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Sensory and chemical characteristics of nori from Indonesian seaweed added with breadfruit leaf extract and grass jelly

Ratna Sari Listyaningrum*, Iip Syarip Hidayatulloh

Food Technology, University of Muhammadiyah Bandung, Bandung, Indonesia

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ABSTRACT

Nori is an authentic Japanese food made from Porphyra seaweed. However, Porphyra is difficult to cultivate in Indonesia because it generally grows in subtropical areas. The demand for nori continues to increase with the development of Japanese, Korean, and Chinese fast-food restaurants in Indonesia. Therefore, it is necessary to make nori using seaweed easily cultivated in Indonesia, namely Eucheuma cottonii and Ulva lactuca. This research aimed to study the sensory and chemical characteristics of nori from Indonesian seaweed added with breadfruit leaf extract and grass jelly. Dried Eucheuma cottonii was obtained from LIPI Oceanography, while dried Ulva lactuca was obtained from waters in Sidoarjo. Dried breadfruit leaf used in this study were obtained from processing fresh breadfruit leaf from the yards of residents of the Babakan Penghulu Village, Cinambo District. Green grass jelly leaf were obtained from Andir. Three nori formulas were made, namely the addition of breadfruit leaf extract (200 ml), a combination of breadfruit leaf and grass jelly (100:100 ml), and the addition of grass jelly (200 ml). The sensory test is carried out using the hedonic test method with 30 untrained panelists. Panellists were asked for their responses regarding color, taste, texture, aroma, and total acceptance on a scale of 1-5, from very dislike to very like. Chemical testing includes water, ash, protein, fat, crude fiber, and antioxidant activity. The results show that the best formula is the one with the addition of breadfruit leaf extract, which gave an overall acceptance score of 3.37, water content of 5.26%, ash content of 2.41 %, fat content of 2.06%, protein content of 22.24%, starch content of 59.97%, and crude fiber of 6.65%, and antioxidant activity of 702.75 ppm. Nori using local Indonesian seaweed with the addition of breadfruit leaf extract can be an alternative to commercial nori.

* Corresponding author
Email : ratna.listyaningrum@umbandung.ac.id
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INTRODUCTION

Nori is a native Japanese food made from *Porphyra* seaweed (Teddy 2009). However, *Porphyra* is difficult to cultivate in Indonesia because it generally grows in subtropical areas. In Indonesia, *Porphyra* can be found on Ambon Island with the type *Porphyra marcosii* CORDERO smaller than *Porphyra* from subtropical regions (Hatta 1990). In fact, with the development of Japanese, Korean, and Chinese fast-food restaurants in Indonesia, the need for nori continues to increase. As nori can also be used as a snack flavor, Indonesian consumers increasingly recognize its presence. Therefore it is necessary to formulate nori using types of seaweed easily cultivated in Indonesia, namely *Eucheuma cottonii* and *Ulva lactuca.*

Nori is known to be rich in nutrients such as protein, minerals, crude fiber, and vitamins. In addition, nori also contains several amino acids, such as glutamate, glycine, and alanine, which play a role in enhancing taste (Lalopua 2018). The formulation of nori with the addition of an antioxidant source to the formula is intended to increase the functional value of the product. According to PERKBPOM of 2005 (BPOM 2005), functional food is processed food containing one or more functional components which, based on scientific studies, have certain physiological functions, proven to be harmless and beneficial to health. Functional food must have sensory characteristics that consumers can accept. It is also served and consumed like food or drinks. Functional food claims must be proven real based on research.

In addition, the results of Astuti and Afifah's research on 100 Indonesian Innovations published by LIPI 2017 about Ketupat became the background for this research. Ketupat is a rice-based Indonesian food, usually wrapped in the webbing of young coconut leaf, but in that research, it changed to breadfruit leaf (*Arthocarpus altilis*), and the results showed it could lower the glycemic index. Resulting from this fact, another innovation emerged: utilizing breadfruit leaf not only as a wrap but as nori which can also be consumed. Adding other ingredients can also be done to create products with optimal benefits. Adding Moringa leaf in nori from *Ptilophora pinnatifida* mimics the color of commercial nori (Wulansari et al. 2022).To aim for functional food, adding grass jelly can increase fiber content. The choice of nori as a functional food product is based on the frequency with which Indonesians consume rice. This functional nori is expected to reduce the blood glucose response of nori-wrapped rice compared to the regular one. Thus, this research aimed to study the sensory and chemical characteristics of nori from Indonesian seaweed added with breadfruit leaf extract and grass jelly.

METHOD

Materials

Dried *Eucheuma cottonii* was obtained from LIPI Oceanography, while dried *Ulva lactuca* was obtained from waters in Sidoarjo. Dried breadfruit leaves used in this study were obtained from processing fresh breadfruit leaves from the yards of Babakan Penghulu Village, Cinambo District residents. Green grass jelly leaves were obtained from Andir.

Preparation of seaweed pulp, breadfruit leaf extract, and grass jelly

The preparation of seaweed pulp follows the research of Ihsan (2016) and Zakaria et al. (2017). Each seaweed was soaked with water in a separate container. *E. cottonii* was soaked for 20 h with a ratio of seaweed to water of 1:20, while *U.lactuca* was soaked for 6 h with a ratio of seaweed to water of 1:10. The soaking time for the two types of seaweed is different due to their different characteristics. *E. cottonii* has a stronger structure than *U.lactuca,* so water takes longer to absorb into the seaweed. Lime juice is added in the soaking process to remove the fishy smell (Putri and Ningtyas 2017). After soaking, the *U.lactuca* was blanched for 15 min to reduce the initial microbial.

The preparation of green grass jelly follows the research of Khoiriyah and Amalia (2014), starting with preparing grass jelly leaf and water in a ratio of 1:10. The leaves were washed and soaked in boiling water for 1 min while stirring. The grass jelly leaves are then kneaded until crushed and filtered. The preparation of breadfruit leaf extract follows Listyaningrum and Amelianawati (2019). The dark green breadfruit leaves were dried and ground. Its powder was dissolved in boiling water with a ratio of 1:10 and then filtered.

Table 1 Nori formulation

Components	Formula		
	A	B	C
E.cottonii (g)	20	20	20
U.lactuca (g)	60	60	60
Breadfruit leaf extract (ml)	200	100	0
Green Grass Jelly (ml)	0	100	200
Spices (g)	5	5	5

Table 2 Sensory characteristics of nori

No	Attribute	Formula		
		A	B	C
1	Color	3.17±1.02 [ab]	3.00±0.78 [a]	3.50±0.77 [b]
2	Texture	3.37±0.93 [b]	2.43±0.82 [a]	3.53±0.90 [b]
3	Aroma	3.13±0.68 [ab]	2.77±0.68 [a]	3.20±0.80 [b]
4	Flavor	3.37±1.10 [b]	2.63±0.72 [a]	3.60±0.93 [b]
5	Overall Accept-ance	3.37±0.76 [b]	2.63±0.76 [a]	3.77±0.93 [b]

Note: Value is an average. The same lowercase letter indicates that the test results are not significantly different based on Duncan's test at the 5% level.

Nori Preparation and Formulation

Seaweed pulp, breadfruit leaf extract, and green grass jelly were mixed according to the ratio in the formulation presented in Table 1.

E.cottonii and *U.lactuca* were mixed with a ratio of 1:3. Then mixed with breadfruit leaf extract and/or green grass jelly, with 3 formulas above. Mixing was done for 2 min, and the slurry was cooked for 15 min over low heat, with continuous stirring. The spices added were garlic powder, pepper, and salt. The cooked slurry weighed 40 g, was printed into thin sheets, and placed on a baking sheet smeared with oil. Drying was carried out in a cabinet dryer at 50°C for 1.5 h. After drying, the nori was removed from the sheets and ready to be packaged in a container covered with silica gel.

Sensory Test

Sensory testing was carried out using a hedonic test by 30 untrained panelists who had previously been given instructions. Panelists were asked for their responses regarding color, taste, texture, aroma, and total acceptance on a scale of 1-5, from very dislike to very like.

Chemical Test

Chemical testing followed AOAC International (2012), including testing for water content (925.10), ash content (923.03), protein content (960.52), fat content (920.39), crude fiber (National Standardization Agency, 2015), starch content (Ifmaily 2018), antioxidant capacity (Sharma and Bhat 2009).

RESULTS AND DISCUSSION

Sensory Characteristics

Sensory tests were conducted to determine which of the three formulations most preferred by consumers. Panelists were asked to give a rating scale from 1-5. The higher acceptance value indicates that the sample is preferred. In this study, 30 untrained panelists were used, consisting of 14 women and 16 men. The test included color, texture, aroma, taste, and total acceptance.

Color is an important quality attribute because it determines the first impression of food products. Based on the statistical analysis results in Table 2, it can be seen that the color of nori from formula B was significantly different from formula C. Still, both were not significantly different from formula A. The nori formula with the addition of grass jelly leaf alone received the highest score from the panelists, while the nori formula by mixing grass jelly leaf with breadfruit leaf extract got the lowest score. The level of panelists' preference for the nori color attribute can be caused by mixing breadfruit leaf extract and grass jelly leaf in the seaweed mixture, which makes the nori color darker. Brighter nori colors tend to be preferred. Nori without sugar plum fruit substitution, which has a higher brightness level, is preferred to nori with sugar palm fruit substitution (Ihsan 2016).

The sensory test results show that the nori formula C texture is preferred. However, based on the statistical analysis results, the nori texture of formula C was not significantly different from formula A. With the addition of grass jelly, the nori formula provided the most elastic texture compared to the other two formulas. Like substitution of sugar palm fruit in nori which causes a reduction in intermolecular interactions and increases the movement of the polymer chains, leads to a decrease in stiffness and an increase in elasticity (Ihsan 2016).

Based on the results of statistical analysis, it can be seen that the nori aroma of formula B was significantly different from formula C. Still, both were not significantly different from formula A. With the addition of grass jelly alone, the nori formula received the highest aroma score from the panelists. In contrast, the nori formula adding grass jelly and breadfruit leaf extract had the lowest aroma score. Grass jelly leaf does not give an additional aroma to nori, in contrast to breadfruit leaf extract, which gives a distinctive aroma, so this can be a factor causing nori formulas with the addition of grass jelly to be the most preferred. Consumers tend to prefer nori with no additional aroma. As presented in Indriyani and Subeki (2020), adding 20% anchovy to nori from spinach and seaweed was preferred among the higher percentage.

Assessment of flavor attributes involves various senses, such as taste, smell, and tactile, so the process is more complex. From the sensory test results, the nori formula C flavor is the most preferred. However, based on the results of statistical analysis, the taste of nori formula C was not significantly different from formula A and was significantly different from formula B. Mixing breadfruit leaf extract and grass jelly gave a more complex taste than other formulas, which tended to lower the preference value.

Overall, the most preferred formula was formula C, namely nori, with the addition of only grass jelly leaf extract, with a value of 3.77. This value is significantly different from formula B and not significantly different from formula A

Chemical Characteristics

Based on the statistical analysis results, which can be seen in Table 3, the water content of nori with the addition of grass jelly gave the highest water content. It differed significantly from nori with mixed formula but not significantly from nori with adding breadfruit leaf extract. The water content of nori produced is lower than the moisture content of the mixed nori of *E.cottonii* and *U.lactuca*, which is 9.85%, but higher than the commercial nori, which is 4.47% (Zakaria et al. 2017). The lower water content can be caused by several factors in the drying process, namely temperature and drying time, and the thickness of the nori dough. Water content also determines the physical properties and shelf life of nori.

Based on the statistical analysis results, the ash content of nori with the addition of breadfruit leaf extract and nori with the addition of grass jelly was significantly different but not significantly different from the nori with the mixed formula. The ash content of the nori produced was lower than the mixed nori of *E.cottonii* and *U.lactuca*, namely by 8.83% (Zakaria et al. 2017), but higher than the ash content of commercial nori, namely by 0.38% (Putri and Ningtyas 2017). The ash content of nori is influenced by the mineral content of the raw seaweed used, as the ash content of nori from *Gracillaria gigas* was 6.77% (Pamungkas et al. 2019).

The fat content of all nori formulations did not show significant differences based on the statistical analysis results. The fat content produced was higher than the mixed nori of *E.cottonii* and *U.lactuca* in Zakaria et al. (2017), which is 0.26%, but smaller than the commercial nori in Putri and Ningtyas (2017), which is 25%. The difference in fat content can be influenced by nori making process. Commercial nori is generally made by frying, so the fat is quite high.

Based on the statistical analysis results, the protein content of all nori formulations did not show significant differences. The resulting protein content was higher than that of the mixed nori of *E.cottonii* and *U.lactuca* (Zakaria et al. 2017), which is 18.84% or compared to commercial nori in (Putri and Ningtyas 2017), which is 20%. The raw seaweed's protein content influences nori's protein content. In (Teddy 2009), the ash content of nori from *Gracillaria* sp. increased by 6.20%.

In Zakaria et al. (2017), the carbohydrate content of mixed nori *E.cottonii* and *U.lactuca* was 62.31%, while commercial nori was 41.80%. This study separated the carbohydrate content test into starch content and crude fiber content. Based on the statistical analysis results, there was no significant difference in the nori starch content of all formulations. In contrast, the nori fiber content with the addition of breadfruit leaf extract and the addition of grass jelly was significantly different but not significantly different from nori with the mixed formula. The carbohydrate content of the seaweed used influences the carbohydrate content of nori. Nori from *Gracillaria* sp. In Teddy (2009), it has a carbohydrate content of 73.03%, while nori with a mixture of *U.lactuca* and *Gracilaria* sp, in Putri and Ningtyas (2017), has a carbohydrate content of 50.42%. The crude fiber content of the nori produced was lower than the mixed nori of *E.cottonii* and sugar plum fruit, which was 11.02% (Ihsan 2016).

Antioxidant activity

Antioxidant activity shows the ability of a material to reduce free radical compounds (Rizqi 2014). The parameter used to determine antioxidant activity is IC50, defined as the concentration of an antioxidant compound that causes a 50% loss of DPPH activity. The DPPH solution was initially purple and turned yellow after reacting with antioxidants. The higher the antioxidant content in a material, the purple will decrease and form a yellow color (Purwaningsih 2012). The results of the nori antioxidant activity test are shown in Table 4.

Based on the statistical analysis results, modified nori with the addition of breadfruit leaf extract produced the lowest IC50 value and significantly differed from other modified nori formulas. This shows that a smaller concentration of antioxidant compounds can cause a 50% loss of free radical activity (DPPH). The lower the IC50 value, the greater the potential as an antioxidant (Widyawati et al. 2011) The antioxidant activity of nori with breadfruit leaf extract was higher than that of modified nori with the addition of grass jelly. This could be due to breadfruit leaf extract's higher antioxidant activity than grass jelly. It is known that breadfruit leaf extract with water solvent has an IC50 value of 755.51 ppm (Listyaningrum and Amelianawati 2019), while IC50 value indicates green grass jelly leaves extract grass jelly drink of 1045 ppm (Khoiriyah and Amalia 2014).

The IC50 value of *E.cottonii* seaweed extract with ethyl acetate solvent was 594.68 ppm (Yanuarti et al. 2017), while *U.lactuca* seaweed extract with ethanol solvent was 60.795 ppm (Arbi et al. 2016). The greater proportion of *U.lactuca* in the formula results in an IC50 value of 700 ppm. The IC50 value of a compound is classified as a very strong antioxidant if it is less than 50 ppm, a strong antioxidant if it is in the range of 50-100 ppm, a moderate antioxidant if it is in the range of 100-150 ppm, and a weak antioxidant if it is in the range of 150-200 ppm. Nori in this study is above the classification of weak antioxidant effects because this range is applied to drugs, which involves extraction with methanol solvent, in contrast to food products which mostly use water as the solvent. The type of solvent used in the extraction process affects the antioxidant activity of the resulting product because, with organic solvents, the antioxidant components were extracted more. The healthy potential of food is different from medicine because the function of food lies in preventing disease, not curing it.

The making of nori also involves heat treatment, which is known to reduce antioxidant activity (Kuda et al. 2005). Nevertheless, the modified nori in this study showed greater antioxidant activity than the dragon-fruit skin nori snack product, which used a 2.5% concentration of soy flour and 0.2% carrageenan concentration with an IC50 value of 11,657.83 ppm (Syarifah 2016).

Table 3 Chemical characteristics of nori

No	Parameter (%)	Formula		
		A	B	C
1	Moisture	5.26±0.04[ab]	5.24±0.13[a]	5.48±0.09[b]
2	Ash	2.41±0.02[a]	2.50±0.06[ab]	2.60±0.04[b]
3	Fat	2.06±0.02[a]	2.09±0.05[a]	2.09±0.03[a]
4	Protein	22.24±0.18[a]	22.87±0.56[a]	23.19±0.38[a]
5	Starch	59.97±0.49[a]	58.32±1.43[a]	58.58±0.96[a]
6	Crude Fiber	6.65±0.05[b]	6.50±0.16[ab]	6.24±0.10[a]

Note: Value is an average. The same lowercase letter indicates that the test results are not significantly different based on Duncan's test at the 5% level.

Table 4 Antioxidant activity of nori

No	Formula	IC_{50} (ppm)
1	Addition of breadfruit leaf extract (A)	702.75±7.03[a]
2	Addition of breadfruit leaf extract and grass jelly (B)	737.00±22.11[b]
3	Addition of grass jelly (C)	767.46±15.29[b]

Note: Value is an average. The same lowercase letter indicates that the test results are not significantly different based on Duncan's test at the 5% level.

Determination of the best nori formula

The best formula is determined by looking at sensory and chemical testing results. The sensory test results found that the formula with the highest total acceptance value was formula C, namely nori, with the addition of grass jelly. However, these results were not significantly different from formula A after going through statistical analysis with a level of 5%. In contrast, the chemical testing results of the three formulas showed that formula A and C's water, fat, protein, and starch content were not significantly different. A significant difference was shown in formula A's crude fiber and antioxidant activity, which was higher than formula C. Crude fiber was obtained using simple chemical analysis, namely hydrolysis by acids or alkalis.

In contrast, dietary fiber was obtained by hydrolysis using enzymes closer to the processes that occur in the human body. Therefore the value of dietary fiber can be several times that of crude fiber. Even so, crude fiber value is still used in the Food Composition List because the method is easier but can still be used as an index of food fiber value. In general, crude fiber is found to be as much as 0.2-0.5 parts of dietary fiber (Korompot 2018). With this explanation, the formula with higher crude fiber and antioxidant activity was chosen as the best nori formula.

CONCLUSION

The best nori formula was the one with the addition of breadfruit leaf extract, which gave an overall acceptance score of 3.37, water content of 5.26%, ash content of 2.41%, fat content of 2.06%, protein content of 22.24%, starch content of 59.97%, and crude fiber of 6.65%, and antioxidant activity of 702.75 ppm.

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REFERENCES

AOAC International. 2012. Official Methods of Analysis of AOAC International.

Arbi, B., W. Farid, and Romadhon. 2016. Aktivitas senyawa bioaktif selada laut (ulva lactuca) sebagai antioksidan pada minyak ikan. *Indonesian Journal of Fisheries Science and Technology* 12(1):12–18.

BPOM. 2005. Peraturan Kepala Pengawas Obat dan Makanan Republik Indonesia Tentang Ketentuan Pokok Pengawasan Pangan Fungsional Nomor HK 00.05.52.0685 tentang Ketentuan Pokok Pengawasan Pangan Fungsional.

Hatta, A. M. 1990. Kemungkinan Budidaya Porphyra (Rhodophyta, bangiales) di Perairan Indonesia. *Oseana* XV(1):1–11.

Ifmaily. 2018. Penetapan Kadar Pati Buah Sukun (Artocarpus altilis L) dengan Metode Luff Schoorl. *Chempublish Journal* 3(1):1–10.

Ihsan, F. 2016. Pembuatan nori dengan pemanfaatan kolang-kaling sebagai bahan substitusi rumput laut jenis Eucheuma cottoni. Universitas Andalas.

Indriyani, R., and Subeki. 2020. Study of the addition of anchovy on sensory and chemical properties of nori from spinach and seaweed (Eucheuma cottonii). *Icsc 2020. Proceeding. Biennial International Conference Safe Community (B-Icsc) "Family Empowering In Safe Community For Health Sustainable Free From Covid-19" Politeknik Kesehatan Tanjungkarang*.

Khoiriyah, N., and L. Amalia. 2014. Formulasi Cincau Jelly Drink (Premna oblongifolia L Merr) sebagai pangan fungsional sumber antioksidan. *Jurnal Gizi dan Pangan* 9(2):73–80.

Korompot. 2018. Kandungan Serat Kasar Dari Bakasang Ikan Tuna (Thunnus Sp .) The Right Fiber Content Of The Tuna Fish Bakasang (Thunnus Sp .) On Various Conditions Of Salt , Temperature And Fermentation Time.

Kuda, T., M. Tsunekawa, T. Hishi, and Y. Araki. 2005. Antioxidant properties of dried "kayamo-nori", a brown alga Scytosiphon lomentaria (Scytosiphonales, Phaeophyceae). *Food Chemistry* 89(4):617–622.

Lalopua, V. M. 2018. Karakteristik Fisik Kimia Nori Rumput Laut Merah Hypnea Saidana Menggunakan Metode Pembuatan Berbeda Dengan Penjemuran Matahari Physical-Chemical Characteristics Of Nori Red Seaweed Hypnea Saidana Using Different Making Methods With Sun Drying. *Majalah BIAM* 14(1):28–36.

Listyaningrum, R. S., and M. Amelianawati. 2019. Kajian Potensi Daun Sukun Dengan Kayu Secang Sebagai Minuman Fungsional. *Journal of Science, Technology and Entrepreneur* 1(1):54–62.

Pamungkas, P., S. Yuwono, and K. Fibrianto. 2019. Potensi rumput laut merah (Gracilaria gigas) dan penambahan daun kenikir (Cosmos caudatus) sebagai bahan baku pembuatan nori. *Jurnal Teknologi Pertanian* 20(3):171–180.

Purwaningsih, S. 2012. Aktivitas Antioksidan dan Komposisi Kimia Keong Matah Merah. *Ilmu Kelautan* 17(1):39–48.

Putri, T., and S. A. Y. U. Ningtyas. 2017. Pembuatan Nori Dari Rumput Laut Campuran Jenis Ulva lactuca linnaeus dan Glacilaria sp. Universitas Sebelas Maret.

Rizqi, M. M. 2014. Formulasi Teh Daun Sukun (Artocarpus Altilis) Dengan Penambahan Kayu Manis Dan Melati Sebagai Minuman Fungsional. Skripsi. Institut Pertanian Bogor.

Sharma, O. P., and T. K. Bhat. 2009. DPPH antioxidant assay revisited. *Food chemistry* 113(4):1202–1205.

Syarifah, I. 2016. Pengaruh Konsentrasi Tepung Kedelai terhadap Karakteristik "Snack Nori" dari Kulit Buah Naga (Hylocereus costaricensis):1–136.

Teddy, M. S. 2009. Pembuatan Nori secara Tradisional dari Rumput Laut Jenis Glacilaria sp. Institut Pertanian Bogor.

Widyawati, P., C. Wijaya, P. Hardjosworo, and D. Sajuthi. 2011. Evaluasi aktivitas antioksidatif ekstrak daun beluntas (Plucea indica) berdasarkan perbedaan ruas daun. *Rekapangan Jurnal Teknologi Pangan* 5(1):1–17.

Wulansari, A., E. Kusuma Dewi, R. Andriani, dan Hamidin Rasulu, and H. Rasulu Abstrak. 2022. Karakteristik Kimia, Organoleptik, dan Aktifitas Antioksidan Nori Tiruan Berbahan Dasar Ptilophora pinnatifida Dengan Variasi Penambahan Daun Kelor 15(1):76–83.

Yanuarti, R., Nurjanah, E. Anwar, and T. Hidayat. 2017. Profil Fenolik dan Aktivitas Antioksidan dari Ekstrak Rumput Laut Turbinaria Conoides dan Eucheuma Cottonii. *Jurnal Pengolahan Hasi Perikanan Indonesia* 20(2):230–237.

Zakaria, F. R., B. P. Priosoeryanto, E. Erniati, and S. Sajida. 2017. Karakteristik Nori Dari Campuran Rumput Laut Ulva lactuca Dan Eucheuma cottonii. *Jurnal Pascapanen dan Bioteknologi Kelautan dan Perikanan* 12(1):23.