Seaweed Flour Fortification to the Preference Level of Milk Chocolate Bar

ABSTRACT

Chocolate is product that mad by cocoa powder as main ingredient. Chocolate contains sugar and fat content that can cause diabetes and constipation. In order to serve good taste of chocolate, it also required to make chocolate that good for health. One of the best way to produce healthier chocolate was the addition of seaweed which contain a lot of fiber. The purpose of this research was to found out the best percentage of seaweed flour in milk chocolate bar preferred by panelists based on organoleptic and chemical test. The research was carried out at the Fisheries Product Processing Laboratory, Faculty of Fisheries and Marine Sciences, Universitas Padjadjaran, and Rumansia Nutrition Laboratory, Faculty of animal husbandry, Universitas Padjadjaran, from March to April 2019. The research method used was an experimental composed of 4 treatments and 20 panelists a repeat. Included treatment was the addition of seaweed flour by 0%, 5%, 10% and 15% based on the amount of chocolate bar. Observations were made on the level of preference which included appearance, aroma, texture and taste by trained panelists, test of water content and dietary fiber content. The results showed that the addition of 5% seaweed flour treatment mostly liked by panelists compared to other treatments with an average value of 7.0, aroma 7.0, texture 6.1 and taste 6.2, water content 2.10% and dietary fiber content of 8.65%

Keywords: *milk chocolate, level of preference, dietary fiber*

1. INTRODUCTION

Seaweed became one of cultivated biological resources[6]. Seaweed has several species such as Eucheuma cottonii, Gracilaria, Gledium, Hypnea and Sargassum[23]. Seaweed has low calorie and contains a dietary fiber of 2,575%[22]. One of potential seaweed types is Eucheuma cottonii[16]. Seaweed could be processed into various foods, beverages, medicines, etc. The practice of Indonesian people to cultivate seaweed was still inferior. It was necessary to do efforts to increase the processed-seaweed consumption in Indonesian to optimize the production of seaweed.

The seaweed could be maximized by the diversification of processed-seaweed products into flour[3]. Seaweed flour can be used as various processed food products such as noodles, cake, and Nugget[29]. Eucheuma cottonii flour contains 69.3% of dietary fiber[10]. The fiber found in seaweed flour can help in the prevention of diseases. Adequacy of fiber intake in Indonesia is still less than the recommendation of the WHO which 25 g/day. According to the results of the National survey 2013, the average population of Indonesia consumed fiber was 6.5 g/day[2]. The food fiber especially soluble food fiber can bind the bile acids thereby reducing total of cholesterol[27]. Fibers Can bind ensnare fat in the intestines and prevent the absorption of fat by the body and dispose of it through the feces. Thus the higher fiber consumed the more bile acid and fat secreted by the body[13]

Fortification is one of alternatives to improve the quality of foodstuffs or products by adding a substance that has nutritional value[6]. Fortification is one of alternative that could rise the quality of promising nutrients using[1]. Seaweed utilization as a fortification material is an alternative to produce food products that have nutritional value[6]. Food products that can utilize seaweed flour as main ingredient was chocolate.

Chocolate is a result of cocoa beans (Theobroma cacao) from the family Sterculiaceae [27]. According to the data Central agency of Statistics (2007), the production of chocolate bars in Indonesia reaches 3,106,336 kg. The sweetener used in chocolate is sugar. Consumption of fat and high sugar can cause diabetes[20]. In addition to serving the well-tested chocolate bar, we also need a good chocolate bar for health, one of which was the addition of seaweed flour

that riched by fiber in chocolate making. The addition of fibers to the chocolate is important for digestive health and prevents diseases such as diabetes and constipation. The addition of seaweed flour can affect the characteristics of organoleptic such as texture, appearance, flavor, aroma and the level of product preference. Based on the above then research on the addition of seaweed flour at the preference level of chocolate bars need to be done.

2. MATERIALS AND METHODS

2.1 Tools and research materials

The equipment used in the process of milk chocolate bar was basin, digital scales, wok, chocolate mold, plastic spatula, and spoon. The tools used in organoleptic and chemical testing were as follows: Tools for an organoleptic test, which were plates as sample serving, assessment sheets, and stationery.

For chemical analysis (water content and dietary fiber), namely cup (erlenmeyer, burette, volumetric pipette, pipette drops, flask, etc.), volumetric measuring instruments, blender, aluminum cup, desiccator, stirrer, condenser, elenmayer, mortar, analytical balance, oven, and electric heater.

Main ingredient materials used by milk chocolate bar were cocoa powder, cocoa butter, seaweed flour, skim milk and refined sugar.

The research was conducted in March 2019 at the Fishery Production Processing Laboratory of the Faculty of Fisheries and Marine Sciences of Padjadjaran University, and test Chemical of Rumansia Nutrition Laboratory, Faculty of Animal Husbandry. Formulation of milk chocolate bar is presented on Table below.

Table 1. Formulation of milk chocolate bar based on the weight chocolate

		Treatment			
No.	Materials	A (0)	B (5%)	C(10%)	D(15%)
1.	Cocoa butter	36 g	36 g	36 g	36 g
2.	Cocoa powder	17 g	17 g	17 g	17 g
3.	Skim milk	18,1 g	18,1 g	18,1 g	18,1 g
4.	Refined sugar	28,4 g	28,4 g	28,4 g	28,4 g
5.	Seaweed flour	0	5 g	10 g	15 g

Source: Nuraeni (2016) in modification

The percentage of seaweed flour used in the milk chocolate bar based on the weight of weighing chocolate bar (cocoa butter, cocoa powder, skim milk, and refined sugar) with the following treatment:

1. Treatment A: Without replenishment of seaweed flour 0%
2. Treatment B: Addition of seaweed flour by 5%
3. Treatment C: Addition of seaweed flour by 10%
4. Treatment D: Addition of seaweed flour by 15%

Panelists in this study were students of the Faculty of Fisheries and Marine Sciences Universitas Padjadjaran who have known and experienced in organoleptic analyzing. The process of making milk chocolate bar namely the preparation stage, the conching 1 stage, the conching 2 stages, tempering, molding chocolate, the completion stage and analysis [18].

2.1.1 Preparation

Prepare all the hygienic tools to avoid chemical reactions, fungi, and bacteria. main ingredients and additional ingredients needed in the manufacture of milk chocolate bar, weighing the ingredients needed in the manufacture of chocolate[18].

Choncing I

The stage of chonching in the manufacture of milk chocolate bar was mixing cocoa butter and cocoa powder to get cocoa liquor which was then mixed with other ingredients.

Choncing II

Cocoa liquor then mixed with other ingredients such as skim milk, sugar, and seaweed flour according to the treatment.

Tempering and molding chocolate

The ingredient that has been mixed should be rested so that not to happen fat blooming, good texture and make chocolate did not stick to the mold. After that, molding the chocolate into the mold and put into the refrigerator so that the chocolate became frozen.

Completion stage and Analysis

Chocolate that has been frozen was carried out by organoleptic analysis process by panelists, chemical analysis test (moisture content and fiber content).

2.2 Analyzed parameters

Analyzed parameters that has been done in this research ware organoleptic and chemical. Organoleptic parameters include the appearance, aroma, flavor, and texture of milk chocolate bar. Organoleptic testing was done with a hedonic analysis. The chemical parameters were water content and dietary fiber content of milk chocolate bar. The test was carried out by 20 semi-trained panelists. Panelists ware asked to fill the preferences level questionnaire according to personal opinion. The numerical scale consists of five types: 1 (very dislike), 3 (dislike), 5 (neutral / normal), 7 (like), and 9 (really like). The preference limit for this product was determined if the product was worth ≥5 valued so that the product is determined was accepted by the panelist[14].

2.2.1 Chemical parameters

A. Moisture content

The principle of water content analysis is the process of evaporation of water from the material by heating. Water content is determined by the formula:

$$\text{Moisture Content (\%bb)} = \frac{(a-(c-b)}{a} \text{ x } 100\%$$

Description:

a= weight of the sample (g)

b = weight (sample + cup) before drying (g)

c = weight (sample + cup) after drying (g)

B. Fibber content (BSN 01 2891 1992)

The basic principle of measuring fiber content is to estimate the sample with alkaline or acid to separate the coarse fiber from other materials, determined by the formula:

$$\text{Crude fiber content (\%)} = \frac{W1-W2-B}{W} \text{ x } 100\%$$

Description:

W = sample weight

W1 = Weight of sample after the oven

W2 = Weight of sample after combustion

B = Weight of filter paper after Sterilized

2.3 Data Analysis

Data from the measurement results of chemical analysis ware analyzed descriptive comparative. The non-parametric analysis performed for organoleptic testing used a two-way variant formula, Friedman test with the chi-square test. The statistical formula used in the Friedman test is as follows (Sudrajat 1999 in Larissa 2017):

$$X^2 = \frac{12}{bk\,(k+1)} \sum_{i=1}^{l} (Rj)^2 - 3b\,(k+1)$$

Description:

X_2 = Friedman Test statistics
b = Repeat
k = Treatment
Rj_2 = Total ranking of each treatment

If any of the same numbers were performed, calculation of correction factor ware needed using the following as formula:

$$FK = 1 - \frac{\Sigma}{bk(k^2-1)} \qquad H_c = \frac{X^2}{FK}$$

Description:

T = $N(t^3-t)$
t = The number of same observation scores for a rank
N = The number of same observation scores for a rank with the same t value

The significant value of the X_1 value can be known by using the chi-squared critical prices table with:

$$db = k-1;\ \alpha = 0{,}05$$

H_0 = The treatment does not give a real level $\alpha = 0.05$
H_1 = treatment gives a noticeable difference to the level $\alpha = 0.05$

If the value of Hc $<X_2\ \alpha$ (K-1), then H_0 and H_1 are rejected, and if the value of Hc> X2α (K-1), then H_0 was rejected and H_1 was accepted. As H_1 was accepted, then there would be a significant difference between the treatment so that multiple comparisons ware needed using the following formula:

$$[\overrightarrow{Ri} - \overrightarrow{Rj} \leq Z\ \{\alpha|k(k-1)\}\sqrt{bk(k-1)/6}$$

Description:

[Ri – Rj] = difference in the number of each treatment
Ri = Average rating from the to-I sample
Rj = Average rating from the J sample
α = Experiment wise error
b = Number of tests
k = Number of treatments
Z = value on Z factor for multiple comparisons

The method used to figured out the selected product was the Bayes method. Bayes method is a technique used for analysis of best decision making by various alternatives that aimed to get a result that considers various criteria

3. RESULTS AND DISCUSSION

3.1 Hedonic analysis

A. The Appearance

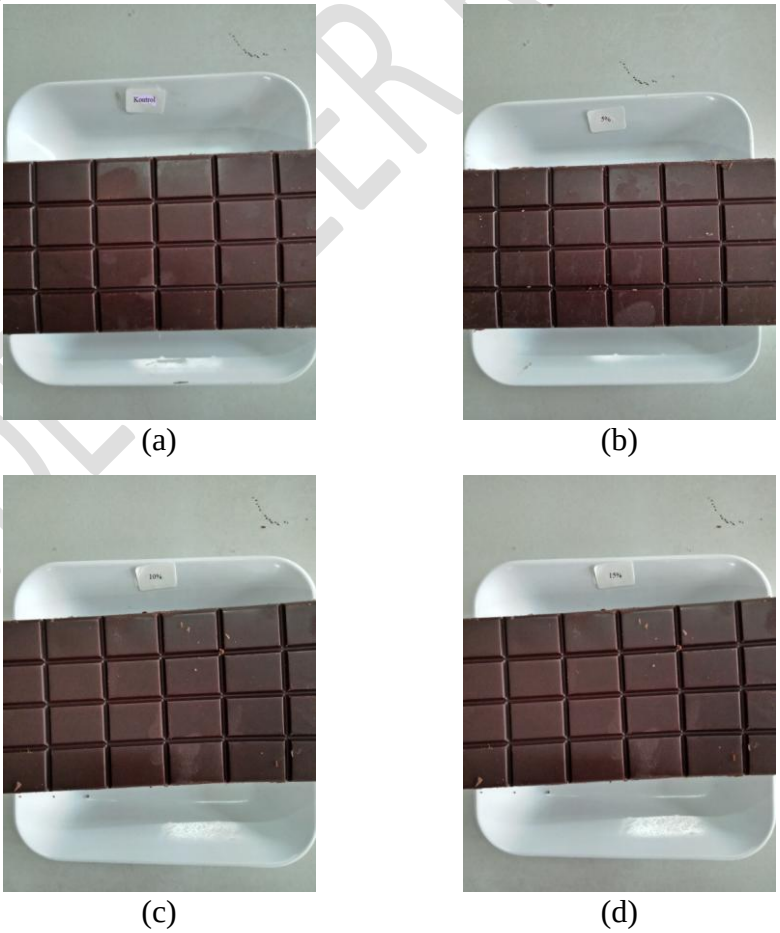
Appearance is the first characteristic assessed in consuming a product. The calculation results the appearance of chocolate bar milk can be seen in Table 2.

Tabel 2. Average of milk chocolate bar appearance

Concentrations of seaweed flour (%)	Median	Average
0	7	6,9 a
5	7	**7,0 a**
10	7	6,8 a
15	7	6,1 a

Description: The average number of treatments followed by the same letter Shown unsignificant difference according to 5% level.

Based on the statistical test to the texture milk chocolate bar was known that every treatment was in the category of preference level to be liked by the value range between 6.1 to 7.0. Milk chocolate bars with the addition of seaweed flour by 5% has the highest average value of 7.0 which produces milk chocolate bar with a shiny brown appearance and had a dark brown color. Addition of seaweed flour by 15% to milk chocolate bar had the lowest value with an average value of 6.1 that had the same appearance to the other chocolate bars. The chocolate milk bar has a shape that looks quite solid. The appearance of milk chocolate bar can be seen in Figure 1



(a) (b)

(c) (d)

Figure 1. Chocolate milk bar with seaweed flour filler: (a) Control, (b) Addition of 5% seaweed flour, (c) supply of flour 10% seaweed, (d) requires 15% seaweed flour.

Unsignificant difference in appearance of milk chocolate bar was suspected because the color and shape produced from all treatments can still be accepted by the panelists so that there was unsignifican difference between treatments caused by the addition of seaweed flour.

The chocolate bar's appearance was influenced by fat blooming which was the occurrence of the flaws that appeared during the storage of chocolate characterized by the emergence of a white coating on the surface of chocolate [5]. Factors that affecting flat blooming was the making process of chocolate which was inappropriate such as the tempering, cooling, temperature, and storage time.

The brown color came from anthocyanins which were red, purple and blue pigment found in cocoa beans[24]. Whereas the pigments contained in the eucheuma cottonii was a red-colored ficoeritrin that more dominant than other color pigments[12]. Seaweed treated to be cleaned to remove dirt and sand, after that it soaked in freshwater then it resoaked by betel lime water then dried it out that produced white typical color of seaweed[4]. So that the addition of seaweed flour did not affect the color of product

B. Aroma

The result of aroma analysis can be seen on the following table 3. Aroma has product appeal that determines level of preference

Table 3. Average aroma milk chocolate bar

Concentrations of seaweed flour (%)	Median	Average
0	7	6,1 ab
5	7	**7,0 b**
10	5	6,8 b
15	7	5,1 a

Description: The average number of treatments followed by the same letter Shown unsignificant difference according to 5% level.

Based on the results of the statistical test against the aroma milk chocolate bar, the treatment with the addition of seaweed flour 5% different the real with a 15% treatment addition of seaweed flour. Assessment panelist on the aroma of milk chocolate bar is known that all of the treatment was pretty neutral that liked by panelist with median values of 5 and 7. Aroma of milk chocolate bar that has the highest average value of 7 that has a chocolate aroma which was liked by panelists.

The strong chocolate aroma can disguise the aroma of seaweed flour, other than that the typical aroma of seaweed flour was hard to recognize because it was not in the bar-shaped component (Winarno in Lusiana 2002). Chocolate aroma was formed during the screening of cocoa beans that were main ingredient in the manufacture of cocoa powder.

Seaweed flour can affect the scent of chocolate because basically seaweed flour has its own scent which was fishy. The scent of seaweed flour that added to the chocolate dough can be camouflaged by the aroma of cocoa powder. The more levels of seaweed flour are added to the stronger chocolate dough the stronger seaweed aroma will be caused, therefore the best concentration of seaweed flour is by 5%, it is evidenced by the level of its acceptance reached an average of 7.

C. Taste

The taste is the most important characteristic of the organoleptic properties of a product. The factors affecting the taste of chocolate derived from alkaloid components such as theobromine, caffeine, phenolic components, pyrazine some peptides and free amino acids that provide a balanced combination of flavors bitter, sour and sweet on chocolate[5]. Chocolate is identical with sweetness[18]. The results of statistical calculations on Table 4 were shown an average taste assessment of the addition of seaweed flour in milk Chocolate bar.

Table 4. Average of Milk Chocolate Bar Taste

Concentrations of seaweed flour (%)	Median	Average
0	7	5,9 a
5	**7**	**6,2 a**
10	5	6,0 a
15	6	5,2 a

Description: The average number of treatments followed by the same letter Shown unsignificant difference according to 5% level.

Taste assessment was done by tasting directly milk chocolate bar. Based on a panelist assessment of milk Chocolate bar obtained median value 5 to 7. Statistical test results state that every chocolate treatment tends to be liked by panelists. Milk chocolate bar that added seaweed flour by 5% gives the highest average value of 6.2 with the most preferred flavor among other treatments.

This value was even better than the control value that has been accepted by the community with an average by 5.9. The lowest average value was at 15% treatment with a value of 5.2 that was not too significant from other values, therefore it can be stated that all treatments do not show real different results between one treatment and another treatment. It means that each treatment was still acceptable by the panelist. Unsignifican difference teste of milk chocolate bar was due to the number of seaweed flour could not dominate another ingredients of milk chocolate bar.

D. Texture

The texture can be detected by the sense of touch. The assessment of the aspect of the texture is not only felt by the sense of the touch but as well as by eating it directly[15]. The results of statistical calculations on Table 5 were shown an average texture assessment of the addition of seaweed flour in milk chocolate bar.

Table 5. The Average Value of Texture of Milk Chocolate Bar

Concentrations of seaweed flour (%)	Median	Average
0	7	**6,8 a**
5	6	6,1 a
10	5	6,0 a
15	5	5,2 a

Description: The average number of treatments followed by the same letter Shown unsignificant difference according to comparison test 5% level.

The good chocolate has a soft texture that can melt gently in the mouth with good taste. From the test results of milk chocolate statistics based on the results of the panelist assessment, there was no significant difference. As on the median value of the textures range from 5 (neutral/Ordinary), 6 (likes) and 7 (likes). The texture of the milk chocolate bar with control treatment or 0% has the highest average value of 6.8. The texture of the milk chocolate bar with the addition of seaweed flour by 15% has the lowest average value of 5.2 with a slightly rough flavor.

The rough texture in the product was caused by seaweed flour due to the existence of coarse fibers[14]. That was because seaweed flour cannot be mashed like wheat flour or rice flour. Seaweed flour was smooth when it dry but will rise and form small circles when it encounters with other substances that cause rough on the tongue. The coarse fiber found in seaweed affects the texture of the product.

Statistical test mentions the assessment of panelists to preference of the texture of milk chocolate bar, shows that panelist tends to like the texture of the milk chocolate bar with control treatment. That was because the higher concentrations of seaweed flour on the product

has ben increasing rough part on the tongue[18]. The softness of chocolate was not only seen from conching because the conching process of homemade chocolate will not be as smooth as conching chocolate in the factory[27].

3.2 Decision-making with *Bayes* Method

Decision making to the value of alternative weights and the criteria of the appearance, aroma, taste, and texture of milk chocolate bar was done by pairwise comparison. The calculation result of the weight of the milk chocolate bar criterion presented in Table 6.

Table 6. The weight value of milk chocolate bar criteria

Criteria	Value
Appearance	0.15
Smell	0.09
Taste	**0.47**
Texture	0.28

Based on the calculation of the weight of the criteria, aroma, texture, and taste milk chocolate bar obtained the result the taste criterion has the highest value with a criterion weight value of 0.47. Furthermore followed by the texture parameter was with a criterion weight value of 0.28 and the weight value of the criteria of the appearance and aroma of 0.15 and 0.09. This indicated that the criteria most influential taste of milk chocolate bar assessment. It generally refers to the bitter after taste of the cocoa powder. The taste caused by foodstuffs is from the process of manufacturing which can be reduced or increased[18]. It showed that even to the other assessments ware good as if the flavor of the milk chocolate bar was not prepared by panelist so that the product cannot be accepted properly.

The calculation results of the weight of the criteria and determination of the best treatment by considering the criteria, appearance, aroma, taste, and texture of the milk chocolate bar presented in Table 7

Table 7. The Decision Matrix For the Milk Chocolate bar Assessment Bayes Method

Treatment	Criteria				Alternate	Priority
(%)	Appearance	Aroma	Taste	Texture	value	value
0%	5	7	7	7	6	**6.72**
25%	10	7	7	7	5	6.43
50%	15	7	5	5	5	5.30
75%	Control	7	7	6	7	6.53
Weight	Weight	0.15	0.09	**0.47**	0.28	24.98

Based on the calculation with the method Bayes obtained that the result of milk chocolate bar with the addition of seaweed flour by 5% had the highest alternative value of 6.72, followed by 0% that has a value of 6.53 in addition 10 % of 6.34 and 15% increase by the lowest alternative value of 5.30%. Milk chocolate bar given the addition of 5% seaweed flour is the most preferred milk chocolate bar by panelists.

3.3 Chemical characteristics

Chemical characteristics are observation parameters that determine the quality of a food product. The chemical parameters measured in this study were moisture content and fiber levels

A. Water content

Tabel 8. Water Content Milk Chocolate Bar

No	Treatment	Water Content (%)
1	0%	1,66
2	5%	2,10

The water content of milk chocolate bar to 2% maximum[17]. Water content on milk chocolate bar control produced by 1.66 and the water content of milk chocolate bar that has been given the addition of seaweed flour by 5% is 2.1. There was carrageenan in seaweed flour that has a character to bind water stronger so water it was not easy to be opened[26]. The addition of seaweed flour affects the appearance and texture of the milk chocolate bar, the higher the addition of seaweed flour texture and appearance the more it looks flabby do to an overwater content.

B. Fiber levels

The addition of seaweed flour can increase the content of food fiber in the final product, so milk chocolate with the addition of seaweed flour can be used as a food fiber source. Results of the analysis of fiber content of milk chocolate bar that was selected showed that the addition of seaweed eucheuma cottonii flour can increase the fiber levels in milk chocolate bar. The fiber content in the milk chocolate bar was from seaweed flour. The result of the observation of fiber content in milk chocolate bar is presented in Table 9.

Tabel 9. Fiber content of milk chocolate bar

No	Treatment	Fiber Content (%)
1	0%	1,32
2	5%	8,65

The fiber that contained in milk chocolate bar with the addition of seaweed flour by 5% had a fiber content of 8.65%, other than that the fiber content without the addition of seaweed flour contained 1.32% of fiber. It happened because seaweed flour was added less than 10%.

According to instructions from the Department of Nutrition, Ministry of Health and Institute of Health Singapore (1999) in Supriadi (2014), a product can be claimed as a source or contain food fiber if the content of fiber ≥3 grams per 100 grams of product (in solid form) or 100 ml (in liquid form). According to that, a milk chocolate bar can be claimed as a source of food fiber.The higher crude fiber content usually contains low calories, low-fat content, and low sugar content that can help reduce the occurrence of obesity and constipation[7]. Fibers can help and accelerate food scraps out through the gastrointestinal tract.

3.3 Overall Observation Result

The overall observation of a milk chocolate bar that has been researched based on the addition of seaweed flour presented in Table 10

Table 10. Overall Observation Result of *milk chocolate bar*

Parameters	Average Seaweed Flour Addition Treatment			
	0%	5%	10%	15%
Hedonic test				
Appearance	6,9 a	**7,0 a**	6,8 a	6,1 a
Aroma	6,1 ab	**7b**	6,8 b	5,1 a
Texture	**6,8 a**	6,1 a	6,0 a	5,2 a
Taste	5,9 a	**6,2 a**	6,0 a	5,2 a
Alternate values	6,43	**6,72**	5,30	6,53

Moisture content	1,66	2,10	-	-
Fiber Content	1,32	**8,65**	-	-

Based on the results of the overall observation milk chocolate bar with the addition of seaweed flour added treatment by 5% was the chosen product that is preferred by panelist. Results of bayes showing milk chocolate bar treatment with 5% of seaweed flour had the highest alternative value compared with other treatment by 7.05 with the most influential criteria to the assessment milk chocolate bar.

From the appearance criteria, the 5% treatment was the most preferred treatment by panelists. The greater addition of seaweed flour concentration the more decreasing as well as of level of the panelist in the milk chocolate bar. Milk chocolate bar manufacturing had the best texture in control treatment, this was due to the addition of seaweed flour can affect the organoleptic properties of the product. The greater concentration of seaweed flour added on the making of milk chocolate bar, the more texture of chocolate changed to slightly softened. The factors that can affect whether the product was in the process of ingredient mixing the used and the absence of emulsifier [27]. Seaweed flour that contained in milk chocolate bar was as emulsifier ingredient that can affect the texture of milk chocolate bar. It was caused by seaweed flour that has a large water-binding capacity[6]. The higher water content in milk chocolate bar products will cause unsolid texture that softened the product.

In the aroma criteria, the best assessment was found in the addition of seaweed flour by 5%. The distinctive and attractive aroma can make the food more preferred by consumers so it was important in the processing of food[27]. The addition of seaweed flour with a concentration of 15% has signigficant difference because the aroma of seaweed flour had a distinctive aroma so that it gave the effect towards aroma but the aroma that is caused by seaweed flour Can be covered by the aroma of cocoa powder. The aroma of chocolate is determined by cocoa powder[18].

The taste is very difficult to understand scientifically because of human tastes are very diverse [7]. The 5% treatment of taste criteria was the most preferred treatment by panelists, the higher concentration of seaweed flour added, the more level of panelist's preference was reduced. This is due to the amount of addition ingredient which is seaweed flour that can change the flavor of chocolate.

Based on the research that has been done previously the level of preference gained in each treatment tends to be the same, but the best treatment was 5% addition. Since the most favorite levels and the use of 5% seaweed flour is considered the most efficient than other treatments. It seen from the higher addition of seaweed on the milk chocolate bar will be as high as the cost incurred.

From water and fiber content analysis to the selected treatment of 5% and 0% (control). The 5% treatment has the higher water content and fiber content, that was due to the content of fiber contained in seaweed flour added containing high fiber. The result is not seen far because seaweed flour added in milk chocolate bar did not surpass 10% so that the results are not significant.

4. CONCLUSION

Based on the results of the study it concluded that the additional treatment of seaweed flour on the milk chocolate bar with a concentration of 5% was the most preferred treatment by panelists with a value of 7.0, Aroma 7.0, texture 6.1, flavor 6.2, content water 2.10% and fiber 8.65%.

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