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OPTIMIZATION OF CARAGENAN CONCENTRATION IN THE PRODUCTION OF NORI IPOMOEA REPTANS SNACKS BASED ON ORGANOLEPTIC TESTING

OPTIMASI KONSENTRASI KARAGENAN PADA PEMBUATAN CAMILAN NORI IPOMOEA REPTANS BERDASARKAN UJI ORGANOLEPTIK

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Abstract

Nori is a seaweed-based food that is favored by the Indonesian people, but its availability is still limited. Meanwhile, the abundant production of land kale (Ipomoea reptans) as a local vegetable has not been optimally utilized, resulting in low economic value and its potential as a food source has not been maximized. One solution to overcome this problem is to use organic land kale as an alternative ingredient for making nori. Organic land kale is known to have good nutritional content and is commonly consumed by the community. This study aims to determine the level of acceptance of analog nori made from organic land kale as a healthy snack through organoleptic tests. The method used was an experiment with a completely randomized design (CRD), consisting of 24 samples, 6 treatments, and 4 repetitions. The treatment given was carrageenan concentration (0%, 0.6%, 0.8%, 1%, 1.2%, and 1.4%). Data were analyzed using the Friedman Test, a non-parametric statistical method, to assess panelists' preferences for taste, color, aroma, and texture parameters. It can be concluded that the results show the addition of carrageenan at 1% produces analog nori with the highest level of acceptance, so it is considered the most optimal formulation.

Keywords : Nori analog, land kale, carrageenan, organoleptic test

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Abstrak

Nori merupakan makanan berbahan dasar rumput laut yang digemari masyarakat Indonesia, namun ketersediaannya masih terbatas. Sementara itu, produksi kangkung darat (Ipomoea reptans) yang melimpah sebagai sayuran lokal belum dimanfaatkan secara optimal, sehingga nilai ekonomisnya masih rendah dan potensinya sebagai sumber pangan belum dimaksimalkan. Salah satu solusi untuk mengatasi masalah tersebut adalah dengan memanfaatkan kangkung darat organik sebagai bahan alternatif pembuatan nori. Kangkung darat organik diketahui memiliki kandungan gizi yang baik dan sudah umum dikonsumsi oleh masyarakat. Penelitian ini bertujuan untuk mengetahui tingkat penerimaan nori analog berbahan dasar kangkung darat organik sebagai camilan sehat melalui uji organoleptik. Metode yang digunakan adalah eksperimen dengan Rancangan Acak Lengkap (RAL), yang terdiri dari 24 sampel, 6 perlakuan, dan 4 kali pengulangan. Perlakuan yang diberikan adalah konsentrasi karagenan (0%, 0,6%, 0,8%, 1%, 1,2%, dan 1,4%). Data dianalisis dengan menggunakan Uji Friedman, yaitu metode statistik non parametrik, untuk menilai kesukaan panelis terhadap parameter rasa, warna, aroma, dan tekstur. Dapat disimpulkan bahwa hasil penelitian menunjukkan penambahan karagenan sebesar 1% menghasilkan nori analog dengan tingkat penerimaan tertinggi, sehingga dianggap sebagai formulasi yang paling optimal.

Kata Kunci : Nori analog, kangkung darat, karagenan, uji organoleptik

1. INTRODUCTION

Water spinach (Ipomoea reptans) is a type of vegetable that is quite abundant in Indonesia, especially in West Java. However, its utilization as a food ingredient is relatively low and has not been utilized optimally. This condition shows a great opportunity to increase the value of water spinach (Ipomoea reptans), one of the optimal uses of water spinach (Ipomoea reptans) is to make vegetable-based analog nori as an alternative to conventional nori made from seaweed. Nori is a popular type of food generally made from red algae (Porphyra spp.), but access to this raw material is limited because it only grows in subtropical climates such as Japan, Korea, and China. This is a barrier for the community in reaching and developing similar products locally. Therefore, the development of analog nori using water spinach (Ipomoea reptans) as a basic ingredient for nori can be an alternative that is more accessible, environmentally friendly, and based on local ingredients.

Land kale (Ipomoea reptans) is a type of green leafy vegetable that is widely consumed and cultivated by the Indonesian people. This plant contains various important nutrients such as vitamins A and C, iron, calcium, dietary fiber, and antioxidant compounds that support body health. The complete nutritional content makes land kale has great potential to be utilized as a healthy alternative food raw material (Stevani, Mustofa, & Wulandari, 2019).

Meanwhile, modern society's awareness of the importance of a healthy and nutritious diet has led to increased consumption of healthy snacks. One type of snack that is quite popular is nori, which is a thin sheet of processed seaweed that is commonly consumed as a snack or complement to main meals. Nori has a distinctive taste and is known to be rich in minerals such as iodine and fiber. However, the availability of seaweed as a raw material for nori is often limited in some regions, and the production process is quite complicated. This condition opens up opportunities to create analog nori made from local ingredients such as land kale which is considered cheaper and environmentally friendly (JITIPARI, 2020).

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The use of land kale as the main ingredient in making analog nori is considered promising, given its high nutritional content, attractive green color, and the texture of the leaves that are suitable for processing into thin sheets like real nori. To achieve a texture and chewiness that resembles seaweed nori, the addition of a binder such as carrageenan is required. Carrageenan is a natural hydrocolloid compound derived from red seaweed and functions as a gelling agent and texture stabilizer in food products (Kokkuvayil Ramadas, Rhim, & Roy, 2024). The addition of carrageenan in certain levels is expected to improve the physical and organoleptic quality of the resulting analog nori (Nasirpour-Tabrizi et al., 2020).

In addition to the selection of ingredients and the addition of binders, the analog nori processing process also requires proper drying and storage methods so that the resulting product is more durable and safe for consumption. Optimal drying serves to reduce water content, inhibit microbial growth, and maintain product color and flavor characteristics (Stevani et al., 2019). Therefore, the innovation of analog nori made from land kale not only expands the types of healthy snacks available on the market but also contributes to efforts to diversify local food based on natural ingredients.

Until now, scientific studies on the development of analog nori from land kale are still very limited. Based on this, this study aims to evaluate the organoleptic characteristics (including taste, aroma, color, and texture) of analog nori made from organic land kale with variations in carrageenan concentration as a step towards creating a local healthy snack that is nutritious and has consumer appeal.

2. RESEARCH METHOD

This study applied an experimental method with a quantitative approach using a Completely Randomized Design (CRD) to evaluate the effect of variations in carrageenan concentration on the level of acceptance of nori made from organic land kale. The experimental design included six different treatments, namely the provision of carrageenan concentrations of 0%, 0.6%, 0.8%, 1%, 1.2%, and 1.4%, to determine the characteristics of texture, color, taste, and aroma, evaluated by 30 panelists. Panelists were purposively selected and consisted of semi-trained individuals who had a basic understanding of sensory evaluation of food products. Selection criteria included prior exposure to food testing or culinary training, and the ability to consistently apply hedonic scales. The sensory evaluation was conducted in a controlled environment to minimize bias, with standardized lighting, proper air circulation, minimal noise, and neutral odor conditions to ensure panelist comfort and concentration.

A 5-point hedonic scale (1 = dislike very much, 5 = like very much) was used to assess the degree of preference for each attribute. The data obtained were analyzed using the Friedman test, which is suitable for detecting differences in ranked data across multiple related samples, particularly for sensory evaluations where normality assumptions may not be met.

Ethical considerations were also addressed in this study. All panelists provided informed consent prior to participation and were informed of their right to withdraw at any time. The study protocol was reviewed to ensure that it adhered to basic ethical guidelines in sensory testing, including confidentiality and voluntary participation. The methodology is clearly structured, utilizing a CRD with six treatment levels and 30 semi-trained panelists. The use of

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a 5-point hedonic scale and the Friedman test is methodologically appropriate. However, more detailed reporting of panelist recruitment, testing conditions, and ethical protocols strengthens the study's transparency and reproducibility.

3. RESULTS AND DISCUSSION

In this chapter the researcher describes the data from the research that has been conducted. The research instrument in this study consists of organoleptic test results based on taste, color, aroma and texture parameters. Testing with SPSS 29 includes the average value of the organoleptic test. The test results can be seen as follows:

Table 1. The Average Ipomoea reptans Nori Texture

	0%	0,6%	0,8%	1%	1,2%	1,4%
Average	1,9	2	2,3	4,1	2,1	2

Based on Table 1, the average texture results showed that the 1% treatment obtained the highest score of 4.1, indicating the highest level of texture liking compared to other treatments which only ranged from 1.9-2.3. This indicates that the formulation at 1% treatment contributed positively to the sensory characteristics of the product.

According to Putri et al. (2021) differences in treatment can affect the structure and flavor of ingredients which have a direct impact on organoleptic assessment. In addition, processing conditions and ingredient formulation are also important factors in determining the final sensory quality (Santosa & Widodo, 2023). Thus, the 1% treatment deserves to be considered as the best treatment, because it shows the highest level of acceptance significantly compared to other treatments.

Table 2. The Average Ipomoea reptans Nori Flavor

	0%	0,6%	0,8%	1%	1,2%	1,4%
Average	2,2	2,2	2,4	3,9	2,1	2

Based on Table 2, the average results of flavor showed that the addition of carrageenan at various concentrations (0%, 0.6%, 0.8%, 1%, 1.2%, and 1.4%) had a significant effect on the sensory parameters tested. The highest mean value was recorded in the treatment with 1% carrageenan at 3.9, while the other treatments showed relatively low values, ranging from 2.0 to 2.4.

An increase in the score at 1% concentration indicates that carrageenan at this level is able to improve the sensory characteristics of the product, possibly because the gel structure

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formed is at an optimal condition, thus providing a texture that is preferred by consumers. Conversely, a decrease in score at concentrations above 1% indicates that excess carrageenan can degrade sensory quality, which may be caused by a texture that is too stiff or a foreign taste due to excess additives.

This is in line with the findings of Wibowo et al. (2022) who stated that the use of the right amount of carrageenan can improve sensory acceptability, but at excessive concentrations it decreases consumer preference due to the formation of a gel structure that is too dense. In addition, according to Ningsih & Ratnawati (2023), the interaction of thickeners with the water content in the product can affect viscosity and final consistency, which has a direct impact on the perception of taste and texture.

Table 3. The Average Ipomoea reptans Nori Color

	0%	0,6%	0,8%	1%	1,2%	1,4%
Average	2	2,5	2,7	3,3	2,2	2,1

Based on Table 3, the average color results showed that the addition of carrageenan had a significant effect on the sensory quality of the product. The highest value was obtained at a concentration of 1% with a score of 3.9, which indicates the best level of acceptance from the panelists. This indicates that at this concentration, carrageenan is able to form an optimal gel structure resulting in a favorable texture.

Conversely, at concentrations above 1%, the mean score decreased to 2.0-2.4, indicating that excess carrageenan can reduce sensory quality, possibly due to a texture that is too stiff or foreign flavors.

According to Nasirpour-Tabrizi et al. (2020) mentioned that the use of carrageenan in a balanced amount can improve the sensory acceptability of low-fat products. According to Chen et al. (2023), the use of excess carrageenan in surimi products results in a gel that is too dense, decreases softness and reduces consumer preference for the product.

Table 4. The Average Ipomoea reptans Nori Fragrance

	0%	0,6%	0,8%	1%	1,2%	1,4%
Average	2,1	2,2	2,5	3,3	2,1	2,2

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Based on Table 4, the average aroma results show that the addition of carrageenan has a significant effect on the sensory quality of the product, especially in terms of aroma. The highest score was obtained at 1% concentration with a score of 3.3, indicating the best level of aroma acceptance from the panelists. This indicates that at this concentration, carrageenan is able to help maintain and strengthen the natural aroma of the product, thus giving a more favorable impression to consumers. On the other hand, at concentrations below and above 1%, the mean value of aroma tended to be lower (2.1-2.5). This indicates that the addition of excess carrageenan can have a masking effect on volatile compounds, so that the aroma of the product is not optimal. Too high a concentration of carrageenan can also lead to an increase in viscosity or the formation of a too dense gel, which inhibits the release of aroma compounds.

According to Buljeta et al. (2021), an increase in carrageenan concentration decreases the release of aroma compounds such as esters, as the high viscosity of the carrageenan gel inhibits aroma diffusion to the product surface. The use of carrageenan in dairy beverages leads to reduced aroma intensity as volatile compounds are trapped in the gel network (Wang et al., 2021). According to Xu et al. (2024) that emulsions with high viscosity due to the addition of ingredients such as carrageenan can reduce the intensity of aroma perceived by panelists. Thus, increasing viscosity in gel systems can improve flavor but significantly inhibit aroma release (Tian et al., 2022).

Table 5. Friedman Test Statistical Test Results

Test Statistics	Value
Number of Sample (N)	30
Chi-Square	313.406
Degress of Freedom (df)	23
Asymptotic Significance (Asymp. Sig.)	0.000

To further substantiate the findings, a Friedman test was conducted to determine whether there were statistically significant differences among the various carrageenan concentrations across sensory parameters. The test involved 30 panelists and produced a Chi-Square value of 313.406 with 23 degrees of freedom. The asymptotic significance (Asymp. Sig.) was 0.000**,** indicating that the differences in panelists' responses across treatments were statistically significant at $p < 0.05$**.**

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This result confirms that the variations in carrageenan concentrations had a significant influence on the overall sensory attributes (taste, color, aroma, and texture) of the Ipomoea reptans nori. The highest ranking obtained consistently at 1% carrageenan across all parameters aligns with the panelists' preference and further validates the sensory optimization at this level. Therefore, incorporating statistical evidence enhances the scientific rigor and reinforces that the 1% formulation is not only descriptively superior but also statistically significant in terms of sensory acceptance.

Discussion

The results of the study indicated that the addition of kappa carrageenan significantly affected the sensory quality of Ipomoea reptans-based nori, especially at the 1% concentration. Based on the average scores of each organoleptic parameter (texture, flavor, color, and aroma), the 1% concentration demonstrated the best outcomes compared to other levels.

In terms of texture**,** the 1% concentration achieved the highest score of 4.1, showing that the texture of the nori at this level was the most preferred by panelists. This indicates that the gel structure formed at this level was optimal in providing a desirable chewy consistency. These findings align with Putri et al. (2021), who stated that ingredient formulation and processing conditions greatly influence sensory quality.

Regarding flavor**,** the highest score was also recorded at the 1% concentration with a value of 3.9. The appropriate amount of carrageenan improved the flavor characteristics of the product, likely due to the development of a suitable structure without producing an off-taste. Higher concentrations (above 1%) led to a decrease in preference, possibly caused by an overly dense gel structure. This is consistent with Wibowo et al. (2022) and Ningsih & Ratnawati (2023), who mentioned that the interaction of thickeners with water content affects viscosity and final taste perception.

For color**,** although there is a slight discrepancy between the narrative and the table (the text mentions 3.9, but the table shows 3.3), it can be generally concluded that the 1% concentration resulted in the most preferred color. This concentration produced a natural and appealing appearance, while higher concentrations might result in dull or overly dark colors due to excessive gel formation. This observation is supported by Nasirpour-Tabrizi et al. (2020) and Chen et al. (2023), who noted that an optimal amount of carrageenan can enhance product appearance, whereas excessive use may reduce it.

In terms of aroma**,** the highest score of 3.3 was again achieved at the 1% concentration. This indicates that carrageenan at this level could help preserve and enhance the natural aroma of Ipomoea reptans, giving a more favorable impression to consumers. Conversely, both lower and higher concentrations resulted in lower aroma scores, likely due to the masking effect on volatile compounds caused by increased gel viscosity. This phenomenon is explained by

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Buljeta et al. (2021), Wang et al. (2021), and Xu et al. (2024), who reported that high viscosity can trap aroma compounds and reduce the intensity of perceived aroma.

In conclusion, the addition of 1% carrageenan is considered the optimal treatment in the development of Ipomoea reptans-based nori, as it achieved the highest scores across all tested organoleptic parameters. This concentration provides a balance between ideal gel structure, desirable texture, preserved natural flavor, appealing color, and optimal aroma release.

CONCLUSION

The addition of carrageenan at varying concentrations (0%, 0.6%, 0.8%, 1%, 1.2%, and 1.4%) influenced the sensory quality of analog nori made from Ipomoea reptans. The treatment with 1% carrageenan produced the most optimal results, with the highest scores in texture (4.1), taste (3.9), color (3.3), and aroma (3.3). In contrast, concentrations above 1% resulted in decreased sensory quality due to the overly dense gel structure, which negatively affected texture and hindered the release of aroma compounds. On the other hand, lower concentrations led to suboptimal structure, making the product less acceptable.

The conclusion aligns with the findings: a 1% carrageenan concentration is the most acceptable formulation for producing analog nori from Ipomoea reptans. To enhance the impact of this study, it is recommended that these findings be considered for the development of plant-based nori products at an industrial scale, offering a sustainable and locally sourced alternative to traditional seaweed-based nori. Furthermore, future research could focus on product shelf-life stability, nutritional fortification, and broader consumer preference studies to validate and expand the potential applications of this formulation.

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