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The Effect of Seaweed (*Eucheuma cottonii*) and Tofu Dregs Formula on Chocolate Pudding

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Abstract. *Eucheuma cottonii* is a seaweed that produces carrageenan which can form a gel texture. Tofu dregs is a by-product of tofu processing in the form of white solids which still contains good nutritional value. Pudding is one of food products that has a soft and gel texture. This study aims to obtain a seaweed chocolate pudding with addition of tofu dregs which is palatable and can be accepted by the panelists. The experimental design used is Randomized Block Design (RBD) consist of one factor with five levels of treatment. The treatment in this study is comparison of seaweed and tofu dregs (a), consisting of a1 = 5%: 25%, a2 = 10%: 20%, a3 = 15%: 15%, a4 = 20%: 10% and a5 = 25%: 5%. Analysis carried out on the chocolate pudding included preference and chemical test. Chemical analysis carried out is a test of protein content and crude fiber content performed on the best pudding from preference test, namely pudding with formula a1 (15%: 15%). The best pudding chosen by the panelists has an average taste score of 3,778 (neither like nor dislike– like a little), average aroma score of 3,822 (neither like nor dislike– like a little), average color score of 4,044 (like a little), and average texture score of 3,667 (neither like nor dislike– like a little). Protein content in the best chocolate pudding from preference test is 3.92%, while dietary fiber content is 5.38%.

1. Introduction

Eucheuma cottonii is a seaweed that produces kappa carrageenan and has abundant nutrients content. Unfortunately, in Indonesia *E. cottonii* is not commonly used in food processing [1]. The seaweed contains carbohydrate, protein and has small amount of fat. *E. cottonii* can functions as emulsifier, thickener, filler, and gel maker. According to a research conducted by [2], pudding made from *E. cottonii* seaweed which was soaked in lime juice for 36 hours produced pudding products that were liked by panelists.

Tofu by product consists of two forms, some are in the form of liquid and some are solid or commonly called tofu dregs. Tofu dregs which still has a nutrient content, consists of a white solid material. The tofu dregs is mostly used for animal feed. Tofu dregs approximately contain 16.1%-33.4% protein on a dry matter basis and approximately 3.6%-4.8% on a wet matter basis [3]. In terms of dietary fiber, the result study from [4] showed that tofu dregs contain $58.21 \pm 0.26\%$ on dry weight basis. Dietary fiber in tofu dregs is very important, since it can protect against coronary heart disease, reduce blood pressure, blood cholesterol and prevent the occurrence of constipation and colon cancer [4].

This research was conducted to acquire a diversification of food product by using *E. cottonii* seaweed and tofu dregs. The aims of this study was to obtain seaweed pudding added with tofu dregs



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which is palatable and can be accepted by the panelists. *E. cottonii* seaweed serves as a gelling agent in the making of pudding as well as an ingredient that can add nutritional value, such as fibers. The pudding will have a sweet taste due to the presence of other additives in the form of granulated sugar. However, the pudding will have a distinctive aroma from tofu dregs and an unattractive whitish color. Therefore, it is necessary to add other ingredients, namely chocolate powder and skim milk in the pudding to produce an attractive aroma and taste. Chocolate is believed can enhance the flavor or taste that is preferred by many people. Chocolate powder was chosen as the flavor since it is widely available and easy to be used in the making of the pudding.

2. Materials and Methods

Materials used in the making of chocolate pudding are tofu dregs obtained from local tofu factory, *E. cottonii* seaweed, chocolate powder, skim milk, and granulated sugar from local market. Chemicals such as for dietary fiber and protein content analysis were from on line shop.

Methods. Research method carried out in this study was divided into two parts, first is the preliminary research and second is the main research. Preliminary research consisted of two phases, phase I was done to determine the ratio of sugar, chocolate powder and skim milk to be used in the pudding, while phase II was conducted to determine the treatment of seaweed soaking process. The main research was carried out to determine the most preferred chocolate pudding by the panelists based on comparison of seaweed and tofu dregs formula.

Analysis carried out on the chocolate pudding was a preference test and chemical tests. The experimental design used in preference test was a Randomized Block Design (RBD) consisting of one factor, namely the ratio of seaweed and tofu dregs used with five levels of treatment. The treatment levels were 5%: 25%, 10%: 20%, 15%: 15%, 20%: 10% and 25%: 5%. Protein and dietary fiber content were tested. Those tests were only carried out on chocolate pudding which has been determined as the most preferable by the panelists.

2.1. Preference Test

Preference test was a method used to determine and assess whether the panelist like or dislike a product. Testing was done by relying on the human senses as a test tool, the aspects tested in the preference test included color, texture, taste and aroma. There were 45 untrained panelists and the preference test was carried out between 09.00 - 11.00 and between 14.00 - 16.00, where the panelists were neither hungry or full at that particular time. The samples to be tested was then given a three digits random code which would then be presented to the panelists and the panelist would score the samples. According to [5], preference test was determined by hedonic rating scale found in tabel 1.

Table 1. Hedonic Rating Scales

Scales	Score Value
Like a lot	5
Like a little	4
Neither like nor dislike	3
Dislike a little	2
Dislike a lot	1

2.2. Protein and Dietary fibre content analysis

Protein and dietary fibre content analysis was done in this research. The protein content test was using the modified Kjeldahl method, while the dietary fiber content test was using 18-8-6-2/MU/SMM-SIG Method. The analysis was mainly conducted on the most preferred chocolate pudding formula, but as comparison, two other samples formula were analyzed.

2.3. Chocolate Pudding Preparations

Chocolate pudding was made by mixing seaweed and tofu dregs, with the ratio as follows: 25%:5%, 20%:10%, 15%:15%, 10%:20%, 5%:25%. The production process of chocolate pudding can be seen in figure 1.

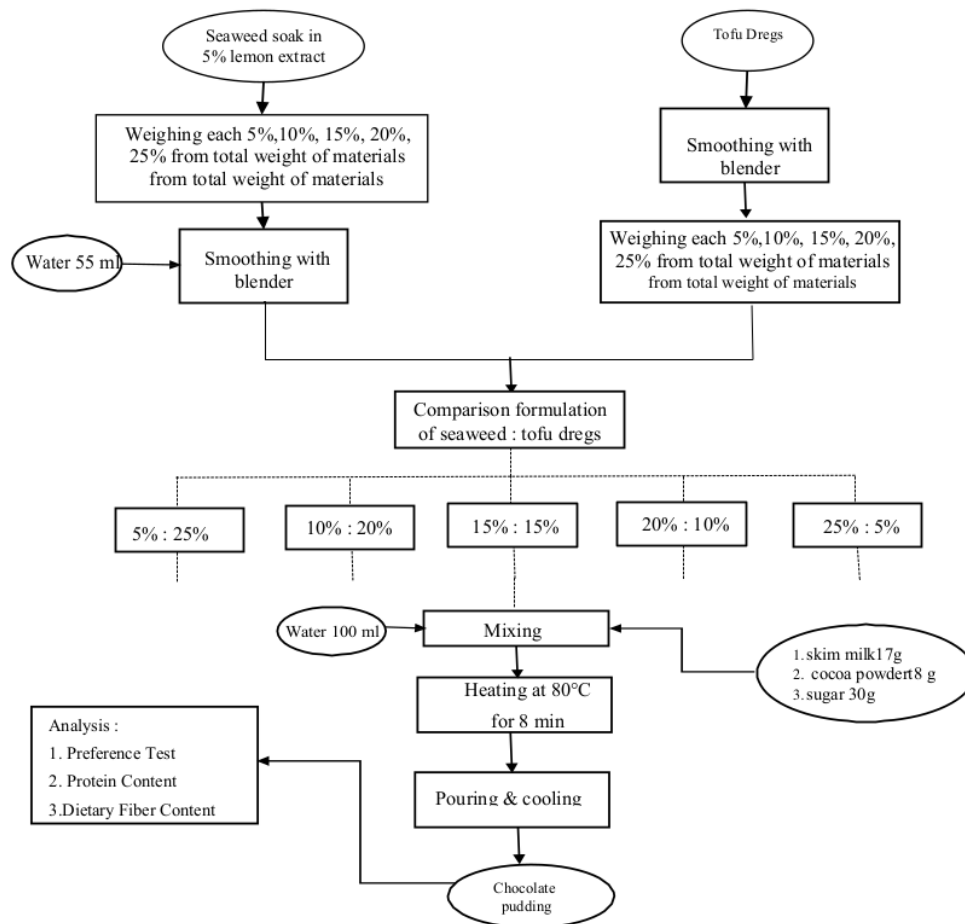


Figure 1. Experimental Design

3. Result and Discussion

3.1. Preference Test

3.1.1. *Texture.* The 15%: 15% ratio of seaweed and tofu dregs has the highest average score of texture preference as described in Figure 2, This may be due to the comparison that the chocolate pudding produced has a dense texture but still feels soft when chewed. This is caused by the presence of carrageenan from seaweed. Carrageenan has an important role in gel formation on chocolate pudding.

Carrageenan is a hydrocolloid compound that is able to dissolve in water and can form a gel in solution. The gel formation is due to the double helix structure of the carrageenan polymer present in the seaweed [6]. According to Statistical analysis there are significant differences among the treatment, thus Duncan test was performed.

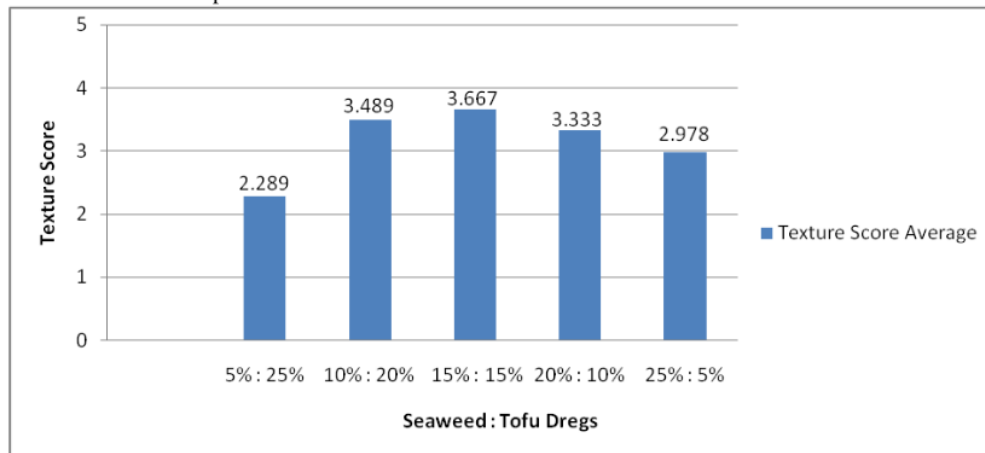


Figure 2. Effect of Seaweed and Tofu Dregs Ratio on the Texture Score of Chocolate Pudding

3.1.2. Color.

Pudding with a 15%: 15% ratio of seaweed and tofu dregs was the most preferred pudding's color by the panelist, which were neither too light nor too dark. The differences of pudding's color from different ratio are shown in figure 3.

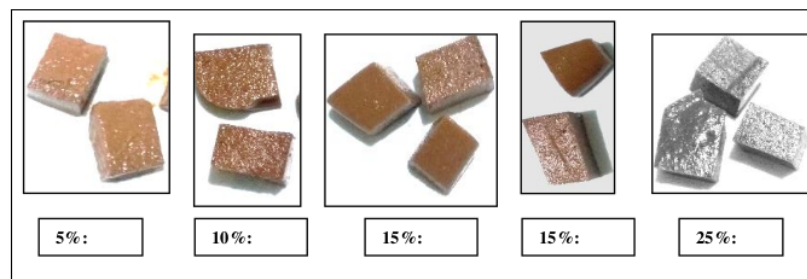


Figure 3. Pudding's color from different ratio

Pudding color was probably influenced by the main ingredients used, namely tofu dregs. Tofu dregs has white color, thus the more tofu dregs is used, the lighter the brown color produced by the pudding and vice versa. This result is similar to [7] that the more tofu dregs was used in bread, the least prefer by the panelist. The effect of seaweed and tofu dregs ratio on chocolate pudding color score is shown in Figure 4. Based on Statistical analysis, there are no differences among the treatment, thus further test was not required.

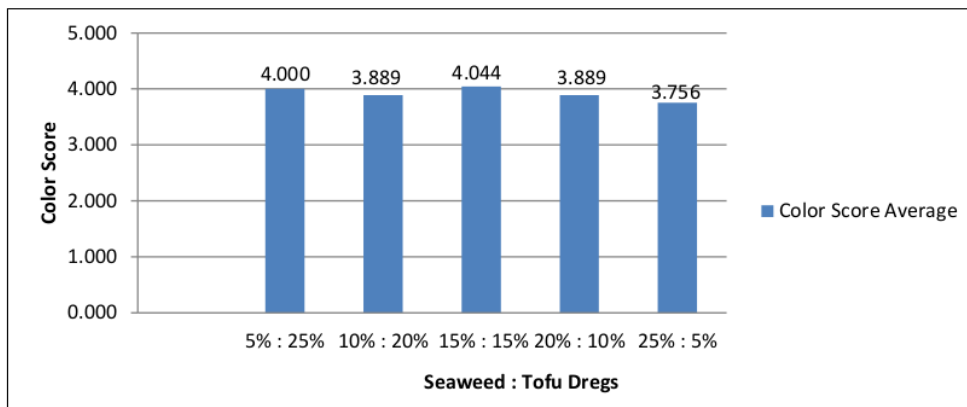


Figure 4. Effect of Seaweed and Tofu Dregs Ratio on the Color Score of Chocolate Pudding

3.1.3. Aroma.

As described in figure 5, the seaweed and tofu dregs ratio of 10% : 20% in the chocolate pudding was most preferred by panelists. Chocolate pudding which was the least preferred by panelist is chocolate pudding with a seaweed and tofu ratio of 5% : 25%. This is due to the amount of tofu dregs that may produce distinctive aroma in the chocolate pudding. The result agree to [7], the aroma was significantly different for 10% of tofu dregs flour used in bread making. The unpleasant aroma in this case is caused by the activity of the lipoxygenase isozymes[8].which is active when soybeans break during the peeling and grinding in tofu production. Statistical analysis showed that there were no differences among the treatment, thus further test was not needed.

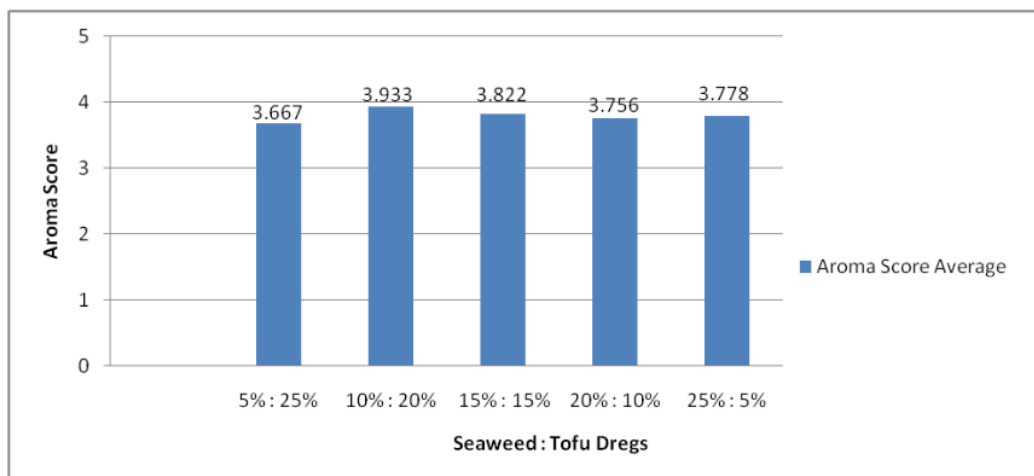


Figure5. Effect of Seaweed and Tofu Dregs Ratio on Aroma Score of Chocolate Pudding

3.1.4. Taste

The most preferred chocolate pudding taste by panelist was the seaweed and tofu dregs ratio of 5%: 25% as shown in figure 6. This may be caused by the higher concentration of tofu, the chocolate pudding produced has a light taste when eaten. The panelists tend to like chocolate pudding with higher concentration of tofu dregs. The lower the concentration of tofu dregs used, the stronger the chocolate flavor found in chocolate pudding and bitter taste of the chocolate pudding. Statistical analysis shows significant differences among the treatment, thus Duncan test was performed.

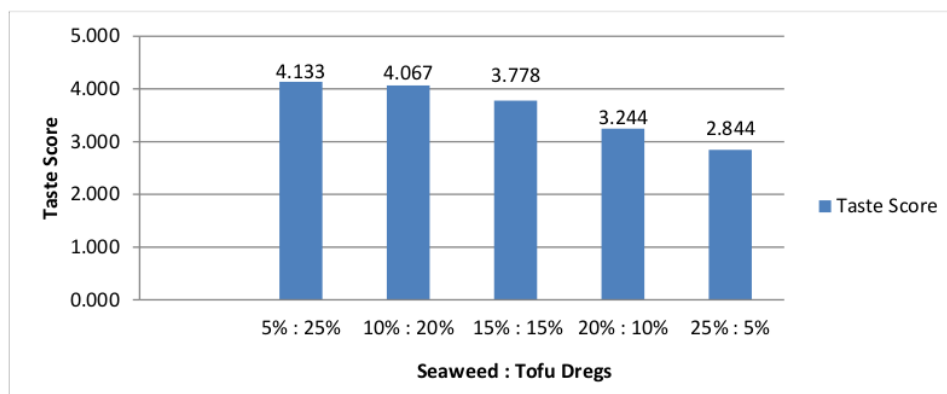


Figure 6. The Effect of Seaweed and Pulp Tofu Ratio on Chocolate Pudding Taste

3.2. Determination of the Best Results from Preference Test

The main aspect to be considered in chocolate pudding is the panelist's preference for the texture of chocolate pudding in each treatment. Based on statistical analysis, the texture of the chocolate pudding was affected by the seaweed and tofu dregs ratio. As seen in table 2, the 15% : 15% ratio has the highest score for texture and color of chocolate pudding. As for the aroma, the 15% : 15% ratio showed no significant difference among the treatments, based on statistical analysis. The chocolate pudding taste for 15% : 15% ratio, according to statistical analysis have no significant differences with the 5% : 25% and 10% : 20%. Since the aim of this study was making seaweed pudding, then the amount of seaweed in the formula should be considered. Therefore, chocolate pudding with 15% : 15% ratio was chosen as the best result.

Table 2. The Overall Results of Preference Test

Seaweed : Tofu Dregs	Texture	Color	Aroma	Taste
5% : 25%	2,289 ^d	4,000 ^a	3,667 ^a	4,133^a
10% : 20%	3,489 ^{ab}	3,889 ^a	3,933^a	4,067 ^{ab}
15% : 15%*	3,667^a	4,044^a	3,822 ^a	3,778 ^{ab}
20% : 10%	3,333 ^{bc}	3,889 ^a	3,756 ^a	3,244 ^c
25% : 5%	2,987 ^c	3,756 ^a	3,778 ^a	2,844 ^d

* Best Result from Preference Test; Different superscript in the same row means differ significantly

3.3. Protein and Dietary fibre content

3.3.1. Protein Content.

As presented in table 3, the 15%: 15% ratio of seaweed and tofu dregs has the highest average protein content of 3.92 % compared to the other treatment of chocolate pudding. Protein content of chocolate pudding was lower compared to protein content in buffalo milk pudding, which were 4.7-6% [9]. Yet, the seaweed pudding has higher protein content compare to mushroom powder fortified potato pudding that only reach 2.28% as described by [10].

Table 3. Protein Content in the Chocolate Pudding

No	Seaweed :Tofu Dregs	Unit	Sample 1	Sample 2	Average
1	5 : 25	%	3.44	3.48	3.460
2	15 : 15*	%	3.89	3.95	3.920
3	25 : 5	%	3.22	3.36	3.290

*Best Result from Preference Test

3.3.2. Dietary Fiber Content.

The result of dietary fiber content is presented in table 4. It shows that the 25%: 5% ratio of seaweed and tofu dregs has the highest average of dietary fiber, slightly above the best result of preference test. The dietary fiber in this chocolate pudding is higher compare to the steamed seasoned cowpea pudding 'moinmoin' which had $4.0 \pm 0.5\text{g}/100\text{g}$ fiber [11] and carrageenan pudding which contain 5.23% [12].

Table 4. Dietary Fiber Content in the Chocolate Pudding

No	Seaweed :Tofu Dregs	Unit	Sample 1	Sample 2	Average
1	5 : 25	%	2.90	2.88	2.890
2	15 : 15*	%	5.40	5.37	5.385
3	25 : 5	%	5.63	5.77	5.700

*Best result from Preference Test

4. Conclusions

The use of *E. cottonii* seaweed and tofu dregs produces chocolate pudding that can be accepted by panelists. Chocolate pudding which is most preferred by panelists is chocolate pudding with seaweed and tofu dregsratio of 15%: 15% and addition of 30 g sugar: 8 g chocolate powder and 17 g skim milk. The chocolate pudding has an average taste score of 3,778 (neither like nor dislike– like a little), average aroma score of 3,822 (neither like nor dislike– like a little), average color score of 4,044 (like a little), and average texture score of 3,667 (neither like nor dislike– like a little). Protein content found in chocolate pudding is 3.92% and dietary fiber content is found in pudding of 5.38%.

5. Acknowledgements

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