Effect of Turmeric Powder Supplementation to The Age of Sexual Maturity, Physical, and Chemical Quality of The First Japanese Quail's (Coturnix japonica) Egg

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Effect of Turmeric Powder Supplementation to The Age of Sexual Maturity, Physical, and Chemical Quality of The First Japanese Quail's (*Coturnix japonica*) Egg

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Abstract

The experiment was conducted to determine the effect of turmeric powder supplementation to the age of sexual maturity, physical, and chemical quality of the first Japanese quail's (*Coturnix japonica*) egg. Forty five quails were assigned into a completely randomized design with three treatments (levels of turmeric powder, i.e., 0; 54; and 108 mg/quail/day) and each treatment used 15 quails. Turmeric powder supplementation was conducted before sexual maturity. Feed and drinking water provided ad libitum. Observed egg is an egg that was first produced. Parameters measured were the age of sexual maturity, feed intake, body weight, physical qualities which include: weight of egg, long axis, short axis, weight and thickness of shell, yolk index, Haugh unit, egg shell index. Whereas the observed chemical quality were cholesterol, HDL, LDL, protein, vitamin B12, vitamin A in eggs and egg shell calcium levels. The results showed that administration of turmeric powder can accelerate the age of maturity, increasing the levels of protein, HDL, vitamin A and B12 in eggs, decreasing the cholesterol and LDL content in eggs, but did not affect feed intake, physical quality of eggs and egg shell calcium levels. Based on the results of this study, it can be concluded that supplementation of turmeric powder improve the chemical quality of Japanese quail eggs (*Coturnix japonica*), so it is good for the development of quail embryos as well as for consumption.

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INTRODUCTION

Quails are useful as a source of animal protein either from eggs or meat. Productivity and quality of quail eggs are associated with their physiological conditions, especially during the initial period of growth. Productivity of quail could be known from their reproductivity performances (Isnaeni *et al.* 2010). Turmeric powder supplementation can improve physiological condition of quail. Turmeric powders can improve liver function by lowering levels of Serum Glutamic Pyruvic Transaminase (SGPT) and Serum Glutamic Oxaloacetic Transaminase (SGOT) in the blood. Turmeric powders also increase the productivity of eggs (Saraswati *et al.*, 2013a). Eggs protect and provide a complete diet for development of embryo and serves as a major source of food for the first few days of a child of quail life. Quail eggs are also good to consume. Indonesian population of about 220 million people requires availability of high-quality food nutrition from animals. Eggs perform several biological functions, including antimicrobial activity, immunomodulators and antioxidants beneficial to health (Kovacs *et al*. 2005). The high rate of egg production makes the Japanese quail is more popular as a source of meat and eggs (Kumari, 2007). Japanese quails (*Coturnix japonica*) are important for laboratory animals, because their maintainance is easy, early sexual maturity. According to nutritionists, the role of eggs as food is very important for healthcare. Quail egg contains the nutritional value of 3 or 4 times more than that of chicken eggs, quail protein content is about 13%, whereas for chicken's eggs it is only 11%. Quail eggs are also very rich in calcium, potassium, iron and phosphorus. As a source of iron, vitamin A and B12, quail eggs are useful for preventing anemia (Brown 2013). Quail eggs help increase hemoglobin levels and help to prevent anemia (Tungsarinkarn *et al*. 2013). Quail eggs do not cause allergies because they contain abundant protein ovomucoid. This protein is often used for anti-allergy drugs and has proven to be very effective in helping reduce the effects of allergies (Takashi *et al*. 1999). Quail eggs are also very good to cure some serious diseases and medical conditions, such as gastrointestinal disorders. In eggs, most of cholesterol and its esters are found on the yolk. Concerns to eat quail egg are due to their high cholesterol content that can lead to liver disease. The research result by Aziz *et al.* (2012) cholesterol of quail eggs is higher than that of cholesterol content in eggs of chicken and duck, cholesterol level in yolk of quail is 16.05 mg/g yolk, whereas in chickens and ducks are 7.65 mg/g and 10.36 mg/g.

Egg quality is a reflection of the physical and chemical state of the egg. Nutrition can affect egg characteristics, such as size and proportions of the main content of the yolk and albumin (Watson 2002). Characteristics of egg quality including egg weight, shell quality, characteristics of the egg yolks and egg whites, chemical composition of eggs need to be improved. One of the ingredients that can improve the quality of the eggs is turmeric powders. The results showed that supplementation of turmeric powder to the quail can improve the reproductive organs and liver (Saraswati *et al.*, 2013a). Liver is an organ that plays a role in the metabolism of nutrients, and vitelogenin as the material forming the yolk. Vitelogenin increases levels in the blood. Turmeric powder also improves the productivity of eggs and extends the production time (Saraswati *et al.*, 2013a). Turmeric powder role in improving liver function is due to the content of curcumin in turmeric amounted to 7.97% and 6.79% content of phytoestrogens (Saraswati *et al.*, 2013b). Based on these conditions, research was conducted to examine the effects of supplementation of turmeric powder upon the age of sexual maturity, the physical and chemical quality of the first eggs of Japanese quail (*Coturnix japonica*).

METHODS

Research was conducted at the Laboratory of Biological Structure and Function Animal, Biology Department F.MIPA UNDIP. This study used Turmeric powder (*Curcuma longa* Linn), day-old quail (DOQ). Completely randomized design was implemented. 100 quails were acclimatized for two weeks in collective cages, then the coefficient of diversity was calculated, 45 quails were taken and acclimatized for one week in individual cages. Feeding and drinking were provided ad libitum. Quails were divided into 3 treated groups with the addition of turmeric powder in feed at a dose (0, 54 mg / quail / day, 108 mg / quail / day). Each treatment in one cage was as much as three quails with five replications of the experiment. The resulted eggs were first analyzed the physical and chemical quality. The parameters observed were age of sexual maturity, feed intake, body weight, egg weight, long axis, short axis, weight and thick shell, index yolk, Haugh unit, index eggshell, cholesterol with the method of Liebermann Burchard (Puwastien *et al.*, 2011), proteins with macro-Kjeldahl method (Puwastien *et al.*, 2011). HDL and LDL with CHOD-PAP

method (Elwakkad *et al.*, 2012), vitamin B12 and vitamin A in eggs by spectrophotometric method and egg shell calcium levels by AAS. The data was analyzed by analysis of variance with SPSS procedures and LSD test with significance level of 95% (Mattjik 2006).

RESULT AND DISCUSSION

Results of research on age sexual maturity of Japanese quail after supplementation with turmeric powder are shown in Table 1.

Table 1. Percentage of age of sexual maturity of Japanese quail (*Coturnix japonica*) after supplementation of turmeric powder.

Age of sexual maturity	P0 (%)	P1(%)	P2(%)
42 days			75
43 days		40	12.5
44 days	42.86	40	12.5
45 days	57.14	20	

Note: P0: Control, P1: treated with turmeric powder 54 mg / quail / day, P2: treated with turmeric powder 108 mg / quqil / day

The results showed that supplementation of turmeric powder could accelerate the age of sexual maturity. Supplementation of turmeric powder until the dose 108 mg / quail / day led to 75% quail began laying eggs at the age of 42 days, two days earlier than control where 42.86% spawn at age 44 days. While the treated eggs with turmeric powder 54 mg / quail / day, 40% of them reached sexual maturity at age 43 days. This result was similar to previous studies, age of sexual maturity of Japanese quail, not supplemented by turmeric powder occurred at the age of 45 days (Saraswati *et al.*, 2013b). Acceleration of sexual mature allegedly associated with the content of phytoestrogens in turmeric amounted to 7.97% (Saraswati *et al.*, 2013a). Phytoestrogens had estrogenic effects, so it would affect the growth of ovarian follicles hierarchy, to being immediately ovulated. Results of research on feed consumption, body weight and physical quality of Japanese quail eggs first seen in Table 2.

Supplementation of turmeric powder did not affect feed intake, which meant turmeric powder did not affect the palatability of the feed. Along with the absence of differences in feed intake, then there was no difference in body weight when sexually matured. Turmeric powder supplementation did not affect the physical quality of eggs both of exterior and interior. Exterior qual-

Table 2. Feed consumption, body weight and physical quality of quail eggs that were produced first time after treatment with turmeric powder supplements on Japanese quail (*Coturnix japonica*)

Parameter	P0	P1	P2
Feed consumption (g)	20.31±3.17	19.93±2.19	19.32±2.44
Body weight when sexually mature (g)	151.33±21.66	146±19.07	150±11.76
Weight of egg (g	8.79±0.59	8.69±0.39	9.02±1.51
Long Axis (cm)	2.87±0.28	2.86±0.13	2.98±0.29
Short Axis (cm)	2.32±0.13	2.31±0.09	2.35±0.69
Weight of shell (g)	1.18±0.16	1.22±0.09	1.35±0.26
Shell thickness (mm)	0.54±0.02	0.42±0.01	0.56±0.01
Diameter of yolk (cm)	2.15±0.17	2.17±0.15	2.01±0.35
Height of yolk (mm)	10.38±0.09	11.63±012	9.65±0.33
Height of white egg (mm)	4.91±0.25	6.15±0.13	6.06±0.14
Weight of yolk (g)	2.38±0.31	2.34±0.24	2.51±0.52
Weight of white egg (g)	4.31±0.36	4.01±0.52	4.33±0.81
Index of yolk	0.48±0.05	0.54±0.08	0.51±0.06
Haugh Unit	62.83±2.3	64.72±1.4	63.89±2.3
Index of egg's shell	6.36±0.76	6.8±0.69	7.15±0.89

Note: P0: Control; P1: Quail supplemented with turmeric powder 54 mg / quail / day; P2: Quail supplemented with 108 mg / quail / day

ity of eggs were long axis, short axis, weight of shell, thickness of shell. While the quality of the interior were the diameter of the yolk, height of yolk, height of white egg, weight of yolk, weight of egg whites, index of yolk, Haugh Unit, Index of eggshell. This feature was supported by morphological images of egg which produced at the first time (Figure 1). In accordance to the results of research Genchev (2012), egg shell on the first egg was still thin and weight of eggs began to stabilize in the third month of production.

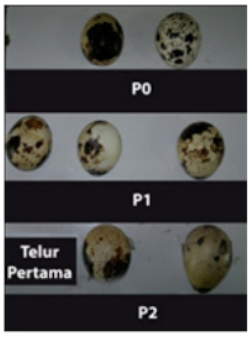

Figure 1. The first produced eggs. P0: Control, P1: treated with turmeric powder 54 mg / quail/ day; today, P2: treated with turmeric powder 108 mg / quail / day

The physical quality of eggs was still in the good range. The egg shape was normal. Overall egg quality was determined by the quality of the contents of the egg and egg shell quality. The quality of the egg contents could be categorized either because there were no traces of blood or other patches, the condition of the white egg was thick and heavy, and yellow egg was not pale. Physical qualities factors could provide clues to the freshness of eggs. Egg Yolk index value were still in the good standard index value of Egg Yolk 0.48 – 0.51, where the average index normal egg yolk was 0.42. Based on the value of the average, value of Haugh unit (HU) was 62.83-63.89. Based on the Haugh unit according to USDA standards, was classified as A qualification (USDA 2000). Haugh unit value category A was 60-72. Haugh unit (HU) is a measure of the quality of inside of eggs derived from the relationship between the height of the white egg with the egg's weight. White egg is one of the indicators that determine the quality of an egg, related to the value of Haugh units. The higher is the portion of thick white egg; the higher is the value Haugh unit and the higher the quality. Research results on the chemical quality of the first Japanese quail eggs could be seen in Table 3.

Supplementation of turmeric powder could lower cholesterol level of eggs. Some research suggested that turmeric powder could reduce cholesterol by increasing the activity of cholesterol-7- α hydrolase or inhibit the activity of HMG CoA reductase (Malekizadeh *et al.,* 2012). Curcumin suppressed the activity of HMG-CoA via inhibition of transcription (Shin *et al.*, 2011). Curcumin stimulated the conversion of cholesterol to bilus acid, a path to eliminate the cholesterol the body (Srinivasan and Sambaiah 1991). Curcumin increased the excretion of cholesterol (Qinna *et al.*, 2012). Turmeric powder reduced levels of cholesterol and triglycerides in the blood quail (Saraswati *et al.* 2013b; Wang and Yixiao 2012). Curcumin inhibited the absorption of dietary cholesterol (Arafa 2005). Curcumin acted as an agent antiatherogenic (Kermanshahi and Riasi. 2006), cause blood cholesterol levels to decrease so that cholesterol transferred into the egg would decrease. Supplementation of turmeric powder increased follicular hierarchy (Saraswati *et al.* 2013a) so that the cholesterol formed would be distributed into developing follicular hierar-

Table 3. Chemical quality of the first produced quail eggs after treatment with turmeric powder supplements on Japanese quail (*Coturnix japonica*)

Parameter	P0	P1	P2
Cholesterol (mg/100g)	802.96±11.43^{a}	783.62±12.98^{ab}	767.77±5.38^{b}
HDL (mg/100g)	117.41±3.63^{b}	127.39±2.19^{a}	134.58±4.98^{a}
LDL (mg/100g)	145.99±6.23^{a}	133.5±3.84^{b}	132.15±3.51^{b}
Vitamin B12 (mg/100g)	1.47±0.002^{b}	1.55±004^{a}	1.61±0.05^{a}
Vitamin A(SI)	544.88±7.35^{b}	565.37±11.47^{a}	563.5±8.10^{a}
Protein (mg/100g)	15.18±0.78^{b}	17.81±0.43^{a}	17.51±0.76^{a}
Ca (%)	38.7±0.82	38.63±0.67	38.15±1.59

Note: different letters in the same column indicate significant differences between treatments. P0: Control; P1: Quail supplemented with turmeric powder 54 mg / quail / day; P2: Quail supplemented with turmeric powder 108 mg / quail / day.

chy, thereby decreasing cholesterol levels in eggs. Cholesterol and its esters were found in the yolk, where they formed an emulsion of low density lipoprotein (LDL), very low density lipoproteins (VLDL) and high density lipoprotein (HDL). HDL was called good cholesterol (Fogelman 2004).

The higher was the dose of turmeric powder were given to levels of 108 mg / quail / day increased levels of HDL and the lower was LDL levels quail eggs. Lipoprotein of egg yolk known as vitellogenin had quality and biochemistry similar to lipoprotein serum. Curcumin increased plasma HDL cholesterol and Apo AI expression in the liver (Shin *et al.*, 2011). Predominant protein in HDL is apolipoprotein A (Mark *et al.*, 1996). Supplementation of curcumin significantly increased HDL-C plasma lipoprotein (Shin *et al.*, 2011). Increased levels of HDL egg allegedly also associated with increased formation of vitelogenin. Vitelogenin was a precursor of egg yolk, in the form glikofosfolipoprotein. Vitelogenin synthesized in the liver was packaged in the form of lipoproteins released toward the surface layer of the growing oocytes. Selectively, vitellogenin would be captured by the receptor endocytosis, and occured cytoplasmic translocation forming the body of egg yolks along with the the proteolytic cleavage from vitelogenin into subunits lipoprotein yolk, lipovitelin, and fosvitin. Turmeric powder vitelogenin increased plasma levels (Saraswati *et al.* 2013a).

Turmeric powder lowered LDL level of quail eggs. Curcumin increased the LDL receptor, playing a role in the removal of LDL from the blood (Peschel *et al.*, 2007). Curcumin lowered LDL, VLDL, and total cholesterol in the liver (Chattopadhyay *et al.* 2004). Curcumin reduced the ratio of LDL / HDL (Qinna *et al.* 2012). Supplementation of 500 mg of curcumin per day for seven days significantly lowered lipid peroxidase, increased HDL cholesterol, lowered total serum cholesterol (Soni and Kuttan. 1992). Cholesterol in eggs was influenced by genetic factors, diet composition (Faitarone *et al.* 2013). Curkumin induced changes in the expression of genes involved in cholesterol homeostasis (Qinna *et al.* 2012). Curcumin acted on the stimulation of the enzyme activity of hepatic cholesterol-7α-hydroxylase. Enzymes found in liver cells would catalyze change cholesterol into bile salts. Increased activity of this enzyme showed an increased catabolism of cholesterol. 7α-hydroxylase reaction in cholesterol biosynthesis was the first step present in bile acid biosynthesis. Due to stimulation of these enzymes by curcumin then the changes in cholesterol Hepatic into bile salts were increased, consequently the levels of cholesterol in the liver was reduced. So as to meet the needs of the cholesterol the number of LDL receptors in the liver will be increased to increase taking LDL in plasma which will be accompanied by a decrease plasma cholesterol and LDL (Curcumin may also reduce levels of apolipoprotein-B, which in turn could reduce levels of LDL (Ravindran *et al.* 2007). Curcumin lowered blood cholesterol concentrations through expression induction of CYP7A1 (Kim and Kim, 2010). Curcumin lowered LDL-C and Apo B (Shin *et al.*, 2011). Apo B form complex lipoproteins with LDL-C. Lipoproteins were synthesized and released from the liver. Low levels of Apo B showed lower levels of LDL-C. Apolipoprotein B-100 was associated with atherosclerosis.

The results showed turmeric powder could increase the absorption of vitamin B12 and vitamin A. Vitamin B 12 is soluble in water, whereas vitamin A is fat-soluble. Turmeric helps release bile which is believed to aid in digestion of food. Turmeric is known to do this by stimulating gallbladder releases bile. Bile plays an important role in the digestion and absorption of fats and fat-soluble vitamins in the small intestine. Turmeric is also known to assist and promote the intestinal flora. Given a dose of 2g / kg of curcumin increased mucous colonies 1.8 mol / g (Irving, 2011), and increased the absorption in the intestine.

Supplementation of turmeric powder did not affect levels of calcium in eggshell. By previous studies, the supplementation of turmeric powder did not affect the weight and thickness of the shell (Saraswati *et al.* 2013b).

CONCLUSION

Supplementation of turmeric powder in feed of quail could accelerate sexual maturity and improve the chemical quality of quail eggs, so it was good for the growth of quail embryo and safe to eat.

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