"The nutritional enrichment of dried noodles by using phycocyanin extracted from Spirulina sp as an effort of food fortification "

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The nutritional enrichment of dried noodles by using phycocyanin extracted from *Spirulina sp* as an effort of food fortification

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Abstract. In order to increase the nutrition value of noodles, the food fortification by using bioactive compound was conducted. The objective of this study was to evaluate the quality characteristics of dried noodles when different concentrations of phycocyanin powder were added to the noodles and assess the effect of phycocyanin to the organoleptic value. The phycocyanin was added at the concentration of 0.5%;1% and 1.5% and the cooking values, swelling index and organoleptic test were performed as product evaluation. The result showed that increasing the phycocyanin leads to the increase of swelling index of noodles as well as the cooking losses. The optimum cooking time was achieved at 6 min at the phycocyanin content of 0.5%. These optimum conditions provided the optimum cooking losses of 1.4%, swelling index of 68% and better appearance.

1. Introduction

Food fortification is a worthwhile approach to improve the quality of nutrition of populations. The challenges of the food industry are to increase the micronutrient level of processed foods [1] in order to reduce micronutrient deficiencies [2]. One of micronutrient from natural resource is phycocyanin which can be extracted from microalgae *Spirulina sp*. Phyocyanin is mostly used for promoting anti-oxidant, anti-cancer, natural food dyes and pharmaceutical [3].

Noodle is staple food majorly composed by wheat flour and commonly consumed by Indonesian population as a substitute of daily rice consumption. Besides, it is available in fresh condition, the noodle is also produced in dry form. The dried noodle has water content of 8-10% and mostly composed by carbohydrate (79.4%), protein (12.1%), fat (1%) [4]. The proportion of carbohydrate are dominant than other nutrition, therefore the attempts are required to improve the noodle's nutrition especially its functionality.

In order to improve its nutritional value, the dried noodle should be fortified by using bioactive compounds. Agustini et al[5] used dried Spirulina powder as fortification agent to increase the quality of noodle. However, the specific antioxidant purpose still was not addressed in that case. Therefore, addition of phycocyanin is best option to deliver noodle product with high antioxidant function. The phycocyanin is able to protect human body from free radical damage, and prevent from degenerative diseases[6]. The objective of this research was to evaluate the use of phycocyanin as fortification agents in dried noodle product. The quality of noodle was evaluated based on its sensoric, anti-oxidant activity, cooking times and swelling quality.

2. Materials and Methods

2.1. Materials

The ingredients used in the research were wheat flour, phycocyanin, chitosan, egg, salt, coconut oil and warm water. The noodles were made of 300 grams of flour, 5 grams of salt, 3 grams of Carboxymethyl cellulose (CMC), two yolks of egg, and phycocyanin 0.5%, 1%, 1.5%, 2%, or 2.5% (w/w).

2.2. Noodles preparation

Noodles were made by mixing the ingredients and phycocyanin in a bowl. The water was slowly poured and the kneading was carried out until it well mixed, homogenous, shiny appearance, soft, smooth and not sticky. The noodle was steamed at 90°C for 5 minutes and then dried at 50°C for 90 minutes. The noodle was pressed and rolled by out it to the roller. The distance between the rollers can be set to get the desire thickness. The noodle was cut at a length of 20 cm and a width of 1 mm. Thin sheet noodles were put to the hammer grill that can change the noodles sheet into the wavy noodles shape, then the wavy noodles shape was steamed in the steamer in the boiling water (100°C) for 5 minutes. Drying was conducted after the steamed noodles were drained and it was heated in the oven at 40 °C for six hours.

2.3. DPPH analysis and EC50 determination

DPPH analysis was used to determine the antioxidant activity. DPPH method was chosen because it is simple, easy, fast and sensitive and only use a little of samples [7]. DPPH method was used when the antioxidant compounds was reacted with DPPH radicals through a hydrogen atom donation mechanism and cause DPPH colour decay from purple to yellow which is then displayed at a wavelength of 517 nm. The effective concentration at which the DPPH radical was scavenged by 50% was expressed as EC_{50}.

2.4. Cooking time (min)

Determination of optimum cooking time was done where about 10 g of noodles were cooked in 300 mL of water and after each minute of cooking for the first 2 minutes, noodles were removed and squeezed between clear glass slides. This procedure was repeated by removing the noodles every 15 seconds until the white core disappeared. This point is determined as the optimum cooking time.

2.5. Cooking loss

Cooking loss was analysed as 25 grams of noodle sample was cooked in 300 mL boiling water at an optimum cooking time. The cooked noodles were strained and the water was collected in a glass and then solids material was determined by evaporating in an oven at 100°C until a constant weight was reached. The cooking loss was expressed as a percentage of the weight difference between the initial solid material and final dry matter.

2.6. Swelling index

The swelling index of cooked noodles was estimated using equation follows:

$$\text{Swelling index (\%)} = \frac{W_{cooked} - W_{dried}}{W_{dried}}$$

Where W_{cooked} is weight of cooked noodles and W_{dried} is weight of noodles after drying

2.7. Organolpetic evaluation

To determine the consumer's response to the dried noodles fortified with phycocyanin, as many as 10 respondents were questioned to give an assessment of dried noodles fortified by 0.5%, 0.1%, and 1.5% phycocyanin. The score of responses were in the range of from 1 to 5 to represent their preferences. The consumer acceptance tests were carried out included colour test, taste, texture and smell.

3. Result and Discussions

3.1. Cooking qualities

The swelling index, cooking time, and cooking loss of dried noodles fortified with phycocyanin powder are shown in Table 1. From the results of the analysis, it can be seen that by increasing the concentration of phycocyanin, the swelling index of dried noodles increased. Swelling index is a comparison between water absorption in noodles that have been boiled and those that have not been boiled. Good quality noodles must have a high swelling index. The high swelling index indicated the ability of noodles to absorb high water and does not easy to break.

The addition of phycocyanin was also affecting the cooking losses. Increasing the phycocyanin concentration lead to increase the cooking loss during the process. This also indicates that phycocyanin will contribute to protein content and therefore, the texture of noodle with high phycocyanin concentration was more brittle. Low protein levels cause softness of the noodle structure. From the results of the study obtained dry noodles with the best treatment results were noodles with 1.5% phycocyanin concentration.

Table 1 Swelling index, Cooking time and cooking loss of noodles supplemented with phycocyanin powder (%)

Noodles	Swelling index	Cooking Loss	Cooking Time (min)
0.5%	68.01%	1.40%	6 minutes 28 seconds
1.0%	77.50%	2.77%	7 minutes 4 seconds
1.5%	88.98%	4.03%	6 minutes 20 seconds

3.2. Organoleptic test

In the current study, the organoleptic evaluation of the optimal prepared noodles fortified with phycocyanin was carried out with the objective to select the best phycocyanin composition added to noodles. The means sensory liking scores for flavor, taste, texture and colour are shown in Figure 1.

The results of the respondents' assessment can be seen in the Figure 1

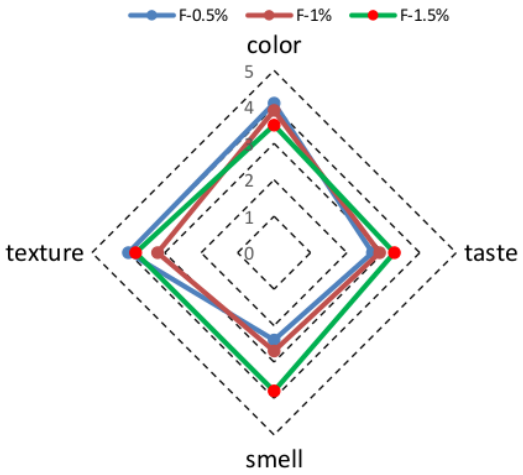

Figure 1. Effect of phycocyanin(%) on sensory liking scores for color, taste; texture; aroma

Figure 1 shows that the increase of phycocyanin will increase the odour of the products, while the phycocyanin also improve most the product taste. However, colour was in opposite condition to the

odour. Most customer preferred product fortified by 0.5% phycocyanin which is in light green (Fig 2). Too much phycocyanin will give dark blue colour of product.

Figure 2 Dried noodles fortified with 0,5%;1,0%;1,5% phycocyanin

3.3. Antioxidant analysis

The phycocyanin was added to improve the antioxidant function of the dried noodles. The content of antioxidant was determined by its EC50 of the products. The EC50 values and antioxidant activity have opposite correlation. High EC50 values means that the antioxidant activity was lower.

Figure 3 shows that increasing phycocyanin contents shows the increase of antioxidant activity. This findings proves that the phycocyanin was attached to the noodles and the fortification was successfully done to increase the functionality of the dried noodles.

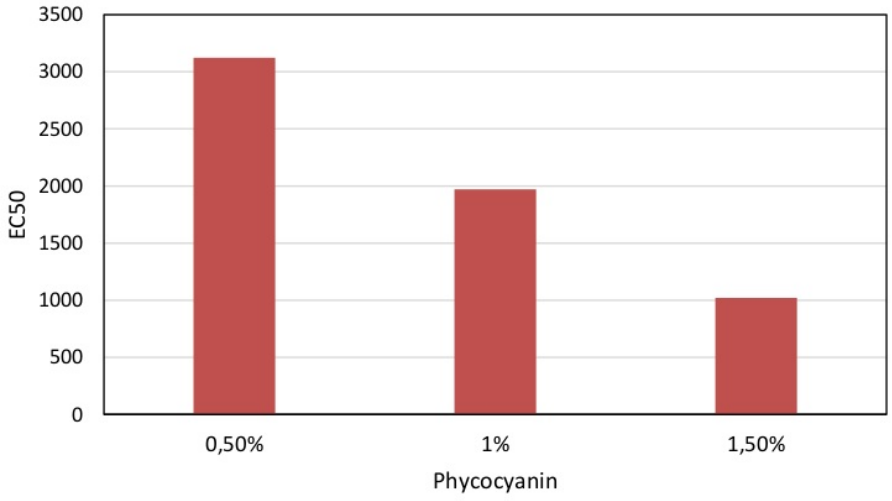

Figure 3. Anti-oxidant activity as function of phycocyanin concentration

4. Conclusions

This research evaluated the production of dried noodles fortified by phycocyanin. The noodle added by 0.5% phycocyanin showed the most preferred noodle as indicated by consumer organoleptic test. The swelling index of optimum product was 68% while the cooking losses only 1.4% for cooking time of 6 min.

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