Study of the use of *Gracilaria sp* from the Karawang Area and *Ulva lactuca* as raw material making of Nori

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**Abstract.** Nori is processed seaweed in the form of dried sheets, generally consumed by Japanese and Korean people. The seaweed used as raw material is *Porphyra sp* which generally grows in Japan and Korea, so Indonesia has to import more and more nori. *Porphyra* seaweed is the raw material for making imported nori, *Porphyra* is not found in Indonesia because the seaweed lives in a subtropical climate. Therefore, it is necessary to look for alternative raw materials besides *Porphyra*. Indonesian waters have various types of seaweed, one of which is *Ulva lactuca* seaweed. *Ulva Lactuca* is one of the red algae plants and belongs to the class Chlorophyceae, shaped like sheet talus like lettuce. *Ulva Lactuca* has similar characteristics to *Porphyra* seaweed in terms of texture and color besides that *Ulva Lactuca* is rich in acrylic acid which functions as an antibiotic, is a source of protein, folic acid, and several types of minerals such as: Ca, K, Mg, Na, Cu, Fe, Zn. Apart from the type of *Ulva Lactuca*, there are also types of *Gracilaria verrucosa* often found in Karawang waters. *Gracilaria* produced in these waters has quite high gel strength and viscosity. The advantages of these properties are expected to improve the quality of the nori products produced. For this reason, in this applied research a study was conducted to make nori with a combination of *Gracilaria sp* and *Ulva sp*. *Ulva sp* (sea lettuce) used is *Ulva lactuca* in Pangandaran waters. The manufacturing process begins with washing the seaweed and soaking the seaweed for 6 hours. *Ulva Lactuca* soaked in NaCl solution with a weight ratio of seaweed: water: salt = 2: 60: 5, soaking seaweed *Gracilaria sp*. in a solution of rice vinegar with a weight ratio of seaweed: water: rice vinegar = 2: 60: 1. Experiments were carried out in 4 weight ratios of *Gracilaria sp*. that is different, namely: sample 1 = 100% *Ulva lactuca*, sample 2 = 97.15% *Ulva lactuca*: 2.85% *Gracilaria sp.*. Sample 3 = 98% *Ulva lactuca*: 2% *Gracilaria sp.*, and sample 4 = 99% *Ulva lactuca*: 1% *Gracilaria sp.*

1. **Introduction**

Seaweed is a very abundant biological resource in Indonesian waters where its use for processing food products is very limited, especially for functional food products. Seaweed contains several bioactive components such as phenolic compounds, natural pigments, sulfated polysaccharides, fiber, and other bioactive components that have been studied for health benefits. Among them are useful for lowering blood pressure and cholesterol, treating breast cancer and colon cancer as well as edema and thyroid, curing swelling, reducing mucus, and improving digestion [1].

The use of seaweed as raw material for functional food in Indonesia has not been widely studied. Functional food is food in the form of normal food products that are consumed as food and beverages which can have beneficial effects on health in addition to the nutritional benefits they contain [2]. To
be categorized as a functional food product, processed seaweed food products must contain high levels of nutrients, fiber, and bioactive components which are almost the same as the content of the raw material.

One of the functional foods from seaweed is nori, which is processed dried seaweed in sheet form, generally consumed by Japanese and Korean people. The seaweed used as raw material is *Porphyra* sp. which generally grows in Japan and Korea, so Indonesia has to import more and more nori. *Porphyra* seaweed is the raw material for making imported nori. *Porphyra* is not found in Indonesia because the seaweed lives in a subtropical climate. Therefore, it is necessary to look for alternative raw materials besides *Porphyra*.

An alternative to *Porphyra* is *Ulva Lactuca* seaweed. *Ulva Lactuca* is a type of green algae included in edible seaweed, which contains antioxidants, antibacterial, antifungal, and anti-tumor properties [3]. *Ulva Lactuca* has a thin sheet-shaped talus, flat, wide, smooth, or often round or oval in dark green color with corrugated sheet edges and is often torn, and perforated. The nutritional content of *Ulva Lactuca* consists of 18.7% water, 14.9% protein, 0.04% fat, 0.2% fiber, vitamin A, vitamin B1, and vitamin C [4]. *Ulva Lactuca* is rich in acinic acid which functions as an antibiotic, is a source of protein, folic acid, and several types of minerals such as: Ca, K, Mg, Na, Cu, Fe, Zn, McHugh [6]. Making seaweed nori using *Ulva Lactuca* requires a combination of other types of grass, namely *Gracilaria* sp.

*Gracilaria* sp is a type of red seaweed (*Rhodophyta*), which is a type of agar-producing seaweed. In the food industry, the main role of agar is as a stabilizing agent and gelling agent [7]. In addition, agar acts as a texture modifier, emulsifying agent, and thickening agent [8].

2. Materials and methods

2.1. Material

2.1.1. *Ulva lactuca*. *Ulva lactuca* has a thin sheet-shaped talus, flat, wide, smooth, or often round or oval in dark green color with corrugated sheet edges and is often torn, and perforated. The nutritional content of *Ulva Lactuca* consists of 18.7% water, 14.9% protein, 0.04% fat, 0.2% fiber, vitamin A, vitamin B1, and vitamin C.

2.1.2. *Gracilaria* sp. *Gracilaria* sp is a type of red seaweed (*Rhodophyta*), which is a type of agar-producing seaweed. In the food industry, the main role of agar is as a stabilizing agent and gelling agent.

2.1.3. Salt. Salt is a compound of NaCl (sodium chloride) which is added to food as a flavor enhancer.

2.1.4. Rice vinegar. Vinegar made from rice in a variety of colors, namely white, red and black. It is light in taste and has a subtle aroma, it is the safest vinegar to use as a food supplement.

2.1.5. Sesame oil. Sesame oil contains a lot of unsaturated fatty acids, especially oleic acid (C18: 1) and linoleic acid (C18: 2, Omega-6). Sesame oil also contains a lot of vitamin E and other functional components that are useful for health.

2.1.6. Cooking oil. Cooking oil is oil derived from plant or animal fat which is purified and is liquid at room temperature and is usually used for frying food ingredients.

2.1.7. Oyster sauce. This sauce is usually used as a flavor enhancer in Chinese dishes that emphasize the roasting process (dry frying). This sauce uses oysters as a source of glutamic acid and its IMP / GMP [9].
2.2. Data analysis

2.2.1. Proximate testing. Analysis of water content and fat content was carried out by gravimetric, ash content, and protein content referring to SNI 01-2354.1-2006 and SNI 01-2354.4-2006. Meanwhile, the analyzed fiber content refers to SNI 01-2891-1992.

2.2.2. Total plate number testing. This test refers to SNI 2886: 2015.

2.3. Data processing and analysis

The data obtained were analyzed statistically with the Analysis of Variance (ANOVA), which was followed by the Least Significant Difference (LSD) test at the 10% significance level.

3. Results and discussion

3.1. Results

3.1.1. Ingredient formulation. Making nori is carried out by adapting the formulation using the best formula in the Ningtyas research (2017) with the substitution of Gracilaria sp seaweed obtained from the waters of Karawang and Ulva Lactuca from Pangandaran beach [1].

3.1.2. Proximate test results

| Parameter          | Unit | Customer Code | Method Specification |
|--------------------|------|---------------|----------------------|
|                    |      | S(1) | S(2)   | S(3) | S(4) |                  |
| Protein Content    | %    | 14.02| 14.66  | 13.09| 13.56| SNI 01- 2354.4- 2006 |
| Fat Level          | %    | 29.88| 31.55  | 43.64| 31.52| IKM/5.4.2/ BLUPPB- K (Gravimetri) |
| Water Content      | %    | 21.3 | 24.985 | 22.21| 21.11| IKM/5.4.2/ BLUPPB- K (Gravimetri) |
| Ash Content        | %    | 11.13| 11.05  | 10.91| 11.59| SNI 01- 2354.1- 2006 |
| Crude Fiber Content| %    | 5.11 | 6.10   | 6.14 | 7.13 | SNI 01- 2891- 1992 |

The highest sample protein content was the second sample with the ratio of Ulva Lactuca: Gracilaria sp seaweed of 97.15%: 2.85%. Assuming all seasoning is done at the same dose, the largest concentration of Gracilaria sp seaweed from all samples is thought to have an effect on the percentage of nori protein content. However, overall, the sample protein content was still below the commercial nori protein content, namely 25 - 50%. The difference in sample protein content with commercial nori is thought to be influenced by the percentage of sample moisture content which is still quite high, ranging from 21.11 - 24.98%. As is known, proximate testing is a test that results in the form of a percentage of nutrients in the material food, so that when the concentration of one component is high, the other components will adjust because the total percentage must be 100%. The water content of commercial nori is 8.44%. The high-water content of the sample was probably caused by temperature fluctuations from the sun source and the drying time for 1 day.
The highest sample protein content was the second sample with the ratio of *Ulva Lactuca: Gracilaria sp* seaweed of 97.15%: 2.85%. Assuming all seasoning is done at the same dose, the largest concentration of Gracilaria sp seaweed from all samples is thought to have an effect on the percentage of nori protein content. However, overall, the sample protein content was still below the commercial nori protein content, namely 25 - 50%. The difference in sample protein content with commercial nori is thought to be influenced by the percentage of sample moisture content which is still quite high, ranging from 21.11 - 24.98%. As is known, proximate testing is a test that results in the form of a percentage of nutrients in the material food, so that when the concentration of one component is high, the other components will adjust because the total percentage must be 100%. The water content of commercial nori is 8.44%. The high water content of the sample was probably caused by temperature fluctuations from the sun source and the drying time for 1 day. The ash content of the samples ranged from 5.11 - 7.13%, with commercial nori ash content ranging from 8.78 - 9.07%. The difference in the ash content of the samples, which tends to be higher than the commercial nori ash content, is thought to be due to the different types of seaweed used. Commercial nori imported from other countries uses *Phorphyra sp*.

3.1.3. Total plate number testing results

| Parameter | Unit | Test Result | Information | Method Specifications |
|-----------|------|-------------|-------------|-----------------------|
| Total Bacteria* | Cfu/ml | 4x10⁴ | <2.5 x 10⁴  | Test Condition | IKM/5.4.7/BLUPPB-K (quantitative) |
|           |      | <2.5 x 10⁴ | <2.5 x 10⁴ | Temperature 26°C |
|           |      | <2.5 x 10⁴ |      | Humidity: 54 RH   |

For dry food products using SNI standard for extrudate snacks, the safe standard ALT value is 1 x 10⁴. The whole sample as shown in Table 2 still meets the SNI standard so it is safe for consumption.

3.1.4. Processing and data analysis. Analysis of the data used in this study using quantitative analysis, namely inferential statistics. The Anova test results with a confidence level of 90% of the research samples can be seen in Table 3.

| Parameter   | F table | F count | Conclusion | Interpretation                                         |
|-------------|---------|---------|------------|-------------------------------------------------------|
| Protein Content | 4.3571 | 4.1908 | Refuse H0  | There is a significant difference in the count of the 4 samples |
| Fat Level   | 4.0593 | 4.1908 | Accept H0  | There is no significant difference in the mean count of 4 samples |
| Water Content | 0.8219 | 4.1908 | Accept H0  | There is no significant difference in the mean count of 4 samples |
| Ash Content | 1.8342 | 4.1908 | Accept H0  | There is no significant difference in the mean count of 4 samples |
| Crude Fiber Content | 0.6783 | 4.1908 | Accept H0 | There is no significant difference in the mean count of 4 samples |

From Table 3, it is known that in the parameter of protein content there is a significant difference in the count of the 4 samples so that the test is continued using the Least Significant Difference test (LSD). The LSD test aims to determine which samples are significantly different. The LSD test results show that sample 2 is significantly different from sample 3; and sample 2 is significantly different from sample 4. Which means that the treatment ratio of *Ulva lactuca*: *Gracilaria sp* 97.15%: 2.85% gives a different effect on the ratio of *Ulva lactuca*: *Gracilaria sp* 98%: 2% and a ratio of 99%: 1%.

4. Conclusion
From the experimental results and data obtained, the following conclusions are obtained:
1. The combination of *Ulva lactuca* and *Gracilaria sp*. Seaweed can be used as a raw material for making nori to replace *Phorpyra sp*. Seaweed.
2. From several comparisons that were tested, based on water content parameters, the optimal ratio of *Ulva lactuca*: *Gracilaria sp* was 98.15%: 2.85% and 99%: 1%. The chemical quality characteristics of sample nori still have high moisture content compared to commercial nori, while the total plate value indicates that the product is safe for consumption because it still conforms to SNI standards.

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