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3 **NORI LEVEL OF PREFERENCE**

4 **WITH MIXED *Sargassum sp.* and *Eucheuma***

5 ***spinosum* SEAWEED AS RAW MATERIAL**

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9 **ABSTRACT**

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

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

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32 **1. INTRODUCTION**

33 Nori is a food made from seaweed (usually red or brown seaweed) that is dried
34 (2006 Giury in Lalopua 2017). Nori is an authentic Japanese food from a group of marine
35 vegetables that are rich in nutritional sources such as: protein, minerals, crude fiber and
36 vitamins needed by the body. Processed seaweed also contain several essential amino
37 acids such as glutamate, glycine and alanine which play a role in creating a distinctive
38 taste of nori and iodine minerals needed for normal functioning of the thyroid gland in the
39 body. In addition to being consumed directly as a snack, nori is also used as a
40 decoration and flavoring for various dishes (Lalopua 2017). Nori in Indonesia is much
41 needed, especially in Chinese and Japanese restaurants that serve ready-to-serve
42 menus that use Nori as flavoring and to add aesthetic value to the food (Sinaga 2018).

43 New innovations that can be developed in making nori are by looking at the
44 similarities in physical characteristics between nori and edible films, especially in terms
45 of shapes in the form of sheets (Riyanto, Wini and Lianny, 2014). The research

46 conducted by Hasanah (2007) in Ihsan (2016), made nori which was given spices and
47 baked from flour jelly from *Gelidium sp.* and succeeded in resembling sheet nori with
48 edible film techniques. Visual characteristics similar to sheet nori are an inspiration to
49 develop nori from many types of seaweed that are widely distributed in Indonesian
50 waters such as *Sargassum sp* and *Eucheuma spinosum*. The aim of this study was to
51 obtain the best nori from a mixture of *Sargassum sp* and *Eucheuma spinosum* seaweed
52 and the most preferred by panelists. The results of this study are expected to provide
53 information about the comparison of the mixture of *Sargassum sp.* and *Eucheuma*
54 *spinosum* which is the best and preferred in making nori based on organoleptic
55 characteristics, increasing the diversity of processed seaweed in Indonesia, and
56 increasing the economic value of seaweed in Indonesia.

57

58 2. MATERIALS AND METHOD

59 2.1 Time And Place of Research

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

66 2.2 Tools and Material

67 The tools used in this research are basin, blender, baking sheet, mass electric
68 scale, measuring cup, oven, spoon, spatula, beaker glass, and label sticker. While the
69 material used is seaweed type *Sargassum sp.* and *Eucheuma spinosum*, clean water,
70 rice, sugar, salt, flavoring, pepper, sesame oil, olive oil, and fish sauce.

71 2.3 Observation Parameters

72 The observed parameters used are hedonic, physical test and chemical test.
73 Organoleptic test aims to determine the appearance, aroma, taste and texture produced
74 based on the level of preference. Physical Test aims to determine the thickness and
75 flexibility or attraction. Furthermore, the chemical test aims to determine the water
76 content and the level of crude fiber contained in the nori product. The method used in
77 physical and chemical testing is the method of Biological Resources Research and
78 Biotechnology Laboratory LPPM Institut Pertanian Bogor.

79 2.4 Data Analysis

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

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$$\chi^2 = \frac{12}{bk(k+1)} \sum_{i=1}^k (T_i)^2 - 3b(k+1)$$

Information :

89 x = Friedman Test Statistics
 90 b = Repeation
 91 k = Treatment
 92 R_j = Total ranking of each treatment

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

95 The following formula:

$$FK = 1 - \frac{\sum T^2}{bk(k^2 - 1)}$$

$$H_C = \frac{x^2}{FR}$$

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

103 Multiple Comparisons using the following formula (Sudrajat 1999):

104 The following formula:

$$|R_i - R_j| \leq Z(\alpha, k)(k-1) \sqrt{bk(k+1)/6}$$

106 Information :
 107 R_i - R_j = Difference in average rank
 108 R_i = Average rating of the i sample
 109 R_j = Average rating of the j sample
 110 α = Experiment wise error
 111 b = Number of data
 112 k = Number of treatments
 113 Z = Value in table Z for multiple comparison

115 Bayes Equation :

116 The following equation:

$$Total\ value_i = \sum_{i=1}^n v_{value_{ij}} (Krit_j)_j$$

121 Information :
 122 Total value = Total final value of alternative to - i
 123 Value = alternative value to - i in the criteria to j
 124 Krit_j = Level of importance (weight) criteria to - j
 125 i = 1,2,3, n; n = number of alternatives
 126 j = 1,2,3, n; n = number of criteria

127 **3. RESULT AND DISCUSSION**

128 **3.1 Hedonic Test**

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

133 **Table 1. Average Appearance of Nori Based on Comparative Differences**
 134 **Sargassum sp. and Eucheuma spinosum**

<i>Sargassum</i> dan <i>E. spinosum</i>	Median	Average
1:1	7	7,4 b
2:1	5	5,1 a
3:1	5	5,1 a

135 Description: The number followed by the same letter shows no significant
 136 difference according to F test at the error level of 5%
 137

138 The 1:1 treatment has a blackish brown appearance with fibers that look not too
 139 dense but evenly distributed and the surface is flat and thin. While the treatment of 2:1
 140 has a blackish brown appearance that is more concentrated than the ratio of 1: 1, while
 141 the seaweed fibers in this treatment are quite dense but not evenly distributed but still
 142 have a fairly flat and thin appearance. The 3: 1 treatment has a brownish-black
 143 appearance but has uneven and very dense seaweed fibers but the surface of the nori in
 144 this treatment is slightly broken in several parts. The presence of cracked surfaces in the
 145 treatment with a ratio of 3: 1 was due to the lack of gel content as a form of the texture of
 146 *Eucheuma spinosum* compared to 1: 3 with *Sargassum* sp. so that a broken surface
 147 forms on some surfaces of nori with this treatment. This is consistent with Sidi's
 148 statement (2014) that the addition of carrageenan to form a gel as a texture can affect
 149 significantly the texture of the product in the form of sheets.
 150



151
 152 **Fig 1. Appearance of Nori with Comparative Differences *Sargassum* sp. and**
 153 ***Eucheuma spinosum*, 1: 1 (Left), 2: 1 (Middle), 3: 1 (Right)**

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

163 The results of statistical tests using the Friedman method show that the mixing
 164 treatment of 1: 1 has a significant difference to the appearance of nori from a mixture of
 165 seaweed *Sargassum* sp. and *Eucheuma spinosum* with other treatments, meaning that
 166 this treatment has an effect on the preference of the panelists on the appearance of the
 167 nori when compared with other treatments. While the mixing treatment of 2: 1 and 3: 1
 168 did not have a significant difference, meaning mixing *Sargassum* sp. and *Eucheuma*
 169 *spinosum* with such comparisons does not affect panelists' preference for appearance of
 170 nori. The results of the Friedman test also show that the treatment of 1: 1 has the
 171 appearance that is most preferred by panelists with a median number of 7 while

172 treatment for 2: 1 and 3: 1 has a median value of 5, which means the panelists do not
173 really like the appearance of those two treatments.

174 **Table 2. Average Aroma of Nori Based on Comparative Differences *Sargassum sp.***
175 **and *Eucheuma spinosum***

<i>Sargassum</i> dan <i>E. spinosum</i>	Median	Average
1:1	7	6,4 a
2:1	5	5,2 a
3:1	5	5,3 a

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

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

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

194 **Table 3. Average Nori Texture Based on Comparative Differences *Sargassum sp.***
195 **and *Eucheuma spinosum***

<i>Sargassum</i> dan <i>E. spinosum</i>	Median	Average
1:1	7	7,1 b
2:1	7	6,1 ab
3:1	5	5,2 a

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

198 The difference in the ratio of mixing between the two seaweeds provides a
199 different texture both in the texture of drought or crispness of the nori and the flexibility of
200 nori. According to Zakaria (2017) the more dough used in making nori, the thicker,
201 heavier, and not crisper will be. This statement is proven by the increasing number of
202 *Sargassum sp.* added to the dough the nori crispness decreases. The crispness of the
203 product is also influenced by the water content of the sample. Increased thickness of nori
204 dried at the same temperature and time contains higher water content. Product
205 crispness decreases with increasing product water content (Cauvain and Young 2008).
206 Beckett (1995) also explained that the biggest component of food is water (55-85%), so
207 that the component is the main factor that will affect the structure and texture of

208 foodstuffs processed. The formation of nori sheets occurs when the water content in the
 209 nori is reduced so that the water content does not dominate the gel and fiber content in
 210 nori. Therefore the formation of texture in thicker nori is due to the addition of more
 211 dough which causes the nori with the treatment of 3: 1 and 2: 1 which have similar
 212 texture not crisper compared to the treatment of 1: 1 which has a thin and crispy texture.

213 Flexibility is another factor besides crispness that is considered in this texture
 214 parameter. In this case, the treatment of 1:1 and 2:1 has a fairly high flexibility, so that
 215 the nori can be rolled or folded without causing damage to the appearance of the nori,
 216 while in the 3: 1 treatment the texture of the nori is slightly stiff even though it is still
 217 flexible . This explains that the more the percentage of *Eucheuma spinosum* added to
 218 the mixture, the higher the flexibility than nori.

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

226 **Table 4. Average Nori Taste Based on Comparative Differences *Sargassum sp.*
 227 *and Eucheuma spinosum***

<i>Sargassum dan E. spinosum</i>	Median	Average
1:1	7	7,2
2:1	5	5,3
3:1	5	4,7

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

230 Addition of more *Sargassum sp.* the dough gives a different taste, the 1:1
 231 treatment has a savory taste, but it still feels the distinctive taste of seaweed also has a
 232 slightly bitter after taste. Whereas the 2:1 treatment had a slightly more bitter after taste
 233 compared to 1:1 treatment and the 3:1 treatment had a slight taste like eating grass even
 234 though it was not like before adding *Eucheuma spinosum* as a texture forming in the
 235 preliminary test.

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

243 3.2 Decision Making with The Bayes Method

244 Decision making by looking at the relative weight values of the appearance
 245 criteria, aroma, texture, and taste of *Sargassum sp.* and *Eucheuma spinosum* is done by
 246 pairwise comparisons by changing the comparison in pairs with a set of numbers that
 247 present the relative priorities of the criteria and alternatives (treatment).
 248

249 **Table 5. Weight Value of the Nori Criteria Based on Comparative Differences
 250 *Sargassum sp.* and *Eucheuma spinosum***

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

251
252 The table above shows the results of the calculation of the weighting criteria of
253 the appearance, aroma, texture, and taste of *Sargassum sp.* and *Eucheuma spinosum*.
254 From the table above, it can be seen that the highest criterion weight is in the taste
255 criteria, which means that the taste criteria are the most important criteria according to
256 the panelists with a weighting criteria of 0.580 followed by the appearance criteria with
257 criteria weight 0.153, then texture with 0.142, and finally aroma with 0.125 . These
258 results indicate that if the flavor of the mixture is nori *Sargassum sp.* and this *Eucheuma*
259 *spinosum* is not liked by the panelists, so the nori product will be rejected by the
260 panelists.

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

266
267
268
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Table 6. Assessment Decision Matrix of *Sargassum sp.* and *Eucheuma spinosum* with the Bayes Method

Treatments	Criteria				Alternative value	Ranking
	Apperance	Aroma	Texture	Taste		
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		

270
271 The results of the calculation of alternative values to determine which treatment
272 is the best treatment and the preferred panelists indicate that the treatment with a ratio of
273 1: 1 seaweed has the highest alternative value, 7 then followed by a treatment ratio of 2:
274 1 seaweed with an alternative value of 5.28 and the last treatment is a ratio of 3: 1 with
275 an alternative value of 3: 1. These results indicate that the comparison of *Sargassum sp.*
276 and 1: 1 *Eucheuma spinosum* is the best and most preferred treatment by panelists.

277 3.3 CHEMICAL TEST

278 3.3.1 Water Content

279 Testing the water content in the best treatment, namely treatment with a
280 comparison between seaweed *Sargassum sp.* and *Eucheuma spinosum* 1: 1 produced
281 water content in the nori of 15.67%. Water content contained in the mixture of
282 *Sargassum sp.* and *Eucheuma spinosum* is lower than commercial nori made from the
283 type of seaweed *Porphyra sp.* mentioned in the study conducted by Lapoula (2018)
284 which has a water content of 16.09% and from nori made from *Gracillaria sp.* which was
285 examined by Teddy (2009) which contained water content of 17.17%. Less water

286 content in nori from a mixture of *Sargassum sp.* and *Eucheuma spinosum* shows that
287 nori made from this material has a higher crispness, this is in accordance with the
288 statement from Andarwulan et al. (2011) which states that the lower the water content,
289 the higher the crispness of nori and conversely the higher the water content, the lower
290 the crispness of nori.

291 **3.3.1 Crude Fiber Content**

292 Crude fiber content in the best treatment of mixed nori from *Sargassum sp.* and
293 *Eucheuma spinosum* is 11.7%. The fiber content in the nori of the seaweed mixture is
294 quite high when compared to the nori of the *Hypnea saidana* type studied by Lapoula
295 (2018), whose crude fiber content is only 4.09%. According to Lapoula (2018), foods with
296 relatively high crude fiber content usually contain low calories, low sugar and fat levels
297 which can prevent obesity and heart disease. Foods with high crude fiber content are
298 reported to reduce weight. The main role of fiber in food is in its ability to bind water,
299 cellulose and pectin. With the presence of fiber can help speed up food debris through
300 the digestive tract to be excreted out. Without the help of fiber, feces with a low water
301 content will stay longer in the intestinal tract and experience difficulty through the
302 intestine to be excreted because the large intestine peristaltic movements are slower
303 (Lapoula 2018).

304 **3.4 Physical Test**

305 **3.4.1 Hardness**

306 Praphesti (2017) stated that the smaller the value of hardness in a product, the
307 higher the crispness of the product, so the force needed to break and tear the product
308 will also be low. The hardness value of *Sargassum sp.* and *Eucheuma spinosum*
309 measured using the TA-XT2i Stable micro-system with a probe of 0.25 s, amounting to
310 300.78 gf, this value is quite low compared to commercial nori which has a hardness
311 value of 408 gf (Sajida 2016) but still more high from nori made from *Gracillaria sp.* and
312 *Ulva lactula* which has a hardness value of 282.56 gf (Praphesti 2017).

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

322 **3.4.2 Thickness**

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

329

330 4. CONCLUSION

331 Based on the results of the study the level of preference seen from the
332 comparison of the composition of nori between seaweed *Sargassum sp.* and *Eucheuma*
333 *spinosum*, it was found that all treatments carried out were still acceptable to panelists,
334 but treatment with a ratio of 1: 1 was preferred by panelists. Chemical characteristics of
335 the *Sargassum sp.* and *Eucheuma spinosum*, namely water content contained in the
336 amount of 15.67%, crude fiber content of 11.7% and physical characteristics of hardness
337 of 300.78 gf, also thickness with nori thickness of 0.347 mm.

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