Original Research Article

NORI LEVEL OF PREFERENCE WITH MIXED *Sargassum sp.* and *Eucheuma spinosum* SEAWEED AS RAW MATERIAL

ABSTRACT

The aim of this research was to obtain the best nori from a mixture of *Sargassum sp* and *Eucheuma spinosum* seaweed and the most preferred by panelists. The research's method used in this study is an experimental method with 3 treatments comparing the seaweed between *Sargassum sp.* and *Eucheuma spinosum* that is 1:1, 2:1, 3:1 then tests that used are hedonic test with 20 semi-trained panelists who have experience in organoleptic assessment as replications, physical and chemical tests were also tested for the best treatment according to hedonic test. This research was conducted at the Fisheries Product Processing Technology Laboratory of the Faculty of Fisheries and Marine Sciences, Universitas Padjadjaran, while the chemical and physical testing of the final results of the research was conducted at the Laboratory of Biological Resources and Biotechnology at LPPM Institut Pertanian Bogor. This research was conducted on February 28, 2019 until March 8, 2019. Based on the results of the research level of preference of nori, it was found that all treatments carried out were still acceptable to the panelists, but the treatment with a ratio of 1: 1 was more preferred by panelists. Chemical characteristics of the Sargassum sp. and Eucheuma spinosum, namely water content contained in the amount of 15.67%, crude fiber content of 11.7% and physical characteristics of hardness of 300.78 gf, also thickness with nori 0.347 mm.

Keywords: *Eucheuma spinosum, Hedonic test, Nori, Sargassum sp., Seaweed*

1. INTRODUCTION

Nori is a food made from seaweed (usually red or brown seaweed) that is dried or baked (Giury 2006 in Lalopua 2017). Nori is an authentic Japanese food from a group of marine vegetables that are rich in nutritional sources such as: protein, minerals, crude fiber and vitamins needed by the body. Processed seaweed also contain several essential amino acids such as glutamate, glycine and alanine which play a role in creating a distinctive taste of nori and iodine minerals needed for normal functioning of the thyroid gland in the body (Winarno 1996). In addition to being consumed directly as a snack, nori is also used as a decoration and flavoring for various dishes (Lalopua 2017). Nori in Indonesia is much needed, especially in Chinese and Japanese restaurants that serve ready-to-serve menus that use Nori as flavoring and to add aesthetic value to the food (Sinaga 2018). The raw material that usually used to make nori, *Porphyra sp*. is not found in Indonesia because *Porphyra sp.* only grows in subtropical waters (Loupatty 2014), therefore, it is necessary to have alternative materials that can replace seaweed

both in terms of nutritional value and in terms of availability of ingredients in tropical Indonesia.

New innovations that can be developed in making nori are by looking at the similarities in physical characteristics between nori and edible films, especially in terms of shapes in the form of sheets (Riyanto, Wini and Lianny, 2014). The research conducted by Hasanah (2007) in Ihsan (2016), made nori from *Gelidium sp.* flour jelly and succeeded in resembling sheet nori with edible film techniques. Visual characteristics similar to sheet nori are an inspiration to develop nori from many types of seaweed that are widely distributed in Indonesian waters such as *Sargassum sp* (Handayani et al. 2004) and *Eucheuma spinosum* (Wahyuni 2016). Both *Sargassum sp.* and *Eucheuma spinosum* also has nutrition value parallel to *Porphyra sp.* (Sormin 2011). The aim of this study was to obtain the best nori from a mixture of *Sargassum sp* and *Eucheuma spinosum* seaweed and the most preferred by panelists. The results of this study are expected to provide information about the comparison of the mixture of *Sargassum sp.* and *Eucheuma spinosum* which is the best and preferred in making nori based on organoleptic characteristics, increasing the diversity of processed seaweed in Indonesia, and increasing the economic value of seaweed in Indonesia.

2. MATERIALS AND METHOD

2.1 Time And Place of Research

Research on the production of nori and organoleptic tests was carried out at the Fisheries and Marine Sciences and Fisheries Science Processing Technology Laboratory of the Universitas Padjadjaran, while the chemical and physical testing of the final results of the research was conducted at the Biological Recourses Research and Biotechnology Laboratory LPPM Institut Pertanian Bogor. This research was conducted on February 28, 2019 until March 8, 2019.

2.2 Tools and Material

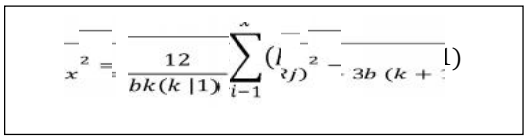
The tools used in this research are basin (3 liters) as a container for storing and washing the seaweed, blender to make puree seaweed, baking pan (17 cm x 23 cm) for baking container, electric scales with a precision of 0.01 gram to measure the spices, measuring cup (10 mL) to measure sesame oil, olive oil and fish sauce, oven for baking nori, spoon to stir and flatten the nori dough, spatula to even out nori dough beaker glass (80 mL) to measure the volume of nori dough, label stickers for labeling samples. While the material used are dried *Sargassum sp.* and *Eucheuma spinosum* (Indonesian standard: SNI 2690:2015), clean water, rice, sugar, salt, flavoring, pepper, sesame oil, olive oil, and fish sauce.

2.3 Observation Parameters

The observed parameters used are hedonic, physical test and chemical test. Organoleptic test aims to determine the appearance, aroma, taste and texture produced based on the level of preference (Jauzak 2012). Physical Test aims to determine the thickness and flexibility or attraction. Furthermore, the chemical test aims to determine the water content and the level of crude fiber contained in the nori product. The method used for chemical testing are reffering to SNI 1992 01-2891 for crude fiber test, SNI 01.2354.2-2006 for water content test, while the physical tests are reffering to Faridah et al. (2014).

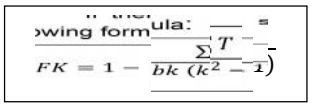
2.4 Data Analysis

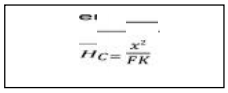
Non-parametric analysis performed for organoleptic testing using a two-way analysis of the Friedman test using the Chi-square test. The statistical formula used in the Friedman test is as follows (Sudrajat 1999):



Rj = Total ranking of each treatment

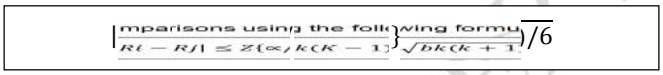
If there is the same number, a correction factor (FK) is calculated using the following formula:





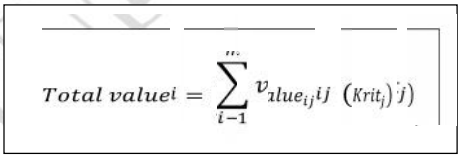
Information :
T = N (t3-t)
t = The same number of observations for one rank.
N = The same number of observations for a number with the same value of t.

Multiple Comparisons using the following formula (Sudrajat 1999):



Information :
Ri - Rj = Difference in average rank
Ri = Average rating of the i sample
Rj = Average rating of the j sample
α = Experiment wise error
b = Number of data
k = Number of treatments
Z = Value in table Z for multiple comparison

Bayes Equation :



Information :
Total value = Total final value of alternative to - i
Value = alternative value to - i in the criteria to j
Kritj = Level of importance (value) criteria to - j
i = 1,2,3, ... n; n = number of alternatives
j = 1,2,3, ... n; n = number of criteria

2.5 Experimenrimentation Process

The following is a research procedure that has been modified from previous research inTeddy (2009) in the preliminary test:

1. Preparation of ingredients, *Sargassum sp*., *Eucheuma spinosum*, salt, sugar, flavorings, pepper, sesame oil, olive oil, and fish sauce.
2. *Sargassum sp.* and *Eucheuma spinosum* is cleaned from dirt using clean water
3. Seaweeds are then soaked using rice water for 24 hours with a ratio of 1:3 beetwen seaweed and rice water
4. The seaweeds are again soaked in clean water for 48 hours with the same ratio and the water is replaced every 24 hours
5. Sugar, salt, flavor, and pepper are then weighed. Sesame oil, olive oil, and fish sauce are measured in accordance with the nori formula according to the table below

Table 1. Seasoning Formula for Making Nori

Bumbu	Persentase yang digunakan
Salt	0,7%
Sugar	1%
Flavoring	0,3%
Pepper	0,3%
Sesame oil	2 mL
Olive oil	2 mL
Fish sauce	3,4 mL

6. Next is the mixing of *Sargassum sp*. and *Eucheuma spinosum* uses a blender according to the following treatment: 1:1, 2:1, and 3:1
7. The seaweed that has been mixed according to the treatment is blended for 3 minutes to become puree
8. Puree is then cooked over medium heat for 5 minutes while adding the spices that have been weighed
9. Cooked puree is measured as much as 60 mL using a measuring cup then printed into a baking pan and leveled and arranged in thickness
10. Puree that has been printed on the baking pan is baked using oven with a temperature of 70ºC for 180 minutes
11. Then carried out observations with hedonic tests with 20 semi-trained panelists and then carried out chemical tests and physical tests.

3. RESULT AND DISCUSSION

3.1 Hedonic Test

Hedonic test or preference test is one type of testing that aims to determine the level of preference of a panelist for a product. The parameters tested included the appearance, aroma, texture, and taste of the mixed mixture of Sargassum sp. and Eucheuma spinosum. The observation resultsof these parameters are as follows

Table 2. Average Appearance of Nori Based on Comparative Differences Sargassum sp. and Eucheuma spinosum

Sargassum dan *E. spinosum*	Median	Average
1:1	7	7,4 b
2:1	5	5,1 a
3:1	5	5,1 a

Description: The number followed by the same letter shows no significant difference according to F test at the error level of 5%

The 1:1 treatment has a blackish brown appearance with fibers that look not too dense but evenly distributed and the surface is flat and thin. While the treatment of 2:1 has a blackish brown appearance that is more concentrated than the ratio of 1: 1, while the seaweed fibers in this treatment are quite dense but not evenly distributed but still have a fairly flat and thin appearance. The 3: 1 treatment has a brownish-black appearance but has uneven and very dense seaweed fibers but the surface of the nori in this treatment is slightly broken in several parts. The presence of cracked surfaces in the treatment with a ratio of 3: 1 was due to the lack of gel content as a form of the texture of *Eucheuma spinosum* compared to 1: 3 with Sargassum sp. so that a broken surface forms on some surfaces of nori with this treatment. This is consistent with Sidi's statement (2014) that the addition of carrageenan to form a gel as a texture can affect significantly the texture of the product in the form of sheets.

Fig 1. Appearance of Nori with Comparative Differences Sargassum sp. and Eucheuma spinosum, 1: 1 (Left), 2: 1 (Middle), 3: 1 (Right)

Lalopua (2017) stated that uneven nori color is caused by a lack of stirring or mixing the mixture well before pouring it into the mold. Lalopua (2017) also stated that the color of nori relies heavily on the color pigments of seaweed used for the manufacture of nori, from his research which made artificial nori from seaweed *Ulva spp.* and *Hypnea saidana* has different colors according to the color pigments of seaweed used. Blackish brown color from nori made from a mixture of *Sargassum sp.* and *Eucheuma spinosum* comes from the *Sargassum sp.* pigment of dark brown that is xanthophyll, while the white Eucheuma spinosum does not provide additional color to the end result of this mixture (Anton 2017).

The results of statistical tests using the Friedman method show that the mixing treatment of 1: 1 has a significant difference to the appearance of nori from a mixture of seaweed *Sargassum sp.* and *Eucheuma spinosum* with other treatments, meaning that this treatment has an effect on the preference of the panelists on the appearance of the nori when compared with other treatments. While the mixing treatment of 2: 1 and 3: 1 did not have a significant difference, meaning mixing *Sargassum sp.* and *Eucheuma spinosum* with such comparisons does not affect panelists' preference for appearance of nori. The results of the Friedman test also show that the treatment of 1: 1 has the appearance that is most preferred by panelists with a median number of 7 while treatment for 2: 1 and 3: 1 has a median value of 5, which means the panelists do not really like the appearance of those two treatments.

Table **3. Average Aroma of Nori Based on Comparative Differences *Sargassum sp.* and *Eucheuma spinosum***

Sargassum* dan *E. spinosum	**Median**	**Average**
1:1	7	6,4 a
2:1	5	5,2 a

Sargassum dan *E. spinosum*	Median	Average
3:1	5	5,3 a

Description: The number followed by the same letter shows no significant difference according to F test at the error level of 5%

The difference in mixing between seaweed *Sargassum sp.* and *Eucheuma spinosum* does not affect the aroma of this nori mixture, some aromas on nori are produced from spices that have a distinctive aroma such as fish sauce, sesame oil, and olive oil which are mixed when making the nori so that the distinctive aroma of seaweed is covered because previously most of the distinctive aroma of seaweed has been removed in the process of soaking using rice water (Putri and Ningtyas, 2017). This is in accordance with Hendrastry's statement (2003) which stated that the process of aroma formation occurs when mixing all ingredients including spices that have a distinctive aroma.

Nori from a mixture of *Sargassum sp.* and *Eucheuma spinosum* which does not affect the aroma of the nori is reinforced by the results of the Friedman statistical test which shows that the three treatments did not have a significant difference at the 5% error level where the ratio of total ranking between treatments was not higher than the final Friedman test result which means no there is a significant difference between the differences in the comparison of *Sargassum sp.* and *Eucheuma spinosum* to the aroma of nori.

Table 4. Average Nori Texture Based on Comparative Differences *Sargassum sp.* and *Eucheuma spinosum*

Sargassum dan *E. spinosum*	Median	Average
1:1	7	7,1 b
2:1	7	6,1 ab
3:1	5	5,2 a

Description: The number followed by the same letter shows no significant difference according to F test at the error level of 5%

The difference in the ratio of mixing between the two seaweeds provides a different texture both in the texture of drought or crispness of the nori and the flexibility of nori. According to Zakaria et al. (2017) the more dough used in making nori, the thicker, heavier, and not crisper will be. This statement is proven by the increasing number of *Sargassum sp.* added to the dough the nori crispness decreases. The crispness of the product is also influenced by the water content of the sample. Increased thickness of nori dried at the same temperature and time contains higher water content. Product crispness decreases with increasing product water content (Cauvain and Young 2008). Beckett (1995) also explained that the biggest component of food is water (55-85%), so that the component is the main factor that will affect the structure and texture of foodstuffs processed. The formation of nori sheets occurs when the water content in the nori is reduced so that the water content does not dominate the gel and fiber content in nori. Therefore the formation of texture in thicker nori is due to the addition of more dough which causes the nori with the treatment of 3: 1 and 2: 1 which have similar texture not crisper compared to the treatment of 1: 1 which has a thin and crispy texture.

Flexibility is another factor besides crispness that is considered in this texture parameter. In this case, the treatment of 1:1 and 2:1 has a fairly high flexibility, so that

the nori can be rolled or folded without causing damage to the appearance of the nori, while in the 3: 1 treatment the texture of the nori is slightly stiff even though it is still flexible . This explains that the more the percentage of *Eucheuma spinosum* added to the mixture, the higher the flexibility than nori.

The Friedman test results on these three treatments of texture are quite preferred and / or can still be accepted by the panelists, this can be seen from the median value of each treatment more than 5. It is also obtained from the results of Friedman's test that 1: 1 treatment has a real difference to the treatment of 3:1, while treatment 2:1 did not have a significant difference both in treatment 1:1 and 3:1 in the texture parameters of nori.

Table 5. Average Nori Taste Based on Comparative Differences Sargassum sp. and Eucheuma spinosum

Sargassum* dan *E. spinosum	**Median**	**Average**
1:1	7	7,2 b
2:1	5	5,3 a
3:1	5	4,7 a

Description: The number followed by the same letter shows no significant difference according to F test at the error level of 5%

Addition of more *Sargassum sp*. the dough gives a different taste, the 1:1 treatment has a savory taste, but it still feels the distinctive taste of seaweed also has a slightly bitter after taste. Whereas the 2:1 treatment had a slightly more bitter after taste compared to 1:1 treatment and the 3:1 treatment had even more bitter after taste and not as savory as other treatments. The bitter after taste is distinctive taste from seaweed that containing glutamate, glycine and alanine (Winarno 1996).

The results of statistical tests using the Friedman method show that the difference in the ratio of seaweed made by nori has a significant difference. Treatment with a ratio of 1: 1 seaweed has a different and higher median value than treatment 2:1 and 3:1, therefore the nori with a ratio of 1:1 seaweed is preferred by panelists. The results of the follow-up test showed that treatment 2: 1 and 3: 1 did not show a significant difference in the 5% error rate of the mixed flavor parameters of *Sargassum sp.* and *Eucheuma spinosum*.

3.2 Decision Making with The Bayes Method

Decision making by looking at the relative weight values of the appearance criteria, aroma, texture, and taste of *Sargassum sp.* and *Eucheuma spinosum* is done by pairwise comparisons by changing the comparison in pairs with a set of numbers that present the relative priorities of the criteria and alternatives (treatment).

Table 6. Weight Value of the Nori Criteria Based on Comparative Differences *Sargassum sp.* and *Eucheuma spinosum*

Criteria	**Weight Value**
Apperance	0,153
Aroma	0,125
Texture	0,142
Taste	0,580

The table above shows the results of the calculation of the weighting criteria of the appearance, aroma, texture, and taste of *Sargassum sp.* and *Eucheuma spinosum*. From the table above, it can be seen that the highest criterion weight is in the taste criteria, which means that the taste criteria are the most important criteria according to the panelists with a weighting criteria of 0.580 followed by the appearance criteria with criteria weight 0.153, then texture with 0.142, and finally aroma with 0.125 . These results indicate that if the flavor of the mixture is nori Sargassum sp. and this Eucheuma spinosum is not liked by the panelists, so the nori product will be rejected by the panelists.

The Bayes method is one method used to carry out analysis in the best decision making from a number of alternatives or treatments taking into account the criteria. The calculation results in determining the best treatment taking into account the appearance criteria, aroma, texture, and taste of Sargassum sp. and Eucheuma spinosum are presented in Table 6

Table 7. Assessment Decision Matrix of *Sargassum sp.* and *Eucheuma spinosum* with the Bayes Method

	Criteria				Alternative	
Treatments	**Apperance**	**Aroma**	**Texture**	**Taste**	**value**	**Ranking**
1:1	7	7	7	7	**7,00**	**1**
2:1	5	5	7	5	5,28	2
3:1	5	5	5	5	5,00	3
Weight Value	0,15	0,12	0,14	**0,58**		

The results of the calculation of alternative values to determine which treatment is the best treatment and the preferred panelists indicate that the treatment with a ratio of 1: 1 seaweed has the highest alternative value, 7 then followed by a treatment ratio of 2: 1 seaweed with an alternative value of 5.28 and the last treatment is a ratio of 3: 1 with an alternative value of 3: 1. These results indicate that the comparison of Sargassum sp. and 1: 1 Eucheuma spinosum is the best and most preferred treatment by panelists.

3.3 CHEMICAL TEST

3.3.1 Water Content

Testing the water content in the best treatment, namely treatment with a comparison between seaweed Sargassum sp. and Eucheuma spinosum 1: 1 produced water content in the nori of 15.67%. Water content contained in the mixture of *Sargassum sp.* and *Eucheuma spinosum* is lower than commercial nori made from the type of seaweed *Porphyra sp.* mentioned in the study conducted by Lalopua (2017) which has a water content of 16.09% and from nori made from *Gracillaria sp.* which was examined by Teddy (2009) which contained water content of 17.17%. Less water content in nori from a mixture of *Sargassum sp.* and *Eucheuma spinosum* shows that nori made from this material has a higher crispness, this is in accordance with the statement from Andarwulan et al. (2011) which states that the lower the water content, the higher the crispness of nori and conversely the higher the water content, the lower the crispness of nori.

3.3.1 Crude Fiber Content

Crude fiber content in the best treatment of mixed nori from *Sargassum sp.* and *Eucheuma spinosum* is 11.7%. The fiber content in the nori of the seaweed mixture is quite high when compared to the nori of the *Hypnea saidana* type studied by Lalopua (2017), whose crude fiber content is only 4.09%. According to Lalopua (2017), foods with relatively high crude fiber content usually contain low calories, low sugar and fat levels which can prevent obesity and heart disease. Foods with high crude fiber content are reported to reduce weight. The main role of fiber in food is in its ability to bind water, cellulose and pectin (Putri, 2011). With the presence of fiber can help speed up food debris through the digestive tract to be excreted out. Without the help of fiber, feces with a low water content will stay longer in the intestinal tract and experience difficulty through the intestine to be excreted because the large intestine peristalic movements are slower (Lalopua 2017).

3.4 Physical Test

3.4.1 Hardness

Praphesti (2017) stated that the smaller the value of hardness in a product, the higher the crispness of the product, so the force needed to break and tear the product will also be low. The hardness value of *Sargassum sp.* and *Eucheuma spinosum* measured using the TA-XT2i Stable micro-system with a probe of 0.25 s, amounting to 300.78 gf, this value is quite low compared to commercial nori which has a hardness value of 408 gf (Zakaria et al. 2017) but still more high from nori made from Gracillaria sp. and Ulva lactula which has a hardness value of 282.56 gf (Praphesti 2017).

Low hardness in *Sargassum sp.* and *Eucheuma spinosum* is caused because the nori has a low water content, because according to Zakaria et al. (2017) texture hardness is influenced by the water content contained in the product, an increase in water content causes an increase in hardness in food products. While the reason why hardness from *Sargassum sp.* and *Eucheuma spinosum* is higher than nori *Gracillaria sp*. *Ulva lactula* is caused due to crude fiber content in *Sargassum sp*. and *Eucheuma spinosum* is higher than that of *Gracillaria sp* and *Ulva lactula*. This is consistent with the statement of Cofradez (2000) which states that fiber content in food products can increase product hardness.

3.4.2 Thickness

The results of thickness measurements from *Sargassum sp.* and *Eucheuma spinosum* which uses a screw micrometer is 0.347 mm. Thickness value in *Sargassum sp.* and *Eucheuma spinosum* is quite high when compared to the commercial nori thickness of 0.224 mm. Nori thickness has an influence on the drying time and product crispness. The more amount of dough used produces inori which is thicker, heavier and not crispy (Cauvain and Young 2008).

4. CONCLUSION

Based on the results of the study the level of preference seen from the comparison of the composition of nori between seaweed *Sargassum sp.* and *Eucheuma spinosum*, it was found that all treatments carried out were still acceptable to panelists, but treatment with a ratio of 1: 1 was preferred by panelists. Chemical characteristics of the *Sargassum sp.* and *Eucheuma spinosum*, namely water content contained in the

amount of 15.67%, crude fiber content of 11.7% and physical characteristics of hardness of 300.78 gf, also thickness with nori thickness of 0.347 mm.

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