Methods

LAB was isolated from spontaneus fermented local goat milk by routine microbiological procedure using MRS agar (code CM 359) as selective media. After growing the culture were tested for purity on the suitable agar medium and then the culture was confirmed using Gram staining and folowed by biochemical test with API 50 CH and Chemical for 16S rRNA.

API 50 CH test (*BioMerieux*) and 16S rRNA was used for the identification bacteria strain. The proteolytic activity was determined using the method of Walter (1984) and the isolates ability to ferment local goat milk was recorded through different tests namely, TPC and pH measurements according the methods described in AOAC (2000).

The data was analyzed using one-way analysis of variance (ANOVA) for repeated measurements using statistical software SPSS 16.0 for windows. The Duncan's multiple range test was used to determine differences at each point.

Results and Discussion

Out of 60 positive colonies for MRS Agar, only 26 were identified as LAB by biochemical tests API CL 50 and 16S rRNA. Among the 26 confirmed cultures 65.4% of isolates were identified as gram positive rod and 34.6% were identified as gram positive coci; the five isolates rod had proteolytic activity and three of them had a high proteolytic activity. The identification of high proteolytic activity bacteria showed that they were *Lactobacillus plantarum* YN 1.1, *Lactobacillus plantarum* YN 1.3 and *Lactobacillus plantarum* YN 1.6. The quantitative measurement of proteolytic activity of the isolates *Lactobacillus plantarum* YN 1.1, *Lactobacillus plantarum* YN 1.3 and *Lactobacillus plantarum* YN 1.6 compared to

Lactobacillus acidophilus FNCC 0051, indicated that the proteolytic activity of isolates *Lactobacillus plantarum* YN 1.1 (0.33 ± 0.005 U/ml), *Lactobacillus plantarum* YN 1.3 (0.32 ± 0.006 U/ml) and *Lactobacillus plantarum* YN 1.6 (0.34 ± 0.005 U/ml) were higher than control (*Lactobacillus acidophilus* FNCC 0051: 0.30 ± 0.008 U/ml). The difference of proteolytic activity could influence the ability in hydrolyzing the protein of local goat milk during fermentation process. The isolates *Lactobacillus plantarum* YN 1.1, *Lactobacillus plantarum* YN 1.3 and *Lactobacillus plantarum* YN 1.6 were able to ferment local goat milk as indicated by the increase of bacterial colonies number of 6 log cycle during 15 hours incubation and followed by decrease in pH value and increase in the total titrable acidity.

Conclusion

This investigation showed that the isolated and identified LAB from local goat milk were *Lactobacillus plantarum* YN 1.1, *Lactobacillus plantarum* YN 1.3 and *Lactobacillus plantarum* YN 1.6 which had proteolytic activity more than *Lactobacillus acidophilus* FNCC 0051 as control and capable of growing in fermented local goat milk after 15 hours incubation at room temperature.

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Total Phenolic Content and Its Antioxidant Activity in Marine Red Algae (*Kappaphycus alvarezii* Doty) Prepared With Different Drying Methods

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Introduction

Numerous studies have reported the excellent antioxidant capabilities of seaweeds or their extracts (Chandini et al., 2008). They live in a harsh environment where they are exposed to a wide range of environmental stress such as light, rapid fluctuations in temperatures, osmotic stress and desiccation. These factors can lead to the formation of free radicals and other strong oxidising agents, but seaweeds seldom suffer any serious photodynamic damage. This fact implies that seaweed cells have some protective mechanisms and compounds (Matsukawa et al., 1997).

Seaweeds contain a large amount of water. When fresh, they have 75-85% water and 15-25% organic components and minerals. Since seaweeds are perishable in their fresh state and deteriorate within a few days after harvest, drying is essential before industrial processing. Drying decreases the water activity which ultimately retards the microbial growth, helps to conserve the desirable qualities. However, in some cases, processing causes loss or no change to the content and activity of naturally occurring antioxidants (Amin and Lee, 2005), but sometimes it leads to the formation of novel compounds with antioxidant activity (Dewanto et al., 2002). However, enzymatic and/or non-enzymatic processes that may occur during drying of the fresh plant tissues may lead to significant changes in the composition of phytochemicals (Capecka et al., 2005). Studies by Nicoli et al., (1999) showed that the overall antioxidant capacity of certain foods may be enhanced due to improvement in the antioxidant properties of naturally occurring antioxidants and the formation of Maillard reaction products (MRPs).

Kappaphycus alvarezii is economically important red tropical seaweeds that are highly demanded for its cell wall polysaccharides, an important source of kappa carrageenan. This seaweed accounts for the largest consumption worldwide (Kumaret al., 2008). It is widely cultivated in Indonesia and the production of seaweed is a priority target in the domestic fisheries revitalization program of 2009. This program was carried out in Lombok, Sumba, South east Sulawesi, Mollucas and Madura Island, although it was not followed with a proper post-harvest handling and processing.

Antioxidant compound in algae are varied and affected by some factors such as species, location of its growth, light, season, harvesting time, growth condition and post harvest handling. The most common procedure for antioxidant activity measurement was 1,1-diphenyl-2-picrylhydrazyl (DPPH) radicals an reducing power.

The purpose of this research was to determine the best extraction solvent and drying method from the point of total phenolic content and antioxidant activity of *K. Alvarezii* algae.

Materials and Methods

The algae were taken from the seaweed cultivation areas in wael Village, western Seram regency, Mollucas Province and Madura Island, Jawa East Province. Samples were collected

in June and September 2010, at the age 25-30 days. Samples were washed with tap water to remove salt and other dirt followed by sun-drying and vacuum oven drying at 40°C until its moisture content was 15%. The dried samples were ground in a grinder and strained through a filter with sieve of 100 mm diameter.

The powdered samples (200g) were extracted using methanol. Concentrated methanol extract obtained was dissolved with 20% methanol (used as a proper volume 100 ml) and successively fractionated using hexane and ethyl acetate solvent. Total phenolic contents were determined by the method of Velioğlu et al. (1998) and described as mg ekivalen asam galat/g dried sample. The ability of the extract to scavenge DPPH radical was assessed by the method of Yen & Chen (1995) and the reducing power by the method described by Dorman et al. (2003).

Data were expressed as mean of three determinations and analyzed using nested design analysis of variance (ANOVA) followed by student's t-test using SPSS system version 16. A significant difference was considered at the level of $P < 0.05$.

Result and Discussion

Total Phenolic Content

The highest total phenolic content of *K. alvarezii* extract algae range was 1.44 ± 0.06 - 2.44 ± 0.27 mg galic acid equivalent/g of dry extract from ethyl acetate fraction, followed by hexane fraction: 0.43 ± 0.18 – 0.58 ± 0.13 mg gallic acid equivalent/g of dry extract, then water fraction: 0.08 ± 0.03 – 0.26 ± 0.03 mg galic acid equivalent/g of dry extract (Table 1).

Table 1. Mean values for total phenolic content types drying and solvent treatment of *K. alvarezii* algae from Mollucas and Madura water area

Location of algae origin	Types drying	Types solvent	Total phenolic content (mg GAE/g of dry extract)
Mollucas	Sun drying	Hexane	$0.43 \pm .18$
		Ethyl acetate	2.05 ± 0.17
		Water	0.17 ± 0.07
	Vacuum oven	Hexane	0.46 ± 0.02
		Ethyl acetate	1.44 ± 0.06
		Water	0.08 ± 0.03
Madura	Sun drying	Hexane	0.56 ± 0.07
		Ethyl acetate	2.21 ± 0.18
		Water	0.17 ± 0.12
	Vacuum oven	Hexane	0.58 ± 0.13
		Ethyl acetate	2.44 ± 0.27
		Water	0.26 ± 0.03

The factors that contribute to the efficiency of solvent extraction are type of solvent, pH, temperature, number of steps and volume of solvent and particle size in the samples. The levels of phenolic compounds in plants, fruits, vegetables and herbs are influenced by genotype, agronomic practices, maturity at harvest and post-harvest storage, climatic, regional and processing conditions (Asami et al., 2003). Phenolics are not uniformly distributed in plants at the tissue, cellular and subcellular levels. These compounds can be found in free, conjugated and polymeric forms or may coexist as complexes with carbohydrate, protein or other plant components. Solubility of phenolic compounds is influenced by the level of phenolic polymerization and interaction with other compounds (Yuan et al., 2005). Phenolic compounds are more soluble if there is a change in the structure of the compound caused by

drying (Li et al., 2009). Ye et al (2005) reported that drying act to free phenolic compounds with a high molecular weight form of free phenolic simpler and thus easier on the extraction.

The low content of total phenolic extracts of algae *K. alvarezii* drying results can be caused by the decomposition of phenolic compounds due to drying temperature and enzyme activity. The enzymes from plant cell such as lipoxygenase can oxidize polyphenols (Akoh & Min, 1997).

Scavenging effect on 1,1-diphenyl-2-picrylhydrazyl radical DPPH:

DPPH reagent has been used extensively for investigating the free radical scavenging activities of compounds. In the DPPH test, the dried extracts are potentially able to reduce the stable DPPH radical to yellow coloured diphenylpicrylhydrazine. The assay is based on the reduction of alcoholic DPPH solution in the presence of a hydrogen-donating antioxidant due to the formation of the non-radical form DPPH-H by the reaction (Shon et al., 2003).

Table 2. Mean values for scavenging radical DPPH(EC_{50}) types drying and solvent treatments of *K. alvarezii* algae from Mollucas and Madura water areas.

Origin of algae	Types of drying	Types of solvent	EC_{50} (ppm)
Mollucas	Sun drying	Hexane	0.42±0.04
		Ethyl acetate	0.13±0.01
		Water	0.96±0.01
	Vacuum oven	Hexane	0.28±0.02
		Ethyl acetate	0.14±0.01
		Water	0.54±0.04
Madura	Sun drying	Hexane	0.26±0.01
		Ethyl acetate	0.25±0.01
		Water	0.87±0.02
	Vacuum oven	Hexane	0.25±0.01
		Ethyl acetate	0.09±0.01
		Water	0.53±0.04

The highest radical scavenging activity could be obtained from ethyl acetate extract of Madura *K. alvarezii* algae dried in vacuum oven at 40 °C. (EC_{50} 0.09 ± 0.01 ppm) followed by ethyl acetate extract of sun dried Mollucas *K. alvarezii* algae (EC_{50} 0.13 ± 0.01 ppm) and ethyl acetate fraction of Mollucas *K. alvarezii* algae dried in vacuum oven at 40 °C (EC_{50} 0.14 ± 0.01 ppm). Ragan and Glombitza (1986) reported the radical scavenging activity of algae to be mostly related to their phenolic contents. *K. alvarezii* is the main industrial source of carrageenan (Having alternative D-glucose 4-sulphate and 3,6-anhydro D-galactose residues), which may also contribute to the antioxidant potential of this seaweed. Components, such as low molecular weight polysaccharides, pigments, protein or peptides, also influence the antioxidant activity (Sriwardhana et al., 2003).

Reducing power

Reducing power is associated with antioxidant activity and may serve as a significant reflection of the antioxidant activity. Compounds with reducing power indicate that they are electron donors and can reduce the oxidized intermediates of lipid peroxidation processes, so that they can act as primary and secondary antioxidants (Yen & Chen, 1995). The results (Figure 3) indicated that reducing power extract of *K. alvarezii* algae was concentration dependent. As the concentration increased from 0.25 mg/ml – 4.0 mg/ml, the highest reduction power was observed from ethyl acetate extract of Madura *K. alvarezii* algae dried in vacuum oven at 40°C: 0.61 ± 0.00. This result indicated that compounds with strongest reducing power were concentrated in the ethyl acetate extract and were of medium polarity. Interestingly, the ethyl acetate extract of *K. alvarezii* algae also exhibited the highest total

phenolic content, indicating that there may be relationship between the total phenolic content and reducing power.

Table 3. Mean values for reducing power types drying and solvent treatments of *K. alvarezii* algae from Mollucas and Madura water areas.

Origin of algae	Types of drying	Types of solvent	Reducing power (mg AAE/g) of dry extract Concentration (mg/ml)			
			4	2	1	0.5
Mollucas	Vacuum oven	Hexane	0.27	0.22	0.05	0.02
		Ethyl acetate	0.57	0.35	0.22	0.11
		Water	0.04	0.02	0.001	0.003
	Sun drying	Hexane	0.33	0.207	0.12	0.057
		Ethyl acetate	0.43	0.221	0.194	0.061
		Water	0.046	0.025	0.029	0.019
Madura	Vacuum oven	Hexane	0.527	0.295	0.117	0.048
		Ethyl acetate	0.614	0.409	0.226	0.131
		Water	0.066	0.025	0.024	0.004
	Sun Drying	Hexane	0.527	0.295	0.119	0.048
		Ethyl acetate	0.602	0.373	0.2	0.102
		Water	0.083	0.035	0.022	0.022

Tapiero et al., (2002) reported that polyphenols are reducing agents and together with other dietary reducing agents such as vitamin C, E and carotenoids, referred to as antioxidants, protect the body's tissues against oxidative stress and associated pathologies such as cancer, coronary heart disease and inflammation. The following functional groups of polyphenolic compounds are important for iron binding: (i) ortho-dihydroxyl groups, e.g. 3'-4', 7-8 dihydroxyl groups; (ii) the presence of 5-OH and/ or 3 -OH in conjunction with a C4 keto group; and (iii) a large number of OH group (Duh, 1988).

Conclusion

Ethyl acetate extract of *K. alvarezii* algae from Madura dried by using vacuum oven at 40°C possessed the highest total phenolic content and antioxidant activity. The ethyl acetate extract of *K. alvarezii* algae from Madura island water could be a potential rich resource of natural antioxidant.

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A Comparative Study of Physico-chemical and Sensorial Properties of Indian Desiccated Dairy Product Ujani Basundi and Basundi

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Abstract

The investigation was carried out to evaluate the chemical as well sensory quality of *ujani basundi* and *basundi*. Variations in composition of *ujani basundi* and *basundi* samples were observed due to the rate of concentration of milk, higher level of sugar addition and initial quality of milk used in the preparation of these products. *Ujani basundi* is more concentrated than the *basundi*, therefore it got brown color and has attractive appearance. It was observed to be sweet with pronounced caramelized flavor in both the products. The *ujani basundi* has a thicker body than the *basundi* which is main characteristic of this product. *Ujani basundi* had higher percentage of constituents than the *basundi*.

The Potential of Local Trevally Fish (*Selaroides spp*) and Catfish (*Clarias sp*) of Central Sulawesi as Natural Sources of Omega 3,6 and 9

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Introduction

Long chain fatty acids omega 3, 6 (PUFA) and 9 (MUFA) are classified as critical nutrients for human health. These fatty acids are the least represented of all fatty acids in the human diet. The oil which is rich in omega-3 is largely derived from cold water fish and sea food products (seafood) (Lee, *et al.*, 2005). Travelly fish (*Selaroides spp*) and Catfish (*Clarias sp*) are abundantly found in the waters of Central Sulawesi. The previous study showed that Travelly (*Selaroides spp*) fish oils contained 24.45% omega-3 and 10.53% omega -6, while Catfish (*Clarias sp*) fish oils contained 34.96% omega 9. Therefore, the aim of this study was to investigate the potential for these fish oils to be used in mixtures to obtain fish oil balanced for omega 3, 6 and 9 fatty acids.

Materials and Methods

Sample preparation.

Trevally fish (*Selaroides spp*) and Catfish (*Clarias sp*) were obtained from the sea of Makassar or Tomini Gulf (Parimo Regency), Central Sulawesi Province These fish oils were extracted by a wet rendering method (AOAC, 2005). Mixing the oil in a ratio of 1: 1 was done using a shaker for 20 minutes at 50°C. The oil samples were then analyzed by converting the fatty acids into fatty acid methyl esters (FAME) which were subsequently injected into a GC column (SHIMADZU-FID) and further analyzed by NMR (ECA 500).

Laboratory Analysis.

Samples (0.3 ml) were methylated using 1.5 ml of Na-Metanolic and heated at 65°C for 15 minutes in a water bath. BF₃-Methanol (1.5ml) was added to the mixture, then heated under the same conditions and the solution was allowed to cool down. The solution was extracted with 0.5 ml of N-Heptane and 1 ml of saturated NaCl, and the top-layer of solution (1 µl) was injected into the Gas Chromatography (using the same conditions as for the standard) as described by the AOAC (1990). ¹H NMR and ¹³C NMR was performed on a mixture of fish oil Travelly (*Selaroides sp*) and Catfish (*Clarias sp.*) Proton Test location determination was conducted using ¹H NMR (JEOL, 2005).

Results and Discussion

The omega-3, 6, 9 and cholesterol contents of two kinds of fish species and mixed oils are presented in Table 1.

Table 1. Omega-3,6,9 and cholesterol contents of two kinds of fish species and mixed oils

Name of fish	Omega-3 (%)	Omega-6 (%)	Omega-9 (%)	Cholesterol**(ppm)
<i>Selaroides spp</i>	24.45 ± 1.45	10.53 ± 0.87	14.52 ± 0.93	<9.5
<i>Clarias sp</i>	1.18 ± 0.74	6.29 ± 0.10	34.96 ± 1.49	<9.5
Mixing (1 : 1)*	15.75 ± 0.36	3.49 ± 0.06	35.52 ± 0,33	<9.5

Means ± standard deviation; *Mixing of *Selaroides spp* and *Clarias sp*; ** Detection limit of cholesterol = < 9.5 ppm

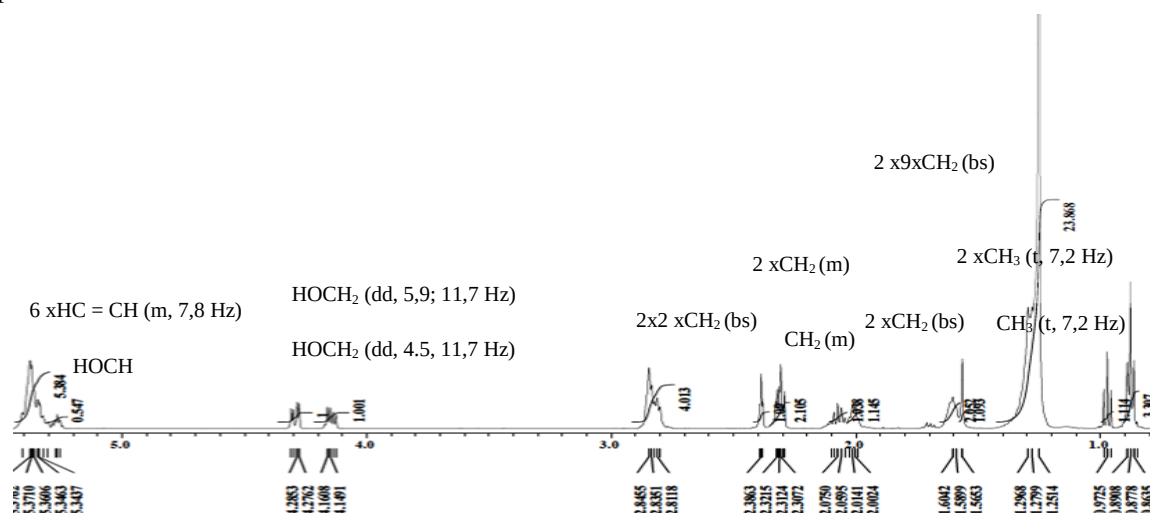


Figure 1. ¹H-NMR spectrum for mixed fish oils

The results of NMR measurements showed an aliphatic chain length of the unsaturated fatty acids, 3 methyl group appears on the shear value chemicals on δ 0.87 (6H, t, J = 7,2 Hz) and 0,97 (3H, t, 7,2 Hz), showed some methylene group on δ 1,29 (2x9H, bs), 1,58 (bs, 6H), 2,06 (4H, m), 2,31 (4H, m), 2,38 94H, m) and 2,84 (8H, m). The presence of 6 saturated bonds was shown in δ 5,37 (6H, m, J = 7,8 Hz). It also demonstrated the glycerol groups that appeared on the δ 4,28 (CA, 2H, dd, J = 5,9; 11,7 Hz) and 4,15 (C-B, 2H, dd, 4,5; 11,7 Hz) and 5,34 (C-A, 1H, m). The existence of methyl groups appeared in different areas of chemical shearing, indicating that the type of unsaturated fatty acids is different. Figure 1 showed linoleic triglycerides in the ¹H-NMR spectra which had the same chemical shear values for methyl groups.

The results conclude that fish oil mixture samples contained mixed triglycerides composed of three types of unsaturated fatty acids Omega-3, 6 and 9. Each of these was bound in the form of glycerol esters in sn1, sn2 and sn3, respectively. It can be concluded that mixture oil of *Selaroides spp* and *Clarias sp* could be a good source of omega 3, 6 and 9 for the human diet.

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The Effectiveness of Some Manual Honey Test For Adulterated and Artificial Honey

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Abstract

There are many manual honey tests to distinguish pure and adulterated or artificial honey, but their effectiveness has never been studied. This study was conducted to determine the effectiveness of several manual honey tests, i.e. raw fish test, hexagon test, solubility test, turbidity test, foam test, heating test, and tensile test. This study was divided into two experiments; the first experiment used various adulterated honey (with sugars: sucrose, fructose and glucose with thickener: CMC and gelatin,) and artificial honeys (sucrose and sago), the second experiment used adulterated honey from natural and synthetic sugars in the various concentrations. Chemical analysis such as pH, water, hydroxymethylfurfural (HMF) and sugar content (sucrose, fructose and glucose) were also conducted to support the result of manual honey test. Compared to other manual honey test, solubility test is the most effective test to detect honey adulterations, and foam test, onion and rawfish test were not effective. We found that honey adulteration with 25% glucose cannot be detected by all the manual honey tests.

The Effect of Corn Oil Addition on Physical Quality and Organoleptic Properties of Mayonnaise

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Introduction

Mayonnaise is probably one of the most widely used sauced in the word today. Mayonnaise is an oil-in water emulsion and is traditionally prepared form vegetable oil and water where egg yolk acts as an emulsifier while salt, vinegar, sugar and other substances act as flavouring (Yang & Lai, 2003). Mayonnaise stability is dependent on several factors such as the amount of oil, amount of egg yolk, viscosity, method of mixing, relative volume of oil phase to aqueous phase and temperature. Mayonnaise must contain 70 – 80% vegetable oil, which makes up its oil phase (Depree, et al., 1991). The use of different vegetable oils or a combination of vegetable oils may enhance the nutritional and sensory traits of mayonnaise (Koprivnjak, 2008). Therefore the aim of this study was to examine the effect of the addition of corn oil on physical quality and the organoleptic properties of mayonnaise.

Materials and Methods

Materials

The following materials were used for mayonnaise production: corn oil, soya oil, vinegar (4%), pasteurized egg yolk (8%), sugar (2%), salt (2%), mustard (1%) and distilled water (8%). Corn oil and soya oil were obtained from the local market. Fresh hen egg yolks were obtained from a local producer Malang, East Java Province, Indonesia.

Preparation of the Emulsion

Four mayonnaise formulations were prepared and physical evaluation was performed. A mayonnaise with a soya oil formulation was used as a control. The treatments are ratio mixture of soya oil and corn oil (70 : 30), (50 : 50) and (30 : 70).

Methods

The research design used a factorial experiment in a Completely Randomized Design. The parameters observed were pH, viscosity using pH meter and viscometer Brookfield according to the method by AOAC (2005), and organoleptic properties were measured using the method described by Lawless and Heyman (1998). The data obtained were analyzed using ANOVA and if were significant differences the analysis was continued using the Duncan Multiple Range Test.

Result and Discussion

The effect of corn oil addition on the pH, viscosity and organoleptic parameters of mayonnaise are presented in Table 1.

Table 1. The effect of corn oil addition on the pH, viscosity, taste, flavor and colour of mayonnaise.

Sampel	Viscosity (cps)	pH	taste	flavour	colour
Mayonnaise Control (75% Soya oil)	2340 ± 120	3,65 ± 0.064	4,2 ± 0.153	4,3 ± 0.264	3,5 ± 0.115
Mayonnaise (70% soya oil; 30% corn oil)	2410 ± 104	3,70 ± 0.005	4,0 ± 0.058	4,4 ± 0.208	3,6 ± 0.1
Mayonnaise (50% soya oil; 50% corn oil)	2630 ± 6.42	3,74 ± 0.050	4,4 ± 0.351	4,3 ± 0.153	3,8 ± 0.557
Mayonnaise (30% soya oil; 70% corn oil)	2760 ± 96.43	3,90 ± 0.062	4,6 ± 0.360	4,8 ± 0.230	4,3 ± 0.1

Means ± standard deviation

The result showed that the viscosity and pH significantly increased using higher concentrations of corn oil. The addition of corn oil (30% and 50%) and decrease in the ratio soya oil in the oil phase of mayonnaise resulted in different composition and properties which caused the difference in viscosity of oil in water emulsion. The pH of mayonnaise can have an effect on the structure of the emulsion. According to Depree and Savage (1991), the viscosity and stability of mayonnaise should be at its highest when the pH is close to the average isoelectric point of the egg yolk protein. The mayonnaise contained a balanced proportion of salt, sugar, vinegar and mustard that contributed to its taste. The yellowish colour of mayonnaise is primarily provided by egg yolk carotenoids. The oil and mustard do not contribute to the color provided by the egg yolk. The higher addition of corn oil showed these sample generated samples that were most preferred.

Conclusion

It could be concluded that mayonnaise with the 70% addition of corn oil gave the best mayonnaise based on physical quality and organoleptic preferences for taste, flavour, and colour.

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Poster 1

Bioethanol Production in Brazil: The Impact on Beef Production and Social Economics in the Last Two Decades

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Introduction

Brazil is the largest producer of sugarcane and oranges, the second largest for soybean, the third largest for corn and an international leader in biofuel production. It also ranks as the world's largest meat exporter, second largest beef producer, and is home to the world's biggest commercial beef herd. The aim of this survey was to assess the impact of the increasing bioethanol production on beef production and social issues.

Materials and Methods

A study was conducted using official databases (1991-2000) about sugarcane crop, bovine herd and population, obtained by regions (North, Northeast, Midwest, Southeast and South) (IBGE, 2010) and by calculating the annual average growth rate (%/y), using regression analysis.

Results and Discussion

In Brazil, the area cultivated with annual crops increased by 2.7%/yr in the last decade, reaching 59.1 million hectares in 2010 (Table 1). In 1991, sugarcane represented 9.5% of all the area of annual crops, increasing to 15.5% (9.16 million ha) in 2010. The area planted with sugarcane grew at a much higher rate than the area with annual crops and in the Southeast, the most developed region of the country is worth mentioning. This region was responsible for 65.8% of the total area cultivated with sugarcane in Brazil and accounted for 55.8% of the area occupied by annual crops in this region in 2010. São Paulo, had 55.3% of the Brazilian sugarcane planted area in 2010 causing increase in land prices. The Midwest region corresponds to 29.1% of the area cultivated with annual crops and to 13% of the total sugarcane area, showing the highest increase in the area cultivated with sugarcane. Although the North region also showed the 2nd highest increase in sugarcane area, it accounts for less than 1% of the area planted with sugarcane. In the last decade, sugarcane yield grew by 9.18%/yr, reaching around 717 million tons in 2010; the productivity increased from 62 ton/ha in 1991 to 79 ton/ha in 2010. During the last decade, only 17% of the increase in sugarcane yield was due to productivity improvements and 83% was due to an increase in harvested area (productivity/yield ratio = 0.17).

On beef production (Table 2), Brazil had approximately 152.1 million heads in 1991 and 209.5 million in 2010. The Brazilian bovine herd grew by 1.98%/yr in the last two decades. The North region encompasses the Amazon forest, representing an agricultural frontier, and it showed the highest increase in bovine herd. The Midwest region is a traditional producer of beef cattle and grains, with the largest bovine herd in 2010 (34.6% of the total) and it showed the 2nd highest growth in herd size in the last two decades. The Southeast, the most technologically developed region had the 2nd largest herd in Brazil in 1991, but since then it showed the lowest growth in herd size (0.26%/y), ranking 3rd in herd size in 2010.

Recent demographic census (2010) reported a population of 190.8 million, rising by 1.38%/y during the last two decades (Table 2). The rural population decreased by 0.95% annually (35.8 million in 1991 to 29.8 million in 2010). In the Southeast region which accounted for 42.1% of the total Brazilian population, had the highest decrease in rural population, where the bucolic countryside has changed, since houses have been demolished due to the rural exodus. The North, followed by Midwest region, showed the highest growth of total and urban populations, but they represented only 8.32 and 7.37%, respectively of the total population. Rural exodus to the cities happened in almost all regions particularly in the Southeast region partially due to the increase in

land values, caused by the sugarcane spread. For the same reasons, bovine farming moved towards Midwest and North, causing concerns on the effect on the Amazon rainforest.

Table 1. Annual average growth rate of total annual crops planted area and sugarcane planted and harvested area, yield and productivity in different regions of Brazil from 1991 up to 2010.

Region	Period	Rel. area ¹ 1991 (%)	Rel. area ² 2010 (%)	Total planted area ³ (%/y)	S.cane planted area ⁴ (%/y)	S.cane harv. area ⁵ (%/y)	S.cane yield ⁶ (%/y)	S.cane produc. ⁷ (%/y)	Produc. /yield ratio ⁸
North	1991-2010	0.92	1.55	1.71	4.44	3.87	6.02	2.07	0.34
	1991-2010			2.27	9.09	10.88	12.16	1.15	0.09
Northeast	1991-2010	13.00	12.45	0.17	-0.44	-0.28	1.11	1.39	1.25
	1991-2010			1.49	1.13	1.48	1.96	0.47	0.24
Midwest	1991-2010	3.72	6.92	5.89	8.41	8.70	9.72	0.93	0.10
	1991-2010			5.31	12.34	12.78	14.29	1.34	0.09
Southeast	1991-2010	26.17	55.80	1.08	4.71	4.65	5.56	0.87	0.16
	1991-2010			3.29	8.71	8.46	9.99	1.41	0.14
South	1991-2010	1.29	3.55	1.08	5.81	5.82	6.89	1.01	0.15
	1991-2010			1.18	7.06	7.06	8.04	0.92	0.11
Brazil	1991-2010	9.48	15.51	1.93	3.92	3.94	5.25	1.26	0.24
	1991-2010			2.70	7.56	7.52	9.18	1.54	0.17

¹ relative sugarcane area in 1991 (% of total annual crops area), ² relative sugarcane area in 2010 (% of total annual crops area), ³ annual average growth rate of total annual crops area (%/y), ⁴ annual average growth rate of sugarcane planted area (%/y), ⁵ annual average growth rate of sugarcane harvested area (%/y), ⁶ annual average growth rate of sugarcane yield (%/y), ⁷ annual average growth rate of sugarcane productivity (%/y), ⁸ productivity/yield ratio.

Table 2. Annual average growth rate of bovine herd and population (urban and rural) in different regions of Brazil from 1991 up to 2010.

Region	Period	Rel. herd ¹ 1991 (%)	Rel. herd ² 2010 (%)	Bovine herd ³ (%/y)	Rel. pop. ⁴ 1991 (%)	Rel. pop. ⁵ 2010 (%)	Total pop. ⁶ (%/y)	Urban pop. ⁷ (%/y)	Rural pop. ⁸ (%/y)
North	1991-2010	10.08	20.09	6.33	6.83	8.32	2.44	3.61	0.13
	1991-2010			3.98			2.09	2.61	0.78
Northeast	1991-2010	17.52	13.72	1.03	28.94	27.83	1.18	2.17	-0.83
	1991-2010			2.51			1.07	1.65	-0.35
Midwest	1991-2010	31.62	34.63	2.30	6.42	7.37	2.12	2.59	-0.58
	1991-2010			1.06			1.91	2.15	0.20
Southeast	1991-2010	24.14	18.26	0.26	42.73	42.13	1.31	1.60	-1.48
	1991-2010			0.07			1.05	1.31	-1.89
South	1991-2010	16.61	13.30	0.45	15.07	14.36	1.12	1.85	-1.71
	1991-2010			0.10			0.87	1.36	-1.47
Brazil	1991-2010	100	100	1.98	100	100	1.38	1.97	-0.95
	1991-2010			1.44			1.17	1.55	-0.65

¹ relative bovine herd in 1991 (% of Brazilian herd), ² relative bovine herd in 2010 (% of Brazilian herd), ³ annual average growth rate of bovine herd (%/y), ⁴ relative population in 1991 (% of Brazilian population), ⁵ relative population in 2010 (% of Brazilian population), ⁶ annual average growth rate of total population (%/y), ⁷ annual average growth rate of urban population (%/y), ⁸ annual average growth rate of rural population (%/y).

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Poster 2

Bacterial Contamination on Beef Obtained From Fresh Market in Chumphon Province, Thailand

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Introduction

Traditional fresh meat shops in Chumphon province are like most small retail shops located in the metropolitan market in each district and supplied by backyard slaughterhouses. The consumption of food-borne pathogens in food is one of the major causes of diarrheal diseases in Thailand. The bacterial pathogens that account for many of these cases include *Salmonella* spp., *Listeria monocytogenes*, *Staphylococcus aureus* and *Escherichia coli* (Minami *et al.*, 2010). The objective of this study was to investigate the microbiology of beef obtained from fresh markets in Chumphon province.

Materials and Methods

Beef samples were collected from meat shops and swabs of surface areas of the meat processing equipment, cutting boards, knives and vendors' hands were collected from fresh market in Pathiu, Tha Sae and Muang Chumphon districts during December 2011. Ten shops were sampled four times (1 time per week with 40 sample sets collected in total. Samples were assessed for total coliform bacterial count by the SPC method., Fecal coliforms and *Escherichia coli* counts were assessed by Most Probable Number (MPN) and *Salmonella* spp. and *Staphylococcus aureus* (*S. aureus*) assessed using the AOAC (2000) method

Result and Discussion

We found total bacteria count and coliform counts ranging from log 6.11-7.05 cfu / g and log 3.87-4.71 MPN / g, respectively, and the contamination with the pathogens *Salmonella* spp., and *Staphylococcus aureus* were 7.50 and 2.50 Percent (n = 40) respectively. The National Bureau of Agricultural commodity and Food Standards (ACFS) recommended limit for total bacterial count for beef is no more than log 5.7cfu/g. However, the level of total bacteria count contamination on beef obtained from the fresh market displays were above the recommended limit of ACFS 6001-2004 in 8 out of 10 shops. The number of total coliforms ranged from log 3.87- 4.71 MPN/g, while fecal coliform counts ranged from log 3.10-4.58 MPN/g and *E. coli* from log 2.76-4.07 MPN/g. The number of total coliforms and fecal coliforms were higher than the recommended limit of ACFS 6001-2004. (log 3.7 MPN/g or 5×10^3 MPN/g). Detection of coliforms is used as an indicator of sanitary quality of water or as a general indicator of sanitary conditions in the food processing environment (Pilasombat *et al.*, 2007). The bacteria isolated from the beef samples that were related to food hygiene included *Salmonella* spp. and *Staphylococcus aureus*. We found *Salmonella* spp. and *S. aureus* contaminated about 7.50 and 2.50 percent of the 40 sampling times. The National Bureau of Agricultural commodity and Food Standard (ACFS) recommends a limit of *Salmonella* spp. in beef which should zero detection and *S. aureus* with no more than log 2.00 MPN / g (1×10^2 MPN / g) in any sample

Table 1. Least squares means of Total bacteria count from beef, cutting board, knife, surface area and vender hand

No.	Total bacteria count (log cfu/g)					No.	Total bacteria count (log cfu/g)				
	B	CB	K	SA	H		B	CB	K	SA	H
1	4.93	7.78	7.15	7.27	6.72	6	6.55	9.90	7.70	10.39	8.69

2	6.80	7.48	6.91	7.16	6.23	7	6.17	8.45	6.55	7.82	5.07
3	7.05	7.54	6.72	7.36	7.31	8	6.11	7.00	6.62	6.83	5.50
4	5.20	9.43	7.52	8.86	7.52	9	6.43	9.67	8.07	7.18	5.61
5	6.65	9.89	7.91	9.64	8.68	10	6.63	8.75	7.10	8.48	5.61

Table 2. Least squares means of Total coliforms, fecal coliforms and *E.coli* from beef, cutting board, knife, surface area and vendor hand

No.	Total Coliforms (log					Fecal Coliforms (log					<i>E.coli</i> (log MPN/g)				
	B	CB	K	SA	H	B	CB	K	SA	H	B	CB	K	SA	H
1	4.30	4.07	4.23	4.22	3.50	3.94	3.99	4.22	3.89	3.48	2.76	2.64	2.00	2.60	1.47
2	3.87	3.70	3.74	3.15	2.90	3.63	3.50	2.89	3.15	2.84	3.63	3.48	2.87	3.07	2.79
3	3.39	3.42	3.02	3.07	3.51	3.10	3.22	2.72	3.49	3.50	3.02	3.19	2.63	3.00	3.50
4	4.30	4.23	4.31	4.28	3.11	4.30	3.13	4.31	3.68	3.10	2.87	3.07	2.98	3.58	2.86
5	4.51	4.23	4.30	4.25	4.31	4.51	4.23	3.63	3.36	3.26	4.07	3.48	3.54	3.35	3.25
6	3.10	3.37	3.54	3.91	3.07	4.32	3.57	3.50	3.89	3.07	3.93	3.57	3.50	3.50	3.00
7	4.59	4.58	4.58	4.71	4.71	3.96	4.55	4.31	4.37	4.40	3.61	3.99	4.21	3.59	2.83
8	4.65	4.71	4.58	4.59	4.57	4.58	4.59	4.58	4.59	4.57	3.76	3.58	3.67	3.75	3.70
9	4.71	4.37	4.58	4.71	4.56	4.37	4.36	4.57	4.57	4.31	3.71	3.82	4.25	4.27	2.89
10	4.71	4.56	4.58	4.71	4.71	4.57	4.55	4.55	4.56	4.50	3.47	3.76	2.69	3.52	3.47

Note: B = beef, CB = cutting board, K = knife, SA = surface area, H = vendor hand

Conclusion

The study shows that beef from backyard slaughterhouses can be significantly poorer in meat hygiene standards and this will be of high public health concern.

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Environmental Factors Affecting Milk Production In Creolles And Anglo Nubian Goats In Ecuador

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Introduction

Adult goat population in Ecuador is 178367 heads, distributed basically in the regions of La Sierra with 151642 heads and La Costa, with 25957 heads (Anon 2003). Predominant breeds are Anglo Nubian, Creolles, Boer and Saanen. In Ecuador, studies with goats are lacking. Therefore, the objective of this research was to characterize daily milk yield of Creolles and Anglo Nubian breeds as affected by different environmental factors during three lactations.

Materials and Methods

Records of ninety nine lactations of 47 Creolles goats and forty five lactations of 28 Anglo Nubian goats of the Experimental Station of Zapotepamba at the Loja Province in Ecuador were used to characterize daily milk production from years 1999 to 1991 and to determine the effect of feeding 200gm/day of concentrate with 14% de PB. Kids received restricted nursering. Data analysis was conducted using a mixed model proceeding of SAS (2007) versión 9.1.3 to evaluate the effects: genotype (Creolle, Anglo Nubian), goat nested into genotype, parity (3), calving season (rainy/dry season) and the genotype x parity and genotype x calving season interactions.

Results and Discussion

Least Square Means for milk yield/day in Creolle goats was 0.45 ± 0.22 kg/head/day, which was similarly reported for this breed in other recent studies (Cofré, 2012; Jhan, 2012; Rabasa *et al.*, 2012). Lower yield was also obtained such as 0.40 kg/head/day in Guatemala (Mendizabal, 1989) and 0.38 kg/head/day in Venezuela (García *et al.*, 1995). Nevertheless, Sanchez de la Rosa (2006) recorded a greater milk yield (0.86 kg/head/day) in Creolle goats in Mexico. Daily average milk yield in Anglo Nubian goats was 0.76 ± 0.22 kg. Similar Results in this breed on semi extensive conditions were found by Ribas (1999) in Cuba, Paz *et al.*, (2007) in Argentina and Frau *et al.*, (2010) in México. Other authors have obtained greater production such as 1.24 kg/day (Palma, 1995), 2.90 kg/day (Torres, 2004) and 1.07 kg/day (Sanchez de la Rosa, 2006). These later Results are consequence of feeding systems in experimental or semi establishment conditions where goats were supplemented with 200-400g of commercial concentrate with 12% PB, 3500 Mcal and pasture harvested in the dry season. Parity effect on milk yield production/day, was highly significant ($p \leq 0.001$). The lowest milk yield/day was obtained at first calving with 0.50 ± 0.15 kg/day. Multíparous goats produced greater milk yield than primiparous did (Paz *et al.*, 2007). These differences are due to an utilization of corporal reserves to complete the morphological development and pregnancy in the first kidding goats; in the third lactation, maximum daily yield of milk was achieved and was maintained constant to the fifth (Garces *et al.*, 2004) quoted by (García, R. 2005).

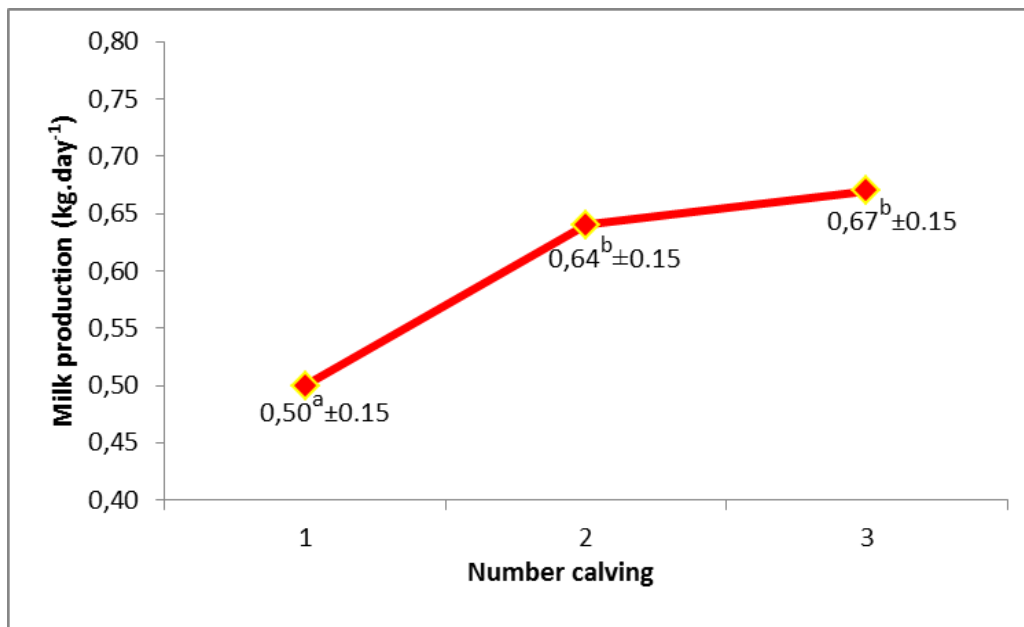


Figure 1. Parity effect on milk yield/day.

Kidding season effect on milk yield/day was not significant in the present trial due to it was conducted on experimental conditions with supplementation of goats in production. These Results are in agreement with those found by Paz *et al.*, (2007). Nevertheless, other authors like Sánchez *et al.*, (2006), Sánchez de la Rosa *et al.*, (2006) and Dickson *et al.*, (2008), on semi extensive conditions, obtained greater milk yield in goats calving during the rainy season in relation to the dry due to a greater pasture disponibility and quality.

It is concluded that the daily average milk yield of Anglo Nubian and Creolle goats was affected by genotype and parity. The average daily milk yield of Anglo Nubian breed was 0,30 kg and was greater than Creolle breed. Both genotypes gave the lowest daily milk yield at first kidding in agreement with results informed by other authors.

Indigenous Livestock Management Among *Siahjel Koochi* Nomads of Iran

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Abstract

There is little information on the nomadic production system of indigenous livestock in Iran. Interviews were carried out with 30 Siahjel nomad families of Raen origin in proximity of about 20 km to Baft in 2010 to characterize the production system. The nomads move their livestock over large distances within the rangelands of the region from May to November and the majority migrates to south during winter and early spring. Eighty seven percent of nomad families stay and manage their animals together with one or more other related families. Siahjel nomads mainly rely on goats and average proportion of goats, sheep and monodactyl per family are 89, 8 and 3 % respectively. Adult breeding females constituted 44%, the largest group within the goat herds, female yearling, bucks, male yearling constituted 12, 8 and 7% respectively. Diseases accounted for 57, % of adult and 88% of young animal deaths, The most prevalent diseases were Enterotoxaemia, Foot and Mouth Disease, Pneumonia, Agalactia and Diarrhoea. Animal sales, meat, cashmere and milk production are the major reasons for keeping goats. Rangeland is considered as the main source of feeding (85%); the remaining 15% are provided by stubble grazing.

Small-scale Dairy Farming for Livelihood Improvement in Different Agro-climatic Zones, Sri Lanka: Constraint and Prospect

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Introduction

Dairying is an important source of supplementary income, especially for the marginal farmers in the mixed crop livestock system in Sri Lanka. Total milk production in 2010 was 247 million liters, meeting 33% of the annual national requirement. Imports to make up the difference costs the nation about Rs. 27 billion annually (Department of Census and Statistics, 2010). According to the national policy for agriculture and livestock, the sector is supposed to achieve a self-sufficiency rate of at least 50% in milk and milk products by 2015. The management of the dairy farming systems highly depends on the different agro-climatic zones in Sri Lanka. Accordingly, potential areas for development needed to be identified to implement dairy development plans. Hence, the diversity of small-scale dairy farmers in different agro-climatic zones needs to be characterized in order to identify opportunities and constraints. The objectives of the study, therefore, were to describe the socio-economic and farm characteristics in different agro-climatic zones and to assess the major constraints to improve livelihoods.

Materials and Methods

The study was conducted in three different agro-climatic zones in Sri Lanka. A cross-sectional survey was conducted using a multistage random stratified sample design. A total of 523 dairy farmers were interviewed and data were collected using a pre-tested structured questionnaire on socio-economic characteristics of households, dairy management practices, herd characteristics, feeding practices, animal health and veterinary services, land utilization, and extension and institutional support received.

Results and Discussion

The results from the study showed the socio-economic household characteristics of the dairy producers. A considerable number of dairy farmers belongs to the 40 <= 50 age group. The proportion of farmers below 30 years of age (10.4%) signifies that the involvement of the younger generation in dairy farming is relatively high in the Up-country. In the Mid-country, almost half of the dairy farmers (48.3%) of the dairy farmers were above the age of 51 years indicating that dairy is a reliable source of income after retirement.

The management system, land area and herd size are closely related and the average land area per farm in the Up-country, the Mid-country and the Coconut Triangle are 0.48, 1.04 and 3.17 acres respectively. The majority (70.3%) of the dairy farmers in the Up-country operated on land less than 0.25 acre and practiced intensive system with small herd size. In the Coconut Triangle 37.8% of the farmers used the semi-intensive system of management, with only 8.1%

relying on the intensive system. In the Up-country, majority (95.0%) of the farmers used compounded feed while, in the Mid-country, most (81.0%) of farmers used pasture only.

More than half of farmers do not receive any government subsidy for dairy farming. Most of the farmers in the Mid-country (47.8%) and Coconut Triangle (48.7%) received subsidy for the construction of cattle shed. Furthermore, the majority of the farmers in the Up-country (76.9%) and Mid-country (66.0%) have not received any kind of training.

The dairy animals are a source of cash income and majority of the farmers (59.7%) in the Mid-country sell their animals and get the money for emergencies. In addition, bull calves are valuable source of income in the Up-country and Coconut Triangle. In addition, limited space and lack of pastures forced Up-country farmers to sell their cattle. The major constraint experienced by the dairy farmers was small capital, especially to buy formulated feeds. Other problems were limited space, lack of pasture and shed problem. Further, time limitation, problems in milk marketing and lack of water were also mentioned. In Up-country, shed problem and calf mortality were 25.4% and 15.2 % respectively. Calves were more at risk due to cold weather in the Up-country.

Conclusion

It can be concluded that the small-scale dairy farming has a potential of improving the welfare of households. In order to protect, promote and develop the small-scale dairy farming in Sri Lanka the government should cooperate to ensure the strengthening of dairy training for farmers and the provision of an effective dairy extension system especially, in the Up-country and Mid-country. Intensifying the dairy farmers in the Coconut triangle, with assured feed supplies could also increase the milk production. In addition, the government should also support pasture development program so that small-scale dairy farming could contribute towards poverty alleviation.

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Study on Relationship Between Different Heat Mode and Kit Survival

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Introduction

The thermal environment at birth and during the early postpartum period is particularly important for the altricial mink kit. At birth, the mink kit energy reserves are limited with only 1% of body weight as fat (Tauson, 1994), and mink kits are not able to thermoregulate before 22–29 days of age, 99% energy is dependent on female mink thermogenesis (Tauson, 2006). At birth time, the environmental temperature was low in the morning and at night. Female mink consumed abundant calories to give birth to the mink kit, therefore maintaining appropriate thermal temperature of the nest was important for the mink kit survival during the first seven days. The aim of this study was to confirm the appropriate heat way and heat temperature of nest for the mink kit survival within the seven days of age.

Materials and Methods

According to the nest size of mink, our research group designed and manufactured the heat plate (L 32.5cm×W 23cm×H 19.2cm) and cage heating structures (L 14.2cm×W 8.0cm) with temperature controller. Pregnant female mink with expected similar birth time was selected for the experiment.

Record the data of feed environmental temperature and humidity during the birth period. Measurements were calculated for survival and growth parameters. Rescue experiment of the female mink after 5 days of delivery followed the methods of Clausen (2008) where evaluation was made on the effect of nest environment on the female mink behavior.

The data was analyzed using GLM procedure of SAS and the differences between the means were compared using Duncan's multiple-range test and SAS 8.2 (SAS, Cary, NC) software.

Results and Discussion

The way of heating plate at the bottom of nest significantly improved the survival rate of 7 days old kit and reduced gather degree as well as extended the rescue time of female mink. These Results showed that external heating measures was beneficial to improve the survival rate of 7 days old kit, as appropriate heat way and temperature could reduce the energy consumption and was more beneficial to produce milk and protect kit. Female mink rescue experiment indicated that the nest environment affected the behavior of female mink, thus influenced the survival of the kits. When female mink rescued kit on the cage, other kits in the nest need not completely rely on their mother energy to maintain warmth and mother need not worry about the adverse effect of nest temperature on the other kits in a short time by the way of heating plate. For the first seven days of live, the survival of kits was better with the use of heating plate at the bottom of the nest than cage heating structure in the nest. It was more beneficial for kit's survival if the bottom of the nest is kept at 19°C.

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A Study on the Learning and Cognition of Conference and Workshop Participation from Animal Producers in Taiwan

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Introduction

There were five livestock production units out of the top ten Taiwan agricultural products (Hsia, 2000). The importance of the animal industry enhances the importance of adult education and extension for farmers. Extension is an informal educational function that applies to any institution that distributes information and advice with the intention of promoting knowledge, attitudes, and skills. The purpose of the study was to determine the cognition and learning attitude on the participation of professional training sessions of animal producers in Taiwan.

Materials and Methods

This study was an exploratory study, using questionnaire approach. The questionnaire determined the cognitive differences between various types of animal husbandry workers, such as whether taking initiative to learn, expectations on seminars and speakers, revised on what they have learned after the seminars, as well as the views on effect of seminars on the development of the industry. During livestock seminars and training courses, questionnaires were distributed to the participants to be completed. Questionnaire using 6-point Likert Scale closed questions, there were six options in each question, from one (indicating strongly disagree), 2, 3, 4, 5 and 6 (indicating strongly agree), subjects gave single answers to better quantify the problem. Questionnaire data were subjected to statistical analysis system in SAS (2004), General Linear Model Procedure (GLM) was used for analysis of variance, and Duncan's new multiple range test compared the significant differences among the means.

Results and Discussion

A total of 829 copies of questionnaire were distributed, and 511 were returned. The recovery rate was 61.64%, in which 32 questionnaires were voided because of more than half of the questions in the questionnaire were not answered. Therefore only 479 questionnaires were effective with adjusted response rate of 57.78%.

Among the respondents, there were 407 males (85%), and 71 females (15%). There were 15 questions set to get the basic information of respondents, while 32 questions were aimed to obtain the answers. The results showed: (1) Regardless how long they worked in the industry, they did not agree that they have learned most of the knowledge and technology in the field, less agreeable for those with less working experience. (2) Animal industry workers went to workshop and conference voluntarily, not appointed by companies or farms. People with higher income had higher willingness to attend. This agreed with Blunt and Yang (2002), who indicated that the positive attitude toward adult continuing education improved life quality, and also enjoyed in learning. (3) Animal industry workers expected to attend workshop and conference, especially for those aged among 35-54, and above 65 years old. (4) Animal industry workers would take notes during workshop and conference, especially those who were the first generation (starting an enterprise) or with the highest income, and then followed by the lowest income. (5) Animal industry workers agreed that speakers should provide

practical suggestions during the conclusion of the presentation. The study suggested that: (1) Organizers of the workshop and conference should invite speakers with practical experience. (2) Speakers should learn continuously to provide new knowledge to farmers annually. (3) Organizers or speakers should provide some time for participants for Q and A, or trouble shooting.

Table 1 Cognition of professional training session participation of animal producers with different income.

	< 20,000	20,000~40,000	40,000~60,000	> 60,000	SEM	Sig.
Already learned most knowledge and technology	3.03 ^b	3.14 ^b	3.25 ^b	3.88 ^a	0.21	*
Attend sessions willingly, not appointed by others	5.17 ^b	5.52 ^{ab}	5.72 ^a	5.81 ^a	0.14	*
Finish work earlier to attending training sessions	4.76 ^b	5.17 ^{ab}	5.06 ^{ab}	5.38 ^a	0.17	*
Expect to attend training sessions	5.41 ^{ab}	5.46 ^{ab}	5.34 ^b	5.69 ^a	0.11	*
Take notes in training sessions	5.51 ^b	5.36 ^{ab}	5.03 ^b	5.63 ^a	0.13	*
Receive proceedings at training sessions	5.31 ^b	5.45 ^b	5.41 ^b	5.84 ^a	0.13	*
Raise hands to ask questions in sessions	4.48 ^b	4.48 ^b	4.44 ^b	5.19 ^a	0.19	*
Read proceedings again after sessions	4.72 ^b	4.91 ^b	5.06 ^{ab}	5.44 ^a	0.15	*

6-point Likert scale (1: strongly disagree; 6: strongly agree)

^{a,b}: Means in the same row with different superscripts are significantly different

*: P < 0.05

Table 2 Cognition of professional training session participation of animal producers with different education level.

	Elementary	Junior	Senior	College	Graduate	SEM	Sig.
Already learned most knowledge and	5.00 ^a	3.25 ^{ab}	3.47 ^{ab}	3.12 ^b	3.31 ^{ab}	0.60	*
Expect to attend training sessions	4.00 ^b	5.33 ^a	5.49 ^a	5.58 ^a	5.40 ^a	0.31	*
Receive proceedings at training	3.00 ^b	5.17 ^a	5.33 ^a	5.64 ^a	5.60 ^a	0.37	**
Agree that speakers should provide	4.00 ^b	5.33 ^a	5.47 ^a	5.53 ^a	5.36 ^a	0.34	*
Training sessions have positive effect to	4.00 ^b	5.75 ^a	5.71 ^a	5.75 ^a	5.49 ^a	0.28	*

6-point Likert scale (1: strongly disagree; 6: strongly agree)

^{a,b}: Means in the same row with different superscripts are significantly different

*: P < 0.05; **: P < 0.01

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Estimation of Reproductive Traits of Silkworm Hybrids

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Abstract

There are many different selection criteria in breeding programs of silkworm. It is very important to increase the mean value of selected economic traits and at the same time, consider resistance and reproductive traits of the silkworm. Crossing between different lines is a useful process to achieve hybrids with better performance. Heterosis will increase the quality of production. In order to investigate the effects of crossbreeding between selected parental lines, four pure Iranian parental silkworm lines (31,32,107,110) were selected individually according to their average cocoon weight that is higher than average population. Individuals were crossed randomly to produce 31 × 32 and 107 × 110 hybrids and each hybrid had 2 groups, random as control and selected. Fifty larvae eggs were selected from each hybrid line and adults were produced. Traits recorded were: live larvae number, live pupa number, pupa vitality percentage in a best cocoon (%), larvae duration (h), hatched larvae number, unhatched eggs percentage (%), unfertilized eggs percentage (%), and total egg number. Results indicated that the highest number of live larvae was in the control group of hybrid 107 × 110 (256.50 larvae), and the low live larvae number was in selected group of hybrid 31 × 32 (201.75 larvae). Performance of selected group of 31 × 32 hybrid was significantly different from the control group. Selection of parental lines on the basis of cocoon weight increased live pupae number in hybrid line 107 × 110 in both control and selected groups (246.50 and 237.25, respectively), the lowest number was in a select group of line 31 × 32 (183.75 pupae). Pupa vitality percentage in best cocoon was higher in hybrid 31 × 32 (0.14%). Selection based on the cocoon weight decreased larvae duration in both lines (5.25h in hybrid 31 × 32 and 0.25h in hybrid 107 × 110) but there was no difference between the two groups of hybrid lines. The hatched larvae number increased in line 31 × 32 and both groups showed similar performance in this line. Crossbreeding between selected lines significantly decreased the unhatched egg percentage in line 31 × 32 (0.63 %). Line 107 × 110 had higher unfertilized egg percentage. Both hybrids produce a similar total egg number (19.25 and 12 eggs from hybrid 31 × 32 and 107 × 110, respectively) and there was no difference between control and selected groups. It is suggested that crossbreeding between selected parental lines would influence the performance of hybrids and could improve performance and fitness in commercial silkworm.

Analyzing the Genetic Structure of Indonesian Swamp Buffalo Populations Using Microsatellite Loci

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Introduction

Microsatellites or simple sequence repeats (SSR) are tandem repeat motifs with 1 - 6 base length distributed non-randomly in all eukaryotic genomes, both coding and non-coding regions (Li *et al.*, 2002). Their polymorphisms can be affected by location and presence of other linked genes. These markers can be used in characterization of species populations, genetic diversity and population studies. Improvement in domestic animals is possible by successful selection of superior animals. Recording is important in animal genetic improvement. Failure to record correct parentage can cause bias in genetic evaluation by introducing errors in estimates of heritability and breeding values. Accuracy of genetic parameters is dependent on correct recording of genetic relationships.

Materials and Methods

DNA samples were extracted from blood and meat specimens by a phenol chloroform method (Sambrook and Russell, 1991) as modified by Andreas *et al.*, (2010). A total of 199 Local swamp buffalo samples and 12 samples of Murrah buffalo (from Medan) were used in this study. The buffalo samples were obtained from 8 provinces or regions, i.e. Aceh (30), Medan (12), Siborong-borong (30), Riau (19), Banten (30), Central Java (30), West Nusa Tenggara (30), and South Sulawesi (30).

Amplification and genotyping results of CSSM66, ILSTS61, and ILSTS17 loci were obtained following methods described by Kathiravan *et al.*, (2009). Genotyping data were analyzed for genotype and allele frequencies, heterozygosity value, and F-statistic using software Popgene 1.3 (Yeh *et al.*, 1999)

Results and Discussion

There was no polymorphism detected for Murrah buffalo from Medan region (Table 1). Table 2 shows that most of local buffalo had the CSSM66 and ILSTS17 loci with the values of H_o less than H_e . These indicated that both of the loci had a low level of heterozygosity. According to Figure 1 Murrah buffalo in Medan (river buffalo) is in its own group separated from swamp buffalo group.

Table 1. Frequency of alleles for CSSM66, ILSTS16 and ILSTS17

Original region (n)	CSSM66		ILSTS61					ILSTS17	
	A	B	A	B	C	D	E	A	B
Aceh (30)	-	1.0000	0.2167	0.1500	0.6000	0.0167	0.0167	0.8167	0.1833
Siborong-borong	-	1.0000	0.2000	0.4000	0.3367	0.0167	0.0167	0.4667	0.5333

(30)										
Medan (12)	-	1.0000	-	1.0000	-	-	-	-	1.0000	
Riau (19)	-	1.0000	0.3947	0.4474	0.1316	0.1316	-	0.5789	0.4211	
Banten (30)	0.2000	0.8000	-	0.0167	0.4333	0.1000	0.4500	0.6000	0.4000	
Central Java (30)	-	1.0000	-	0.2833	0.3333	0.2000	0.1833	0.5167	0.4833	
West Nusa Tenggara (30)	-	1.0000	0.0333	0.2500	0.1500	0.1833	0.3833	0.7000	0.3000	
South Sulawesi (30)	-	1.0000	0.3333	0.1000	0.1667	0.4833	0.2167	0.3167	0.6833	
Total	0.284	0.9716	0.1043	0.2678	0.3033	0.1445	0.1801	0.5379	0.4621	

All buffaloes observed had only one type of allele on CSSM66, i.e., a B allele for all regions except Banten.

Table 2. Measures of genetic variation in Indonesian buffalo

Locus	N	na	ne	Heterozygosity		F_{IS}	F_{IT}	F_{ST}
				Ho	He			
CSSM66	211	2.0000	1.0585	0.0000	0.0554	1.0000	1.0000	0.1795
ILSTS61	211	5.0000	4.3878	0.6161	0.7739	-0.0113	0.2359	0.7728
ILSTS17	211	2.0000	1.9886	0.0806	0.4983	0.8058	0.8487	0.8825
Mean		3.0000	2.4783	0.2322	0.4425	0.3454	0.4978	0.8238

N = number of observations; na = observed number of alleles; ne = effective number of alleles; Ho = Observed heterozygosity; He = Expected heterozygosity; PIC = Polymorphism information content; F_{IS} = Within population inbreeding estimate, F_{IT} = Total inbreeding estimate, F_{ST} = Measure of population differentiation

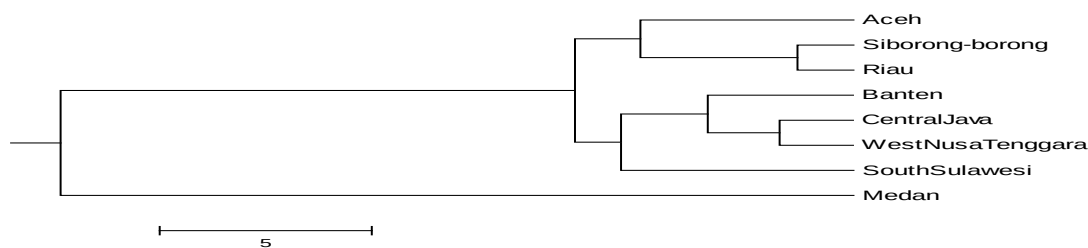


Figure 1. Dendrogram of relationships among 8 buffalo populations

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Estimation of Genetic Parameters and Breeding Values for Longevity Traits for Friesian Cattle in Egypt

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Introduction

Longevity in dairy cattle is generally defined as the length of time a cow remains productive in the herd. With increased longevity, the mean productivity of the herd increases because the culling decisions are based on production, and the proportion of mature cows, which produce more milk than young cows, is increased. Further, the economic importance of herd life compared with milk production is considered higher than other non production traits, (El-Awady and Tawfik, 1991). Longevity has been measured by certain characteristics such as age at last calving, number of lactations completed, length of lifetime from first calving to disposal, age at disposal and survival to various ages (Hoque and Hodges, 1980). The objectives of this study were to estimate genetic parameters and breeding values of longevity traits of a commercial herd of Friesian cattle in Egypt.

Materials and Methods

Data used in this investigation were collected from 4370 records relevant to 874 purebred Friesian cows which belong to Shobratana Animal Production Society, located in the Northern part of Nile River Delta, Egypt. These cows were daughters of 43 sires covered the period from 1985 to 2003. Longevity traits studied were total milk yield during productive life (TMYPL), number of days of lactation during productive life (NDLPL), number of days of total life (NDTL), number of days of productive life (NDPL), milk yield per days of lactation (MYDL), milk yield per days of total life (MYDTL), milk yield per days of total productive life (MYDPL) and number of lactation completed (NLC). Data were analyzed using Linear Mixed Model Least Squares and Maximum Likelihood (LSMLMW) computer program of Harvey (1990). The sire of cow was fitted as random effect, month and year of calving/birth were fitted as fixed effects and age at first calving and days opened as covariates.

Results

Table 1. Overall mean standard deviation (SD) and coefficients of variation (CV %) of longevity traits of Friesian cow.

Traits	Means	SD	CV%
Total milk yield during productive life (kg)	21796	8766	40.2
Number of days of lactation during productive life (d)	1230	437.9	35.6
Number of days of total life (d)	2401	598.9	24.9
Number of days of productive life (d)	1554	563.1	36.2
Number of lactation completed (lactation)	3.73	1.27	33.9
Milk yield per days of lactation (kg)	18.63	6.13	32.9

Milk yield per days of total life (kg)	9.14	3.13	34.2
Milk yield per days of total productive life (kg)	14.8	4.95	33.5

Table 2. Heritability estimates (on diagonal), genetic correlations (above diagonal) and phenotypic correlations (below diagonal) for longevity trait of Friesian cow.

Trait	TMYPL	NDLPL	NDTL	NDPL	NLC	MYDL	MYDTL	MYDPL
TMYPL	0.268	0.988	1.00	1.00	0.975	0.332	1.17	NA
NDLPL	0.829	0.365	1.00	1.00	0.994	0.261	1.30	0.136
NDTL	0.829	0.933	0.401	1.00	1.010	0.321	1.37	NA
NDPL	0.829	0.933	1.00	0.403	1.010	0.315	1.38	0.050
NLC	0.900	0.876	0.883	0.883	0.401	0.266	1.27	NA
MYDL	0.519	0.050	0.148	0.148	0.332	0.024	0.183	0.818
MYDTL	0.892	0.606	0.554	0.554	0.748	0.708	0.049	NA
MYDPL	0.517	NA	0.050	NA	0.319	NA	0.806	NA

Table 3. Range, Minimum and maximum of breeding values of sires (n = 43).

Traits	Range	Min.	Max.
Total milk yield during productive life (kg)	4624	-931	3692
Number of days of lactation during productive life (d)	388	-224	164
Number of days of total life (d)	556	-313	242
Number of days of productive life (d)	558	-315	243
Number of lactation completed (lactation)	1.33	-0.718	0.607
Milk yield per days of lactation (kg)	0.272	-0.128	0.144
Milk yield per days of total life (kg)	0.642	-0.353	0.289

Conclusion

The estimates of heritability of longevity traits suggest that improvement of these traits could be achieved through selection. The high positive genetic correlation between longevity traits clarified that these traits were likely to be controlled by the same number of genes so that these traits could be improved simultaneously through selective breeding. In addition, the present results showed the importance of evaluating the sires and selecting the top ranking sires with the highest positive breeding values. The usefulness of these top-ranking sires can be preserved for future use in the form of frozen semen.

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Using Recombinant-DNA Technology to Change Rumen Fermentation

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Abstract

If the rumen micro-organisms can be changed through genetic engineering, then they can be used for different purposes in ruminant feed. In this regard, three areas will be considered:

- Inserting genetic material from microbial species into the rumen and ensuring its expression
- Selecting gene product(s) that will be useful for host animal feeding.
- Finding replacement of new species in the rumen
- However, these objectives must consider the ethical aspects and international markets. Researchers need to ensure that new species of bacteria and their products do not have a negative effect for humans and the environment.
- The goal of this paper is to review Recombinant-DNA technologies and the use of these methods to change and improve the rumen fermentation.

Dominant Bacterial Populations in the Rumen of Sika Deer, a Holstein Cow, and a Boer Goat

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Introduction

Sika deer (*Cervus nippon*) are important ruminants in China because their velvet antlers are used in Chinese medicine. In previous studies on the rumen bacterial diversity using 16S rRNA clone libraries, we found that *Prevotella* spp. was the dominant bacteria in the rumen of Sika deer. However, very little is known about the difference in the ruminal bacteria between Sika deer and other ruminants, which may provide more information to understand the rumen fermentation of Sika deer. Thus, the objectives of the present study were to identity and compare the dominant bacteria in the rumens of Sika deer, a Holstein cow, and a Boer goat.

Materials and Methods

Four male rumen-cannulated domestic Sika deer (*Cervus nippon*), one Holstein cow and one Boer goat were used in this study. The Holstein cow and Sika deer were offered concentrated diets. Corn stalks were used as a forage source for the Holstein cow and two Sika deer (CS group), whereas the other two Sika deers were fed oak leaves (OL group), and the Boer goat grazed pasture. After 30 days of feeding, whole rumen contents were collected via rumen cannula, and stored at -80°C for analysis.

Total genomic DNA was extracted from the whole rumen contents of each animal using the PowerSoil[®] DNA Isolation Kit. Variable region V3 of the bacterial 16S rRNA gene was amplified using the primers of F341GC and R534. Electrophoresis was performed using Bio-Rad's DCode detection system. The gels were analyzed using arithmetic averages (UPGMA) of BioNumerics 6.0 software. Dominant bands were excised from DGGE gel and were reamplified. The PCR products were subcloned, and positive clones (white) were sequenced. The sequences were compared with sequences deposited in NCBI using the BLAST program. Sequences from the present study were submitted to NCBI under the accession numbers KC887758 to KC887903.

Results and Discussion

The results of DGGE banding patterns (Fig.1) showed that the number of bands was the most abundant in the Holstein cow, followed by Sika deer, and the Boer goat. Samples from different hosts or the same host (Sika deer) under different diets clustered together. These results suggest that the rumen bacterial diversity may have been affected by host species and the different diets, which was also found in a previous study. Moreover, the dominant bands were more apparent in the DGGE profiles of Sika deer than the Holstein cow and the Boer goat, which suggests that the rumen fermentation of Sika deer may be unique compared to the Holstein cow and the Boer goat. In addition, the difference of DGGE band between the CS group and OL group may be the result of tannins contained in the oak leaves. Overall, a total of 47 sequences were obtained from the Holstein cow, 16 sequences from the Boer goat, 53 sequences from the CS group, and 30 sequences from the OL group. Sequence analysis showed that *Eubacterium ruminantium* and *Pseudobutyrvibrio ruminis*, which have also been

found in yaks, Gayals and Yunnan yellow cattle, and *Prevotella* spp. were the predominant bacteria in the rumen of the Holstein cow. *Eubacterium ruminantium*, a cellulolytic bacteria, and *Pseudobutyrvibrio ruminis*, a butyrate-producing bacteria, are common inhabitants of the bovine rumen.. The predominance of *Prevotella* spp. in the bovine rumen was likely because of the wide variety of polysaccharides. *Prevotella* spp., are also thought to be important contributors for the degradation of xylan in the rumen. *Clostridium populeti*, a cellulolytic bacterium, was dominant in the rumen of the Boer goat, which may be explained because the Boer goat was grazing pasture. *Succinivibrio dextrinosolvens* and *Prevotella* spp. were dominant in both OL and CS groups, which were consistent with our findings that propionate acid was relatively high in the rumen of Sika deer (about 26 mmol/L). Thus, the dominant bacteria of Sika deer may be important in the propionate pathway of rumen fermentation, and should be further investigated. Moreover, *Dialister succinatiphilus* was found in the rumen of Sika deer feeding oak leaves, which has not been reported in other ruminants.

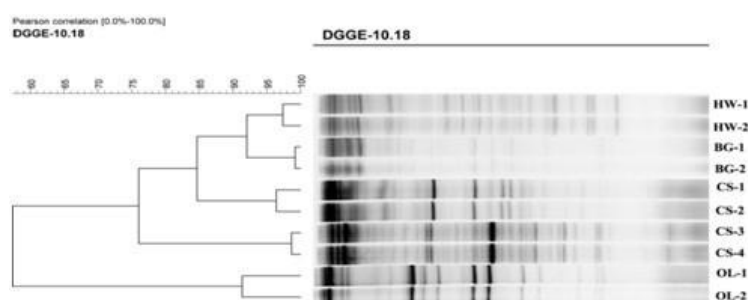


Figure 1. DGGE clustering patterns for the rumen bacterial V3 region from Sika deer, hostein cattle and Boer goat. HS-1and HS-2:Hostein cattle; BG-1 and BG-2:Boer goat; CS-1 and CS-2:Sika deer C feeding corn stalk based diets;CS-3 and CS-4:Sika deer D feeding corn stalk based diets;OL-1 and OL-2:Sika deer feeding oak leaves based diets.

Conclusion

Despite having only one cow and one goat, DGGE results showed that the host species and diets likely affected the rumen bacterial diversity. The known dominant bacteria in the rumen of the Holstein cow contained *Eubacterium ruminantium*, *Pseudobutyrvibrio ruminis* and *Prevotella* spp. While, *Clostridium populeti* was the dominant bacteria in the rumen of Boer goat. In addition, *Succinivibrio dextrinosolvens* and *Prevotella* spp. were predominant in the rumen of Sika deer.

Effects of Yeast Culture on *in vitro* Fermentation and Microbial Communities of Low-Quality Forages and Mixed Diets

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[†]*Diamond V, Cedar Rapids, IA.*

Abstract

Two experiments were conducted to investigate the effects of yeast culture (XP, Diamond V, Cedar Rapids, IA) on *in vitro* ruminal fermentation of single forage or mixed diets. In Experiment 1, an *in vitro* test was used to determine the effects of various concentrations (0, 1, 2 and 3 g/L) of XP on ruminal fermentation of major forage sources in China (rice straw, RS; corn stover, CS; corn silage without grain, CSNG; and corn silage with grain, CSG). Total Volatile fatty acids (VFA) peaked at 1 g/L XP for RS, CSNG, and CSG, and increased linearly ($P < 0.01$) for CS. Molar proportion of acetate decreased while propionate increased linearly ($P < 0.01$) with increasing amount of XP for RS, CS and CSNG. Microbial protein (MCP) increased linearly ($P < 0.01$) with increasing levels of XP for RS, which peaked at 1 and 2 g/L XP for CSG and CSNG, respectively. The fungal population was increased ($P < 0.05$) with 1 g/L XP for all forages, except CSNG. population of *Ruminococcus flavefaciens* increased ($P < 0.05$) at 1 or 2 g/L XP for RS, CSNG and CSG. In Experiment 2, effects of 3 concentrations of XP (0, 1 and 2 g/L) were tested on *in vitro* ruminal fermentation of 3 mixed diets with various ingredient combinations: (1) CSC (corn, soybean meal, corn stover = 33:22:45), (2) CSCC (corn, soybean meal, corn stover, corn silage = 33:22:22.5:22.5) or (3) CSCCA (corn, soybean meal, corn stover, corn silage, alfalfa = 33:22:19:21:5). Total VFA concentrations were influenced by diets ($P < 0.01$) and enhanced linearly by increasing concentrations of XP ($P < 0.01$). Molar proportion of acetate was reduced ($P < 0.01$), but propionate proportion was enhanced with increasing concentrations of XP ($P < 0.01$). Ammonia nitrogen was decreased and MCP was increased by addition of XP (linear, $P < 0.01$; quadratic, $P < 0.05$). The fungal population was higher with the addition of XP (quadratic, $P < 0.01$). The percentage of *R. albus* was affected by diets ($P < 0.01$), level of XP (linear and quadratic, $P < 0.01$) and their interaction ($P < 0.01$). From the present two *in vitro* studies, it was inferred that the addition of XP could improve the rumen fermentation of forages and mixed diets by stimulating the number of fiber-digesting rumen microbes, especially populations of fungi.

Synergistic Effect of Cellulase and Xylanase on *in vitro* Rumen Fermentation and Microbial Population With Rice Straw as Substrate

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Abstract

The *in vitro* gas test was conducted to investigate the effects of cellulase (CEL) and xylanase (XYL) on *in vitro* rumen fermentation and microbial population with rice straw as substrate. Three levels of CEL (0, 7.5 and 15 endoglucanase units/g of substrate DM) and XYL (0, 15 and 30 xylanase units/g of substrate DM) were tested in a 3×3 factorial arrangement. Addition of CEL and XYL increased the cumulative gas production (CEL, quadratic, $P < 0.01$; XYL, quadratic, $P < 0.01$), theoretical maximum of gas production (CEL, quadratic, $P < 0.05$; XYL, quadratic, $P < 0.01$), and rate of gas production (CEL, quadratic, $P < 0.01$; XYL, quadratic, $P < 0.01$). The CEL $\times$ XYL interactions were also observed on these three parameters. Lag time of gas production (linear, $P < 0.01$) was decreased by addition of CEL. Methane emissions were increased linearly by CEL addition (linear, $P < 0.01$), while the methane production was greater when XYL was added at the intermediate dose (quadratic, $P < 0.01$). Total volatile fatty acids (CEL, quadratic, $P < 0.01$; XYL, linear and quadratic, $P < 0.05$) were enhanced by the addition of either CEL or XYL. CEL increased acetate, but decreased propionate proportion (linear and quadratic, $P < 0.01$). The ratio of acetate to propionate was increased (linear and quadratic, $P < 0.01$). Ammonia nitrogen was reduced by CEL (linear and quadratic, $P < 0.05$), while microbial protein was enhanced by the addition of CEL (quadratic, $P < 0.01$) and XYL (linear and quadratic, $P < 0.01$). *In vitro* degradability of DM and neutral detergent fiber were increased by addition of CEL (quadratic, $P < 0.05$), or XYL (quadratic, $P < 0.01$). Addition of CEL increased the copy number of total bacteria (linear, $P < 0.01$) and *Fibrobacter succinogens* (linear and quadratic, $P < 0.05$), while the *Ruminococcus albus* and *R. flavefaciens* population were not affected by CEL and XYL ($P > 0.05$). The outcome of this research indicated that the application of CEL and XYL could improve rumen fermentation, increase rice straw digestion, and affect the rumen microbial population. The combination of CEL and XYL at the middle dosage level is more effective than either single doses of CEL or XYL.

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Haematology of Broilers Given Water From Four Different Sources in Eastern Nigeria

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Introduction

Water is one of the most important nutrients for animals including poultry birds. It is involved in every aspect of poultry metabolism and plays an important role in body temperature regulation, food digestion, and body waste excretion (Valais&Silva, 1991). Animals need to consume sufficient water to satisfy their requirements; but the quality of water taken should be considered most since the hygienic and physio-chemical quality of drinking play key role in ensuring efficient animal production as well as enhancing fertility and reducing mortality (Li, 2009). High levels of bacteria contaminants, minerals, or other pollutants in drinking can have detrimental effects on normal physiological properties resulting to inferior performance (Blake & Hess, 2010). The use of blood examination as a way of assessing health status of animals is due to the fact that it plays a role in physiological, nutritional and pathological status of the animal. This experiment aims at using hematological indices as a measure of the health situation of broilers.

Materials and Methods

Water was obtained from Otamini river, rain water from aluminum roof, bore hole water from school farm all within the University' s compound, while pipe-borne water was collected from public supply within Owerri metropolis, Imo State, Nigeria. Two hundred day-old broilers were given drinking water from these sources till eight weeks of age. Feeding and other management practices were uniform through all treatments. Blood samples taken from ten randomly selected birds per treatment were analyzed on the eighth week and data collected were analyzed using one-way analysis of variance according to Steel and Torrie (1980).

Results and Discussion

As shown in Table 1, hemoglobin of broilers given water from these sources ranged between 7.9 g/dl (river water), and 9.13 g/dl (pipe-borne water). Packed cell volume ranged between 23.67 % (river water) which was significantly ($p<0.01$) lower than the other three treatments that were 26.00 % (rain water), 27.33 % (pipe-borne water) and 28.67 % (bore hole water). There was no significant difference ($p>0.01$) in red blood cell (RBC) count between broilers drinking bore hole water and river water. Moreover, there were no significant differences in MCV, MCH, MCHC of broilers in the different treatment; but broilers that were given river water had higher white blood cell (WBC) count than all other treatments. The lower level of hemoglobin may have resulted in lower PCV and RBC which may reduce oxygen transport in the blood. Increase in the level of WBC in broilers given river water may suggest an attempt to stimulate immunity against possible contaminants associated with river water.

Table 1. Hematology of broilers given water from different sources.

Parameters	Pipe-borne water	Rain water	River water	Bore hole
Hb (g/dl)	9.13 ± 0.40	8.67 ± 0.49	7.9 ± 0.14	9.10 ± 0.74
PCV (%)	27.33 ^a ± 1.18	26.00 ^a ± 1.47	23.67 ^b ± 0.47	28.67 ^a ± 1.31
RBC (x10 ¹² /L)	2.81 ^{ab} ± 0.06	2.86 ^{ab} ± 0.15	2.20 ^b ± 0.11	3.26 ^a ± 0.13
MCV (fl)	97.53 ± 2.11	91.30 ± 0.72	108.17 ± 3.10	91.13 ± 4.46
MCH (pg)	32.57 ± 0.74	30.43 ± 0.30	36.13 ± 1.10	29.80 ± 1.63
MCHC (g/dl)	33.37 ± 0.02	33.33 ± 0.06	33.40 ± 0.07	33.23 ± 0.02
WBC (/mm ³)	4533.33 ^b ± 300.92	4266.67 ^b ±	5920.00 ^a ±	4766.67 ^b ±
Neutrophils (%)	32.33 ± 4.90	169.97	108.01	209.56
Lymphocytes (%)	62.33 ± 5.17	44.67 ± 2.87	40.67 ± 5.36	40.00 ± 4.90
Eosinophils (%)	0.67 ± 0.47	43.33 ± 3.30	54.33 ± 5.14	58.00 ± 6.16
Basophils (%)	4.67 ± 1.70	0.67 ± 0.47	0	0
		11.33 ± 1.25	5.00 ± 1.47	2.00 ± 1.41

^{ab}Means with different superscripts are significantly different (p<0.01)

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Effect of Feed Additives on Methane Production as Determined by The Tracer Technique SF₆ in Bovine

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Introduction

Rumen methane is a byproduct produced during the process of microbial digestion and represents a loss of 2 - 12% of the feed energy. Furthermore, methane (CH₄) expelled by ruminants has been a great cause of concern as CH₄ presents a greenhouse effect of 21 times greater than CO₂ (UNFCC, 2005). Ruminants, mainly cattle and sheep, are important sources of CH₄ emission, accounting for about one third of global anthropogenic CH₄ emission of this gas (IPCC, 2007). The objective of this study was to evaluate the effect of feed additives on methane production by bovine using the tracer technique sulfur hexafluoride (SF₆).

Material and Methods

The trial was conducted at the College of Veterinary Medicine and Animal Science, University of São Paulo, Brazil. Six ruminally cannulated dry cows with the average weight of 873 ± 81 kg were used. Cows were housed in individual stalls and assigned to one of three experimental diets which are isocaloric and isoproteic, according to the additive used, as follows: Control (no additives); Monensin (addition of 300 mg of monensin/animal/day); or Tannin (addition of 100 g tannin/animal/day - concentrate extract of condensed tannin obtained from Acacia-black (*Acacia decurrens*)). A twice replicated 3x3 Latin square was used as the experimental design (n = 18 experimental units). Feed was offered twice daily at 08:00 and 16:00 h as total mixed ration with a roughage:concentrate ratio of 50:50. Each of the 3 periods lasted 21 days, the first 15 days used for diet adaptation and the last 6 for measuring dry matter intake and methane production every 24 hours through a device using the SF₆ tracer technique (Johnson *et al.*, 1994). Corn silage was the roughage source and the concentrate consisted of ground corn, soybean meal, white salt, calcium phosphate, limestone, mineral supplement and feed additives, the latter ones mixed to the respective diet treatments. Dry matter intake and the rate of CH₄ emission were analyzed by the Statistical Analysis System 9.2 (SAS Institute Inc., Cary, NC, USA) using the MIXED procedure. In the model, treatment effect was considered fixed and the effects of period, square and animal within square were considered random. The effect of treatment was separated by Tukey's test at a significance level of 0.05.

Results and Discussion

The results for dry matter (DM) intake, presented in Table 1, did not show significant differences (P>0.05) among treatments. For methane production, monensin significantly (P<0.05) lowered CH₄ production, expressed in grams per day (g/d) and in megacalories per animal per day (Mcal/Ani/d) when compared to the control treatment. Similar result was observed by Wedegaertner and Johnson (1983), who showed that monensin reduced methane production and energy loss in the feces and urine, thus increasing the energy retention in calves by 19%. Recently, Jayanegara *et al.*, (2012) evaluated 30 trials, comprising 171 treatments with tannin in diet, and reported a direct effect of tannin on the methanogenic

archaea and an indirect effect due to the reduced rumen degradation of nutrients. In the present trial, tannin was proved to be less effective in reducing methane production ($P>0.05$). However, it is believed that its usage in higher doses in diet may cause significant reduction of methane emissions.

Table 1. Effect of additives on feed intake and methane production, determined by SF₆ tracer technique in bovine.

Variables *	Treatments			SEM	Probability
	Control	Monensin	Tannin		
Intake					
DMI (kg/Ani/d)	18.0	16.9	17.0	0.44	0.3376
BWI (% BW)	2.09	1.94	1.96	0.06	0.1520
MWI (g/kg of BW ^{0.75})	113.1	105.4	106.4	2.96	0.1928
Methane					
CH ₄ (g/d)	374.0 ^a	283.0 ^b	334.0 ^{ab}	17.87	0.0451
CH ₄ (g/kg DMI)	20.7	16.8	19.9	0.97	0.2006
CH ₄ (% GE)	6.41	5.27	6.16	0.30	0.2702
CH ₄ (Mcal/Ani/d)	4.92 ^a	3.72 ^b	4.39 ^{ab}	0.24	0.0451
GEI (Mcal/Ani/d)	76.7	70.9	72.8	1.91	0.3700

* DMI = Dry matter intake; BWI = Dry matter intake in relation to body weight; MWI = Dry matter intake per unit of metabolic weight; CH₄ = Methane; GEI = Gross Energy Ingested.

Monensin (300 mg/animal/day) and tannin (100 g/animal/day) can be added to diet for feedlot cattle, without influencing dry matter intake. The addition of monensin to a diet with a roughage:concentrate ratio of 50:50 proves to be an interesting option for cattle diets, aiming at energy efficiency of animals, with consequent reduction in methane emissions. No significant differences were obtained when tannin was added in diet and therefore, higher dosage could be introduced.

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Evaluation of Ruminal pH Continuous Measurement Methodology Through Accuracy and Precision

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Introduction

The measurement of ruminal pH is important to diagnose rumen acidosis (Penner *et al.*, 2006). This allows the development of preventive and control measures in order to reduce the losses caused by this metabolic disorder. Thus, the objective of this trial was to compare the conventional methodology of ruminal pH measurement to the methodology of continuous measurement by evaluating the accuracy and precision.

Material and Methods

The present study was carried out at the College of Veterinary Medicine and Animal Science (FMVZ/USP), Brazil. Six ruminally cannulated dry cows (730 ± 70 kg of weight) were used in this trial. Cows were housed in individual pens with concrete floor equipped with individual feed bunks and automatic water fountains shared by two animals. The experimental design was a twice replicated 3x3 Latin square in three experimental periods of 21 days each. The animals were distributed in each of the isoenergetic and isoproteic experimental diets, according to the energy source used: Control-diet of low ether extract; Soybean-diet of high ether extract (inclusion of 15% soybean grain); Citrus pulp-diet of low ether extract and high concentration of pectin (inclusion of 15% of citrus pulp). Diets were offered twice a day at 08:00 and 16:00 h as total mixed ration. In each experimental period, 20 days were used for diet adaptation. On the 21st day, ruminal fluid was sampled for rumen pH determination before (time zero) and 1.5; 3.0; 4.5; 6.0; 7.5; 9.0; 10.5 and 12 h after morning meal using a vacuum pump. Immediately after sampling, 100 mL of rumen fluid were used for pH determination by a portable digital pH meter (HANNA instruments). Continuous pH measurement was performed by a data logger pH Lethbridge Research Centre (LRCpH)) previously programmed for a 10 min-interval of measurement (Penner *et al.*, 2006). The calibration of data loggers allowed the calculation of a slope and an intercept before and after the test for measured data adjustment. Data analysis was performed by statistical program Statistical Analysis System 9.2 (SAS Institute Inc., Cary, NC, USA). Accuracy was evaluated through mean bias calculated as the difference between the value obtained by the alternative method and the value observed by the manual method. Precision was evaluated by the root mean square prediction error (RMSPE) (Rodrigues, 2010).

Results and Discussion

The alternative methodologies (continuous and continuous adjusted) resulted in biased estimation of rumen pH (Table 1). Both the continuous and the continuous adjusted measurement underestimated rumen pH values when compared to those obtained by the conventional method, evidenced by negative value in mean biases which were statistically different from zero (P<0.05). Values obtained by the continuous measurement were more accurate than those obtained by the adjusted continuous measurement as they were closer to the pH value obtained through conventional method. Continuous measurement underestimated the value obtained by conventional methodology by 0.15 unit of pH whereas

the adjusted continuous measurement underestimated the values by 0.27 unit of pH. The residual error observed for continuous measurement methodology was higher when compared to the adjusted continuous measurement ($P < 0.05$) (Table 1). In this way, the values obtained by continuous adjusted measurement were more precise. The regression coefficients of the bias determined in relation to the conventional pH were statistically different from zero ($P < 0.05$) for the alternative methods (continuous and continuous adjusted). This showed that the pH value affected the bias magnitude, i.e. the accuracy. No differences ($P > 0.05$) between linear biases of the alternative methods were observed, indicating that this pH effect on bias magnitude is independent from the adjustment method (adjusted or not adjusted).

This lack of accuracy and precision among the methods can be explained not only by the differences between the equipments used for pH measurement, but also the sampling methods. Based on conventional sampling method, rumen fluid is collected from 3 different anatomic points and at different portions of the rumen once it is done by a punctured copper tube, while, in the alternative method, the measurement is done by a data logger placed in only one point (rumen bottom).

Table 1. Accuracy and precision of alternative methodologies for pH measurement (continuous and adjusted continuous measurement) compared to the conventional methodology.

Item	Indicator	
	Data logger	Adjusted data logger
Measurements	162	162
Conventional pH	6.44	6.44
Alternative pH	6.29	6.17
Mean bias ^{1,2}	-0.157 ^{a,**}	-0.279 ^{b,**}
RMSPE ³	0.294	0.309
Residual error ⁴	0.248 ^a	0.130 ^b
Linear regression between biases and conventional pH		
Linear bias ⁵	-0.470 ^a	-0.429 ^a
R ^{2[6]}	0.1396	0.1055
Pr > t ⁷	<0.0001	<0.0001

¹Means in the same line, followed by different letters, differ by analysis of variance at 5% significance; ²Probability of T test for mean = 0; * $P < 0.01$; ** $P < 0.0001$; ³Root mean square prediction error (standard deviation); ⁴Values in the same line, followed by different letters, differ by Hartley test at 5% significance; ⁵Angular coefficient of regression models between biases and conventional pH. Values in the same line, followed by different letters, differ by straight line comparison methodology at 5% significance; ⁶Coefficient of determination of the linear regression model of biases in relation to the conventional pH; ⁷Probability to accept the null hypothesis: linear bias = 0.

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Determination of Protein Ruminal Degradability of Common Feed Ingredients in Sika Deer

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Abstract

In order to investigate the protein degradation in rumen of several common feed ingredients in deer, four male sika deer fitted with rumen cannulas were used to estimate the protein ruminal degradability of cottonseed meal, corn germ meal, rapeseed meal, distillers' dried grains with soluble (DDGS), corn gluten meal, corn fiber and Chinese wildrye using nylon bag technology. The results showed: (1) protein ruminal degradability of cottonseed meal was always the highest, compared with other common feed ingredients, the difference in protein ruminal degradability at all time point was extremely significant ($P < 0.01$) (2) The protein ruminal degradability at 48 hour in descending order was cottonseed meal, corn gluten meal, Chinese wild rye, DDGS, corn germ meal, rapeseed meal and corn fiber, and the protein ruminal dynamic degradability showed the similar changes. It is concluded that protein protection technology of protein bypass rumen must be used in practice to reduce wastage of protein source because of high degradability of cottonseed meal. Rapeseed meal is a kind of new protein supplement to develop because of its low protein ruminal degradability. Corn germ meal, DDGS, corn gluten meal, corn fiber and Chinese wildrye can be used as common feed ingredients in deer production.

Effects of Supplementing Concentrates Including Rapeseed Oils on Milk Fatty Acid Profile of Donkey

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Introduction

Donkey milk was characterized by having abundant unsaturated fatty acids (UFA), especially linoleic acid and linolenic acid (Chiolalo *et al.*, 2004). There is a considerable interest in developing nutritional strategies to enhance the UFA content in donkey milk. However, there is little information about the effect of dietary fat on milk fatty acid (FA) composition in donkeys. Therefore, the objective of this study was to investigate the response of milk fatty acids to supplementation containing rapeseed oils.

Materials and Methods

Animal and treatment

Twelve multiparous Jiangyue breed donkeys (5 ± 2 years, 220 ± 35 kg live weight, 70 ± 10 days in milk, mean $\pm$ SD) were used in a completely randomised design with two dietary treatment groups, six donkeys of each. The control group (CON) was offered a local commercial diet of 6 kg DM/donkey/day. The supplementation group (SUP) was offered with the same commercial diet (i.e. CON) of 4.5 kg DM/donkey/day as a basal diet and supplemented with concentrates of 1.5 kg DM/donkey/day which contained rapeseed oil. All donkeys were fed on CON diet prior to the study and six of them were gradually acclimated to full supplementation over 14 days prior to commencing a 14 days collection period, given three times a day at 0800 h, 1400 h, and 2000 h with equal amount allocated each time. Donkeys for SUP individually supplemented with concentrates once a day at 2000 h. Individual donkey daily intake was measured by weighing the refusal daily at 2400 h. A 0.5 liter of milk was stripped at 0900 h and 2100 h twice a day by hand from each donkey.

Sampling and Analysis

Daily samples of CON and concentrates were collected and stored at -20°C . At the end of the study, feed samples were pooled together per treatment and then two sub-samples were used for chemical analysis. Daily milk samples were stored at -20°C , milk samples were pooled together per donkey and then analysed for FA at the end. Milk FA was extracted and esterified according to GB 5413.27-2010. Fatty acid methyl esters (FAME) were analysed using a gas chromatograph (GC-2014C, Shimadzu, Japan).

The Genstat statistical package (Version 13.3; VSN International) was used for analysis. The analysis for milk FA included the fixed effect of the treatments and the random effect of donkeys, using a single mean value from each donkey. Significance of treatment effects was declared at $P < 0.05$.

Results and Discussion

It was reported that feeding fresh herbage containing higher percentages of linolenic acid increased the levels of linolenic acid in plasma and milk of donkeys (Chiofalo *et al.*, 2005), and manipulated the milk fatty acid profile through dietary fat addition (Hoffman *et al.*, 1998),

or fatty acid (Scott *et al.*, 2010) in mares. But in our study rapeseed oil was added to concentrate as a proportion in donkey diet to evaluate its effect on milk fatty acids. Results indicated that proportions of C6:0, C8:0, C10:0, C12:0, C14:1, C14:0, C15:0, C17:1, C17:0, C18:3 and C18:0 in milk fat were not affected by treatments ($P>0.05$). Percentage of C16:1, C16:0, C18:1 and total MUFA were decreased in SUP group ($P<0.05$), while proportions of C18:2 and total PUFA were enhanced significantly ($P<0.05$).

As for monogastric herbivore, the small intestine is the primary site for the absorption of dietary fat and long-chain fatty acids (Doreau and Chilliard, 1997). There are two major sources of long chain fatty acids in milk, the first is uptake by the mammary gland of blood lipoproteins derived from dietary lipid and the mobilization of adipose tissue, the second source is by FA synthesis *de novo* within mammary epithelial cell (Emery, 1973). It was thought that the FA composition of products was determined by dietary FA composition in non-ruminants (Doreau *et al.*, 2010) and the increase of C18:2 content in milk fat could be attributed to the high content of C18:2 of vegetable oil in diet. Fat supplementation increases FA absorption and hence the flux of exogenous FA, which results in decreased *de novo* synthesis of FA (Rudolph *et al.*, 2010). Palmitic acid (C16:0) is predominantly synthesized *de novo* from mammalian tissues and this could explain the significant increase in the content of C16:0 and C16:1 when supplemented with vegetable oils in this study. Overall, dietary supplementation of rapeseed oil could enhance the content of C18:2 while reduce the proportions of *de novo* fatty acids to some extent.

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Effect of Feeding Optimal Ration on Nutrient Utilization and Physiological Endurance Limit of Dromedary Camels

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Abstract

The experiment was conducted using three dromedary camels weighing 545-640 kg (8-10 years) to study the effect of feeding optimal ration on dry matter intake, nutrient digestibility, nutritive value of feeds and physiological responses of dromedary camels fed on three dietary treatments T₁, T₂ and T₃. The camels were offered gram straw (*Cicer arietinum*) as sole ration in all the treatments and supplemented with concentrate mixture with 60, 65 and 75% total digestible nutrients, in T₁, T₂ and T₃, respectively. The chemical composition of gram straw was 90.03% dry matter (DM), 6.30% crude protein (CP), 41.86% crude fiber (CF), 1.09% ether extract (EE), 42.92% nitrogen free extract (NFE) and 7.82% total ash on dry matter basis. The dry matter intake (kg/day) differed significantly from each other but there was non-significant difference between T₂ and T₃. The digestible crude protein intake (g/day) and total digestible nutrient intake (kg/day) were significantly ($P<0.05$) higher in T₃ followed by T₂ and T₁. The total water intake in T₁, T₂ and T₃ was 28.38, 33.23 and 34.06, respectively with lower water intake in T₁ as compared to T₂ and T₃. The digestibility coefficient of DM was significantly ($P<0.05$) higher in T₃ followed by T₂ and T₁ but there was non-significant difference between the treatments for OM digestibility. Likewise, CP and EE digestibility was better in T₃ as compared to other treatment groups. The CF and NFE digestibility was lower in T₁ as compared to T₂ and T₃. The digestible crude protein (DCP) and total digestible nutrient (TDN) contents in the feeds were 3.30 and 52.31; 4.85 and 58.60 and 5.28 and 63.58, respectively in T₁, T₂ and T₃ which were significantly different from each other. The digestible energy (DE) and metabolizable energy (ME) contents were higher in T₃ and lower in T₁ but there was non-significant difference between T₂ and T₃. The physiological responses of the camels viz. pulse rate, respiration rate and rectal temperature increased with duration of work whereas speed of operation decreased with duration of work. The fatigue score was found to increase with duration of work. Based on this study, it could be concluded that feeding of higher density of energy (75% TDN), in concentrate mixture as supplement improved the dry matter intake, nutrient utilization of ration and physiological endurance limit of dromedary camels.

Effective Utilization of Earthworms for The Control of Fish Diseases and Enhanced Growth for Better Food Security

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Abstract

Fisheries are an important sector in India- it provides employment to millions of people and contributes to food security of the country. Massive fish mortalities have been observed in different countries due to bacterial, fungal, viral and protozoan diseases and resulting in heavy economic losses. Bacteria, the major group of pathogens, pose one of the most significant threats to successful fish production throughout the world. Extracting and using biologically active compounds from earthworms has traditionally been practiced by indigenous people throughout the world. In the present investigation, extract of earthworm, *Eudrillus eugineia* was prepared and antimicrobial activity of the extract was determined by well diffusion method. Firstly, tissue and organs were aseptically collected from diseased common carp and bacteria were identified through Gram staining method. The different bacteria were isolated i.e. *Aeromonas hydrophila*, *Micrococcus luteus*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Enterobacter aerogens*, *Escherichia coli*. All these are pathogenic bacteria but Gram negative bacteria dominated the population. The earthworm extract showed zone of inhibition against pathogenic bacteria in well diffusion method. After 24h of incubation period, it was observed that earthworm extract showed antibacterial activity against all the pathogenic bacteria. It was also found that maximum zone of inhibition shown against *Aeromonas hydrophila* by earthworm extract of *Eudrillus eugineia*. In one another experiment, we found that earthworm extract also enhanced the growth of fish. It was observed that when earthworm extract used as feed ingredient for fish feed, it enhances the growth of fish about 1.5 times more as compared to normal supplementary feed. Hence, the study conclusively proved that the earthworm extract has strong antibacterial properties which would be effective in treating bacterial infections in fishes and also acts as a growth promoting substance.

Effect of Palm Kernel Expeller Oligosaccharides on Gut Bacterial Population in Rats

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Introduction

Many research focused on the application of endogenous enzymes to improve the nutritive quality of palm kernel expeller (PKE) for incorporation in poultry feed. However, results on growth performance and efficiency of feed utilization in poultry are somewhat inconsistent. It has been reported PKE contain substantial quantity of oligosaccharides, a complex carbohydrate with the capability to improve host health by promoting the growth of beneficial microorganisms in the gut (Swanson *et al.*, 2002). The aim of this study was to evaluate effect of the PKE oligosaccharides extracts on fecal bacterial population using rats as animal model.

Materials and Methods

PKE extracts; raw PKE extract (PKE), enzyme-treated PKE extract (PKE_{ENZ}), and steam + enzyme-treated PKE extract (SPKE_{ENZ}) was prepared separately by shaking the PKE in distilled water at 4°C for 24 h, centrifuged at 10,000 rpm for 10 min, and filtered through Whatman No. 1 filter paper. PKE_{ENZ} and SPKE_{ENZ} were PKE fermented with enzyme (60% moisture, 1% enzyme, 55°C) for 24 h prior to extraction. PKE filtrate was lyophilized by freeze drying to obtain solid PKE extract. Enzyme was obtained through solid state fermentation of PKE using *Aspergillus terreus* as inoculum. The oligosaccharides and reducing sugar concentrations were determined by HPLC.

Thirty-two rats (180-200g) were acclimatized with basal feed for rats for one week. The rats were then randomly assigned to four groups (n = 8); Control group, PKE group, PKE_{ENZ} group, and SPKE_{ENZ}. Rats in the treatment groups were fed through oral administration the assigned extract while distilled water was used for control. At the end of 4 week fecal samples were collected in Falcon tubes, weighed, and immediately frozen at -20°C to be used for microbial quantification by real time PCR.

Results and discussion

Enzyme-treated PKE extracts (PKE_{ENZ} and SPKE_{ENZ}) contained higher (P<0.05) oligosaccharides than PKE extract. On the other hand, the reducing sugar content of both PKE and PKE_{ENZ} treatments were lower than that of SPKE_{ENZ}. SPKE_{ENZ} extract recorded significant increase of beneficial bacteria, with the reduction of harmful bacteria (Table 1). On the other hand, PKE_{ENZ} extract only increased population of *Lactobacillus* and suppressed *Enterococcus* population compared to control group. This is in agreement with a study by Swanson *et al.*, (2002) who showed that treatment with mannoooligosaccharides significantly increased the fecal *Lactobacillus* but not *Bifidobacteria*.

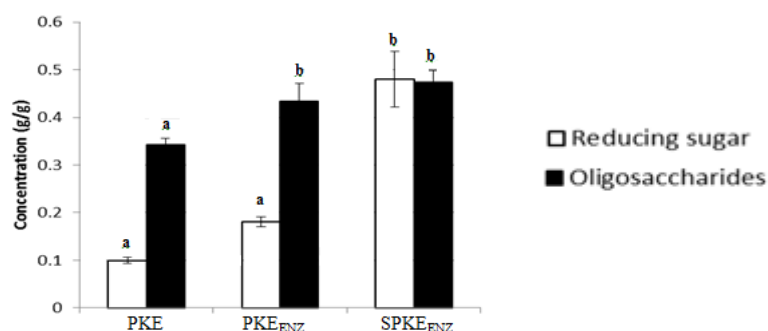


Figure 1. Concentration of oligosaccharides and total reducing sugar in PKE-extract.

Oligosaccharides preparation in this study is not purified thus may contain a mixture of prebiotics. These impurities may present in higher concentration in the SPKE_{ENZ} extract as steam treatment prior to enzyme treatment cause defibrillation, providing cleavages for penetration of the lignocellulolytic enzymes into the mannan fiber, thus increasing the efficiency of these enzyme to release simple sugars and other oligosaccharides (Rangnekar *et al.*, 1992). The synergetic effect of different prebiotics would be an effective way to improve gut microflora.

Table 1. Effect of PKE-extract on fecal bacterial population.

Microorganism	Control	PKE	PKE _{ENZ}	SPKE _{ENZ}
<i>Lactobacillus</i>	5.91 ± 0.21 ^a	6.01 ± 0.31 ^a	6.29 ± 0.37 ^b	6.46 ± 0.4 ^b
<i>Bifidobacteria</i>	4.8 ± 0.23 ^a	4.97 ± 0.29 ^{ab}	5.01 ± 0.36 ^{ab}	5.08 ± 0.21 ^b
<i>Enterococcus</i>	6.77 ± 0.30 ^a	6.50 ± 0.28 ^{ab}	6.45 ± 0.33 ^b	6.48 ± 0.39 ^b
<i>Enterobacter</i>	5.51 ± 0.53 ^a	5.25 ± 0.35 ^{ab}	5.29 ± 0.62 ^{ab}	4.93 ± 0.41 ^b
<i>E. coli</i>	4.95 ± 0.59 ^a	4.51 ± 0.49 ^{ab}	4.83 ± 0.77 ^a	4.27 ± 0.40 ^b
Total bacteria	11.78 ± 0.29 ^a	11.96 ± 0.17 ^{ab}	12 ± 0.19 ^b	12.3 ± 0.22 ^c

*Results are mean values ± SD (log cfu/ml)

** ^{a-c} Means in the same row with different letters are significantly different at (P<0.05)

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Mineral Contents of Commercial Broiler Rations Manufactured in Nigeria

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Introduction

Minerals are inorganic nutrients usually required in small amounts by animals and are essential for animal health, survival and production due to their participation in physiological, structural, catalytic and regulatory functions of animal organism (Eruvbetine, 2003). Poultry requires relatively large amounts of some minerals such as calcium, phosphorus, sodium (macro minerals) and trace amounts of others such as zinc, copper, iron, manganese, cobalt, selenium (micro minerals). Macro minerals are necessary for a variety of metabolic processes, while trace minerals play vital roles in various metabolic, enzymatic and biochemical reactions that ultimately leading to better growth rate, egg production and feed efficiency.

According to Okoli *et al.*, (2012), one of the major problems of commercial poultry feeds manufacturing in Nigeria is the high cost of feed ingredients. This may lead to the production of feeds that are poor in essential minerals as the labels on the commercial feed packaging only show the amount of calcium and available phosphorus in the feed but give no indication of the inclusion levels of other minerals that are still vital in the diet. Low mineral inclusion levels may lead to suboptimal production (Ceylan *et al.*, 2007), while excessive addition may cause toxicity and accumulation of trace element in litter and when added to agricultural land as soil amendment (manure) will impact soils, groundwater and food chain. This study evaluated the mineral content of commercial broiler rations produced in Nigeria.

Materials and methods

This research work was carried out from June to August 2011. A preliminary field survey was carried out to identify commercial feed sellers in Owerri. Based on this survey, four brands of commercial feeds coded GF, LF, VF and TF were selected for study. Both feed sampling and analyses methods adopted have earlier been reported by Okoli *et al.*, (2012). Data collected were subjected to statistical analysis using randomized completely block design (RCBD). When analysis of variance indicated significant differences (effects), means were compared and separated using statistical software (SAS, 1999).

Results and Discussion

Table 1 showed the mineral content of broiler starter rations (BS) across the 4 brands evaluated. Significant differences ($P < 0.05$) were observed between the analyzed results and the recommended standard values. For example, Ca values ranges from 91mg/100g in VF to 345mg/100g in LF and were significantly lower than the Standard Organization of Nigeria (SON) recommended values of 1000mg/100g for broiler starter rations. There were however no significant differences ($P > 0.05$) between brands values.

Similarly, Mg composition ranged from 20mg/100g in VF to 42 mg/100g and were again significantly lower ($P < 0.05$) than the 52.5 mg/100g recommended SON. For K mineral, its composition in the BS diet ranges from 0.47 in LF to 0.52 in GF. All the other minerals analyzed followed the same trend.

Table 2 showed the mineral content of the broiler finisher rations. The values obtained were also significantly lower ($P<0.05$) than the values recommended by the SON. There was an exception in Mg concentration in TF which gave a value higher than that of SON recommended value. Results obtained for other minerals followed a similar trend with that reported for broiler starter rations.

These results re-emphasize the need for functional feed quality assurance programs for Nigeria. Setting up a functional directorate of feed quality under the SON with the responsibility of assuring commercial feed quality is suggested as a means of optimizing production efficiency.

Table 1: Mineral contents of commercial broiler starter rations manufactured in Nigeria

Brands	GF	LF	VF	TF	SON	SEM
Minerals	(mg/100g)	(mg/100g)	(mg/100g)	(mg/100g)	Requirement (mg/100g)	
Ca	132 ^b	345 ^b	91 ^b	315 ^b	1000 ^a	163
Mg	24 ^b	32 ^b	20 ^b	42 ^{ac}	52.5 ^a	5.94
K	0.52 ^b	0.47 ^b	0.48 ^b	0.49 ^b	375 ^a	74.90
Na	0.02 ^b	0.5 ^b	0.05 ^b	0.80 ^b	225 ^a	44.93
P	0.034 ^b	0.04 ^b	0.027 ^b	0.03 ^b	450 ^a	89.99
Fe	0.06 ^b	0.07 ^b	0.06 ^b	0.06 ^b	9.25 ^a	1.83
Mn	0.26 ^b	0.95 ^b	1.81 ^b	0.90 ^b	5.75 ^a	0.98
Zn	1.2 ^b	1.90 ^b	1.10 ^b	1.20 ^b	4.75 ^a	0.69
Cu	0.04 ^b	0.37 ^a	0.05 ^b	0.03 ^b	0.50 ^a	0.09
Pb	0.03 ^b	0.69 ^a	0.0	0.05 ^b	--	0.16
Cd	0.006 ^b	0.0	0.0	0.019 ^a	--	0.004

^{abcde} within the same rows show that means are significantly different ($p<0.05$).

SON = Standard organization of Nigeria

Table 2: Mineral contents of commercial broiler finisher rations manufactured in Nigeria

Brands	GF	LF	VF mg/100	TF mg/100	SON mg/100	SEM
Mineral	mg/100	mg/100				
Ca	229	279 ^b	247 ^b	347 ^b	1000 ^a	150
Mg	35 ^b	48 ^a	45 ^{bc}	60 ^a	52.5 ^{ac}	4.13
K	0.45 ^b	0.44 ^b	0.48 ^b	0.48 ^b	375 ^a	74.90
Na	1.90 ^b	0.3 ^b	1.0 ^b	1.20 ^b	225 ^a	44.70
P	0.090 ^b	0.09 ^b	0.063 ^b	0.056 ^b	450 ^a	89.90
Fe	0.02 ^b	0.08 ^b	0.07 ^b	0.09 ^b	9.25 ^a	1.83
Mn	0.16 ^b	1.72 ^b	0.39 ^b	0.73 ^b	5.75 ^a	1.03
Zn	1.0 ^b	1.20 ^b	1.40 ^b	1.50 ^b	4.75 ^a	0.70
Cu	0.09 ^b	0.03 ^b	0.25 ^b	0.01 ^b	0.95 ^a	0.17
Pb	0.05 ^b	0.09 ^{ab}	0.0	0.19 ^a	--	0.04
Cd	0.004 ^a	0.0	0.007 ^a	0.0	--	0.00

^{abcde} within the same rows show that means are significantly different ($p<0.05$).

SON = Standard organization of Nigeria

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Effects of Borax and Kerosene Treatment on Bacterial Population in Pig Dung

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Introduction

The obnoxious odour and pathogenic agents emanating from pig dung or slurry is becoming a very big threat to human and animal health. Thus, there are strict regulations being considered by governments even to the extent of closing down piggery farms due to the fear of environmental pollution (Okoli et al., 2004). Many of the bacteria in livestock waste are pathogenic and zoonotic, thereby posing threat to health in pig production environments. The high cost of equipment and chemicals that could be used to ameliorate the pig dung malady has been a teething and challenging problem in the pig industry in Nigeria, which is currently made up of mostly small-scale producers.

Closure of some pig farms due to environmental pollution would be tantamount to shortage of animal protein and its associated malnutrition problems. There is therefore the need to research practicable local technologies for odor control in the Nigerian pig industry.

Materials and Methods

The experiment was carried out at the School of Agric. and Agricultural Technology, Federal University of Technology, Owerri, Imo State, Nigeria. Dung was collected from local pig farms, mixed properly and allowed to stand for a two day pre-treatment period after collection to allow bacterial activities.

The treatment involved borax and kerosene application at three concentration levels of 0, 50, 100 and 150 g respectively to two kilograms of in seven litre calibrated plastic buckets. Each treatment was replicated three times in a Completely Randomized Design (C.R.D.).

The bacteria load change in the pig dung was analysed on the 2nd, 4th and 6th day after the treatments. Samples from each treatment bucket were collected using sterile bottles and subjected to bacterial culture. Ten-fold serial dilution of the homogenized samples were prepared by adding 5 g of the dung sample in 45 ml of sterile deionized water and mixing thoroughly after which 0.1 ml aliquot of the appropriate dilution was drawn and inoculated onto nutrient agar. After overnight incubation, at 37OC the bacterial load was enumerated using a colony counter (SuntexR) to count the colony forming unit (CFU). Discrete colonies of organisms on the nutrient agar plates were purified by repeatedly sub-culturing them onto fresh plates of nutrient agar to obtain pure isolates. Each pure culture was then transferred unto nutrient agar slant and incubated at 37OC for 24 hours.

Pure isolates of bacteria were presumptuously identified on the basis of their cultural and morphological characteristics. Each isolate was then subjected to standard biochemical tests according to methods described by Cheesbrough (1983) as well as standard biochemical tests such as Gram's reaction, motility test, citrate utilization test, catalase reaction, indole production, Oxidase reduction potential, nitrate reduction, urease test as well as pigmentation.

The carbohydrate utilization and fermentation tests were carried out for glucose, sucrose, lactose, maltose, xylose, arabinose, mannitol, inositol and sorbitol.

Data generated were presented in tables.

Results and Discussion

The results in tables 1 and 2 showed that both borax and kerosene had the ability to eliminate bacteria from the pig dung indicating elimination of odorous gases produced by the activities of these bacteria.

Borax at 150 g treatment eliminated all the bacteria by the 4th day of treatment (Table 1), while kerosene could not eliminate *Clostridium* species by the 6th day of treatment even at 330 ml application. Kerosene may therefore be serving more as an odour masking agent in the present study than a strong bactericide. Masking agents such as kerosene, which is a hydrocarbon, are liable to degradation by microbes in livestock slurry (Udebuani, 2011), which may explain why their use is only appropriate for short-term odour reduction as explained by Smith *et al.*, (1980).

Table 1. Frequency of isolation of an array of eight bacterial organisms from borax

S/N	Bacteria	2 nd Day				4 th Day				6 th Day			
		0	50	100	150	0	50	100	150	0	50	100	150
1	<i>Staphylococcus</i>	+	+	-	-	+	-	-	-	+	-	-	-
2	<i>Streptococcus</i>	+	+	-	-	+	-	-	-	+	-	-	-
3	<i>Bacillus</i>	+	+	+	-	+	+	-	-	+	-	-	-
4	<i>Proteus</i>	+	+	+	-	+	-	-	-	+	-	-	-
5	<i>Pseudomonas</i>	+	+	+	-	+	-	-	-	+	-	-	-
6	<i>Salmonella</i>	+	+	+	+	+	+	+	-	+	+	+	-
7	<i>Escherichia</i>	+	+	+	-	+	-	-	-	+	-	-	-
8	<i>Clostridium</i>	+	+	+	+	+	+	+	-	+	+	+	-

Key: + = Present; - = Absent

Table 2. Frequency of isolation of an array of eight bacterial organisms from kerosene

S/NO	Bacteria	2 nd Day				4 th Day				6 th Day			
		0	110	220	330	0	110	220	330	0	110	220	330
1	<i>Staphylococcus</i>	+	+	-	-	+	-	-	-	+	-	-	-
2	<i>Streptococcus</i>	+	+	+	-	+	-	-	-	+	-	-	-
3	<i>Bacillus</i>	+	+	+	+	+	-	-	-	+	-	-	-
4	<i>Proteus</i>	+	+	+	+	+	-	-	-	+	-	-	-
5	<i>Pseudomonas</i>	+	+	+	+	+	+	-	-	+	-	-	-
6	<i>Salmonella</i>	+	+	+	+	+	+	+	+	+	+	+	-
7	<i>Escherichia</i>	+	+	+	-	+	+	-	-	+	-	-	-
8	<i>Clostridium</i>	+	+	+	+	+	+	+	+	+	+	+	+

Key: + = Present; - = Absent

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Particle Size Effect on Bulk Density of Selected Commercial Broiler Starter Feed Produce in Nigeria

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Introduction

Nutrition is to provide energy and nutrients to help the animal's body to carry out its physiological activities so as to keep the animal in good health condition. If this is optimized, productive efficiency must be achieved (Whitehead, 2002). Young birds have limited gut capacity that can limit nutrient intake. This makes the amount of nutrient consumed to be dependent on bulk density. This study was designed to evaluate the effect of particle sizes on bulk density of selected commercial broiler starter feed produce in Nigeria.

Materials and Methods

This study lasted for 3 months and was carried out in the Animal Science laboratory of the Department of Animal Science and Technology, Federal University of Technology Owerri, Nigeria. Four most popular feed brands, coded VF, TF, GF and LF were identified. A total of 16 samples made up of four samples each of VF, TF, GF and LF were collected, and sampling done once every month. Four particle sizes were determined using sieve analysis, and subjected to bulk density (BD) analysis by using a glass beaker of known volume (250 cm³). Data generated on bulk density were subjected to analysis of variance (ANOVA) test according to Steel and Torrie (1980), and means separated using Duncan's New Multiple Range Test (DNMRT).

Results and Discussion

Particle size effect on BD of LF broiler starter feed were significantly ($P < 0.05$) higher when particle size is < 1.00 mm than when particle size is 1.18 mm (Table 1). However, BD of particle size of 1.18 mm were similar ($P > 0.05$) to BD of 2.00 and > 2.00 mm particle sizes. BD of GF broiler starter feeds were significantly ($P < 0.05$) higher in 2.00 and > 2.00 mm particle sizes than in < 1.00 and 1.18 mm particle sizes which were similar ($P > 0.05$). BD of TF broiler starter feeds was significantly ($P < 0.05$) higher in < 1.00 mm particle size than other particle sizes which were similar ($P > 0.05$). BD of VF broiler starter feeds at < 1.00 mm particle size were significantly ($P < 0.05$) lower than particle sizes at 2.00 and > 2.00 mm, but similar ($P > 0.05$) to BD of 1.18 mm particle size which were similar ($P > 0.05$) to BD of 2.00 and > 2.00 mm particle sizes.

Table 1. Particle size effect on bulk density of selected commercial broiler starter feeds in Nigeria.

Feeds	Particle sizes				SEM
	< 1.00 mm	1.18 mm	2.00 mm	> 2.00 mm	
LF	0.56 ^a	0.51 ^{ab}	0.46 ^b	0.46 ^b	0.0234
GF	0.49 ^b	0.53 ^b	0.60 ^a	0.63 ^a	0.032
TF	0.53 ^a	0.49 ^b	0.42 ^b	0.39 ^b	0.081
VF	0.49 ^b	0.52 ^{ab}	0.60 ^a	0.60 ^a	0.041

The average bulk densities of the selected commercial feed brands are in the order of $TF < LF < VF < GF$. This probably means that among the feed brands studied, GF feed brand with highest bulk density will help young chicks increase nutrient and feed intake. This agrees with the results of Nir *et al.*, (1990).

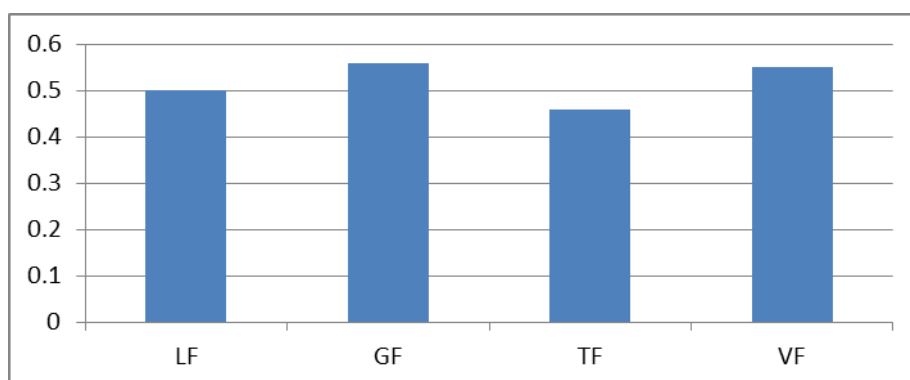


Figure 1. Average bulk densities of selected feed brands

Conclusion

Particle size has significant ($P < 0.05$) effect on bulk density of feeds. There is need for feed standard regulators in Nigeria to also consider bulk density as an index of feed quality control measure, and incorporate it in on-farm quality control programs.

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Effect of Hamacozyme® Supplemented Dried Rumen Digesta Meal-based Diets on Chicken Egg Quality

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Abstract

Four experimental layer diets were formulated to contain 0.20% Hamacozyme® supplemented dried rumen digesta meal (DRDM) at 0, 10, 20 and 30% respectively. Each diet was fed to thirty (4-months into lay) laying hens for 48 days. There were significant differences ($P < 0.05$) in egg weight and haugh unit among the groups. However, there were no significant ($P > 0.05$) differences among groups in egg shell thickness, yolk and albumen indices and egg circumference, respectively. The result of this trial showed that diet with 0.20% Hamacozyme® and supplemented with DRDM could improve the performance of laying hens at 30% dietary inclusion level.

Keywords: enzyme, supplementation, rumen digesta, poultry, diet.

Introduction

Dried rumen digesta is undigested feed collected from the rumen of slaughtered ruminant animal. The digesta is rich in nutrients, feed particles, rumen microbes and products of fermentation (Esonu *et al.*, 2006). The nutrient composition of digesta is considerably influenced by the type of diet and species of animal and the time interval between feeding and slaughtering (Okorie, 2005).

Recycling of rumen digesta not only removes its pollution tendencies, but becomes an alternative feedstuff for poultry. Different methods such as application of heat (Adeniji & Balogun, 2002), sun drying and open air drying (Okorie, 2005) had been used to process rumen digesta as animal feed. These methods slightly improved its nutritive value, thus other methods such as enzyme treatment need to be harnessed to further enhance its digestibility and nutritive value. Enzymes have been shown to improve animal performance and nutrient digestibility when added to poultry diets containing cereals and their by-products (Elwinger, 2002 and Esonu *et al.*, 2006).

Materials and Methods

Rumen Digesta was collected from slaughtered cattle and sun dried for 4 days. The sun dried material was milled in a hammer mill to a finely ground dried rumen digesta meal (DRDM). Sample of the material was then subjected to proximate analysis according to AOAC (2000). Hamacozyme® (a cellulolytic enzyme) was procured from an animal feed store for the treatment of DRDM. Four layer diets containing 0, 10, 20 and 30% DRDM that was treated with 0.20% Hamacozyme were formulated. The diets represented treatment 1, 2, 3 and 4, respectively. One hundred and twenty Shika brown layers were divided into 4 treatment groups of 30 birds each and randomly assigned to the 4 diets in a completely randomized design experiment of ninety days. Each treatment group was divided into five replicates of six birds each. The birds were housed in compartments measuring 4 x 6m each. Feed and water were provided *ad-libitum*. The total number of eggs laid was recorded. The internal characteristics of egg such as haugh unit, shell thickness, yolk and albumin indices were

measured. The data obtained were subjected to Analysis of variance (ANOVA) and separation of means where applicable, were done according to the procedure of SAS (2007).

Results and Discussion

Results showed that Hamacozyme supplemented DRDM-based diets performed significantly ($P<0.05$) better in the haugh unit and yolk colour than the control groups. However, there were no significant ($P>0.05$) differences in shell thickness, egg yolk index, egg circumference and albumen index values among the treatment groups. The yolk index values were within the standard range of 0.31–0.41. The yolk colour increased with increasing dietary levels of DRDM.

The relatively improved performance of DRDM-based diets could be attributed to high protein levels from the dried rumen digesta. The enzyme enhanced dried rumen digesta could probably have increased availability of nutrients (Elwinger, 2002). Adequate crude fibre in the DRDM could have activated the intestine, leading to more frequent peristaltic movement and thus, more enzyme production resulting in efficient digestion of nutrients. The increased intensity of egg yolk colouration with increasing levels of DRDM is an indication of efficient absorption and utilization of the Xanthophylls pigment present in the DRDM (Esonu *et al.*, 2007). The results of the experiment showed that 0.20% Hamacozyme supplemented DRDM could improve egg quality indices in laying hens up to 30% dietary inclusion level.

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Growth Response of Broiler Birds Fed with *Ocimum gratissimum* L. Supplemented Diets

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Introduction

The use of antibiotics in livestock production achieved good performance. However, their potential side effects became a global public health concern (Donoghue, 2003) and eventually led to the ban of these products especially in the western world. This has triggered an explosion of interest in the use of herbs and spices as supplements in animal rations (Owen, 2011). TCM (2011) reported that up to one third of all commercial swine and chicken rations in Europe have been using mixtures of herbs and spices to accelerate growth and maintain health.

Some of these useful herbs and spices are indigenous to Africa and include ginger (*Zingiber officinale*), garlic (*Allium sativum*), bitter leaf (*Vernonia amygdalifolia*) and scent leaf (*Ocimum gratissimum*) among others. *Ocimum gratissimum* commonly referred to as “scent leaf” is a herbaceous perennial plant which is pantropical and widely naturalized in many regions (Nnabugwu, 2010). Available information on the use of *Ocimum gratissimum* as feed ingredient is scarce.

This study therefore aims at assessing the effect of *Ocimum gratissimum* supplemented diets on the performance of broiler chickens.

Materials and methods

Seventy-two Anak broilers were used in a 56 day feeding trial. Four experimental diets were formulated to contain 0%, 1.0%, 1.5% and 2.0% scent leaf meal (SLM) and designated as T₁, T₂, T₃ and T₄ respectively. These diets were randomly assigned to four groups of 18 chicks; each replicated 3 times to give 6 birds per replicate in a completely randomized design (CRD) experiment. Feed and water were offered *ad libitum*. Data were collected on feed intake, weight gain and was used to calculate other growth performance parameters.

Results

The results show that there were no significant ($P>0.05$) differences in feed intake and body weight gain. However, there was significant difference ($P<0.05$) in feed conversion ratio and feed cost/kg body weight gain (₦). Birds fed diet 2 (T₂) recorded the most favourable feed conversion ratio and feed cost per kg weight gain (₦). It was concluded that a better feed conversion ratio and cost of feed per kg weight gain can be achieved by the inclusion of 1.0% SLM in broiler diets.

Table 1. Growth performance of broiler birds fed diets containing varying levels of *Ocimum gratissimum*.

Parameters	T ₁ (0%)	T ₂ (1%)	T ₃ (1.5%)	T ₄ (2%)	SEM
Initial body weight (g)	150.00	136.51	150.00	142.73	8.96

Final body weight (g)	2583.35	2685.71	2473.01	2442.46	133.24
Body weight gain (g)	2433.53	2549.20	2323.01	2300.40	133.21
Total feed intake(g)	4993.57	5032.46	4989.25	4828.73	299.12
Feed conversion ratio	2.05 ^{ab}	1.96 ^b	2.15 ^a	2.10 ^a	0.07*
Feed cost (₦/Kg)	84.78	88.91	91.09	93.02	-
Feed cost/kg weight gain (₦)	174.08 ^b	174.56 ^b	196.15 ^a	195.34 ^a	3.78*

* = significant difference ($P < 0.05$)

a, b: means along the same row with different superscripts are significant difference ($P < 0.05$).

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Biomass Production, Composition and *in vitro* Digestibility of Eight Indigenous Leguminous Shrubs as a Potential Food Resource for Cattle During Dry Season in West Timor, Indonesia

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Introduction

The population of beef cattle in East Nusa Tenggara province is 720,000 heads 60% of the province area is dominated by natural savana pasture maintaining a stocking rate of 4-5 cattle/km².

A classical problem of beef cattle production in East Nusa Tenggara in particular in West Timor district is lack of feed during the dry season. Therefore this causes cattle to lose weight and an increase in mortality (especially less than 1 year animals). Weight loss in dry season reached up to 20-25% of the total cattle weight (Bamualim, 1994) The objective of this research was to determine the nutritive value of some indigenous legume species as a potential food resource during the dry season.

Materials and methods

Chemical composition, biomass production and “in vitro” digestibility of eight shrub legumes were evaluated in this study, i.e. CT Q5455, CT millgara, CP bundey, CP molle, MB Juanita, MB cadaarga, DL and SS. The eight legumes were plated in 4 blocks or replication based on soil fertility and in plots of 5x5 m² size. The legumes were planted as monoculture in using seeds in rows of holes in each plot, at distance of 50 cm between rows and 25 cm between holes. Five seed were planted in each hole. Phosphorus fertilizer (P) at level of 50 kg/ha was applied once just before planting and watering using sprinkler was regularly applied 3 times per week.

The measurements were done in 1 m² sub-plot of each plot. Biomass yield measurement was done by harvesting legumes in three 1 m² sub-plots on each plot at 120 days after planting. Sample of biomass from each plot was taken for analysis of DM, OM, CP content (AOAC, 2011); Neutral Detergent Fibre (NDF), Acid Detergent Fibre (ADF), cellulose, hemicellulose, and lignin content (Goering and Van Soest, 1970); and in-vitro DM, OM and CP digestibility test (Tilley and Terry, 1963). Data were statistically analysed using GENSTAT release 12.2 (Anonymous, 2010).

Results and Discussion

The legumes differ in biomass yield at 90 days after planting ($P < 0.01$). The highest biomass yield was determined in CT millgara, CT Q5455, and DL, while the lowest in CP molle. Results agree with previous reports in which forage production varied among shrub legumes species (Gonzalez-Andres and Ortiz, 1996). It must be explained by physiological differences such as leaf wide index, relationship of leaf-water, carbohydrates reservation, and water utilization efficiency (Stur *et al.*, 1994). Whitbread *et al.*, (2005) reported biomass production of CT millgara increased from 1,277 kg DM/ha in the first year become 4,047 kg DM/ha in

the third year, while MB juanita was relatively stable with 3,382 kg DM/ha in the first year and 4,940 kg DM/ha in the third year.

Crude protein content ranged from 17.68 to 19.29% and was high in all the shrubs showing its potential use as protein feed supplement. Lignin content ranged from 10.47 – 11.78%. In general, no changes were detected ($P>0.05$) in DM digestibility, except for DL which showed significantly high ($P<0.01$) DM and OM digestibility compared to the others. DL contained highest CP but lowest concentration of crude fibre and lignin. It is well known that high CP content supports high digestibility whereas fibre and mainly lignin content depress nutritive utilization (Van Soest, 1993; Jung and Allen, 1995).

Conclusion

CT millgara, CT Q5455, DL and MB cadaarga produced highest digestible protein at 90 days after planting compared to the other four legumes. Thus, these legumes are potential legumes as protein feed supplement to improve crude protein availability, Therefore it has potential to be developed in West Timor.

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***Zapoteca tetragona* as Alternative Roughage Source for Ruminant**

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Introduction

Zapoteca tetragona is a leguminous tree which is widely planted in the buffering forest zone in Indonesia. The tree originally came from south or Central America and brought to Indonesia by the forestry people in 1936. Previously, it was called White Calliandra or *Calliandra tetragona* since the flower has white color while Red Calliandra (*Calliandra calothyrsus*) has red flower. *Z. tetragona* is a fast growing tree and re-grows well after several cuttings. The dry matter (DM) leaf production of *Z. tetragona* (t/ha/year) was the highest among *A. angustissima*, *C. calothyrsus* and *L. diversifolia* (Sajimin and Purwantari, 2006).

The information of *Z. tetragona* as ruminant feed is scarce, indicating that *Z. tetragona* may be under-utilized. Crude Protein (CP) content of *Z. tetragona* is high and thus a potential protein source. However, leaves contain several secondary compounds and therefore nutritional evaluation requires defining chemical composition but also its potential digestive utilization by *in vitro* and *in vivo* assays.

Materials and Methods

Freeze dried leaf meal of *Z. tetragona* was prepared and used for chemical analysis and *in vitro* experiments. Fresh leaf and chopped elephant grass (EG) were used for *in vivo* experiment. Total phenol and condensed tannin analysis followed the methods described by IAEA (1999) and non protein amino acid analysis (NPAA) analysis followed the AOAC method (1984). Fresh *Z. tetragona* leaf and chopped EG were mixed at different rate, increasing the proportion of leguminous tree (15, 30, 45 and 100%) and used as a substrate in the *in vitro* trial (some detail of the *in vitro* trial are required?). Diet including the ratio *Z. tetragona*:EG (30:70) was tested in the *in vivo* experiment using 8 cannulated sheep (24 ± 1.56 kg Live weight). The experiment lasted for 21 days and the last 7 days feces and urine were collected daily. Daily intake, DM and CP digestibilities were calculated and Ammonia, protozoa and total bacteria concentration were determined in the rumen liquor.

Results and Discussion

Analysis of *Z. tetragona* confirmed the high CP (23.49%) and showed a phenol, condensed tannin and NPAA content of 3.31%, 0.73% and 0.6%, respectively. In the *in vitro* trial at 3-h incubation time, the inclusion of 30% *Z. tetragona* improve gas production in relation to EG reflecting the high degradability of the legume. Total gas production at 48-h was 83 ml and 72.2 ml for 30% and 0% *Z. tetragona* in EG respectively.

Table 1. *In vitro* DM and CP digestibilities

Treatments	DM digestibility (%)		CP digestibility (%)	
	In rumen	In rumen	In rumen	In rumen liquor
100% Elephant	61.79 ^b	68.72	68.97	87.61
<i>Z. tetragona</i>				
15%	72.08 ^a	73.84	82.92	92.38

30%	69.93 ^a	72.90	77.38	88.46
45%	73.01 ^a	75.71	82.84	89.64
100%	71.55 ^a	73.21	77.86	88.16

Different letter on the same column denotes significant difference (P<0.05)

Table 2. Intake, digestibility nitrogen at increasing level of *Z. tetragona* retention and rumen condition of sheep fed elephant grass (EG) and 30% *Z. tetragona*

Parameters	100% EG	30% <i>Z. tetragona</i>
Intake: DM (g/day)	682.56	795.16
DM (g/kgBW ^{0.75})	64.70	70.36
CP (g/day)	60.54	122.63
Digestibility: DM (%)	56.58	62.23
CP (%)	56.53	71.45
Nitrogen Retention (g/day)	2.34	14.45
Rumen concentration		
NH ₃ (mM/l)	14.55	13.75
Total bacteria (units/ml)	1.72 × 10 ⁹	6.9 × 10 ⁹
Protozoa number/ml	2.07 × 10 ⁴	1.04 × 10 ⁵

Inclusion of *Z. tetragona* in EG diets improves intake by 16.50%, P<0) (Table 2.), indicating that *Z. tetragona* is palatable to sheep. Moreover CP digestibility and nitrogen retention for 30:70 and 0:100 *Z. tetragona*:EG ratio was improved with legume inclusion. Observed values agrees well with previous reports using *Glyricidia* (latin name) as a protein source including also in EG rations (Khamseekhoew *et al.*, 1991) in such report total DM and CP (ruminal plus intestinal) digestibility when *Glyricidia* was included in EG diets at 40 or 0% were 85.6% and 89.3%, respectively. From the present findings, it can be suggested that secondary compounds in *Z.tetragona* did not show any apparent negative effect either on digestibility (DM and CP) or in rumen microbial population. On the contrary, 30%-inclusion on EG diets improves intake, digestibility and ruminal counts of bacteria and protozoa.

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Amino Acid Profiles of Commercial Broiler Rations Produced in Nigeria

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Introduction

Amino acids are organic molecules which form the building blocks of protein and together with fat, carbohydrates, vitamins, trace Elements, minerals and water are the basic components of food and feed. Chicken tissues have the ability to make some of the required amino acids, if the other amino acids are in adequate supply. However, the requirement of amino acids in poultry feed varies, depending on the species and age of the chicks (Yasuhiko, 2003).

A major constraint of commercial intensive poultry production in Nigeria is the high cost of commercially available feeds resulting from expensive raw material inputs. High cost of inputs has been shown to drive the production of poor quality feeds in Nigeria (Okoli *et al.*, 2007). Feed manufacturers have been shown to compromise the values of important constituents like amino acids in commercial ration, since feed labels in Nigeria only display guaranteed crude protein content but give no indication of actual values of micro ingredients like amino acids (Omede, 2004). Furthermore, the feed quality scheme for the country is not comprehensive and usually not enforced, thus leaving farmers to bear the brunt of unethical practices in the industry (Omede, 2010).

In this study we reported the amino acids profile of commercial broiler rations marketed in Nigeria

Materials and methods

This research work was carried out from June to August, 2010. A preliminary field survey was carried out to identify commercial feed sellers in Owerri. Based on this survey, four brands of commercial feeds coded GF, LF, VF and TF were selected for study.

Each brand was sampled 4 times. It was ascertained that none of the batches of feeds being sampled has stayed in the store for more than one week. During each visit, a single feed type namely broiler Starter (BS) or broiler finisher (BF) was sampled. Sampling was by carefully opening randomly selected feedbags and collecting about 50 grams of feed into clean air tight plastic containers. Five bags were sampled per feed type in this way and later pooled and homogenized thoroughly to form a representative sample of that feed type. Overall, 250 grams of each sample type was collected, sealed and carefully labelled.

The feed samples were first digested and later analyzed in the laboratory for their crude protein compositions using the Kjeldahl method and quantitative amino acid content of each feed type analysed by Standard MAFF (1982) method. Data collected were subjected to statistical analysis using randomized completely block design (RCBD). When analysis of variance indicated significant differences (effects), means were compared and separated using statistical software (SAS, 1999).

Results and Discussion

Table 1 showed the amino acid contents in broiler starter (BS). The result showed that GF brand had significantly higher ($p < 0.05$) amino acid content than LF, TF and VF. There was

however no significant difference between the amino acid profiles generated for LF, TF and VF. The amino acid contents which ranged from 7.694% in LF to 14.029% in GF broiler starters were lower than the standard amino acid requirement for broiler starter rations (Reddy, 2004).

Table 1. Amino acid content of commercial broiler starter rations produced in Nigeria

<i>Sample Name</i>	<i>Amino Acid Content (%)</i>
LF	7.694 ^b
GF	14.029 ^a
TF	8.435 ^b
VF	9.212 ^b
SEM	1.429

^{ab} means within a column with different superscript are significantly ($p < 0.05$) different

Table 2 showed the amino acid profiles of commercial broiler finisher rations (BF) produced in Nigeria. TF had significantly higher ($p < 0.05$) amino acid content than GF and VF and was followed by LF. However, there was no significant difference between the amino acid profiles of GF and VF. The amino acid profiles of these commercial broiler finisher rations ranged from 7.518% in GF to 11.523% in TF. Only TF value was in line with the level of amino acid recommended in literature review (Reddy, 2004). It is also strange that LF and TF had a much higher amino acid values in their broilers finisher (10.271 and 11.523% respectively) than in their broiler starters (7.694 and 8.435%).

Table 2. Amino Acid content of commercial broiler finisher produced in Nigeria.

<i>Sample Name</i>	<i>Amino Acid Content in BF (%)</i>
LF	10.271 ^{ab}
GF	7.518 ^b
TF	11.523 ^a
VF	7.945 ^b
SEM	0.953

^{ab} means within a column with different superscript are significantly ($p < 0.05$) difference.

Conclusion

The results generated from this study showed that none of the commercial poultry feed manufacturers in Nigeria adhered to the recommended standards for optimal amino acid needs of commercial broilers. This may lead to poor performance of commercial broilers produced in Nigeria.

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Poster 31

Effect of Different Level of Methionine and Lysine on Ruminal Amino Acid Content of Dairy Cattle

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Introduction

Lysine and Methionine are the most limiting amino acids for milk protein synthesis in dairy cows (Vyas and Erdman, 2009). Balancing for these AA is of practical significance as a means to enhance milk protein production and to improve efficiency of milk protein synthesis (Cho *et al.*, 2007). Microbial protein in the rumen is one of the important protein sources for dairy cattle and provide 70% protein source for the host. The objective is to understand the effect of different level of methionine and lysine on ruminal amino acid content of dairy cattle.

Materials and Methods

There were three 2-3 year old female Holstein dairy cattle. Experimental design was a 3 x 2 factorial design, according to the three different methionine levels: 0.15%, 0.25%, and 0.35% of dry matter and two different lysine levels: 0.25%, and 0.5% of dry matter. Animals were housed in the individual pen, including a pail, feeding trough, and salt brick. Napier grass and concentrate were mixed (according to the ratio 60% Napier grass with 40% concentrate) and feed twice a day (8.8 kg of dry matter per day were consumed by cattle). The rumen liquid were collected once a day and doing the measurement including the rumen pH, ammonia concentration, nitrate concentration, oxidation-reduction potential and electric conductivity. Amino acid content of rumen liquid were determine once a week.

Results

The results showed that the ruminal liquid pH had no significant difference between different levels of methionine and lysine treatments. Oxidation-reduction potential were significant lower in 0.5% of lysine treatment compared with 0.25% ($P<0.001$). Electric conductivity were significant higher in 0.35% of methionine treatment compared with other treatment ($P<0.001$). Ammonia concentration and nitrate concentration were significant higher in 0.35% of methionine treatment ($P<0.001$). In Amino acids, there were significant higher of amino acid content in 0.35% of methionine treatment compared with other treatment except arginine and cysteine, and total amino acid content also significant higher in the same treatment ($P<0.001$). However, there were no significant difference between different levels of lysine.

Table 1. Effect of different methionine levels on ruminal amino acid content of cattle.

	0.15%	0.25%	0.35%	SEM	<i>P value</i>
ASP	1.06 ^b	1.25 ^{ab}	1.41 ^a	0.11	*
GLU	1.39 ^b	1.57 ^{ab}	1.86 ^a	0.16	*
SER	0.46 ^b	0.50 ^{ab}	0.60 ^a	0.05	*
HIS	0.26 ^{ab}	0.20 ^b	0.29 ^a	0.04	*
GLY	0.47 ^b	0.51 ^b	0.63 ^a	0.04	**
THR	0.53 ^b	0.58 ^b	0.68 ^a	0.05	*
ARG	0.50	0.58	0.65	0.08	NS
ALA	0.69 ^b	0.74 ^b	0.93 ^a	0.08	*
TYR	0.43 ^b	0.49 ^b	0.59 ^a	0.04	**
CYS	0.17	0.18	0.19	0.02	NS
VAL	0.37 ^b	0.47 ^b	0.67 ^a	0.05	***
MET	0.32 ^b	0.40 ^a	0.45 ^a	0.04	*
PHE	0.46 ^b	0.49 ^b	0.66 ^a	0.06	**
ILE	0.34 ^b	0.38 ^b	0.57 ^a	0.05	***
LEU	0.69 ^b	0.77 ^b	0.99 ^a	0.09	**
LYS	0.57 ^b	0.65 ^b	0.86 ^a	0.05	***
PRO	1.74 ^c	2.03 ^b	2.45 ^a	0.13	***
TOTAL	10.43 ^b	11.78 ^b	14.49 ^a	0.87	***

^{a,b,c} means with different superscripts in the same row differ significantly.

Significant: NS: P>0.05, *: P<0.05, **: P<0.01, ***: P<0.001

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***Mimosa pigra* Meal as a Replacement for Soybean Meal Protein in growing Japanese Quail**

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Introduction

Mimosa pigra is a weed that can be used as feedstuff for animals. The chemical composition is similar to *Leuceana leucocephala*. Dried leaves of *M. pigra* can be included in the diets of quail, broiler, laying hen and pigs (Devendra, 1989). The above information obviously reflects that *M. pigra* meal is a promising alternative protein source in animal diets. *M. pigra* leaves have a high protein content of 20 to 23% in DM according to Vearasilp *et al.*, (1981). Therefore, the present study is aimed at evaluating growth performance of Japanese quails fed on diets containing various CP replacement levels with *M. pigra* meal.

Materials and Methods

Animals and Sampling methods

The experiment was performed using 240 Japanese quails, divided into 4 equal groups. All quails were fed concentrates twice daily. Individual body weight and feed consumption per cage were measured at the end of the week till the 7th week to determine the feed consumption, average daily feed intake (ADFI), feed conversion ratio (FCR) and feed efficiency (FE, %).

Experimental design and treatments

Japanese quails were randomly divided into four treatment groups comprising six replications and ten quails in each according to Completely Randomized Design (CRD). The dietary treatments were T1: control diet with complete soybean meal (SBM), T2: replacing 7% SBM with *M. pigra* meal, T3: replacing 14% SBM with *M. pigra* meal and T4: replacing 21 % SBM with *M. pigra* meal. All diets were isonitrogenous and formulated to meet or exceed the NRC (1994) recommendations for all nutrients, regardless of treatment.

Statistical methods

All data were subjected to analysis of variance using ANOVA (SAS, 1996) and treatment means were statistically compared by Duncan's New Multiple Range Test (Steel & Torrie, 1980).

Results and Discussion

The mean growth performance of the Japanese quails in all the treatments showed significant differences among the means ($P < 0.05$). There were significant differences in the mean monthly weight gain thus indicating that *M. pigra* meal could partially or wholly replace SBM without affecting the growth performance (Table 1).

Table 1. Effects of replacing protein from SBM with protein from *M. pigra* meal on feed

efficiency and productive performance in meat quails

Items	Dietary treatments				SEM
	T1	T2	T3	T4	
Weigh gain (g)	47.08 ^a	49.38 ^a	67.09 ^b	56.25 ^{ab}	2.53
ADG (g/day)	1.31 ^a	1.37 ^a	1.86 ^b	1.56 ^{ab}	1.09
FCR	2.19 ^b	2.07 ^{ab}	1.69 ^{ab}	2.18 ^b	0.07
FE (%)	35.05 ^b	33.08 ^{ab}	27.54 ^a	34.82 ^b	1.09
Feed intake (g/days)	16.48 ^a	16.20 ^a	18.18 ^b	19.38 ^c	0.37

^{a,b,c} Means in the same row with different superscripts are significantly different ($P < 0.05$), SEM = standard error of mean, ADG = Average daily gain, FCR = feed conversion ratio, FE = feed efficiency, T1 = control diet with complete soybean meal (SBM), T2 = replacing 7% SBM with *M. pigra* meal, T3 = replacing 14% SBM with *M. pigra* meal, T4 = replacing 21% SBM with *M. pigra* meal.

Conclusion

It could be concluded that inclusion of 14 % of *M. pigra* meal as replacement for SBM in the diet of Japanese quails significantly improved the feed intake, ADG, FCR, FE and weigh gain ($P < 0.05$). It is recommended that *M. pigra* meal should be used by Japanese quail farmers to replace SBM in order to save cost and increase production.

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The Study of Growth Performance on Crossbred Native Chicken (Chee)

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Introduction

Native chicken meat is one of the most commonly used local animal protein sources because of its nutritional value and relative reasonable prices in Thailand. The meat of the indigenous Thai strains had lower contents of fat and cholesterol compared with that of the imported breeds, especially relative to the Rhode chickens (Jaturasitha *et al.*, 2008). The meat and eggs are considered rich sources of protein and iron (Haunshi *et al.*, 2011). The lowest final weight and daily weight gain were found in native chicken. A crossbred chicken, from Chee Native chicken crossed by broiler and layer hen, was intended to assist the farmers with profitable production of chicken meat. Crossbred native chicken is an innovation developed by the researcher for farmers. The growth performance, of crossbred native chicken (Chee) was determined in this study.

Materials and Methods

Chickens and growth performance measurement

The chickens were randomly assigned into 2 groups with 100 chickens per group, and 25 chickens per pen. Chickens of two groups were fed 21% protein. Feed and water were provided ad libitum. Body weights were recorded weekly, and feed intakes were measured from d 1 to d56. The experiment ended when body weights reached 1.2 kg. Average daily gain and feed conversion ratio were calculated.

Statistical Analysis

Data were analyzed by ANOVA (SAS Institute, 1997). The means were used to evaluate chicken growth performance. Significant differences among treatment means were separated using the multiple range tests with a 5% probability.

Result and Discussions

The objectives of the research was testing the performance of 2 groups of crossbred native chicken, (1) Chee x Broiler-layer crossbreed hen, LBC (2) Chee x SRB-Layer crossbreed hen, LSRBC. Both of crossbred hens were from the Korat chicken meat project. The growth performance of crossbred production were performed under Mahasarakham University farm with 21 % of protein feed following the Department of Livestock guideline. The experiment ended when weights of chicken reached 1200 g. Initial weight, BW 8 wk, BWG 8 wk, ADG and FCR of crossbred native chickens (Chee) were shown in Table 1. The results showed that there was significant difference in all traits among treatments groups. The ADG was affected by breed groups (19.43 g/d and 13.62 g/d for the LBC and LSRBC, respectively). The lowest growth performance was found in LSRBC groups ($P<0.01$). Similarly, Duangjinda *et al.*, (2007) reported that ADG of crossbred native Chee chicken was 17.7 – 18.8 g/d. Therefore, the LBC had better growth performance than the LSRBC.

Table 1. Effect of breed groups on growth performance in crossbred native chicken

Breed Groups¹

Traits	LBC	LSRBC	P-value
Initial BW (g)	45.80 ^A	38.12 ^B	0.0024
BW 8 wk (g)	1133.78 ^A	800.96 ^B	0.0001
BWG 8 wk (g)	1087.98 ^A	762.84 ^B	0.0001
ADG (g/d)	19.43 ^A	13.62 ^B	0.0001
FCR	2.07 ^B	2.44 ^A	0.0001

^{A,B} Means in the same row with different superscripts are significantly different ($P < 0.01$).

¹LBC: (Broilers + Layers) × Chee, and LSRBC: (Shanghai Road Bar + Layers) × Chee

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Effects of Oils Supplemented Diets on Short Term Free Choice Test in Crossbred Brahman Cattle

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Introduction

Choice feeding experiments (choice tests) provide a possibility to study factors influencing the animal's decision of what and how much feed to eat under conditions being widely controlled (reviewed by Meier *et al.*, 2012). The vegetable oils are commonly added to ruminant diets to enhance the proportion of desirable unsaturated fatty acids in edible products (Raes *et al.*, 2004). Therefore, the objective of this research was to compare the palatability of 3 different types of oil supplementation in the short term feeding periods in beef cattle. We hypothesized that the feeding choices of cattle would be different because of the different oil flavors. The frequency of behaviors of cattle in free choice group would be different from the control group.

Materials and Methods

Animals and treatments

Crossbred two-year old Brahman cattle (male, n = 12) with an initial BW of 303.83 ± 41.59 kg were used for the study. One group (control, n = 3) received approximately 6 kg of concentrate per day, another one (free choice, n = 9) were fed the same basal diet as the control group, such as 2 kg/d basal diet supplemented with 35 g/d of corn oil (CO), palm oil (PO) and rice bran oil (RO) filled into 3 feeding buckets, respectively. All feeds were delivered at 0730 h and 1530 h daily. Cattle also received *ad libitum* straw, had free stall unit and were individually fed according to treatments.

Free choice test

DMI were determined for each diet per pen as DM offered minus DM refused within 30 min. The frequency of switching, visits, eating, self-grooming, drinking and disturbance from neighbors were recorded within 30 min/meal per day (Herskin and Munksgaard, 2000).

Statistical analysis

SPSS 16.0 was used. The Duncan's multiple range test was used to determine differences at each point.

Results and Discussion

The results showed that the DMI of PO (Morning: 306.23g; Afternoon: 611.85g) was significant lower than the DMI of RO (Morning: 654.17g; Afternoon: 852.32g) and CO (Morning: 742.54g; Afternoon: 860.30g) ($P < 0.05$) during the morning and afternoon feeding. However, there was no significant difference between the DMI of RO and CO. In addition, the DMI of PO in the morning was significantly lower than that in the afternoon ($P = 0.04$). On the contrary, the DMI of RO and CO in the morning was similar to those in the afternoon.

The cattle preferred the feed supplemented with RO and CO, rather than PO. It was probably because of the less acceptable unique flavor of PO compared with RO and CO. There was no significant difference of behavioral frequencies between CG and FCG during the observation of 30 min/meal (Table 1). Because of the feeding motivation, the high frequency of behavior was eating (Herskin and Munksgaard, 2000). Although the disturbance from the neighbors was rare event during the 1 day test, this kind of behavior reminded the authors to consider whether the cattle would show this behavior during a long term feeding. From the frequency of switching we found that beef cattle choose the diets alternately during feeding periods. Although the behavioral activities did not show any differences in short term test, the behavioral parameters could be the indicators during the mid-term or long term feeding test. Therefore, further research will be needed.

Table 1. Effects of oil supplemented diets on frequencies/30 min of behaviors of cattle during feeding periods

Behaviors	Control	Free choice	P-value
Switching	24.67 ± 4.37	17.56 ± 1.38	0.06
Visits	13.33 ± 1.86	13.44 ± 1.92	0.97
Eating	53.33 ± 3.48	44.56 ± 3.44	0.20
Self-grooming	6.67 ± 0.67	6.89 ± 1.73	0.94
Drinking	7.00 ± 2.52	2.44 ± 0.85	0.61
Disturbance from neighbors	1.00 ± 0.58	0.44 ± 0.18	0.27

Values are as Mean ± SE.

Conclusion

It is concluded that the short term feeding choice test of cattle was affected by different oil supplements. The effects of oil supplemented diets were not obvious on the frequency of behaviors in short term free choice test in crossbred Brahman cattle.

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Effect of Different Levels of Premix Supplementation in Diet on Performance and Hepatic Enzyme Values of Broiler Chickens

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Introduction

Poultry industry is a growing industry in Thailand, but general supplemented levels of minerals and vitamins in animal feed were recommended by international research institutions. NRC (1994) gives the minimum levels of minerals and vitamins that can protect the animals from deficiency diseases or disorders. At the recommended levels, the animals may not show any clinical signs of deficiency while the productivity may not always be highest. Because there are some factors that influence the requirement of minerals and vitamins such as environmental variation, stress, toxins and anti-nutrients in the diet. These will increase the requirement of vitamins and minerals of the animals. Therefore, the supplementation of minerals and vitamins for the highest performance should be raised approximately 100-500% from recommended levels (Khajarn, 2004). This study was aimed to investigate the effect of different levels of premix supplementation in the diet on performance and hepatic enzyme values of broiler chickens.

Materials and Methods

A total of 90 male day-old chicks were randomly distributed into three groups (A, B and C) containing five replicates of 6 chickens in each. The chickens of group A, B and C were supplemented with commercial vitamin-mineral premix along with corn-soybean diet at 0.25%, 0.50% and 0.75% of total feed. All chickens were given feeds and drinking water *ad libitum*. At 42 days old, body weight gain, average daily gain, feed intake and feed conversion ratio were calculated. Two chickens of each replicate were random selected to collect blood sample for hepatic enzyme studies. Alanine aminotransferase (ALT) and aspartate aminotransferase (AST) concentration were quantified. Data were analyzed as a completely randomized design (CRD). A value of $P \leq 0.05$ was considered significant.

Results and Discussions

The present study results were presented in Table 1. There were no significant differences ($P > 0.05$) in body weight gain, average daily gain and feed intake between groups. Different studies have shown that vitamin-mineral supplemented to basal low vitamin-mineral diet improved body weight gain of broiler chickens (Islam *et al.*, 2004; Deyhim *et al.*, 1995). While, it was observed that group A had significantly greater ($P \leq 0.05$) feed conversion ratio than group C but it not significantly different ($P > 0.05$) with group B. However, the performance of broiler chickens might be decreased with higher level of premix in the diet. This was probably because the chickens in this study were less stressed under small-scale and intensive care conditions. Moreover, in practice, premix manufacturers use much higher concentrations than those specified by NRC (1994) (Sayadi *et al.*, 2005; Inal *et al.*, 1991). This portion of the study is concerned with the negative interactions of these essential trace elements that decreases bioavailability.

There were no significant difference ($P>0.05$) in ALT and AST between groups. The levels of hepatic transaminases of all groups were generally accepted as reference range for physiological values of I.S.I.S. (2002) (ALT; 0-13 IU/L and AST; 115-398 IU/L) in *Gallus* specie. Hepatic transaminases, ALT and AST are enzymes located in liver cells that leak out into the general circulation when liver cells are injured. These results showed that liver is not injured in all chickens that received higher level premix.

Table 1. Mean $\pm$ S D of body weight gain (BWG), average daily gain (ADG), feed intake (FI), feed conversion ratio (FCR), alanine aminotransferase (ALT) and aspartate aminotransferase (AST) at 42 days of age of the experimental broiler chickens.

Parameters	Groups*		
	A (0.25% premix)	B (0.50% premix)	C (0.75% premix)
Initial weight (g)	44.58 $\pm$ 0.83	44.14 $\pm$ 0.65	42.90 $\pm$ 1.77
BWG (g)	1,462.28 $\pm$ 196.59	1,267.28 $\pm$ 222.44	1,135 $\pm$ 270.85
ADG (g/d)	34.82 $\pm$ 4.68	30.17 $\pm$ 5.29	27.05 $\pm$ 6.45
FI (g)	2,605.89 $\pm$ 238.63	2,529.31 $\pm$ 350.04	2,530.04 $\pm$ 732.89
FCR	1.79 $\pm$ 0.09 ^a	2.01 $\pm$ 0.21 ^{ab}	2.20 $\pm$ 0.21 ^b
ALT (IU/L)	12.00 $\pm$ 1.58	12.80 $\pm$ 4.76	13.20 $\pm$ 3.27
AST (IU/L)	283.20 $\pm$ 139.50	229.40 $\pm$ 33.82	251.00 $\pm$ 56.29

^{a,b}Means in the same row with different superscripts are significantly different ($P\leq 0.05$)

*Each 1 kilogram of premix contains: vitamin A 4,000,000 I.U., vitamin D₃ 300,000 I.U., vitamin E 2.00 g., vitamin K₃ 0.40 g., vitamin B₁ 0.08 g., vitamin B₂ 1.20 g., vitamin B₆ 0.20 g., vitamin B₁₂ 0.001 g., choline chloride 40.00 g., pantothenic acid 1.60 g., nicotinic acid 4.00 g., biotin 0.002 g., folic acid 0.20 g., ferric 2.40 g., zinc 24.00 g., copper 1.80 g., manganese 32.00 g., iodine 0.40 g., selenium 0.04 g., BHA 0.026 g. and carrier to 1 kilogram.

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Effect of Dietary Supplementation Level of *Boesenbergia pundurata* on Production Performance of Broiler Chickens

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Introduction

Broiler chicken industry is an important agriculture export sector in Thailand. Currently, many countries prohibit import of chicken meat raised with the use of antimicrobials. In addition, the use of such compounds has increased the risk of anti-microbial resistance. Antibiotic growth promoters such as AGPs were used extensively in broiler chicken industry, resulting in the problems mentioned earlier. Thus, the use of local or herbal substances in substitution of antibiotics would be an alternative to solve the problems and reduce cost. *Boesenbergia pundurata* or Kra-Chai is a tropical herb containing essential oil which had anti-bacterial (Pattaratanawadee *et al.*, 2006) and anti-parasitic properties. Most of the previous studies on the effects of *Boesenbergia pundurata* were based on *in vitro* conditions. Thus, the current investigation was aimed to study the effects of dietary supplementation of dry *Boesenbergia pundurata* powders on production performance of broiler chickens.

Materials and Methods

A total of 96 male day-old chicks were randomly distributed into four groups (T1; Control, T2, T3 and T4) containing four replicates of 6 chickens in each. The chickens of group T1, T2, T3 and T4 were fed with the corn-soybean diet supplemented with dry *Boesenbergia pundurata* powders at 0.00%, 0.05%, 0.10% and 0.15%, respectively. All birds were fed *ad libitum* and free to access drinking water. Feed intake and body weight were recorded weekly. At 36 days old, average daily gain, average daily feed intake and feed conversion ratio were calculated. All data were analyzed as a completely randomized design (CRD) by ANOVA and then Duncan multiple test was used to detect significant difference at $P \leq 0.05$.

Results and Discussions

The results are shown in Table 1. There were no significant differences ($P > 0.05$) for average feed intake and feed conversion ratio among experimental treatments. There was lower average daily gain; ADG ($P \leq 0.05$) for the birds (at 0-3 and 0-6 weeks) fed on the diet supplemented with dry powders of *Boesenbergia pundurata* at 0.10%, when compared with the birds fed on the other dietary treatments. Conversely, the birds at 4-6 weeks in T3 was not different in ADG compared with other birds fed on other dietary treatments. From the earlier study (Khumboulai, 2005), the body weight gain of broiler chickens at 4-6 weeks fed on 3% of *Boesenbergia pundurata* were lower than that of the chickens fed on control diet, but no difference was noted for the chickens fed on *Boesenbergia pundurata* at 1% compared with the chickens fed on the control diet. However, the overall (0-7 weeks) body weight gain was lower for the chicken fed on *Boesenbergia pundurata* at 3% as reported by Khumboulai, 2005. This would agree with the results of the current study. The discrepancy for the age of chickens might be the effect of dose on the chicken's response to antimicrobial property of essential oil in *Boesenbergia pundurata* (Miksusanti *et al.*, 2009).

Table 1. Mean $\pm$ SD of average daily gain (ADG), average daily feed intake (ADFI) and feed conversion ratio (FCR) at different ages of the experimental broiler chickens.

Item	Experimental treatment			
	T1 (0.00%)	T2 (0.05%)	T3 (0.10%)	T4 (0.15%)
ADG, g/day				
0-3 wks	33.79 $\pm$ 0.65 ^a	31.17 $\pm$ 1.87 ^{ab}	29.26 $\pm$ 1.67 ^b	31.59 $\pm$ 2.67 ^{ab}
4-6 wks	66.50 $\pm$ 2.80	60.81 $\pm$ 4.95	58.33 $\pm$ 6.55	62.29 $\pm$ 6.52
0-6 wks	50.14 $\pm$ 1.67 ^a	45.99 $\pm$ 3.13 ^{ab}	43.80 $\pm$ 4.02 ^b	46.94 $\pm$ 2.04 ^{ab}
ADFI, g				
0-3 wks	58.98 $\pm$ 2.17	62.60 $\pm$ 9.57	64.35 $\pm$ 5.12	64.78 $\pm$ 7.54
4-6 wks	156.50 $\pm$ 3.89	153.48 $\pm$ 13.04	153.85 $\pm$ 15.98	144.98 $\pm$ 8.73
0-6 wks	103.33 $\pm$ 1.20	103.33 $\pm$ 9.59	104.00 $\pm$ 7.26	99.13 $\pm$ 4.61
FCR				
0-3 wks	1.75 $\pm$ 0.10	2.07 $\pm$ 0.47	2.30 $\pm$ 0.41	2.08 $\pm$ 0.38
4-6 wks	2.36 $\pm$ 0.05	2.57 $\pm$ 0.45	2.77 $\pm$ 0.41	2.33 $\pm$ 0.12
0-6 wks	2.28 $\pm$ 0.06	2.56 $\pm$ 0.52	2.80 $\pm$ 0.48	2.40 $\pm$ 0.15

^{a,b} Means in the same row with different superscripts are significantly different ($P \leq 0.05$)

From the results of the present study, the ADG of the birds in T2, T3 and T4 at age of 4 weeks was rather high (data not showed), when compared with that of the birds in the T1. The birds especially in T4 had higher value of ADG than those in T1. The important change at the 4th week of the experiment was that the diet changed from starter to grower diet for broiler chickens. This change would be a stress factor affecting the intestinal microbiota (Lu *et al.*, 2003). This implies that supplementation of *Boesenbergia pundurata* is suitable during diet formula change that is linked to a large change of intestinal microbes. Therefore, dose and time for suitable dietary supplementation of dry *Boesenbergia pundurata* powders for broiler chickens should be further elucidated.

In conclusion, dietary supplementation of dry *Boesenbergia pundurata* powders for broiler chickens at 0.05%, 0.10% and 0.15% had no effect on growth performance, except at the level 0.10% that resulted in lower growth rate compared with control diet.

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Supplementing Selenium from Selenium-enriched Kale Sprout (*Brassica oleracea* var. *alboglabra* L.) In Broiler Diets

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Introduction

Organic Se has been recognized to be more bioavailable than inorganic Se in poultry (Chinrasri *et al.*, 2009). The imported organic Se from Se-enriched yeast mostly consisted of selenomethionine (Schrauzer, 2003). On the other hand, organic Se could also be synthesized by plants. Therefore, Se-enriched kale sprout (*Brassica oleracea* var. *alboglabra* L.) has been locally produced in our laboratory. The production of Se-enriched kale sprout has been developed under hydroponic system using sodium selenite as Se source. The hydroponically produced Se-enriched kale sprout (HPSeKS) contained 581.48 mgSe/kg with organic Se is the major Se forms (Maneethong *et al.*, 2013). Thus, the purpose of this study was to determine effects of Se from HPSeKS on performance and carcass percentage in broilers.

Materials and Methods

Three hundred and sixty male broilers (10 day-old) were randomly assigned to 6 groups, with 4 replicates of 15 broilers each. Broilers were kept in evaporative cooling system housing. Internal light was provided for 24 h/d. The room temperature was 32°C at the first week and was gradually decreased to 25°C from d 30 until the end of the trial. The dietary treatments were T1: control diet, T2: control diet plus 0.3 mg Se/kg from sodium selenite (Na₂SeO₃), T3: control diet plus 0.3 mg Se/kg from Se-enriched yeast, T4, T5 and T6: control diet plus 0.3 mg Se/kg from HPSeKS. The control diet was formulated to meet the nutrient requirement of broiler (NRC, 1994), without Se supplementation. Feed intake and body weight was recorded and used for average daily gain (ADG) and feed conversion ratio (FCR) calculations. On d 42, 12 chickens from each treatment were weighed live and slaughtered. Carcasses were weighed for calculation of carcass percentage.

The data were analyzed according to Completely Randomized Design (SAS, 1996). The differences among means of each parameter were compared by Duncan's New Multiple Range Test.

Results and Discussion

Selenium supplementation from sodium selenite, Se-enriched yeast and HPSeKS did not influence feed intake, ADG, FCR and carcass percentage of broilers (Table 1). The current results are consistent with numerous previous reports (Payne and Southern, 2005; Wang and Xu, 2008; Skrivan *et al.*, 2010). Additionally, increasing dietary Se supplementation from HPSeKS up to 2 mg/kg did not negatively affect performance and carcass percentage of broilers (Table 1). The result reflected that no sign of toxic response of broilers fed high level

of Se from HPSeKS. Generally, clinical sign of Se toxicity in broiler occurred when it received diet containing 9 mgSe/kg (Echevarria *et al.*, 1988).

The results demonstrate that Se from HPSeKS could be used safely in the diet of broilers without adverse conditions on performance and carcass percentage.

Table 1 Effects of various Se sources on performance and carcass percentage in broilers

Items	Dietary treatments ¹						SEM	p-value
	T1	T2	T3	T4	T5	T6		
Feed Intake (g/h)	3562.80	3651.40	3583.60	3702.40	3614.10	3693.10	28.62	0.6902
Feed Intake (g/h/d)	97.02	99.91	97.30	100.77	98.72	100.79	0.79	0.6327
ADG (g/d)	55.59	55.19	52.96	58.63	53.30	56.25	0.74	0.2632
FCR	1.64	1.73	1.73	1.63	1.75	1.70	0.02	0.3907
Carcass (%)	80.30	80.25	80.25	80.83	80.56	81.44	0.16	0.9315

¹T1 = control diet; T2 = control diet plus 0.3 mg Se/kg from sodium selenite; T3: control diet plus 0.3 mg Se/kg from Se-enriched yeast, T4, T5 and T6: control diet plus 0.3, 1.0 and 2.0 mg Se/kg from HPSeKS.

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Conventional and Deep-litter Pig Production System: The Effects on Growth Performances

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Introduction

Organic farming was the original type of agriculture, and has been practiced for thousands of years. In Thailand, swine production units have declined in number but increased in size. The deep - litter swine was backyard production for small holder farming and Thai traditional pig production system. Currently, emphasis is put on welfare and health of pigs, as well as on ecological care in pig meat production which encourages development of alternative pig keeping systems. Conventional ways of pig production cannot fulfill the requirements with respect to pig welfare and health. Recent trends indicate the increasing popularity of deep - litter pig keeping in countries with developed pig production techniques (Margeta *et al.*, 2010) and these systems are cheaper to establish and are perceived as being more welfare friendly to pigs, compared to conventional housing system. (Morrison *et al.*, 2006)

The objective of this study was to investigate the effects of conventional and deep - litter pig production systems on growth performance.

Materials and Methods

A total of 16 piglets at 15.75 ± 1.19 kg of weight were randomly allocated into 2 treatments: traditional concrete - based house (TCBH) received only commercial diet and deep - litter house (DLH) received commercial diet and grasses or native vegetables (50/50). Bedding materials with 10 parts rice hulls with 1 part soil and topping by salts about 500 g and addition of a bacterial mixture. There were six replicates for each treatment. Body weights and feed intakes were measured every 7 days through the study.

Results and discussions

There was no significant difference in final weight, weight gain, age at 90 kg of body weight, age at 100 kg of body weight and average daily gain between the traditional concrete – base house group and DLH group although TCBH received commercial diet while another group received commercial diet and grasses or native vegetables.

Table 1. Growth performance of fattening pig kept on the traditional concrete – base house and deep–litter house systems

Traits	Way of fattening	
	Traditional concrete – base house system	Deep – litter house system
Final weight (kg)	103.17 ± 10.48^a	99.94 ± 16.82^a
Weight gain (kg)	87.33 ± 10.37^a	84.28 ± 15.58^a
Age at 90 kg of body weight (day)	122.82 ± 9.09^a	126.17 ± 10.58^a
Age at 100 kg of body weight (day)	137.85 ± 11.34^a	140.18 ± 11.75^a
Average daily gain (g)	$1,003.82 \pm 119.22^a$	968.23 ± 127.21^a

Conclusion

Keeping of pigs in deep–litter is an alternative efficient system for waste management and pig production. It has many advantages such as positive effect on pig welfare and health, reduce

cost of housing, and spent bedding litter for fertilizer. Therefore, keeping of pigs in deep - litter is a suitable way of pig production for family farms in Thailand.

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Effect of Cutting Intervals on Nutritive Value of *Commelina diffusa*

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Introduction

Commelina diffusa is classified a native plant in the *Commelinaceae* family, as weeds in agricultural system and found in Chumphon, Thailand. The chemical composition of *Commelina diffusa* were high moisture content (87.89% MC) and high protein content (14.78% CP) while fiber components (CF, NDF, ADF and ADL) were 17.12, 49.55, 25.94 and 7.10%, respectively (Chullanandana, 2011). However, nutritional information of *Commelina diffusa* is still scarce. Then, the following research was study cutting intervals of *Commelina diffusa* on chemical composition and rumen digestibility for ruminants feed.

Materials and Methods

40 Plots (1m x 1m separated by 30 cm) were demarcated and further divided into three similar units (n = 6). Mature *Commelina diffusa* vines were obtained from the wild around the experimental site. Plots were harvested at two stages of maturity (at 6 and 10 weeks). Samples of the freshly harvested forage were made per plot, chopped and mixed thoroughly. Samples were dried Air oven at 60 °C, ground to pass a 1-mm screen and analyzed for DM (AOAC, 1990) and subsamples also were retained for analysis of CP, NDF, ADF, ADL and *in sacco* technique (Ørskov *et al.*, 1980). Two ruminally fistulated non-lactating dairy cows (average 450 kg LW) were used to incubate nylon bags. They were in tie stalls for period and fed 2 kg/cow/day (16%CP concentrate) and fresh grass *ad libitum*. Bags were incubated at 6, 12, 24, 48, 72 and 96 hours. Data on nutritive values were subjected to analysis of variance, using T-test.

Results and Discussion

Effect of plant maturity on chemical composition and rumen digestibility of *Commelina diffusa*. This study was harvested at 6 and 10 week of growth. The results that *Commelina diffusa* is a high MC and CP. Concentration of CP was decreased from 19.60% at 6 weeks to 12.31% at 10 weeks ($P < 0.05$). In contrast, CF and NDF content were increased ($P < 0.05$) with advancing maturity. Similarly, Lanyasunya *et al.*, (2006) reported that CP concentration in *Commelina benghalensis* declined ($P < 0.0001$) by 48% from 17.59% at 6 weeks to 9.25% at 14 weeks whereas NDF concentration increased by 23.90% between 6 and 14 weeks (from 32.64% to 39.86%). The increase in fiber content was associated with accumulation of structural components, whereas the decrease of CP content with advancing maturity was attributed to the decrease in the actual concentration of CP in the leaf swards, stem and leaf to stem ratio (Lanyasunya *et al.*, 2007). Moreover, Chullanandana and Kanloun (2012) found that CP content of *Thysanostigma siamensis* was significantly ($P < 0.05$) decreased by advancing maturity (CP was 17.32, 14.24 and 11.34%, respectively). In contrast, cell wall contents (NDF, ADF and ADL) were significantly ($P < 0.05$) increased with advancing maturity (45, 65 and 85 days).

In Figure 1, presented rumen digestibility in DM and CP were decreased with advancing maturity ($P < 0.05$). Lanyasunya *et al.*, (2008) shown that effective degradability (ED at $k = 0.05 \text{ h}^{-1}$) of DM was not influenced by advancing maturity of *Commelina benghalensis*, while that CP declined slightly with advancing age ($P < 0.05$).

Table 1. Effect advancing maturity of *Commelina diffusa* on chemical composition (N = 6).

Chemical composition (%)	Age of harvest (weeks) ^a	
	6	10
Moisture content (MC)	88.07	88.20
Ash	14.20 ^a	11.15 ^b
Crude protein (CP)	19.60 ^a	12.31 ^b
Ether extract (EE)	1.71	1.74
Crude fiber, CF)	16.75 ^b	21.52 ^a
Neutral detergent fiber (NDF)	50.18 ^b	55.99 ^a
Acid detergent fiber (ADF)	28.25	28.78
Acid detergent lignin (ADL)	8.46	7.33

^a Means within each row with different letters differ significantly at P<0.05.

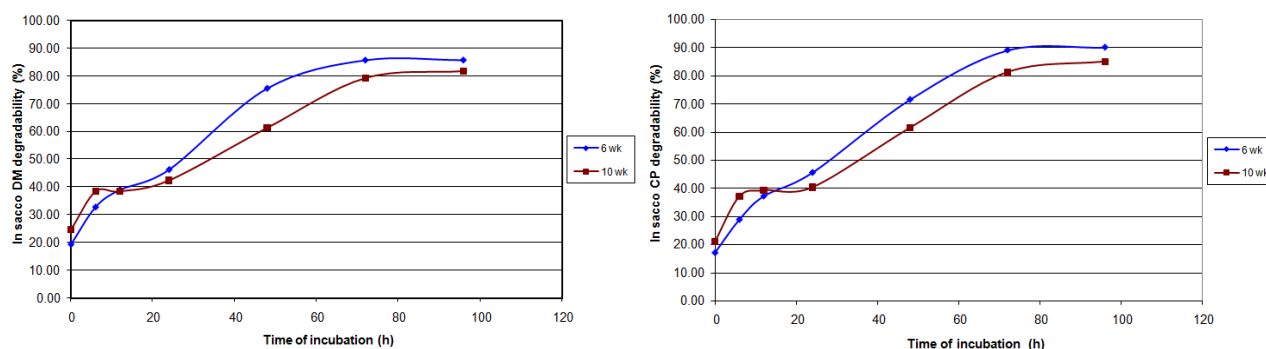


Figure 1. Rumen digestibility of *Commelina diffusa*

In conclusion, *Commelina diffusa* could be better feed for ruminants when harvested at 6-week intervals.

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Poster 40

Effect of Parity on Indigenous Chicken Egg Size, Number of Eggs and Hatchability

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Introduction

Indigenous chicken (IC) (*Gallus Domesticus*) is a poultry species of importance for nutrition and incomesecurity among the poor rural households in Africa. They are raised by the majority of the resource-poor rural households and play a vital gender role to women, widows and orphaned children in terms of cash incomes and savings, food security, nutrition and socio-cultural activities. In Malawi poultry dominates the livestock sector in number with 42 %of the poultry population (57,840,385)being IC from exotic breeds (and 75-80% of animal protein in rural areas comes from IC.The demand for these products is ever-increasing due to urbanization, increasing human population, decreasing agricultural land and consumer preference for IC meat.Evidently local chickens have a potential to contribute to economy of Malawi. However, apart from raising chickens for income generation, small-scale farmers tend to sell their chickens either because of a small number of eggs laid per clutch or because of high number of non hatchedeggs after the incubation period. The objective of this study was to evaluate the effects of parity on reproductive performance of local chickens. Specifically, the aim was to assess the effect of parity on number of eggs laid per parity, their sizes and total number of eggs hatched.

Materials and Methods

The study was conducted at Bunda College of Agriculture, using 16 hens of 4 parities. All the hens were tagged for easy identification. The IC hens were managed under semi-intensive productionsystem. The hens were released for scavenging at between 07:00 hrs and 16: 30hrs daily. Maize bran was supplemented ad lib two times a day at 08: 00 hrs and 15:00 hrs. Laying nests were provided once the Chicken starts layingin the Chickens house. Data on egg size was collected using a Jiffy- Way scale, number of eggs laid per chicken was collected by counting and hatchability was calculated as a function of eggs hatched over those laid.The analysis employed the General linear model (The GLM Procedure) and Logitmodel (The Logistic Procedure) of Statistical Analysis System (SAS).

Results and Discussions

It was observed that local chickens laid few eggs per clutch with an average number of eggs of 9(SD = 2.8) per chicken per clutch. The number of eggs laid per clutch was significantly ($P<0.0001$ and $P=0.005$) affected by both IC phenotypic group and parity, respectively. This was in line with the study done by Gondwe (2004) who reportedthat IC in Malawi lay eggs in the range of 6-28 eggs per clutch and similar results were also reported for Tanzania (Mwalusanya *et al.*, 1991). Egg production potentially was affected by factors as feed consumption, water intake, and parasite infestation. The henswere on free range and were supplemented with maize bran and not feed ration. Phenotypic group and parity had as well significant likelihood of influencing the probability that an egg wouldhatch and not egg size; (Table 1).Increase in parity was associated with high probability (Odds ratio = 3) of hatching more eggsunder their natural undisturbed incubation. With appropriate managerial levels, poor rural households are likely to increase the longevity of the IC and subsequently benefit more as the performance was predicted to increase with parity.

Table 1. Odds ratio of the binary logit model used to predict the factors influencing hatching of an egg in Indigenous Chicken in Malawi.

Effect	Estimate	95% Wald Confidence Limits		P-value
		Lower	Upper	
Egg size	1.4	0.81	2.59	0.2118
IC ¹ Phenotypic group	0.7	0.52	0.94	0.0167
Parity	3.0	1.79	5.13	< 0.0001

¹Indigenous Chicken

King'ori (1991) reported that one of the most influential parameters of hatchability is egg weight. Egg weight correlate to egg size and in this study egg size ranges; small (35-49 g), medium (49-56 g) and large (57-70g), were used as opposed to actual weights because of the nature of scale used. This might have affected the results that egg size was non-significant on affecting hatching. In Malawi IC are known to be good hatchers but with poor chick survival (Gondwe, 2004). According to Farooq *et al.*, (2000), hatchability is affected by factors such as fertility, egg quality, egg weight, handling of eggs and management condition during incubation and hatching.

Conclusion

Parity affected the number of eggs laid and influenced hatchability with increase in parity. However, parity did not affect eggs' size. Therefore, under village conditions good managerial practices would increase the performance of IC chickens and contribute to improved livelihoods of the poor rural households.

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Fatty Acid Content in Meat of Young Selenga Cattle

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Introduction

Meat quality depends on the ratio of its major components such as moisture, fat, protein, minerals, and its content in full and defective proteins. Meat quality and chemical composition are affected by the level of feeding, breed, age and sex of the animals. In this regard, the study of chemical composition and determination of biological value of meat obtained from young Selenga beef cattle is of interest to us. In this study we examined the fatty acid profile of young Selenga cattle.

Materials and Methods

Young Selenga cattle fattened during 2008 to 2009 in the Nart Researcher Center of Mongolian State University of Agriculture which located in Bornuur sub province, Tuv Aimag province, Mongolia were studied. Fatty acids content of the meat from the animals were determined using gas chromatography (HP-4890) in Laboratory of Food Engineering and Biotechnology, School of Food Engineering and Biotechnology, The Mongolian University of Science and Technology.

Results

Table 1 presents the saturated and short chain fatty acids contents in different cuts of meat of younger Selenga cattle.

Table 1. Content of fatty acids (%) of different cuts of young Selenga cattle

Meat Cuts	Saturated fatty acids					Short chain fatty acids			Long chain fatty acids		
	Myristic acid	Pentadecanoic acid	Palmitic acid	Heptadecanoic acid	Stearic acid	myristoleic acid	palmitoleic acid	Oleic acid	lynolic acid	Linoleic acid	Arachidonic acid
Round meat	2.30	0.46	24.01	0.31	18.0	0.46	6.25	39.92	4.43	0.24	0.17
Sirloin	2.47	0.49	24.01	0.41	17.88	0.08	6.14	37.90	5.43	0.04	0.17
Short Loin	2.41	0.59	23.61	0.96	18.0	0.48	5.23	39.40	4.82	0.33	0.90
Chuck	2.27	0.38	24.83	0.49	18.17	0.54	5.21	40.0	4.80	0.17	0.14

The results show that the saturated fatty acids made up of 2.27-2.47% myristoleic acid, 17.88 – 18.17% Stearic acid, and 23.61-24.83 Palmitic acid (highest). But for the short chain fatty acids contain 37.9-40.0% Oleic acid, for long chain fatty acids contain Linoleic acid 4.43 – 5.43%.

Table 2. Comparison of the content of fatty acid of meat of younger Selenga cattle with

other results of the literature

Researchs		Saturated fatty acids					Short chain fatty acids			Long chain fatty acids		
		Myristic acid	Pentadecanoic acid	Palmitic acid	Heptadecanoic acid	Stearic acid	Myristoleic acid	palmitoleic acid	Oleic acid	Lynolic acid	Linoleic acid	Arachidonic acid
We are	Round meat	2.30	0.46	24.01	0.31	18.0	0.46	6.25	39.92	4.43	0.24	0.17
	Sirloin	2.47	0.49	24.01	0.41	17.88	0.08	6.14	37.90	5.43	0.04	0.17
	Short Loin	2.41	0.59	23.61	0.96	18.0	0.48	5.23	39.40	4.82	0.33	0.90
	Chuck	2.27	0.38	24.83	0.49	18.17	0.54	5.21	40.0	4.80	0.17	0.14
Our research		2.36	0.48	24.11	0.54	18.01	0.39	5.70	39.30	4.87	0.19	0.34
E. Dumaa		4.41	2.30	35.04	3.06	0.52	5.63	5.63	8.46	9.93	0.20	-
B. Enkhtuya		2.37	0.56	25.9	0.39	18.9	0.56	2.93	39.72	5.47	0.77	0.84

Discussion

Lipid and fatty acids play many important biological roles such as providing energy and protect the flexibility of cell membrane. Chemical and physical features of lipid depend on length of the carbon chain and the ratio of saturated and unsaturated fatty acids. When carbon atom of fatty acids increases, the chain length and melting temperature increase, but when the ratio of unsaturated acid increases, melting temperature decreases.

We have identified the fatty acids at different parts of the muscles of young Selenga cattle. Of the fatty acids tested, 11 were saturated lipids. Palmetin acid is 23.61% on the shoulder muscles, 24.01% bucket, 24.01% for the heart muscle, and the biggest part 24.83% of of it on the back muscles.

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Haemoparasites of Traditionally Reared West African Dwarf (WAD) Small Ruminants in the Tropical Humid Rainforest of Southeastern Nigeria

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Introduction

Small ruminant production is popular in Nigeria, with great economic potentials because of their high fertility and early maturity as well as their adaptability to humid environment (Ademosun, 1988). Apart from producing hides, skins and other products, meat production is the most important. The benefits derived from these animals however, are limited by low productivity from numerous factors of which the major one is disease (Akerejola *et al.*, 1979). For example mortality rates of 34.12% and 36.20% have been reported respectively for sheep and goats in the old Bendel State (ILCA, 1987), one of the close neighbouring states of Owerri. Most apparent are diseases caused by blood parasites.

This work was designed to investigate and document the prevalence of blood parasites of these ruminants reared under traditional husbandry system in Owerri, the tropical humid rainforest of southeastern Nigeria.

Materials and Methods

This study investigated the prevalence of haemoparasites of West African Dwarf (WAD) small ruminants reared under traditional husbandry system in the tropical humid rainforest of Owerri southeastern Nigeria, from June to August, 2011. Blood samples were collected from 500 (260 goats and 240 sheep) animals and examined for haemoparasites, following standard procedures as described by Foreyt (1991). Data obtained were analysed, using simple averages and percentages.

Results and Discussion

Results showed that 160 (32.0%) of the animals were infected with blood parasites. Of these, 90 (34.6%) goats were infected, while 70 (29.2%) sheep were infected. The period during which this study was carried out was the rainy season, which favors the survival and proliferation of the arthropod vectors responsible for the transmissions of pathogenic organisms and could be the reason for the relatively high prevalence of haemoparasites recorded among the WAD small ruminants examined. These animals are considered to be resistant to diseases such as trypanosomiasis, under natural condition (Adejinmi *et al.*, 2004). *Plasmodium sp* recorded the highest prevalence of 56.3% in both sheep and goats, *Anaplasma* and *Eperythrozoon* (18.8%) each and *Trypanosoma sp* (6.3%). The prevalence of these haemoparasites in animals has been also documented by Ukaga *et al.*, (2002). *Plasmodium*, the causative organism of malaria in man was commonly encountered in these animals, suggesting that the ruminants could serve as reservoirs of infection in the study areas, especially as these animals are housed in close proximity with their owners. Malaria parasitaemia in humans is wide-spread in the study area (Egwunyenga *et al.*, 1996).

The high prevalence of blood parasites recorded in this study, suggests that the economic gains accruable to the peasant farmers would be reduced, following the morbidity, mortality, reduced growth rate of the animals and subsequent disinterest in their production.

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Moist-Treatment as a Method of Improving The Nutritive Value of Cassava For Starter Broilers

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Introduction

Maize constitutes the bulk of dietary energy for poultry and pigs in Nigeria. However, its inadequate availability due to its use and stable food for human and raw material for agro-industries, its cost has increased by over 2000% in the last 25 years (Udedibie, 2003). This has adversely affected poultry production in the country leading to the need to search for alternatives. Nigeria is the greatest producers of cassava in the world today, producing about 34 million metric tones per annum (FAO, 2005). However, cassava as alternative source of energy, has certain limitations; it is dusty and contains cyanogeneticglucosides, linamarin and lotaustrain, which on hydrolysis, by the enzyme, linamarase yield hydrogen cyanide (HCN) which is very toxic (Sayre, 2007). Since most enzymes are denatured at temperatures above 45°C (Okeudo, 2000) it is expected that if fresh cassava tubers are cooked, the product will be HCN-free and non-dusty since the starch will gelatinize and the enzymes responsible for HCN production will have been destroyed. This paper reports the response of starter broilers to diets in which maize was replaced with cooked cassava tuber meal.

Materials and Methods

The research was carried out in the Federal University of Technology, Owerri-Nigeria. Cassava tubers were bought from the local markets around the University. They were peeled, washed, cut into pieces and then cooked for one hour. The cooked tubers were then sun-dried until they became crispy and then milled in a hammer mill using 2 mm sieve. Three diets were made such that diet 1 (control) contained maize as source of energy and no cassava tuber meal, while in diets 2 and 3, cassava tuber meal replaced 50% and 100% of the maize, respectively. Each diet was fed to a group of 40 day-old broilers replicated into 4 for four weeks. Feed and water were provided *ad-libitum*. Data generated were subjected to analysis of variance (Steel and Torrie, 1980).

Results and Discussion

The fresh cassava tubers used for the study contained about 800 ppm HCN. The cooked cassava tuber meal contained about 50 ppm. Data on the performance of the birds are shown in table 1. The birds on the control diet recorded significantly ($p < 0.05$) higher feed intake and body weight relative to the ones on diet 3. Feed conversion ratio (FCR) was also affected by the treatments, with the control group having superior FCR (2.53) as against 3.03 and 3.26 for those on diets 2 and 3. Cost of production increased as maize replacement increased. Earlier study by Udedibie *et al.*, (2004) using sun-dried cassava tuber meal produced similar result. It is therefore concluded that cooking fresh cassava tubers for one hour is not an effective method for improving the nutritive value of cassava tubers for starter broilers.

Table 1. Performance of the experimental starter broilers

Parameters	Diet 1 Control	Diet 2 50% replacement	Diet 3 100% replacement	SEM
Av. Initial body weight (g)	121.80	123.85	126.07	5.82

Av. Final body weight (g)	839.54 ^a	644.44 ^b	558.33 ^b	26.36
Av. Body weight gain (g)	717.74 ^a	520.59 ^b	432.26 ^b	16.74
Av. Growth rate	25.63 ^a	18.59 ^{ab}	15.43 ^b	2.42
Av. Feed intake (g/ld)	64.91 ^a	56.41 ^{ab}	50.33 ^b	3.36
Av. Feed conversion ratio (g feed/g gain)	2.53 ^a	3.03 ^{ab}	3.26 ^b	0.18
Cost of feed (N/kg)	72.60	73.00	74.25	
Cost of prod. (N/kg/bird)	181.5	221.19	242.05	
Mortality (%)	1	5	5	

^{ab}Mean within a row with different superscripts are significantly different (P<0.05).

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Effect of Cartilage Powder and Chondroitin Sulfate Supplementation on the Tibia property and Mineral Composition of Laying Hens

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Introduction

For laying hens, bone calcium is used for eggshell formation, and in such a long-term usage, this will lead to fragile bones and susceptibility to fracture due to osteoporosis (Beck and Hansen, 2004). Extreme bone fragility and high fracture incidences occur at the end of the laying period. The objective of the present study was to utilize cartilage powder produced from discarded chicken tibia and supplemented into chicken feed to reduce lameness incidence in chickens, and to understand the effects of cartilage powder and chondroitin on the bone of old layers.

Materials and Methods

In this experiment, a total of 75 White leghorn hens of 98-wk-old were randomly allocated into three dietary treatments for 8 wk according to their respective body weight, 25 replications in each treatment. During the trial, using 16L: 8D lighting program, 120 g feed and ad libitum drinking water was provided to the birds daily. The experiment had three treatments: control, cartilage powder and chondroitin sulfate. At the end of experiment, 6 birds from each treatment were randomly selected and sacrificed; breast, thigh meat, liver and tibia were excised for laboratory analysis

Results and Discussion

The results showed that cartilage powder group had better tibia strength than control and chondroitin sulfate group, though not significant ($P > 0.05$). Cartilage powder and chondroitin sulfate supplemented group had significantly ($P < 0.05$) higher tibia strength, and higher width (upper and lower part) than control group. Dietary cartilage powder and chondroitin supplementation significantly ($P < 0.05$) increased tibia bone density. Some researchers (Canalis *et al.*, 1988; Mohan and Baylink, 1991; Blanquaert *et al.*, 1995) found that chondroitin sulfate had a high affinity on bone growth factor stored in the matrix that might increase the biological activity of bone growth factor (Sommer and Rifkin, 1989; Tardieu *et al.*, 1992), which stimulates osteoblast cell proliferation and activity (hence, activity of alkaline phosphatase), leading to an increased longitudinal bone growth rate and mineral deposition rate, enabling a significant increase in bone mass.

On carcass, added cartilage powder and chondroitin sulfate in the ash and closely related to the formation bone of calcium, phosphorus, magnesium mineral levels on leg, breast and liver and tibia higher than the control group. This is due to the fact that chondroitin sulfate not only binds calcium ion but also with other alkaline-earth metal ions, along with magnesium, strontium and barium (Uchisawa *et al.*, 1991).

In conclusion, if tibia bones from poultry slaughter house could be made into cartilage powder and supplemented into poultry feed, it might be able to increase the tibia strength of aged laying hens, and significantly improve the tibia density. It may also increase the added value of slaughter waste and could be used as a preliminary trial applicable on health products in human.

Table 1. Effect of dietary cartilage powder and chondroitin supplementation on laying hens tibia mineral composition

Items	Treatment			Significance	SEM
	Control	Cartilage powder	Chondroitin		
Ash, %	53.4 ^b	57.6 ^a	53.6 ^b	*	1.1
P, %	0.946	0.954	0.977	NS	0.021
Mg, %	0.099	0.112	0.114	NS	0.005
Ca, %	0.0199	0.0209	0.0202	NS	0.0027

Table 2. Effect of dietary cartilage powder and chondroitin supplementation on layer tibia length, strength and density.

Items	Treatment			Significance	SEM
	Control	Cartilage powder	Chondroitin		
Length (cm)	11.82 ^b	12.00 ^{ab}	12.08 ^b	*	0.06
Width (upper) ,cm	1.97 ^b	2.15 ^a	2.16 ^a	***	0.03
Width (middle), cm	1.03	0.79	0.80	NS	0.15
Width (lower), cm	1.23 ^b	1.32 ^a	1.35 ^a	*	0.03
Strength, kg/cm	17.38	18.54	17.37	NS	1.06
Density ¹	1.49 ^b	2.46 ^a	2.31 ^a	*	0.27

¹Density is scored 1-5, the higher the score, the more dense the bone.

NS: No significant difference; *: p<0.05; ***: p<0.001.

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Effects of Season Variation on Male Reproductive Characteristics of Nubian Goats and Barbado Sheep

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Introduction

The semen characteristics of ram are greatly affected by libido, breed, age, environment (seasons, daylight length, climatic temperature and humidity) and management (Ibrahim, 1997), which result in affecting the reproductive ability. Rams show a marked seasonal variation in many reproductive aspects, characteristics that generally increase from spring to autumn (Rosa *et al.*, 2012). The present study was therefore undertaken to investigate the effects of season variation on male reproductive characteristics of Nubian goats and Barbado sheep.

Materials and Methods

There were eight 2-3 year old 8 male Nubian goats and 8 male Barbado sheep. The semen was collected on the following four periods: hot season (May), warm season (June to September), cool season (April & October-November), and the cold season (December to March). Animals were housed separately in two pens according to their species, fed on Pangola hay ad libitum. Semen was collected from each ram every three days, and the environmental temperature, rectal temperature, reaction time per ejaculation, semen qualities (volume, gross motility, individual sperm motility, total/live/dead sperm number, abnormal sperm rate, sperm survival rate, concentrations, pH value) were recorded.

Results

The results shown that Barbado sheep had higher gross motility, individual sperm motility, total sperm number, live sperm number ($P<0.01$), concentration ($P<0.001$), and sperm survival rate ($P<0.001$) compared with Nubian goats. Rectal temperature was highest in May. The ejaculation time was lowest in May too. Semen concentration was lowest in April and October to November. The dead sperm number was lower in June to September, April and October to November. The pH value of semen was also lower in hot season (May, June to September).

Table 1 Rectal temperature, semen quantity and quality of Nubian goats and Barbado sheep.

Items	Nubian goat	Barbado sheep	SEM	Sig.
Volume (ml)	0.803 ^a	0.695 ^b	0.017	***
Rectal temperature (°C)	38.677 ^a	38.547 ^b	0.016	***
Gross motility	3.57 ^b	3.72 ^a	0.04	*
Individual sperm motility	3.18 ^b	3.42 ^a	0.03	**
Total sperm number	1,329 ^b	1,448 ^a	25	***
Live sperm number	867 ^b	979 ^a	22	***
Dead sperm number	459	466	11	NS
Sperm survival rate (%)	61.2 ^b	65.6 ^a	0.8	***
Abnormal sperm rate (%)	2.72 ^a	2.10 ^b	0.13	*
Concentration (10 ⁶)	2,655 ^b	2,874 ^a	50	***
pH value	6.974 ^a	6.744 ^b	0.023	***
Ejaculate second (s)	49.2	52.9	2.6	NS

^{a-b} Means with different superscripts in the same row differ significantly (P<0.05).

NS: No significant difference; *: P<0.05; **: P<0.01; ***: P<0.001

Table 2 Effects of seasons on rectal temperature, semen quantity and quality of Nubian goats and Barbado sheep.

Items	May	Jun-Sep	Apr, Nov	Oct- Dec-Mar	SEM	Sig.
Environmental temperature (°C)	25.74 ^a	25.06 ^b	22.64 ^c	18.41 ^d	0.11	***
Rectal temperature (°C)	39.01 ^a	38.73 ^b	38.53 ^c	38.45 ^d	0.03	*
Ejaculation time (sec)	33 ^c	48 ^b	46 ^b	67 ^a	4	*
Volume (mL)	0.717	0.714	0.819	0.707	0.029	NS
Concentrations (10 ⁹)	3.02 ^a	2.74 ^{bc}	2.64 ^c	2.90 ^{ab}	0.87	*
Gross motility	3.54 ^b	3.74 ^a	3.72 ^a	3.48 ^b	0.06	*
Individual sperm motility	3.29 ^{ab}	3.30 ^{ab}	3.45 ^a	3.19 ^b	0.05	*
Total sperm number	1,513 ^a	1,375 ^{bc}	1,326 ^c	1,464 ^{ab}	43	*
Live sperm number	976	936	920	913	39	NS
Died sperm number	537 ^a	433 ^b	406 ^b	547 ^a	19	*
Sperm survival rate (%)	62.1 ^b	65.2 ^{ab}	66.8 ^a	58.1 ^c	1.4	*
Abnormal sperm rate (%)	1.34 ^c	2.04 ^b	3.02 ^a	2.42 ^{ab}	0.23	*
pH value	6.59 ^c	6.53 ^c	6.96 ^b	7.24 ^a	0.04	*

^{a-c} Means with different superscripts in the same row differ significantly (P<0.05).

NS: No significant difference; *: P<0.05; ***: P<0.001

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Effects of Elevated Crude Glycerin Concentrations on Feed Intake, Blood Metabolites and Hormone Concentrations in Goats

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Introduction

Recent increases in biofuel production have led to increased prices of traditional feedstuffs, leaving livestock producers searching for alternative feeds to lower production costs without sacrificing animal performance. Crude glycerin (rich in glycerol) is the principal by-product of biodiesel production. Approximately 10% of the weight of oil or fat used to produce biodiesel becomes glycerin (Dasari *et al.*, 2005). These by-products provide alternative ingredients for livestock feed, but a better understanding of their feeding value is needed. Although glycerin is generally recognized as safe for use in animal feed (FDA, 2006) there is little information available on feeding rates and production responses in goats fed moderate to high amounts of glycerol. Therefore, our objective was to determine the effects of crude glycerin on feed intake, and serum metabolite and hormone profiles when compared with corn as a dietary energy source (0, 5, 10, and 20% of dietary DM).

Materials and Methods

Four male crossbred (Thai Native x Anglo Nubian) goats (approximately 18 months old) averaging 26 ± 3.0 kg (initial BW) were randomly assigned to a 4x4 Latin Square Design to receive four diets, T₁ = concentrate containing 0, 5, 10 and 20% crude glycerin (GC) on DM basis, to investigate the effects of crude glycerin on intake, rumen fermentation and blood metabolites. Each goat was kept individually in metabolism crates where water and mineral salt were available at all times. Diets were fed once daily for *ad libitum* consumption and contained 25% chopped hay. Each experimental period lasted for 21 days during which feed intake were recorded. At the end of each period, rumen fluid samples were collected by stomach tube at 0 and 4 h-post feeding for analysis of pH, NH₃-N and VFA concentrations. Blood samples were collected via jugular vein for analysis of metabolic parameters (glucose, BHBA and PCV) and insulin by commercial kits (Sigma Chemical Co., St. Louis, USA). All data were subjected to analysis of variance using Proc. GLM and treatment means were compared using Duncan's Multiple Range Test.

Results and Discussion

The results showed that (Table 1) overall mean feed intakes (total DMI, %BW and g/kgW^{0.75}) were similar for all treatments. Although DMI (%BW) tended to be slightly lower for goats fed inclusion of 0% GC as compared with other treatments. Overall mean ruminal pH was within the normal ranges which have been reported as optimal for microbial digestion of fiber and also digestion of protein (6.0-7.0) (Hoover, 1986). No significance ($p > 0.05$) of GC inclusion was detected for blood glucose, BHBA and PCV (Table 2) and all were within the normal range 50-75 mg/dL and 22-38 mg/dL, respectively (Kaneko, 1980; Jain, 1993). The plasma insulin was lower for the diet 0% GC than for the diets 10 and 20% GC, while the difference between the diets 5, 10 and 20% GC were not significant. However, insulin concentrations were not correlated with glucose concentrations. Circulating insulin concentrations usually correspond to changes in circulating glucose concentrations (Jenny and

Polan, 1975). However, insulin secretion is a result of many factors and in some cases has been shown to have a low correlation with blood glucose concentrations (McAtee and Trenkle, 1971). In conclusion, these results imply that GC can be fed to goats at 20% of dietary DM without negative effects on feed intake and blood metabolites when compared with goats not fed crude glycerin. However, further research should be directed toward investigating the effects of GC in the diet and its interactive effects with other energy-based feedstuffs to develop improved, cost-effective feeding strategies of biofuel by-products in feedlot systems.

Table 1. Effects of 0, 5, 10 and 20% dietary crude glycerin on feed intake of goats.

Item	Crude glycerin, % of dietary DM				SEM
	T1 (0)	T2 (5)	T3 (10)	T4 (20)	
Total DMI, kg/d	0.908	0.946	0.970	0.915	0.03
DMI %BW	2.82	3.12	3.23	2.89	0.14
DMI g/kg W ^{0.75}	67.29	73.36	75.69	68.49	3.12

^{a-b} Within rows not sharing a common superscripts are significantly different (P<0.05)

SEM = Standard error of the mean (n = 4)

Table 2. Effects of 0, 5, 10 and 20% dietary crude glycerin on rumen fermentation characteristics and blood metabolites of goats.

Item	Crude glycerin, % of dietary DM				SEM
	T1 (0)	T2 (5)	T3 (10)	T4 (20)	
Ruminal pH	6.53	6.51	6.48	6.49	0.06
Insulin, μ U/ml	1.85 ^b	2.94 ^{ab}	7.60 ^a	7.44 ^a	1.29
Glucose, mg/dl	67.36	71.59	71.95	75.73	2.59
BHBA, mg/dl	4.82	5.75	4.66	4.62	0.33
PCV, %	31.25	31.12	29.12	31.25	1.50

^{a-b} Within rows not sharing a common superscripts are significantly different (P<0.05)

SEM = Standard error of the mean (n = 4)

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Porcine Pregnancy Detection Through Phage Display Technology

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Introduction

Improving pig-breeding efficiency is a key point to increase the profitability of pig farming. The concentration of progesterone in blood has been showed as a crucial indicator to confirm if a sow is pregnant or not. Once embryo implantation has occurred the concentration of progesterone rises and remains at a high level to maintain a suitable environment for embryo development until delivery (Guthrie *et al.*, 1972). In contrast the non-pregnant sow is influenced by estrogen and returned to estrous, leading to a decrease of progesterone concentration. Hence the measurement of progesterone concentration in serum or milk has been widely used to monitor the estrous cycle and pregnancy diagnosis (Ellendorff *et al.*, 1976).

Phage display technology has been used in a wide variety of applications including: the identification of peptide agonists or antagonists for receptors, the identification of peptide drug and vaccine candidates, the identification of targets for the angiogenesis inhibition of tumor and the identification of peptides for diagnostic and therapeutic applications (Azzazy & Highsmith, 2002).

In this study phage display technology was used to develop a diagnostic platform for the detection of progesterone and evaluate its potential of replacing antibody for the development of diagnostic kit in porcine pregnancy detection.

Materials and Methods

Preparation of progesterone-BSA conjugate

Progesterone-3-O-carboxymethyloxime (P-3-O-CMO) was coupled to bovine serum albumin (BSA) via position 3 by mixed anhydride reaction, as described previously (Basu *et al.*, 2003). The progesterone-BSA conjugate was verified by Western blot analysis using mouse anti-progesterone monoclonal antibody.

Phage display heptapeptide library and biopanning with progesterone-BSA conjugate

Phage-displayed library was biopanned with progesterone-BSA conjugate. The microtiter plate wells were coated with progesterone-BSA conjugate. Phages (2×10^{11} pfu) were added and incubated at 37°C for 1 hr. The wells were washed 10 times with TBST to remove the unbound phages. The bound phages were eluted by elution buffer. Small parts of the eluted phage were used for titer measurement. The remaining aliquot was used to infect *E. coli* ER2738 cells for phage amplification. The eluted phages cross-reactive with BSA were removed through several rounds of biopanning against BSA.

Binding specificity of the selected phage

The selected phages were blotted onto nitrocellulose membrane and incubated for 1h. The membrane was incubated with blocking buffer (TBST containing 5% gelatin) for 1h and then washed with TBST. The progesterone or TBS was incubated with the membrane for 1h. After washing with TBST, the mouse anti-progesterone antibodies were incubated with the membrane for 1h. After washing with TBST, the membrane was incubated with alkaline phosphatase-conjugated goat anti-mouse antibody for 1h. The blot was developed and visualized with NBT/BCIP substrate at room temperature with agitation until a purple spot

appeared.

Results

Analysis of progesterone-BSA conjugate

The Western blot analysis showed that the molecular weight of progesterone-3-O-CMO-BSA conjugate was 68.4 kDa. It indicated that progesterone was conjugated onto BSA (Fig. 1B)

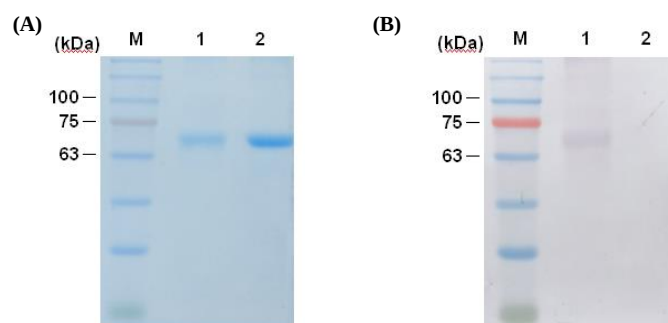


Figure 1. Analysis of progesterone-BSA conjugate. (A) SDS-PAGE (B)Western blot analysis of progesterone-BSA conjugate (lane 1) and BSA (lane 2) using mouse anti-progesterone monoclonal antibody.

Selected phages with high binding affinity to progesterone

Several eluted phages were randomly selected, amplified, purified and then assayed by dot blot analysis to evaluate their binding affinity to progesterone (Fig 2). These phages were assayed to bind progesterone by dot blot analysis. The results showed that phage clone 18 and 74 have higher affinity and specificity to progesterone. In conclusion, the selected phages have the potential for the development of diagnostic kit in porcine pregnancy detection.

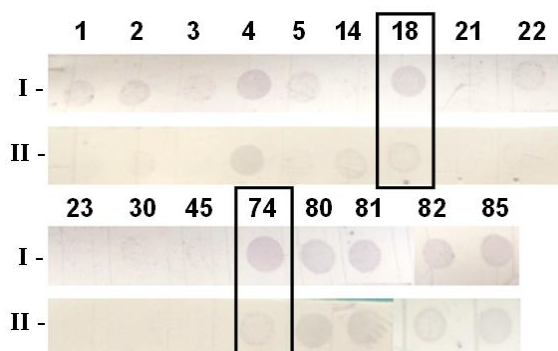


Figure 2. Dot blot analysis of selected phages bind to progesterone. The blots were incubated with progesterone (panel I) or TBS (panel II).

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Swine Pleuropneumonia Pathogen Detection by Phage Display Technology

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Introduction

Swine pleuropneumonia caused by *Actinobacillus pleuropneumoniae* (*App*) is a severe respiratory disease with high mortality which leads to major economic losses in the swine industry. On the basis of the presence of capsular polysaccharide antigens 15 serotypes have been reported, which have regionally variable prevalence and distribution (Bandara *et al.*, 2003). All serotypes are capable of causing disease, although there is evidence that the virulence varies in different serotypes (Ramjeet *et al.*, 2005).

A number of different assays have been developed for serotyping of *App* including serological assays and multiplexed PCR methods (Mittal, 1990; Jessing *et al.*, 2003). Phage display technology was first described by Smith to identify polypeptides with specific bait-binding activity and subsequently evolved with various applications (Pande *et al.*, 2010). A phage display library is a heterogeneous mixture of phage clones. Each phage clone carries a DNA fragment with different nucleotide sequences in its coat protein DNA, and therefore, displays a different peptide on its coat protein surface. Screening of lipopolysaccharide (LPS)-binding peptides by the phage display method has been widely employed (Matsumoto *et al.*, 2010).

Early identification of herds subclinically infected with *App* is essential for control of the disease. Different *App* serotypes cause clinical signs with varying degrees of severity. Therefore, the serotype analysis of the pathogen is crucial for disease diagnosis. In this study a novel serotyping method was developed using phage display peptide platform for the detection of *App* serotype 2, which is one of the most prevalent serotypes in several countries.

Materials and Methods

Phage display libraries and biopanning

A phage-displayed heptapeptide library (Ph.D.-7) was purchased from New England Biolabs. The library contains random heptapeptides fused to the N-terminus of M13 phage minor coat protein III. The library consisted of about 2.8×10^9 independent clones which should represent most of the 1.28×10^9 possible seven-residue sequences. The library was used for biopanning with lipopolysaccharide (LPS) of *App* serotype 2.

Binding specificity of the selected phage to App serotype 2, 3, 5 LPS

The binding specificities of the selected phages to the *App* serotype 2, 3, 5 LPS were analyzed by ELISA according to the phage library manufacturer's recommendation.

App serotype 2 detection using selected phages

The selected phages were used for *App* serotype 2 detection by dot blot analysis. Briefly, capture phage clones (2×10^{10} pfu) were blotted onto nitrocellulose membrane and incubated for 1 h. The membrane was incubated with blocking buffer (TBST containing 5% BSA) for 1 h and then washed with TBST. The purified LPS of *App* serotype 2 was incubated with the membrane for 1 h. After washing with TBST, the detection phage clones (2×10^{10} pfu) were incubated with the membrane for 1 h. After washing with TBST, the membrane was incubated with alkaline phosphatase-conjugated rabbit anti-M13 pVIII antibody for 1 h. The blot was developed and visualized with NBT/BCIP substrate with agitation until a purple spot

appeared.

Results

Table 1. Phage recovery of biopanning

biopanning	Input phages ¹	Eluted phages ¹	Recovery ²
first round	2.0×10^{11}	8.53×10^5	4.27×10^{-6}
last round	2.0×10^{11}	3.05×10^6	1.53×10^{-5}

¹ The unit of phage numbers is pfu/100 μ l ² Recovery = Eluted phages / Input phages

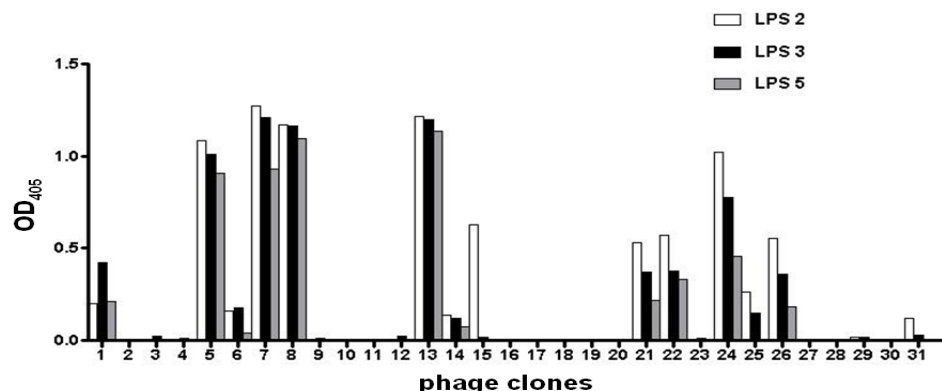


Figure 1. The ELISA results of eluted phage clones binding with LPS of *App* serotype 2, 3 and 5.

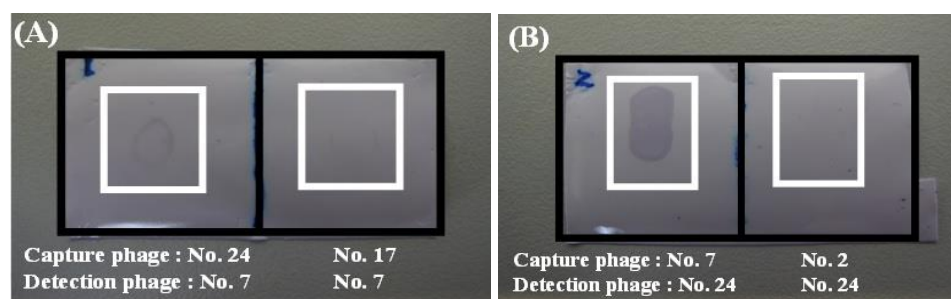


Figure 2. The detection of *App* serotype 2 LPS using selected phages.

(A) Phage clone 24 or 17 was used as capture phage and clone 7 as detection phage.

(B) Phage clone 7 or 2 was used as capture phage and clone 24 as detection phage.

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Stabilization of Goat Milk Kefir Colloid Drink Using Konjac Flour: A Preliminary Study

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Introduction

Dilution of goat milk kefir could cause a separation phase, therefore an additional agent such as neutral polysaccharide i.e. incompatible thermodynamic konjac flour or milk protein need to be added to stabilize milk colloid system (Tolstoguzov, 2003). This addition resulted in a segregative separation phase as reported by Abhyankar *et al.* (2011). However, ionic phase of modified konjac flour through microfluidisation modification could reduce the movement of UHT skimmed milk casein micelle to the basement of the colloid system (Tobin *et al.*, 2011).

Therefore, the aim of this study was to determine the effect of addition of modified konjac flour in goat milk drink on its colloid system.

Materials and Methods

Goat milk kefir were diluted using aquadest in the following ratio, goat milk kefir (ml): aquadest (ml) = 100:0; 70:30; 60:40 and 50:50. The water holding capacity and syneresis of diluted goat milk kefir were measured following the methods described by Sadar (2004). Konjac flour in lactate acid solution was treated in microwave with medium low power for 10 minutes (Yu *et al.*, 1996) and heat treatment at 90°C for 30 minutes in waterbath (Gong *et al.*, 2006). The modified flour was then added to commercial goat milk kefir and laboratory made goat milk kefir.

Results and Discussion

The addition of aquadest in goat milk kefir reduced the water holding capacity and increased syneresis of goat milk kefir drink as presented in Table 1.

Table 1. Water holding capacity and syneresis of goat milk kefir drink

Kefir(ml) : Aquadest(ml)	Water Holding Capacity (%)	Syneresis
100 : 0	55.76	0.0002
70 : 30	49.56	0.3685
60 : 40	49.60	0.7045
50 : 50	47.70	0.9145

It showed that the capability of colloid system in goat milk kefir in water hydration decreased due to dilution affect and therefore the aquadest addition not hydrated anymore hence syneresis occurred. The addition of modified konjac flour in commercial goat milk kefir drink still showed a syneresis, on the contrary in laboratory made one syneresis did not observed. This result indicated that modified konjac flour could stabilize colloid system in laboratory goat milk kefir drink, and it is due to addition of other non-milk ingredients which prevent the modified konjac flour to act as colloid system stabilizer. The FTIR analysis of Konjac flour showed three peak with wave number 3390.63 indicated hydrogen bond i.e. O-H group from

glucomanan of konjac flour, C–H bonding was showed by wave number 2927.74 and wave number 2156.27 indicated carbon–carbon bonding with three double bond. Modified konjac flour using water bath indicated the wave number shift to 3427.27 and a similar wave number (3402.20) was also determined in microwave modified konjac flour. It is believed that water molecules entering polysaccharide molecules as result of gelatinisation during heating together with microwave length increased the O–H bond strength.

Conclusion

The addition of aquadest did not hydrate anymore and modified konjac flour stabilized colloid system of goat milk kefir.

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Response of Broiler Fed Cocoa Pod Fermented by *Phanerochaete chrysosporium* and *Monascus purpureus* in the Diet

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Introduction

Nutrient content of cocoa pods containing 11.71% crude protein, 11.80% fat, 34.90% BETN but high in crude fiber 33.79% (cellulose 12.07% and lignin 15.13%), tannin 0.13% and theobromine 0.17%. Its utilization as animal feed was limited, especially in poultry. Cocoa pods can be used in broiler diet at just 5%, because of their limiting factor such as: lignin, cellulose and antinutrient tannin and theobromine.

Therefore, to improve the quality of cocoa pods as poultry feed, the content of lignin, cellulose, theobromine and tannin could be reduced through fermentation by *Phanerochaete chrysosporium*. According Kersten and Cullen (2007) *Phanerochaete chrysosporium* can degrade lignin and its compounds effectively by producing extracellular peroxidase enzymes such as lignin peroxidase (LiP) and manganese peroxidase (MNP). Fermented product by *Phanerochaete chrysosporium* followed with fermentation by *Monascus purpureus* to produced monacolin. Monacolin is a carotenoid pigment produced by *Monascus purpureus* also known as lovastatin which is an agent hypercholesterolemia. Utilization of fermented product by *Monascus purpureus* at 30 % in the diet of laying hens reduced cholesterol of chicken eggs about 46.63% (Nuraini et al., 2012).

Nutrient quality of cocoa pods after fermentation by *Phanerochaete chrysosporium* and folowed by *Monascus purpureus* increased as compared with before fermentation. Protein content 21,69 %, crude fiber 14.45% 400,71 mg/kg. So that this experiment aims to study the effect of feeding fermented product by *Phanerochaete chrysosporium* and *Monascus purpureus* (high carotenoid monacolin) in the diet and performance of broiler.

Materials and Methods

One hundred (100) 4-day-old CP 707 broiler chicks were studied in this experiment. Product fermented contain 80% cocoa pods with 20% tofu waste. Fermentation was carried out with 7% inoculum of *Phanerochaete chrysosporium* and incubated for 8 days. This is followed by fermentation with 7% inoculum of *Monascus purpureus*, incubation for 8 days. The experimental design used was Completely Randomized Design (CRD) with 5 treatments; 0, 5, 10, 15% fermented product (PF) in the diet and 5 replications. The variable observed were feed intake (g/bird), weight gain (g/bird), feed conversion, carcass percentage and blood cholesterol (mg/dl).

Results and Discussion

Feed Consumption, Body Weight Gain and Feed Conversion

The effect of feeding fermented product by *Phanerochaete chrysosporium* followed by *Monascus purpureus* on broilers performance are presented in Table 1.

Table 1. Broiler performance feeding fermented product

Parameter	Diet			
	0% PF (A)	5% PF (B)	10% PF (C)	15% PF (D)
Feed Cons (g/bird)	2430.95 ^c	2460.38 ^b	2495.06 ^a	2526.60 ^a

Body Weight Gain (g/bird)	1227.64 ^c	1260.38 ^c	1300.60 ^b	1350.51 ^a
Feed	1.98 ^a	1.95 ^{ab}	1.92 ^{bc}	1.87 ^c
Total Cholesterol (mg/dl)				
Carcass (%)	68.24 ^c	70.05 ^{bc}	71.40 ^{ab}	72.69 ^a

Note: Means in the same row with different superscript differ significantly (P<0.05)

PF = product fermented

Increasing utilization of fermented product in the broiler diet have significantly (P<0.05) affected feed consumption, weight gain and feed conversion. Feed consumption of broiler was high in the treatment using 15% product fermented. It showed that the fermented product preferred (palatable) up to 15% in the diet. In accordance with Murugesan et al., (2005), fermentation products have a preferred flavor and have a few vitamins (B1, B2, and B12) that are preferred when compared to original material. Highest body weight gain of broiler at treatment D, indicated a high feed nutrient in the diet which were used to produce meat leading to an increase in weight gain.

Increasing fermented product in the diet leads to the higher content of carotenoids monocolin. According to Erdogrul and Azirak (2004), red yeast rice (fermentation by *Monascus purpureus*) produced monacolin that can inhibit the action of the Hydroxymetyl Glutaryl-CoA reductase enzyme (HMG Co-A reductase) that play a role in the formation of mevalonate in the synthesis. Hence, cholesterol could not synthesized.

Conclusion

Utilization of fermented product by *Monascus purpureus* up to 15 % in the diet can improved the performance of broiler.

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Comparison of Two Methods of Combing Using Long and Short Combs on Raeini Goat Cashmere Characteristics

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Abstract

The double coated Cashmere goat breeds have pronounced fiber shedding and exhibit non-continuous pattern of fiber growth throughout the year. Method of cashmere collection affects many aspects of cashmere characteristics. The aim of this study was to evaluate the quality and quantity of cashmere collected by long and short combs. In April 2011, a total of 40 female Raeini cashmere goats of different ages in the summer grazing area of Baft city in Kerman Province South of Iran, the main cashmere producing area, were divided into two groups of 20 goats each. Fiber weight, duration of combing, fiber diameter, and down percentage of cashmere harvested by long and short combs were measured. Cashmere fibers were analyzed using a Laserscan instrument. A general linear model including age, kind of comb and stage of combing was used to analyze the data and measure the relationships between different cashmere characteristics. The overall means $\pm$ standard deviations were for cashmere weight 21.7 ± 2.0 , 31.4 ± 2.4 g, fiber diameter 19.7 ± 0.1 , 19.4 ± 0.2 μ m, fiber diameter standard deviation 3.5 ± 0.03 , 3.6 ± 0.05 μ m, cashmere yield 84.3 ± 0.9 , $83.6 \pm 1.0\%$ and duration of combing 2.8 ± 0.1 , 3.7 ± 0.2 min for long and short combs, respectively. Taking into account the time spent to comb the animals, the amount of cashmere combed per goat and collection of finer cashmere; it is concluded that the short comb has the advantage of collecting more weight of down fiber with lower fiber diameter.

Effect of Cumin Essential Oil on *in vitro* Gas Production Parameters of Alfalfa Hay, Barley Grain and Sugar Beet Pulp

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Introduction

The goal of ruminant microbiologist and nutritionists is to manipulate the ruminal microbial ecosystems to improve the efficiency of converting feed to animal products consumable by humans. The use of feed additives such as antibiotics has proven to be a useful tool to reduce energy (in the form of methane) and nitrogen losses from the diet (Schelling, 1984). But, the use of antibiotics as growth promoters in animal feed is facing reduced social acceptance due to the appearance of residues and resistant strains of bacteria (Gustafson and Bowen, 1997). Antibiotic application in feed animal has been prohibited in the European Union since January 2003 (Regulation 1831/2003/EC). For this reason, scientists have become interested in evaluating other alternatives to modulate rumen fermentation. Essential oils (EO) are plant secondary metabolites responsible for the odor and color of plants and spices. Their antibacterial, antifungal and antioxidant properties make them useful as natural additives in animal feeds. The mechanism by which EO are thought to exert their antimicrobial activity is through the disruption the cell wall structure affecting electron transport ion gradients, protein translocation, phosphorylation steps and other enzyme dependent reactions (Ultee et al., 1999; Dorman and Deans, 2000). The objective of the present study was to evaluate the effects of Cumin essential oil (CEO) on *in vitro* gas production parameters of alfalfa hay (AH), barley grain (BG) and/or sugar beet pulp (BP).

Material and Methods

The effect CEO was evaluated using *in vitro* gas production technique (Menke and Steingas, 1988). Samples were AH, BG and BP. Approximately 0.3 g of each sample (four replicates) were ground through a 2-mm screen and was placed in a 100 ml glass syringe. Treatments with control (no additive) and CEO at 200 µl /g DM were used. Two syringes were considered as blank (contained buffered rumen fluid plus CEO). Then, syringes were incubated in four replicates. Two sheep (45±2kg, body weight) fitted with rumen cannulae were used as donors of rumen fluid. Animals were fed 1.5 kg DM alfalfa hay and 0.4 kg DM concentrates (165 g CP/kg DM) per head per day. Rumen content was collected before the morning feeding and then immediately strained through four layers of cheesecloth and mixed in a 2:1 with buffer. Forty ml of buffered rumen fluid was added into the syringes. Each syringe was gassed with CO₂ then incubated at 38.6°C. The volume of gas produced was determined at 2, 4, 8, 12, 24, 36, 72 and 96 h after the incubation. The gas production data were fitted using an exponential equation of $P = b (1 - e^{-ct})$, where b is the volume of gas produced, c is the fractional rate constant of gas production (%/h), t is the incubation time (h) and P is the volume of gas produced at time t . Statistical analysis was conducted using SAS (1999) software.

Results and Discussion

Effect of CEO on *in vitro* gas production parameters is shown in Table1. Cumin essential oil resulted in significant ($P < 0.01$) decrease in both b and c parameters of gas production of AH and BP. Addition of CEO to BG do not show significant effects on both b and c parameters. Results of the present study demonstrated that the gas production parameters of the feed

samples were significantly different ($P<0.01$). In addition, results indicated that the gas production parameters of the feed samples were significantly altered when CEO was included in the medium.

Table 1. Gas production parameters of alfalfa hay, barley grain and sugar beet pulp as untreated or treated with cumin essential oil as 200 $\mu\text{l/g}$ DM.

Gas parameter	Treatment							SEM
	production	AH	BG	BP	AH+CEO	BG+CEO	BP+CEO	
b (ml/ 0.3 g)		49.32 ^a	98.72 ^c	84.01 ^d	28.7 ^b	107.1 ^c	47.5	1.49
c (%/ h)		0.068 ^a	0.038 ^c	0.088 ^d	0.031 ^b	0.028 ^c	0.032	0.004

a, b, c, d Means with difference letters in each row were significant ($p<0.01$)

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Milk Hygiene from Farm to Beverage Milk Shop

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Introduction

Milk production of local dairy farms in Thailand is managed through their dairy cooperative. The raw milk is sent to milk collection center for quality test and then poured into cooling bulk tank and sent to the milk cooperative. From the cooperative, milk is sold for pasteurization and some for local beverages milk shop. Local beverage milk shops in Maha Sarakham have a thriving business in the community. Raw milk is heated by boiling, without prior checking the quality, before being made into the beverages. Most Thai people will not consume raw milk like in other countries (Millogo et al., 2010). Milk hygiene in the dairy chain, from dairy farm to beverage milk shops is important for health of the consumers. Gran et al. (2002) and Bonfoh et al. (2003) reported that transporting and delivery time by milk vendor are the important factors that determine the hygiene of the raw milk. The objective of this study was to investigate the hygiene of raw milk by standard plate count in the milk chain from farm to beverage milk shop in Maha Sarakham, Thailand.

Materials and Methods

Raw milk was sampled during two seasons; rainy (July – October 2010) and winter (November – February 2011). The milk was sampled at four points of the chain: 1) dairy farm (15 samples), 2) milk collecting center (before pouring into the bulk tank) (15 samples), 3) Dairy Cooperative (pre-packaged milk) and 4) beverage milk shop (9 samples). Raw milk was collected in 10ml sterile tubes, 3 tubes per sampling point that were immediately stored in box containing ice and sent to laboratory within 1 hr. The SPC was determined by Spread Plate method. Data of SPC was transformed by log₁₀ before analysis.

Result and discussion

The SPC is show in Table 1. Raw milk was delivered in 72.6 min from farm to milk collection center for cooling down in the raining season and for 81.8 min in the winter season. In the raining season, the SPC increased significantly ($P < 0.05$), from dairy farm to milk collection center. The result was similar to study by Bonfoh et al. (2003) who reported that milk flora developed during transportation from farm to the selling points. In winter, SPC was not significantly increased. Raw milk, pre-packed at milk cooperative and milk that arrived at beverage milk shops were not significantly different in both seasons (Figure 1).

In the raining season, the farmer should quickly transport the milk to milk collection center to avoid increased bacterial multiplication. However, the standard plate counts of milk quality from all points did not exceed the levels stated in the Agricultural Commodity and Food Standard of Thailand.

Table 1. Standard plate count and time for transport raw milk from milk farm to milk collection center in raining and winter.

place	number	Raining			winter		
		Time (min)	SPC ^{1/}	SEM	Time (min)	SPC ^{1/}	SEM
Milk farm	15	72.6	5.729 ^A	0.030	81.8	5.706	0.22

Milk collection center	15	-	5.867 ^B	0.030	-	5.776	0.018

Means in the same row with different superscripts are statistically significant at P<0.05
^{1/} (Log10 cfu/ml)

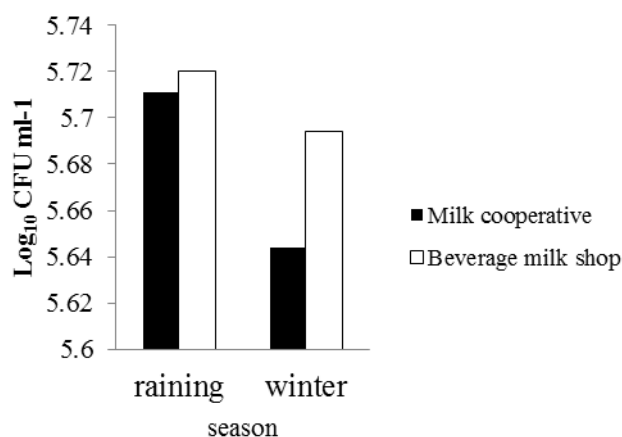


Figure 1. Log10 CFU/ml of SPC from milk cooperative to beverage milk shop in different seasons

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The Study on Selection, Culling and Farm Recording in Dairy Cattle in Kuntarawichi Mahasarakham

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Introduction

Kuntarawichai is a district of Maha Sarakham Province, the district with the highest dairy cow in the province (Department of Provincial Development Strategy, Maha Sarakham, 2006) by the encouragement by the government. However, the average milk production was less than other districts and other Provinces. In addition to feed and sanitary management, the selection and culling the cow were also important. The objective of this study was to study the selection and recoding methods in 30 dairy farms in Kuntarawichai, Maha Sarakham province during September to October, 2010 by the questionnaire.

Materials and Methods

Thirty dairy farms in Kuntarawichai, Maha Sarakham province were interviewed for 30 dairy farms for farm management, emphasis of selection and culling cow method.

Result and discussion

The study found that all dairy cows were the Holstein Friesian crossbred cow, the most was 85-94 percent of Holstein Friesian. Artificial insemination breeding was usually done by the livestock official (83.33 %) but the most farmers (73.33 %) not familiar with estimated breeding value (EBV), as a result, semen selection would not use EBV (93.33 %). The farmer would not pay attention in the genetic performance in the semen and let the livestock official choice the semen for their cows. The consideration for selection cows into farm were milk production record (43.33%), udder conformation (33.33%), linear type trait (10.00%). The first 3 reasons for culling cow were age of cow (96.67%), failure to conceive (93.33%) and low milk production (90%). The failure to conceive and the low milk production are in the primary seasons for culling described by Bascom and Young (1998) according to Feliciano *et al.*, (1988) they reported that the first 3 reasons for culling were reproduction, udder problem and low production respectively. but the age of cow was not included in those reasons. The criteria for culling in failure to conceive, the farmer would cull when failure in insemination was greater than 10 times (66.67%), 6-10 times (20.00%), 1-5 times (6.67%) and never cull (6.67%). The farmers did not record information about individual health treatment and milk production, they memorize themselves.

For conclusion, the small dairy farmers in Kuntarawichai lacked knowledge, and do not pay any attention to semen selection based on estimated breeding value. The farmers rarely cull the cows even when they have not concieved for a long time. Therefore, the dairy extension or livestock officials should provide knowledge on genetic selection and the importance of data recording for improving efficiency in dairy genetic development.

Table 1. Table captions should be placed above the table.

percent

Choice the semen	
farmer	13.33
Livestock official	86.67
total	100
The insemination	
Livestock official	83.33
farmer	16.67
total	100
EBV knowledge (EBV)	
Understand	26.67
Not understand	73.33
total	100
Culling reason	
Reproductive problem	93.33
Mastitis	26.67
Milk production	90.00
age	96.67
Calving problem	3.33
behavior	13.33
Disorder	10.00

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Development of the *Centella asiatica* Crude Extracts Using DMSO, Tween 20, Propylene Glycol and Tween 80 as Solvent Solutions for Creating Teat Dips

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Introduction

Mastitis is a costly disease in dairy farm. The losses resulting from the disease include reduced milk production, decreased milk quality, discarded abnormal milk and milk from cows treated with antibiotic, increased drug cost and veterinary service (DeGraves and Fetrow, 1993). The disease is predominantly caused by bacteria and induced inflammation of the mammary gland. The most common bacteria causative agents are *Staphylococcus aureus*, *Streptococcus agalactiae*, *Streptococcus bovis*, *Streptococcus uberis*, *Escherichia coli*, *Klebsiella pneumonia*, *Enterococcus faecalis*, and other pathogens (Harmon, 1996). The most common treatment of intramammary infusion is with antibiotic but it is considered not a good one because it leads to bacteria resistance and leaves antibiotic residues in marketed milk. Therefore, a good replacement is *Centella asiatica* crude extracts which consists of asiatic acid, madecassic acid and asiaticoside that can inhibit and kill *S. aureus* (Wijeweera *et al.*, 2006). The aim of this study is to develop the *Centella asiatica* crude extracts using DMSO, Tween 20, Tween 80 and Propylene glycol as solvent solutions for creating a teat dip and to test the antibacterial activity of the crude extract solution against mastitis pathogen.

Materials and Methods

C. asiatica was extracted with 95% ethanol. Then, the mixture of DMSO with Tween 20, Tween 80 and Propylene glycol, respectively were used as solvents. The crude extracts solution in group 1 was a mixture of DMSO and Tween 20 (7:3), group 2 was a mixture of DMSO and Tween 80 (4:1) and the last group was a mixture of DMSO, propylene glycol and Tween 20 (3:2:5).

Disc diffusion test was performed using sterile 6 mm-diameter discs. The disc diffusion test was determined by measuring the diameter of the inhibition zone. Experiments were performed in triplicate and the mean of the diameters of the inhibition zones was calculated.

The MIC value was determined using sterile 96 well microtiterplates with resazurin indicator. The MBC was evaluated by touching the loop from each well of MIC plate and streaking it on Blood agar (BA).

Results and Discussion

The antibacterial activity of crude extracts against mastitis pathogens are presented in Table 1. A mixture solution of group 1 has inhibited the mastitis pathogens more than group 2 and group 3, but propylene glycol can inhibit the pathogens. The MIC/MBC values are presented in Table 2. A mixture solutions of group 1 are 15.63-31.25 mg/ml and 62.50-125mg/ml, respectively. It has the capacity to inhibit and kill the mastitis pathogen more than group 2 and group 3. The propylene glycol in group 3 can inhibit the pathogen. Therefore, it cannot be used as mix solution with the crude extract.

Table 1. Antibacterial activity, measured as inhibition zone of the crude extract solution against mastitis pathogens

Mastitis pathogens	DMSO + Tween 20 (mg/disc)			DMSO + Tween 80 (mg/disc)			DMSO + Tween 20 + Propylene glycol (mg/disc)		
	8	16	20	8	16	20	8	16	20
<i>E. coli</i>	7.16	8.61	9.85	6.24	7.39	7.31	7.96	10.30	11.62
<i>En. faecalis</i>	7.18	8.11	9.05	6.38	7.00	7.50	9.68	12.27	12.10
<i>St. agalactiae</i>	7.38	8.22	9.95	6.31	7.08	7.13	9.58	10.34	12.14
<i>S. aureus</i>	7.56	8.67	9.85	6.45	7.48	7.38	11.67	12.47	13.35
<i>St. bovis</i>	7.35	8.31	9.81	6.32	7.32	7.27	9.53	9.93	11.45
<i>St. uberis</i>	7.30	8.69	9.82	6.65	7.28	7.57	10.40	10.89	11.95

Table 2. The MIC/MBC values of the crude extract solution against mastitis pathogens

Mastitis pathogens	DMSO + Tween 20 (mg/ml)		DMSO + Tween 80 (mg/ml)		DMSO + Tween 20 + Propylene glycol (mg/ml)	
	MIC	MBC	MIC	MBC	MIC	MBC
<i>E. coli</i>	15.63	62.50	31.25	125.00	31.25	125.00
<i>En. faecalis</i>	31.25	125.00	31.25	62.50	15.63	62.50
<i>St. agalactiae</i>	31.25	125.00	125.00	62.50	15.63	125.00
<i>S. aureus</i>	31.25	62.50	31.25	62.50	15.63	62.50
<i>St. bovis</i>	15.63	62.50	15.63	62.50	15.63	62.50
<i>St. uberis</i>	31.25	62.50	31.25	62.50	15.63	125.00

Conclusion

Crude extracts of *Centella asiatica* were developed to create teat dip solutions to decrease intramammary infection in cow's udder especially Mastitis. The crude extracts solution with DMSO and Tween 20 had average inhibition zones ranged from 7.16-9.95 mm in diameter and it had an MIC/MBC value of 15.63-31.25 and 62.5-125 mg/ml, respectively. It inhibited mastitis pathogen more than the solution with DMSO and Tween 80 and the solution with DMSO, propylene glycol and Tween 20. The propylene glycol has inhibited pathogen therefore it cannot be used for the solvent solution.

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Microbial Contamination in Beef, Water and Equipments in Backyard Slaughterhouse in Chumphon Province

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Introduction

The slaughtering process is important to assure meat quality. In Chumphon Province, meat was supplied from backyard slaughterhouse. The consumption of food with contaminated foodborne pathogens is one of the major causes of diarrheal diseases in Thailand. The bacterial pathogens that account for much of these cases include *Salmonella spp.*, *Listeria monocytogenes*, *Staphylococcus aureus* and *Escherichia coli* (Minami et. al., 2010). The microbiological contamination of carcasses occurs mainly during meat processing and manipulation, such as skinning, evisceration, storage and distribution at slaughterhouses and retail establishments (Gill, 1998; Abdalla et. al., 2009). The objective of this study was to investigate the microbiological picture of beef, water and equipments in backyard slaughterhouse in Chumphon Province.

Materials and Methods

Samples of sirloin beef and water used in processing were sampled. In addition, swap sampling of knives, floor, equipments and workers hands were also collected from four backyard slaughterhouses in Mab – Ammarit, Pathiu, Laung Saun and Muang Chumphon Districts during the period December 2011 – January 2012. The exercises were conducted four times. Samples were evaluated for aerobic plate count (APC), coliforms count (CC), *Escherichia colicount* (ECC) and *Salmonella spp.* by AOAC methods (2000).

Results and Discussions

The APC, CC and ECC of beef samples ranged from log 0.63 – 0.86, log 0.15 – 0.89 and log 0.15 – 1.20, respectively. National Bureau of Agricultural Commodity and Food Standard (ACFS) recommended limits of total bacteria count and CC in beef are no exceeding log 5.7 cfu/g, log 3.69 or 5×10^3 MPN /g. However, the level of APC, CC and ECC contamination on beef obtained from the backyard slaughterhouses displayed under the recommended limit of ACFS 6001-2004. It was discovered that *Salmonella spp.* contaminated about 25% (4/16) of the samples. ACFS recommended limit of *Salmonella spp.* in beef was not detected.

The APC from water used in processing and swap sampling of floor, knives, equipments and worker hands were log 0.56 - 2.31, 1.23 – 5.85, 2.04 – 7.15, 2.12 – 7.28, 1.11 – 4.00, CC were log 0.45 - 1.00, 0.45 – 1.77, 0.31 – 1.31, 0.56 – 2.24 and 0.24 – 1.14 and ECC were 0.34 – 0.72, 0.48 – 2.28, 0.29 – 1.84, 0.57 – 3.14 and 0.30 – 1.89, respectively. Microbiological contamination could be due to various aspects that include environmental conditions of the slaughterhouse, as well as animal and farm management factors (Inthavong et al., 2006).

Table 1 Mean of APC, CC and ECC from beef, water in process, swap sampling of floor, knives, equipments and workers hands in backyard slaughterhouse

Sample	APC (log cfu/g)	CC (log MPN/ml)	ECC (log MPN/ml)

	A	B	C	D	A	B	C	D	A	B	C	D
Beef	0.82	0.63	0.86	0.67	0.56	0.70	0.15	0.89	0.37	0.64	0.15	1.20
Water	0.56	1.91	1.36	2.31	0.48	0.53	0.45	1.00	0.34	0.72	0.34	0.53
Floor	1.23	5.85	2.61	5.27	0.49	1.40	0.45	1.77	0.48	1.25	0.56	2.28
Knives	2.04	7.15	3.43	5.44	0.31	1.31	0.55	1.22	0.29	0.66	0.53	1.84
Equipment	2.12	7.26	3.49	7.28	0.56	1.34	0.57	2.24	0.64	1.66	0.57	3.14
Worker hand	1.11	3.45	1.81	4.00	0.24	0.70	0.51	1.14	0.31	0.30	0.34	1.89

Note: A = Mab Ammarit, B = Pathiu, C = Muang Chumphon, D = Laung Suan Districts

Conclusion

The results obtained indicated that microbiological contaminations of beef carcasses during the slaughter process in the four abattoirs Chumphon Province were low. The carcasses were contaminated with *Salmonella spp.*, which is considered a risk to human health. Microbiological contamination could be due to various aspects that included environmental slaughterhouse conditions as well as beef cattle and farm management factors.

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The Growth of Indonesian Local Sheep in Rural Production Systems

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Summary

Eighteen male 0-12 months old local sheep was used in this study for determining the growth performance of Indonesian local sheep in rural are, namely growth rate, body weight and age at reaching puberty and maturity. Regression-correlation analysis was used to obtain the growth curve. The results showed that dry matter intake of the local sheep in rural area was limited, and only giving the daily body weight gain of 57.86 g. The growth curve of local sheep showed the puberty was reached at age of 6 m.o. or at body weight of 17.70 kg, while maturity was reached at 12 m.o. or at BW 31 kg.

Keyword: local sheep, growth curve, rural

Introduction

Sheep is one of dominant meat animals in rural area in Indonesia. Developing this animal for providing farmer the maximum benefit should be based on the actual performance of growth of this sheep in rural area. Many studies to improve the sheep performance were done by feeding manipulation, but the study on the basic data of the growth performance was very limited. This study was aimed to determine the growth curve of local sheep on rural rearing condition. The benefits of this growth curve are able for standardizing sheep performance, for selection and breeding.

Materials and Methods

The study was used 18 male local sheep, aged 0-12 months obtained from Pagergunung village, subdistrict Pringsurat, district Temanggung, Indonesia. The sheep were weighed on a body weight hanging scale, while the age was based on recording or farmer information and teeth condition. These data were analyzed with regression-correlation analysis for determine growth curve based on the knowledge of growth.

Results and Discussion

Indonesian local sheep is believed to be descendants from crosses of Java thin tailed and fat tailed sheep. They were characterized with white coat color, or some with black spotted, and in the top of tail deposited some little fat, and then getting smaller in the tips of tail. In the study area, the purpose of raising sheep originally for obtaining much fertilizer needed for their horticultural farms, but later it was shown to produce meat.

Sheep production systems in Rural

Sheep production systems in rural have been integrated with crop production and farming systems. They are especially dependent on the agro-ecological environment and because of the ruminant digestive systems, must always depend on hight fibre vegetation or crop residu for their feed base. Feed was given twice a day consisting of forage and concentrates. Forage given was dependent on the nature and extent of the crop residues produced, while the concentrate feeding was consisted of rice bran, cassava, and by product of coffee industry.

Based on the amount of feed given, it can be calculated that the average of dry matter intake (DMI) of male local sheep at 20 kg body weight (BW) was 970.8 g, crude protein (CP) 121.0

g, respectively. These were below the Nutrients Requirements standard of Ranjhan (1981) for ram at 20 kg BW receiving 1000 g DM, 127 g CP and 560 g total digestible Nutrients (TDN) may give 130 g ADG. The high NDF and ADF were relatively high, being 56.79 and 38.30%, respectively, indicated that the utilization of feed by animal was not high.

Sheep Growth Curve

The growth curve and growth rate of the local sheep are presented in Figure 1. Owens et al. (1993) stated that the growth curve (mass or cumulative weight plotted against age) is sigmoid, consisting of a pre-pubertal accelerating phase plus a post-pubertal decelerating phase. Based on this curve, birth weight of local sheep was calculated about 3 kg, maturity was reached at age of 12 months and body weight at around 31 kg. The puberty as indicated by turning point of the growth curve (Owens et al., 1993) was occurred at the age of 6 months and body weight about 17.70 kg. Average daily gain (ADG) of local sheep in the rural production systems was 57.86 g with the highest ADG (87.50 g) was achieved at the age of 6 months.

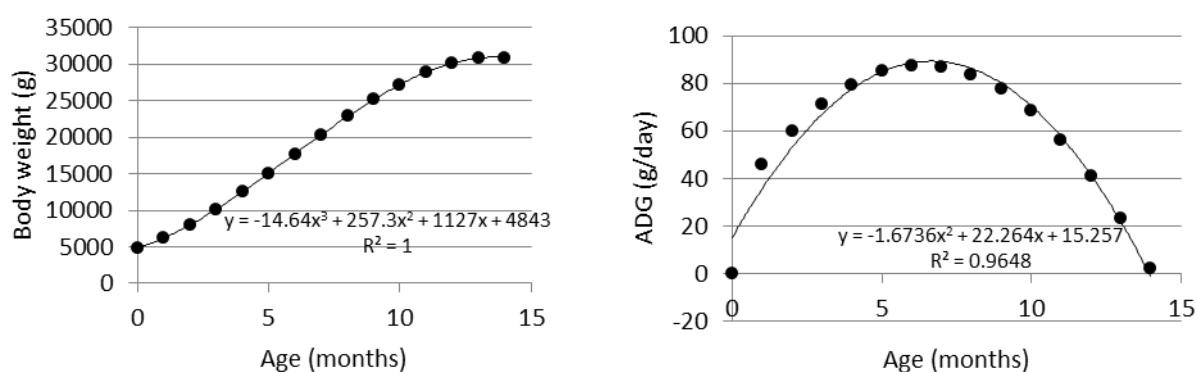


Figure 1. The curve and equation prediction for growth (left) and growth rate (right) of local sheep in rural production systems.

These results lead to the some recommendations for better production management, such as separation of male and female of sheep should be done before the age of 6 months, fattening lambs should be started from age 6 months and slaughtered at age of 12 months. The growth curve showed that at age of 12 months the body weight sheep is keep steady or even start to fall.

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Relationship between live weight and carcass weight in Indonesian local sheep

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Summary

This study was aimed to determine the correlation between the live weight and carcass weight in Indonesian local sheep. This study was used the data of live weight or slaughter weight and carcass weight of eighty sheep collected from eight feeding experimental studies on carcass quality. The results showed that the live weight averaged at 20.04 kg resulted in carcass weight of 8.18 kg, or equal to 40.82%. The correlation of live weight and carcass weight was found linear and strong as shown by high r value, being 0.94.

Keywords: slaughter weight, carcass weight, correlation, sheep

Introduction

Carcass weight is one of production parameters in meat animals. Many producers prefer larger carcasses because it will give the larger income; however, some factors are influenced the carcass size such as animal conditions (breed, weight and age), nutrition and management put to the animal prior the animals were slaughtered. Ely et al. (1979) slaughtered early-weaned lambs at 41 or 50 kg, and reported a 4% increase in dressing percents for the heavier slaughter weight lambs. The broad use of optimal slaughter weights will be common to the industry when the economic value of a carcass is related to yield grade and increased value is passed on to the producer and lamb feeder (Snowder et al., 1994). Also, Breed characterization for producing carcass also must be clearly understood before lamb producers can optimize approaches to lamb production. The purpose of this study was to determine the correlation between the live weight and carcass weight in Indonesian local sheep in order to know the live weight range of sheep that produce the maximum carcass weight.

Materials and Methods

This study used slaughtered data of eighty local male sheep at age range of 1-1.5 y.o., collected from eight feeding experimental studies. These studies mostly were done in 3 months feeding treatments after 1 month adaptation period. The feeding was set to provide enough dry matter intake (4% of live weight) and at least 12% crude protein. The data used were live weight or slaughter weight, and carcass weight. The live weight or slaughter weight was obtained by weighing sheep after 24 h fasting prior to be slaughtered. Carcass weight was obtained from sheep after being slaughtered, bled, skinned, disemboweled, and separated the head, removed the four lower legs and tail, and was then 12 h withered. The percentage of carcass weight to slaughter weight was also measured. Data were analyzed using correlation and regression analysis. The strength of relationship was determined based on the correlation value (r) between the two variables as follows: 0 to 0.199 (very weak); 0.20 to 0.399 (weak); 0.40 to 0.599 (medium); 0.60 to 0.799 (strong) and 0.80 to 1.0 (very strong).

Results and Discussion

Data used in this study was ranged at 12.5 - 32.0 kg of body weight, while the carcass weight was ranged at 4.06 – 14.97 kg. Figure 1., showed the correlation between slaughter weight and carcass weight of local sheep was the value found high, being 0.94. This was in agreement with the statement of Berg and Butterfield (1976) that the carcass weight is affected by the slaughter weight. If the data of carcass was calculated in percentage to the slaughter weight, the sheep slaughtered at 12.5 - 32 kg live weight resulting in carcass percentages ranged at 29.42 - 51.28%.

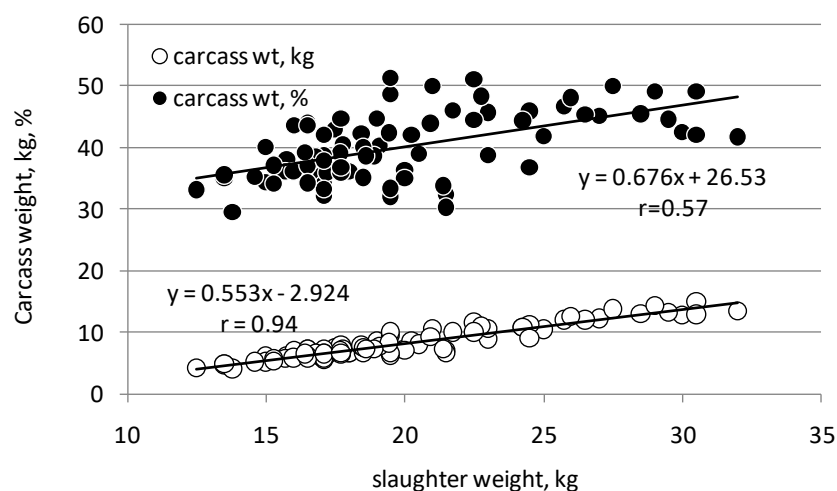


Figure 1. Correlation between slaughter weight and carcass weight and its percentage

The relationship between slaughter weights to the carcass percentage was found moderate correlation, being 0.57 indicated a greater carcass percentage will be obtained by higher slaughter weight. The percentage of carcass in Indonesian local sheep was found low if compared to other breeds, such as Targhee × Hampshire crossed lambs slaughtered at 52 - 77 kg live weight which found ranged at 52.7 – 59.0% (Borton et al., 2005), as well as to Rambouillet, Targhee, Columbia and Polyplay lambs (Snowder et al., 1994) slaughtered at 52.3 – 53.9 kg live weight were 50.4, 50.1, 49.3 and 51.5%, respectively.

The implication of this result for production management was the Indonesian local sheep should be slaughtered at higher live weight to produce higher carcass production. Moreover, the better breeding program to develop the bigger size crossbred lamb based on local sheep should be considered.

Sustainability Beef Cattle Development for Beef Supply in Central Java, Indonesia

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Summary

The study aims were to identify farm potency to support the production sustainability and technology adoption and to support the beef self sufficiency program in Central Java. The regencies were Blora, Sragen and Wonogiri. Farmers was chosen by purposive sampling is based on scale of ownership minimal 2 animal unit (AU). 50 (fifty) farmers on every regency was chosen. So Total of 150 beef cattle farmer was chosen as respondents. Beef cattle were owned by farmers were 2.48-3.62 AU. Usually farmers raise their cattle by small scale. Farmers with high number cattle own have adoption technology tend to decrease. The result showed production pattern positively influence technology level.

Keywords: development, sustainable, beef supply, beef cattle,

Introduction

Livestock development especially to develop beef cattle in Indonesia should be done through sustainability, modern and professional efforts. Utilization of technology innovation to enhance the efficiency business is needed. Constraint to develop beef cattle especially local strain is low productivity. Reproduction disorder usually is occurred in local beef cattle due to estrus delay (Yusuf et al., 2012). Longer time of estrus cycle after birth limits reproduction efficiency in tropical area (Montiel and Ahuja, 2005). Service per conception is high (Ilham, 2006), low quality of mating management (Winugroho, 2002) and low ability of farmer to adopt the technology (Roesali et al., 2009). Effort to increase the beef cattle productivity is conducted through policies which apply to the beef cattle farmers. There were five factors which should be applied to obtain the self sufficiency program 1) depress the mortality, 2) prevent the female productive cow, 3) delay the slaughter time follow the genetic potency, 4) conduct the artificial insemination, and 5) increase the genetic quality and improve the business efficiency. The objective of the study were to identify farm potency to support the production sustainability and technology adoption and to support the beef self sufficiency program in Central Java.

Materials and Methods

Survey method was used in the study. Beef cattle farmers location were chosen as purposive in 3 (three) regency in Central Java is based on Location Quotient (LQ) > 1, the regencies were Blora, Sragen and Wonogiri. Farmers was chosen by purposive sampling is based on scale of ownership minimal 2 animal unit (AU). 50 (fifty) farmers on every regency was chosen. So Total of 150 beef cattle farmer was chosen as respondents. Descriptive analysis was used to identify the farm potency and logit analysis was used to determine the technology adoption.

Results and Discussion

Result of the study showed farm potency was based on land power supporting which was chosen on location quotient (L/Q) was good. All of regencies have (L/Q) >1. Land width was 0.52 ha on average and can support cattle feed. Number of cattle raised by farmers was 2.99 AU. Farmers profile is shown in Table 1. Implementing of Integration of plant-cattle program by government is one of policy which is socializing to the beef cattle farmers. Most of Beef cattle farmers have the knowledge on feed processing such as rice straw fermentation (61.33%). From the amount 32.61% farmers can produce for their own cattle and 16.67% of farmers can produce rice straw fermentation for cattle owned by group. Barrier and constraint to apply rice straw fermentation was time is allocated to prepare the material and labor.

Table 1. Farmers Profile in three regencies

Item	Wonogiri	Sragen	Blora
L/Q	1.8	1.9	1.7
Land width (Ha)	0.62	0.54	0.40
Number of cattle (AU)	3.62	2.86	2.48
Age (year)	41.02	44.10	45.22
Education (year)	6.74	7.34	6.55
Experience (year)	16.17	11.1	12
Number of Family (persons)	3.66	2.5	2.9
Beef cattle contribution (%)	41.24	37.85	36.58

Adoption technology of feed significantly was affected by education, experience, number of cattle. However land width and LQ not significantly influence the adoption technology. Model was fit because chi square on (0.000) significance level and level of prediction was 63.33%. Education level was relatively high ($\beta=-1.52$ sig. 0.096) and experience was relatively long ($\beta=-0.69$ sig. 0.091). Adoption technology of feed was decreased. Finding the result showed the increasing number of cattle owned by farmers ($\beta=-0.77$ sig. 0.0345) would decreased the adoption technology level even production pattern positively influence to the adoption technology level. Beef cattle were owned by farmers were 2.48-3.62 AU. Usually farmers raise their cattle by small scale. Farmers with high number cattle own have adoption technology tend to decrease. The result showed production pattern positively influence adoption technology level.

Duck Farmer Perception on Raising Pattern in Brebes Regency, Central Java, Indonesia

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Introduction

Brebes regency in Central Java Province is center of duck development which have the highest population of duck and also is recognized as salted egg production. The duck development in this regency is supported by agroecosystem of Brebes area. Duck population in 2011 was 568,370 birds and the labour were 2,273 persons (Animal Husbandry and Animal Health Office, Central Java, 2011). Duck is an important commodity in Brebes Regency. Duck raising is very common conducted by the farmers to generate additional income for livelihood of farmers. Traditionally, duck farmers raise duck in paddy field so duck can eat from the paddy by product. The traditional raising pattern is now decreasing due to many of paddy field have been converted to estate and industrial plant. Semi intensive pattern develop because the decreasing of paddy field and the increasing of pesticide in paddy cultivate. The study was investigated the duck raising pattern was choosed by farmers in Brebes Regency.

Results and Discussion

Duck Raising Pattern

Rice field scarcity and trend of increasing the pesticide utilization on paddy, hence attract farmers to move to intensive raising pattern. Okabe et al. (2003) stated that duck raising in the paddy fields would cause the decreasing of land nitrogen and palatability of rice will be low.

Farmers feel that intensive raising pattern would cause the feed cost increase. Feed cost contribute the highest number in production cost so funding availability to feed duck everyday is needed to support the sustainability of duck raising. Hendayana (1991) stated that intensive pattern tend to reduce the feed availability and reduce productivity then would appear the disease. Up to present still many farmers raise duck through semi-intensive pattern although the ability to raise duck in the field just only 300 heads per farmers.

Farmers perception of duck raising pattern was chosen

Based on deep interview with Nurudin (Head of “Bebek Umbaran” duck farmers group in Negarayu Village, Tonjong Subdistrick, Brebes Regency, he stated that with intensive pattern usually duck can run and get the feed from the paddy by product, water plant, and fish will be disappear. But the semi intensive pattern would produce egg with egg yolk more sharper yellow hence would entail the egg price compared with egg produced by intensive pattern. The duck raise by semi intensive pattern can more resistant to disease and can minimize the feed cost.

The result showed, in 2012, the mortality of duck caused by avian influenza of duck raised by intensive pattern is higher than duck raised by semi intensive pattern. Almost 70% of duck raised by intensive pattern was died. Duck was raised in paddy field could fed fish, water plant, and paddy by product. The condition could increase the antibody of duck.

Duck is raise in the paddy field will feel secure, safe, not easy to become stress because of human and new view and condition (Haque et al., 2005). Rochfort et al. (2008) stated that forage contain saponine. Saponine is very useful for antiviral, increase the immune system, increase the daily gain and increase the Feed conversion ratio (FCR) efficiency. The

increasing of forage on duck raising could reduce the rice bran utilization. Based on study of Sumekar (2012) found that utilization of forage like water hyacinth could improve the duck performance. The regression coefficient has positive sign and significant ($P < 0.01$), therefore incorporate forage in the duck feed will increase the production.

Conclusion

Duck raise in the paddy field and duck raise in semi intensive patterns would produce egg with egg yolk more sharper. Duck will more resistant to avian influenza disease and will minimize the feed cost.

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Poster 61

Removed Cholesterol of Lactic Acid Bacteria Isolated from Mink

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Abstract

This study evaluated the cholesterol-lowering property of lactic acid bacteria (LAB) isolated from mink in vitro and. Two strains were investigated, *Enterococcus faecium* MDF1104 and *Lactobacillus plantarum* MDL1118. Growth curves indicated that these strains rapidly proliferated following 2 to 10 hours of incubation. Both bacteria were shown to remove cholesterol from broth natural hen yolk and skimmed milk. Both of the bacteria could remove synthetic cholesterol from MRS broth with 2% (w/v) sodium taurocholate, (93.13% and 82.22% reduction respectively). The Experimental mice total serum cholesterol was declined (0.90mmol/L) ($p<0.01$) when the combination of *L. plantarum* and *E. faecium* was used. Based on these results, mink source *L. plantarum* MDL1118, *E. faecium* MDF1104 and a combination of the two may serve as promising candidates as potential cholesterol-lowering probiotics.

Keywords: Mink source, *Enterococcus faecium*, *Lactobacillus plantarum*, Cholesterol removal

Introduction

Probiotics are considered to have potential health-promoting benefits as biotherapeutic agents. Other studies have reported that some lactic acid bacteria (LAB) could lower both total cholesterol and low-density lipoprotein (LDL) cholesterol. Interestingly, these studies have also indicated that the removal of cholesterol varies depending on the source and species of LAB used (Sirilun,2010). Mink (*Mustela vison*) are small carnivores that can tolerate up to 35% of fat in their diets. Despite high fat intake, cardiovascular and cerebrovascular disease in mink has never been reported. The aims of the present study were to investigate the effect of LABs isolated from mink on cholesterol removal both in vitro, and evaluate their probiotic properties.

Materials and Methods

Strains

The two strains used in this study *Lactobacillus plantarum* (MDL1118) and *Enterococcus faecium* (MDF1104) were isolated from the intestines of mink. Strains were serially transferred three times in broth and incubated at 37°C for 24 h.

Method

Bacterial growth was monitored by measuring the optical density (OD) value of the culture broth at 650 nm by ultraviolet-visible spectrophotometer. The method described by Rudel and Morris (1973) was used to determine the amounts of cholesterol in the spent broth and uninoculated broth. 4% fresh hen egg yolk, or 12% skimmed milk, or 0.2% sodium thioglycollate as a cholesterol source, was measured at 4, 8, 12, 16 and 24h. Freshly prepared

overnight LAB cultures were fed to mice with 0.3ml suspensions by intragastric gavage for 35days the serum total cholesterol levels were measured.

Statistical Analysis

All data were analyzed using the SAS 8.2 software, a one-way analysis of variance (ANOVA) was performed, and the differences between the means were compared using Duncan's multiple-range test.

Results and Discussion

Cholesterol removal ratio varied among strains ($p<0.05$) and ranged from 10 to 58 %. In general, *L. plantarum* assimilated more cholesterol in media containing yolk compared to *E. faecalis*, which was 58.15% for *L. plantarum* and 38.45% for *E. faecalis*. The combination of *L. plantarum* and *E. faecium* achieved the highest ($p<0.01$) skimmed milk cholesterol removal (48.95%), far more than the LAB alone. The two LABs could remove synthetic cholesterol from MRS broth with 2% (wt/v) sodium taurocholate, *E. faecium* was higher ($p<0.01$) than *L. plantarum*, i.e. 93.13% versus 82.22%. The total serum cholesterol measured was different between the mice gavaged with *L. plantarum* or *E. faecium* or the combination of the two bacteria. The amount of cholesterol was lowest ($p<0.01$) (0.90 mmol/L), when the combination of *L. plantarum* and *E. faecium* was used. *L. plantarum* or *E. faecium* were applied alone compared with the control, 1.08, 1.13 and 1.39mmol/L, respectively.

The reduction of cholesterol by different LABs from different sources has been demonstrated in humans, mice, pig and broiler chicken studies (Ooi, 2010). However, there is a lack of information on LABs isolated from mink and their ability to lower cholesterol levels. Some studies have reported that LAB can remove cholesterol *in vitro* and also lower cholesterol levels *in vivo*. This study has confirmed these previous observations. However, the study also found a significant difference in lowering cholesterol levels *in vitro*. *L. plantarum* did not match its high cholesterol lowering effect *in vivo*. *E. faecium* MDF1104 reduced more serum cholesterol than *L. plantarum* MDL1118 *in vivo*.

Conclusion

The results demonstrated a beneficial effect of *L. plantarum* MDL1118 and *E. faecium* MDF1104 strains in removing cholesterol. Based on our findings, *L. plantarum* MDL1118, *E. faecium* MDF1104 and their combination may be promising candidates for use as probiotics strain.

Dairy Cow-based Measures of Welfare on Conventional Dairy Farms in The Tunisian Sahel

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Abstract

In recent years, there has been increased focus on animal welfare in livestock production. The aim of this study was to assess the dairy cows' welfare in small farms in the Sahel of Tunisia based on several animal-based measures: body condition, cleanliness, lameness, and injuries. The indicator parameters were determined through specific methods. Fifty dairy farms were investigated and 350 cows were evaluated. Among the 350 evaluated cows, 254 (72.58%) had a BCS between 1.5 and 2 which was considered thin, 96 (27.42%) had dull hair on their back, 78 (22.28%) showed skin lesions in different body zones, 98 (28%) showed fear at the observer's approach and 35 (10%) were moderately lame. The percentage scores of 3 and 4 in body cleanliness was 17% at the level of the lower legs, 17% in the udder region and 23% in the area of the flank and upper legs. The obtained results indicated that more than 70% of the assessed cows were thin, which had a negative impact on their health and welfare. Avoidance distance ($P < 0.001$), stepping ($P < 0.001$), cleanliness ($P < 0.001$) and lameness ($P < 0.01$) were affected by farm, whereas kicking was not significantly different between farms. The main factors that affect the dairy cows' welfare were inappropriate feeding and the tied housing system. The study confirmed that animals differ in their relationship with the stockholder, performance, and health state. The welfare assessment confirmed the importance of quality housing for ensuring better performance from animals, thus also affecting their health and productivity.

Keywords: *Animal Welfare, Human-animal Relationship, Tunisian Holstein, Welfare Indicators.*

Effects of Seed Coating Methods on Seed Germination of *Medicago sativa* in Different Moisture Stress Levels and Sowing Depths

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Abstract

This research performed in order to expand different scientific dimension of seed coating in our country, as a new method and increase of quickness and percentage of budding and consequently help to increase of initial continuation of *Medicago Sativa* species in situation of dryness and different depth of planting. This plan carried out as factorial test in the form of completely coincidental pattern with three repetitions. The care of percentage of soil moisture (dryness) in three level of 9%, 14%, 21%, dried soil weight, the care of depth of planting in two levels of three times of seed thickness and planting at surface and the care of covering substance in four observes level without covering (NC), substance with organic base (OC), substance with Hydrogel base (HC), and substance with mineral base (CC) has been used, during the test the factor of Germination percentage tested and measured. The triple interaction effects of soil moisture, sowing depths and coating materials indicated that Germination percentage in all coating materials regardless of the coating type in 14% and 21% soil moisture levels and surface sowing depth was more than treatment testator without cover (NC) in 9% moisture. According to result there was no Germination in this level. In attendance sowing depth three times the diameter of seed and 21% soil moisture there was no significant difference in Germination percentage between testator and coating treatment but in testator treatment with surface field and 21% moisture was the most recent Germination in this level and It was almost constantly another treatment in three times the diameter of seed.

Key words: Seed coating, Soil moisture, Sowing depth, Germination percentage.

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Effect of Fairy shrimps in layers diet on production performance and yolk colour of egg

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Abstract

This study was designed to determine effect of supplemented fairy shrimps in laying hens diet on egg production and egg quality. A total of 120 commercial laying hens (22 week old) were used in completely randomized arrangement with fairy shrimps supplementation. Five dietary treatments included: Control (C), commercial colour (CC), fairy shrimps (FS) 0.1%, 0.3% and 0.5%. Each of the five dietary treatments was fed up to 70 days (24 birds/treatment). Live performance, egg production, egg weight and quality were determined for whole period. Dietary treatments had no effect ($P>0.05$) on live performance, egg weight, yolk weight, and egg production. Therefore, laying hens fed diets with fairy shrimp were significantly ($P<0.05$) increased yolk colour when compared to control diet.

Key words: Layers Hen, Fairy shrimps, Egg Colour, Egg Quality

Introduction

In Thailand, yolk colour is an important criterion for consumers choice of eggs. The yolk colour is important and associated with good quality of eggs. Egg yolk colour directly reflects the concentration of pigments in the diets of laying hens. It is usually measured with special colour fans covering the different levels of coloration (from pale yellow to orange and red) and reflecting the different combinations of yellow and red carotenoids in the diets. The most used is the Roche Yolk Colour Fan (RYCF) displaying a scale from 1 (pale yellow) to 15 (reddish orange), designed hereafter by RYCF (Hernandez and Blanch, 2000; Beardsworth and Hernandez, 2004.). Due to the contribution of other carotenoids brought by various feed ingredients, but also to individual variations of the canthaxanthin physiological transfer process, it appears that a given RYCF score corresponds to a wide range of canthaxanthin concentrations. Carotenoids occur in the animal kingdom, especially in insects, birds and fish, but animals depend entirely on their feed for their supply. Although animals cannot synthesise carotenoids *de novo*, some of them can however convert carotenoids into functionally active retinoids (retinol and derivatives). For planktivorous fish, the primary dietary source of carotenoids is phytoplankton, which produces these compounds by primary biosynthetic processes. Secondary sources are marine animals that have accumulated quantities of carotenoids from their consumption of phytoplankton, and which are subsequently consumed by other marine animals that are higher up on the food chain. (Gilchrist and Lee, 1972). Main

sources relevant to the food chain of wild salmonids are zooplankton, other crustaceans, and red fish oils. These natural sources provide essentially astaxanthin.

Three species of fairy shrimps in Thailand, *Streptocephalus sirindhornae* (Sanoamuang et al., 2000); *S. siamensis* (Sanoamuang and Saengphan, 2006); and *Branchinella thailandensis* (Sanoamuang et al., 2002), have been discovered. Fairy shrimps have great potential as live food organisms for a variety of aquatic animals. The cysts of fairy shrimps contain 45-50% protein and 5-6% lipids while adult fairy shrimps have higher protein and carotene contents. Their high carotenoid content also makes them ideal for colour enhancement in ornamental fish culture (Suksomnit et al., 2011). The nutritional analysis reveals that all three species of fairy shrimp in Thailand contain high protein levels, particularly essential amino acids that are needed for growth and reproduction. *Branchinella thailandensis* has the highest carotenoids content of 254.41 µg g⁻¹, followed by *S. siamensis* (211.92 µg g⁻¹) and *S. sirindhornae* (128.93 µg g⁻¹). Carotenoid content analysis shows the presence of dominant groups consisting of β-carotene, canthaxanthin, astaxanthin, and lutein (Dararat et al., 2012).

Although, fairy shrimp have been evaluated in poultry production to a limited extent, little work has been carried out to investigate the possibility and efficiency of rearing fairy shrimp for use as a feed ingredient in poultry diets, determine the growth performance, egg traits and colour of egg yolk when fed fairy shrimp to layer chickens.

Materials and Methods

The experiment was performed at the Experimental Unit of the Rajamangala University of Technology Isan Sakon Nakhon Campus and received prior approval from the Animal Protocol Review Committee of the Institution. A total of 120 hens excluded from receiving feed, 1.70±0.12 kgBW and 22 wk old commercial laying hens, were randomly allocated to 120 pens in an environmentally open room conditions throughout the experimental period (70 days).

The fairy shrimp was added directly to the feed, without changing its composition. Feed intake, and body weight gain were measured weekly during experimental period. Diets were presented in mash form and provided daily according to expected intake and hens had free access to water. Experimental diets were formulated to produce control diet (no colour diet) and control diet supplemented with three levels of fairy shrimp (0.1, 0.3 and 0.5%) and control diet supplemented with commercial colour (0.002%) and fed to layer hens in a completely randomized design.

Egg production was determined each day and was calculated on a hen day basis. Hens were given ad-libitum of feed per hen per day; unconsumed feed was measured each morning. Feed conversion ratio (FCR) was calculated as the ratio of grams of feed to grams of egg produced per hen-day. Eggs were saved whole period to measure egg weight. Egg mass was calculated as a factor of egg weight and hen-day egg production. Five eggs were randomly chosen in each replicate from the eggs laid every days whole period to determine yolk colour, yolk index, yolk weight, albumen weight, albumen index and eggshell weight. Haugh unit was calculated using the following formula: Haugh unit = 100 log HA + 7.57 - 1.7WE 0.37

Where, HA is albumen height and WE is egg weight (Doyon *et al.* 1986). Yolk colour was measured biweekly on one egg per cage (20 eggs/treatment) using a Roche color fan.

The experiment had a completely randomized design (CRD) (analysis of variance; ANOVA), All analyses were performed using the SPSS statistical package (SPSS, 1999). Results are presented as means and a pooled SE.

Table 1. The ingredients of basal diets (Control)

Ingredient	Weight (kg)
Fish meal	10.5
Cassava chip	38.8
Fine bran	17.0
Full fat soybean	5.0
Soybean oil	0.5
Soybean meal	19.3
Di-calcium phosphate	1.0
Shell meal	6.3
DL-Met	0.3
Premix	1.0
Salt	0.3
Total	100.0

Table 2. Analyzed chemical composition of experimental diets

	FS	Control	CC	FS 0.1%	FS 0.3%	FS 0.5%
DM(%)	5.61	90.32	88.97	88.91	90.08	89.24
OM(%DM)	93.58	93.98	93.80	93.35	93.58	93.56
CP(%DM)	64.53	18.59	18.84	19.06	19.16	19.38
EE(%DM)	28.34	4.48	4.50	4.67	4.59	4.58
CF(%DM)	-	3.52	3.54	3.63	3.60	3.65
Ash(%DM)	6.42	6.02	6.20	6.65	6.42	6.44
Ca(%DM)	-	3.44	3.35	3.48	3.25	3.41
P(%DM)	-	1.30	1.20	1.28	1.58	1.74
NFE(%DM)	0.71	67.39	66.92	65.99	66.23	65.95

Carotenoids (µg/kg)	38.44	-	-	-	-	-

CC = Commercial colour, FS = Fairy shrimp,

Results and Discussion

This research was to determine the effect of fairy shrimp (FS) in laying hen diets and monitor the effects of commercial sources of carotene in diets. FS contains carotenoids lower than report of Dararat et al.(2012), (38.44 vs 140.43 µg/kg). It might be that dry process was destroyed natural pigment in FS. The results of performance traits are presented in Table 2. Fairy shrimp did not affect on egg production and egg quality. Average egg weight of hen fed diet with FS0.1% was higher than hen fed other diets (P=0.043). Table 3. Effect of fairy shrimp on feed intake and egg production

	Control	CC	FS 0.1%	FS 0.3%	FS 0.5%	SE	P-value
Initial Wt.(g)	1705.4	1702.5	1700.8	1704.6	1670.8	25.0	0.842
Final Wt.(g)	2250.0	2195.4	2230.4	2252.1	2265.8	36.0	0.683
Wt. gain (g)	544.6	492.9	529.6	547.5	595.0	35.0	0.371
DMI (g)	104.2	100.2	109.9	103.2	104.5	2.2	0.053
AEW (g)	54.9ab	54.5b	56.7a	54.8ab	53.9b	0.7	0.043
FE	1.90	1.84	1.94	1.88	1.94	0.04	0.423
EP (%)	86.7	91.4	85.7	89.4	88.2	2.1	0.336

CC = Commercial colour, FS = Fairy shrimp, SE= standard error, Wt. = weight, DMI = dry matter intake, AEW = average egg weight, FE = feed per egg weight, EP = egg production, All parameters were not significant between treatment except yolk colour. Laying hens fed diet with FS was higher yolk colour than hens fed control diet (P<0.05). Yolk color become darker in hen fed FS at high level when compared to control diet. Because of FS contains natural pigments such as carotenoids, which in combination with dietary available pigments.

Table 4. Effect of fairy shrimp on egg quality.

	Control	CC	FS 0.1%	FS 0.3%	FS 0.5%	SE	P-value

YC	1.98e	13.94a	3.10d	4.18c	5.24b	0.13	0.000
YI(%)	28.7	30.6	30.0	30.6	28.1	2.99	0.965
Ywt. (g)	14.6	14.8	15.2	14.5	14.4	0.28	0.302
Albwt. (g)	31.4	32.1	33.5	32.7	31.8	0.60	0.124
AlbI(%)	7.0	6.4	6.4	6.6	6.5	0.52	0.931
ESwt (g)	6.8	6.8	6.8	6.7	6.6	0.15	0.929
HU(%)	71.2	67.6	69.2	70.1	67.7	3.29	0.925

YC = yolk colour, YI = yolk index, Ywt = yolk weight, Albwt = albumen weight, AlbI = albumen index, ESwt = egg shell weight, HU = Haugh unit

Conclusion

This experiment has been concluded that feeding laying hens diets containing fairy shrimp did not affect egg production, egg weight, feed consumption and efficiency of the hens. Fairy shrimp supplementation in laying hen diet was increase yolk colour.

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Water Resources Suitability Model by Using GIS (Case Study: Boroujerd Rangeland, Sarab Sefid)

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Abstract.

Water resources suitability is one of the most factors to sustainability utilization of natural potential by rangeland grazing suitability. To determination this factor in short time, low cost and height accuracy is most challenges of expertise and ranchers. Using suitable technique for this subject can be sustainable utilization comprising from rangeland ecosystems according to its degradation and heavy grazing. This research was conducted in Boroujerd Sarab Sefid rangeland from 1991 to 2012. Some factors such as slope, aspect and height maps provided by using satellite imagery, basic information, analog and digitized maps such as; topographic and DEM (Digital Elevation Model). Also measurements of field were conducted by excursion and interview with herders to determination of places of water resources such as permanent and temporary springs and permanent and temporary rivers too. Water resources map of area prepared by using ArcGIS9.3 software with integration of digitized information and field data. At the end determined water resources suitability by using three sub models such as quantity and quality and distance from water resources. Result show that form 16 types all of them were I and II classes of water resources suitability which have not any limitation according to quantity and quality and distance to animal husbandry and livestock. As a final conclusion this research show that using RS and GIS can useful to water resources suitability of rangeland ecosystems with height accuracy and speed and low cost if considered standards and criteria of using GIS and RS.

Keywords: Water resources, Suitability, Model, GIS, Borujerd, Rangelands

Productive traits of silkworm hybrids from selected parental lines

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The aim of silkworm breeding includes achieving superior performance in larvae egg, cocoon and raw silk production continued in various conditions. Silkworm breeding is not economic as expected because of some conditions such as their low prolificacy and poor reproductive. It is suggested that crossbreeding would improve the product performance of native silkworm lines. In order to investigate the effect of crossbreeding on the prolificacy of Iranian silkworm, four native silkworm lines (31, 32, 103, 104) were selected based on the individual cocoon weight and were crossed to produce hybrid lines 31×32 and 103×104 (with tow control and selected groups in each hybrid line). Studied traits were: cocoon number, cocoon percentage (%), double cocoon number, double cocoon percentage (%), double cocoon weight (g) and 10000 larvae cocoon weight (g). Hybrid 103×104 produced more cocoon than line 31×32 but the difference was not significant, otherwise there was a significant difference in cocoon number between control and selected groups of hybrid 103×104 (4.50 and 7.75 cocoons, respectively), it is likely indicating that selection based on the cocoon weight, had an effect on the cocoon number in this hybrid line (3.25 cocoon). It was reduced in hybrid 31×32. Both hybrid groups had similar cocoon percentage but the double cocoon percentage increased in hybrid 103×104 (1.64 %). The average double cocoon percentage were 3.74 and 2.10 % in selected and control groups of hybrid 103×104, respectively. Double cocoon weight increased in hybrid 31×32 (0.38g), furthermore 10000 larvae cocoon weight increased in both groups of hybrid 31×32 and control group of hybrid 103×104. The differences were significant. Results showed that the crossbreeding of different pure lines of native silkworm of Iran would improve productive performance of F1 hybrids and meaningfully had an effect on the economic traits. Also selection of parental pure lines in accordance with their economic traits, could result in more prolific hybrids.

Season-Dependent Shifts in the Rumen Methanogen of Tibetan Sheep Revealed with Real-Time PCR

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Summary

A real time PCR assay was developed to monitored changed of methanogen in rumens of Tibetan sheep during season shift. The dynamic of methanogen was found in agreement with result from nutrition-based experiments. The percentage of methanogen 16S rDNA to total bacteria DNA, is 0.33%, 0.32%, 0.22% and 1.44% respectively, in autumn, winter, spring and summer. There was no significant change in rumen methanogen (relative to bacteria) between winter and autumn, methanogens of summer was significant increase by 353.15%, 334.69% and 545.31% than that of winter, autumn and spring.

Introduction

Methanogens are belongs to archaeobacteria. Archaeobacteria (or archaea) forms an ancient microbial lineage, which is a third life form. They are an essential part of luminal intestinal microbial ecosystems, where they respire hydrogen to produce methane. This microbiota is highly responsive to changes in diet, age, antibiotic use, and the health of the host animal and varies according to geographical location, season, and feeding regimen. Different seasons, due to the diet and inhabiting environment variation, could harbor a distinct population of ruminant microbe. The present work aimed to get insight to the methanogen population of Tibetan sheep's rumen, and further to deduce the survival strategy of Tibetan sheep just under different season.

Materials and Methods

Experimental site

Tibetan sheep from sheep breed of Sanjiaochen, going to be sampled, were full grazing on Gangcha county of Qinghai province, China, at the height of 3 240~3 400m of sea level.

Rumen sampling

The rumen contents were sampled in the middle of winter, summer and autumn. Tibetan sheep in 2 years old were fasted for more than 18 h before slaughtered. The samples from each kind of ruminant were mixed and the containers immediately sealed and stored in liquid nitrogen.

Total DNA extraction and PCR

Total DNA was extracted by means of a modified freezing/thawing protocol designed for various cell types (1). Primers used were 5'-TTC GGT GGA TCD CAR AGR GC-3' (sense primer) and 5'-GBA RGT CGW AWC CGT AGA ATC C-3' (antisense primer), which were

supplied by International Atomic Energy Agency. The fragment lengths of the methanogen PCR products including the 40-bp long GC clamp were 200 bp.

The quantification of bacteria DNA in total rumen DNA with a pair of prokaryotic universal and specific methanogen population primers were performed with a Cyclar IQ Multicolor Real-Time PCR Detection system (BIO-RAD, USA). SYBR Green Real-time PCR Master Mix (TOYOBO CO., LTD. OSAKA JAPAN) was used for PCR amplification.

Data analysis

The efficiency of real-time PCR was calculated by $10E^{-1/\text{slope}}$ of the standard curve). Quantification of methanogens genome copy numbers was done using the LightCycler® software version 3.1. The relative quantitation of methanogen was calculated by the formula, $2^{-\Delta\Delta CT}$ to achieve the same result for relative quantitation which is a proportion of methanogens to bacteria in rumen.

Results and Discussion

The quantification of rumen bacteria during the diet switch was done with a Light Cycler system. Quantitative methanogen relative to total bacteria in rumen was used to compare the methanogen relative change with season switch. In autumn, winter and summer, methanogen relative to total bacteria is 0.33%, 0.32%, 1.44%, respectively. There was no significant change in rumen (relative to bacteria) between winter and autumn, and methanogen of spring decreased 29.78% and 32.64% of autumn and winter, methanogen of summer was significant change higher 353.15% and 334.69% than that of winter and autumn.

From table 1, we could find that grass crude protein and NDF in summer were higher than that of other seasons, animal feed intake was higher also. During autumn and winter, however, animal nitrogen intake decreased. We found that methanogen decreased at the same time. It was probably due to the deficiencies in nitrogen limited the fibre-degrading microbes and reduced H_2 concentration. During winter and autumn, cold stress in animals often increases voluntary feed intake and rumen turnover rate, but deficiencies forage in these time. For grazing ruminants, this has been suggested to increase the P/E ratio in the nutrients available for maintenance or production to improved pasture to achieve increased livestock output while reducing methane and net carbon emissions.

Table 1. Nutrient component of herbage during spring winter, summer and autumn

Season	DM (%)	CP (%)	NDF (%)	ADF (%)	methanogen as a percenatge of total bacteria (%)
Summer	94.02	11.06	39.27	30.78	1.44
Autumn	94.36	8.91	44.94	31.66	0.32
Winter	94.62	6.30	47.50	33.40	0.33

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