

Sensory Evaluation and Acceptance of Moringa Sheet: A Comprehensive Analysis

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Abstract

Moringa leaves are readily available natural ingredients in Malaysia, rich in various nutrients such as antioxidants and vitamins. Although this moringa tree is easy to grow, its use is still limited, and many people still do not know the benefits of this leaf. Accordingly, the research conducted is to produce an innovative product based on moringa leaves. Moringa leaves will be processed to produce moringa sheets. The product produced is similar to nori produced from seaweed. To produce Moringa sheets, cleaned Moringa leaves undergo processing until they achieve a thin and crispy consistency. The drying method, conducted at a temperature of 60°C, effectively yields well-dried pieces while preserving the nutritional content within. These Moringa sheets undergo a taste evaluation process involving 35 panelists. Each panelist receives four different samples labeled with codes F1-276, F2-835, F3-902, and F4-control. Panelists complete a hedonic form to assess the acceptance of each sample based on taste, aroma, mouthfeel, texture, and overall acceptance. Sensory data are analyzed using SPSS software to determine ANOVA -Test. The research findings indicate that the F2 sample is more accepted by the panelists compared to the other samples. This innovative moringa sheet product is seen to be able to compete with nori in the market. This will help the use of local natural ingredients in producing special food products.

Keywords: Moringa Sheet, Moringa, Carrageenan.

1.0 Introduction

Nori is a food product made from seaweed belonging to the genus of *Porphyra*, which has been dried or baked. It is dried edible seaweed used in Japanese cuisine, made from species of the red algae genus nor purple layer *Pyropia*, including *P. yezoensis* and *P. tenera*. Nori usually produces in large, thin, dried sheet where It has a strong and distinctive flavor (Sinurat, Fransiska, Utomo, Subaryono, Nurhayati & Sihono, 2022). The largest suppliers of *Porphyra* genus seaweed are primarily located in East Asia, particularly in countries like Japan, China, and Korea (Rosida, Nurani, & Danil, 2021). These countries have a long history of nori cultivation and consumption, and they dominate the global market for this seaweed.

In Malaysia, the only place that provide a favorable environment for the production and growth of diverse types of seaweed species is most located at the eastern coast of Sabah (Ku Yaacob, 2013). Accordingly, the Malaysian

Government sees the need to develop products based on seaweed, fish and shrimp as food products so that these three commodities can be sustainable (Ismail, Abdullah, Ismail, Karim, Ramaiya, Benjamin, Awang, & Zakaria, 2024). However, the development of innovative food products such as nori that uses other plants such as moringa is an innovation with high potential. Referring to a study conducted by Endah, Alfi, Winda, Puji, Nur & Rina (2024), moringa can be used as a food product with good nutritional value. So, the use of moringa as a food product needs to be diversified. Therefore, this seek underscores the transformative potential of leveraging locally available raw materials, such as Moringa leaves, to innovate and elevate the nutritional profile of sheet products in the food industry. Referring to Israk, Rahmana, Fuad & Alia (2021), the use of moringa needs to be expanded due to the importance of nutritional value such as protein content and high traditional medicinal values. Thus, by pioneering the utilization of Moringa leaves in sheet production, aiming to create a product akin to Nori seaweed but with enhanced nutritional attributes.

The study conducted is to determine user acceptance of the innovative product, namely moringa sheet, which uses moringa leaves as the main substitute for seaweed. In the development of this product, the methodological approach involves a series of meticulously designed processes, including bleaching, blending, cooking, and semi-drying of Moringa leaves to fabricate sheets. A bleaching method serves to mitigate the inherent bitter taste of Moringa leaves, thereby enhancing palatability. Following processing, sensory acceptance testing is conducted to evaluate the sensory attributes of the Moringa-based sheets compared to conventional Nori seaweed products. In Malaysia future, Moringa leaves could be presenting as a viable alternative to Nori seaweed in sheet production.

2.0 Literature review

2.1 Nori seaweed

"Nori," commonly known as purple laver or *Porphyra yezoensis*, a marine vegetable that rich in nutritious ingredients required by the human body such as protein, minerals, crude fiber, and vitamins. It is a popular Asian snack that commonly marketed in large, thin, dried sheets, with strong and distinctive flavor (Sinurat et al., 2022). The consumption of nori remains a growing trend in Malaysia due to the nutrients offered.

Nori seaweed boasts a rich array of essential nutrients (refer Table 1.1), making it a valuable addition to any diet. It is particularly notable for its high levels of vitamins and minerals such as Na, K, Ca, Mg, P, Mn, I, Fe, and Zn, (Campagnol, Lorenzo, Santos & Cichoski, 2022). Nori also offered an excellent source of vitamins A, C, and B vitamins, including B12 which a nutrient often lacking in plant-based diets. From its abundance of vitamins and minerals to its antioxidant and anti-inflammatory properties, nori provides a holistic approach to promoting health and preventing disease. These shown it can be consumed for all age groups especially for vegans as their vitamin B12 sources (Hamid et al., 2015).

Table 1.1 Nutritional composition of various seaweed species

Seaweed Species	Nutrition				
	% Protein	% Total lipid	% Carbohydrate	% Crude fibre	% Ash
Gracilaria cervicornis	19.70	0.43	63.10	5.65	-
Pyropia tenera	36.60	3.04	-	3.26	11.55
Kappaphycus alvarezii	16.24	0.74	27.40	29.40	-
Undaria pinnatifida	15.69	2.23	-	2.92	29.84

(Gamero-Vega, Palacios & Quitral, 2020)

The benefits of nori that uses seaweed is seen as a product that is proven to be good in terms of nutrition. However, Malaysia as a country that does not produce seaweed needs to find other alternatives to replace seaweed as a food product that is similar to nori. Accordingly, the study found that moringa is another alternative that can be developed in the production of nori-like products.

2.2 Moringa oleifera

Moringa oleifera, which belongs to the Moringaceae family are almost edible on every part of the tree. It is highly nutritious and contain many essential minerals, vitamins, antioxidants, protein and flavonoids, as well as isothiocyanates. Moringa oil from the seeds has been used as a cosmetic item such as body and hair care. The mainly roots are used as a spice while the other parts could be a dried powder for wide medicinal purpose (Trigo, Castello & Ortola, 2023). Meanwhile, moringa leaves and fruit are used as a delicious ingredient when cooked with coconut milk (Hairul, Palal & Abidin, 2024).

Moringa leaves are also known as the store house of nutrients which make it the main reason to undergo the nori sheet production using it as the raw material. It also carried out various pharmacological activities in human body system, such as analgesic, antihypertensive, antitumor activity, and anti-inflammatory effects (refer Table 1.2). The most vital component content found in Moringa oleifera leaves is Quercetin, a flavonoid known for its numerous health benefits. Quercetin exhibits anti-cancer properties by inhibiting the growth of cancer cells, making Moringa leaves a promising dietary addition for cancer prevention and management (Malemnganbi & Singh, 2021).

Table 1.2. Nutritional composition of moringa oleifera leaves, flowers, immature pods

Seaweed Species	Nutrition			
	% Protein	% Total Fat	% Carbohydrate	% Dietary Fibre
Leaves	22.4	5.0	27.1	31.0
Flowers	18.9	2.9	36.0	32.5
Immature pods	19.3	1.3	25.0	46.8

(Grosshagauer, Pirkwieser, Kraemer & Samoza, 2021)

The good nutritional value of moringa needs to be diversified in its use such as in food, health and beauty products. The use of moringa in food products will diversify the functions of moringa other than what is used as a current cooking ingredient. Accordingly, the development of Moringa Sheet innovation is seen as an innovation that has the potential to be accepted by consumers. In order to obtain information on consumer acceptance, consumer acceptance analysis was conducted so that the products produced are not only of good quality in terms of nutrition but are well received by consumers.

3.0 Methodology

The sample preparations involve two mainly ingredient which were Moringa oleifera leaves where it was freshly collected from Kampung Tanah Merah, Muar, and carrageenan as gelling agent to the nori production. Salt, umami, white pepper and smoke paprika were the seasonings to enhance the aroma and Nori taste. The fresh Moringa oleifera leaves were undergo quality check to removing any damage or discolored portions then subjected to a series processing steps including bleaching, blending, cooking and semi-drying at 60°C, to fabricate Moringa-based sheets. The purpose of bleaching Moringa leaves was to mitigate the inherent bitter taste associated that helps improve the overall sensory attributes of Moringa Sheet, making it more appealing for consumption (Ademiluyi, Aladeselu, Oboh, & Boligon, 2018).

Three formulations of Moringa Sheet were carried out to distinct the impact of varying proportions of Moringa leaf puree and carrageenan percentage which could discern the impact on sensory attributes. The formulation was devised to achieve a range of Moringa leaf puree to carrageenan ratios specifically 96%:1%, 95.5%:1.5% and 95%:2%. Continuously, Sensory evaluation test was conducted involving 35 panellists to assess the acceptance of respondent. Referring to Ahmad & Safuan (2021), sensory testing needs to be conducted using a sensory room that has a suitable environment and lighting in order to have a positive impact during the sensory evaluation. The test was evaluated using 9 point hedonic tests (Anjani, Zakaria & Widowaty, 2021) towards the appearance, aroma, taste, mouthfeel, texture, and overall acceptance for each formulation. The samples were labelled with F1 – 276, F2- 835 and F3- 902. SPSS version 21 software was used to assist the analysis process of the study findings.

4.0 Discussion of analysis and findings

Based on conducting the sensory evaluation test (refer Table 1.3), 4 samples were prepared with 1 controlled sample (nori sheet) and 3 formulations where different in Moringa leaf puree to carrageenan ratios. Those different ratios give 6 different attributes towards the sheet produced in term of the appearance, aroma, taste, mouthfeel, texture and overall acceptability. A total of 35 panelist were received 4 samples with random coded. They were asked to rate them based on the degree of liking on a nine-point hedonic scales (1=dislike extremely, 5=neither like nor dislike, 9=like extremely) in the Hedonic Form provided (Santoso et al., 2019).

Table 1.3: Tukey's HSD result for sensory scores of Moringa Sheet

ATTRIBUTES	Control	F1	F2	F3
Appearance	4.34±0.152c	3.83±0.258a	4.31±0.240c	4.17±0.313b
Aroma	4.31±0.195b	3.95±0.306a	4.35±0.216b	4.34±0.256b
Taste	4.27±0.205b	3.99±0.284a	4.25±0.278b	4.23±0.229b
Mouthfeel	4.37±0.385b	3.91±0.272a	4.37±0.373b	4.11±0.333b
Texture	4.35±0.165b	3.98±0.329a	4.33±0.180b	4.29±0.243b
Overall Flavour	4.49±0.238c	3.98±0.308a	4.44±0.291c	4.25±0.333b

The sensory evaluation revealed formulation F2 (95.5%:1.5%) as a promising candidate for nori sheet production, demonstrating high acceptability and closely matching the sensory profile of the control sample. While not identical, formulation F2's minor differences suggest its potential as a viable alternative, harnessing the nutritional benefits of moringa leaves. These findings underscore the significance of ongoing research and optimization efforts in meeting consumer preferences and advancing sustainability in the food industry. With further refinement, moringa-based products like formulation F2 could offer a nutritious, environmentally friendly option for consumers seeking diverse and innovative food choices. Consumer acceptance of the F2 formulation, especially in terms of taste, shows that the original bitter taste of moringa was successfully reduced by using the moringa leaf bleaching method before the moringa sheet was produced. Salman, Prangdimurti & Hunaefi (2023) used the same method to eliminate the bitter taste of moringa so that the product produced could be well received by consumers.

Referring to the spider web analysis (Figure 1.1), underscores the promising potential of formulation F2 as a viable alternative for nori sheet production. The spider plot visualization further elucidated the comparative sensory attributes of each sample, with formulation F2 closely aligning with the controlled product across multiple dimensions. While slight variations were observed, formulation F2 exhibited high acceptability and showcased comparable taste, aroma, texture, and overall flavor profiles to the control. These findings highlight the robustness of formulation F2 and its capacity to meet consumer expectations for sensory quality. Moving forward, continued optimization efforts guided by spider plot insights hold the key to further refining moringa-based products, ensuring they offer both nutritional benefits and exceptional sensory experiences.

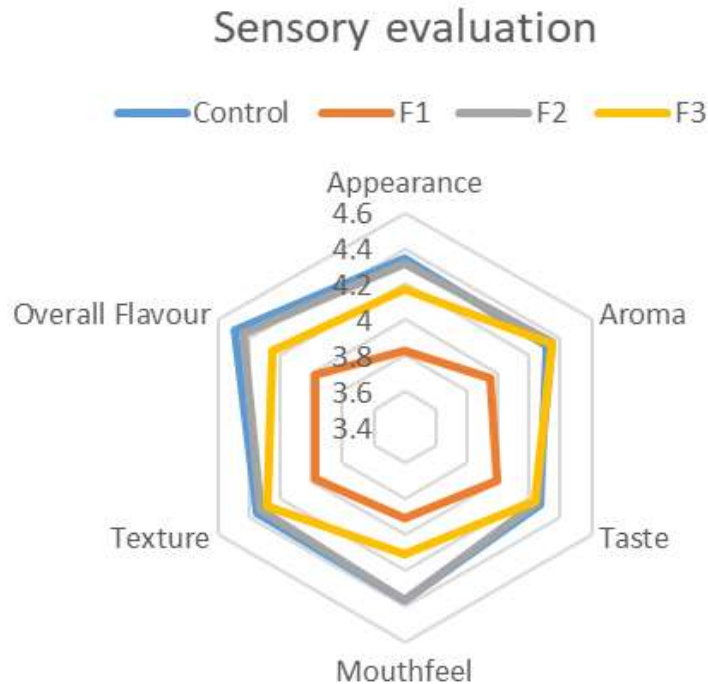


Figure 1.1: Spider web for sensory scores of Moringa Sheet

Figure 1.1 shows that moringa sheet in the F2 formulation is comparable to the sample control in the market. This acceptance shows that the samples on the F2 formulation have the potential to be marketed because consumers can accept the quality of the product in line with existing products on the market. This is in line with the research conducted by Abdullah & Azam (2011), where existing products have indeed been accepted by consumers, but if innovative food products can be accepted by consumers, it shows that the product has potential in the future.

5.0 Conclusion and future research

Moringa sheets represents a groundbreaking innovation with significant potential in the local food market. Extensive research has been conducted to address the pressing issue of reducing reliance on imported nori from foreign countries. By utilizing moringa-based products, not only can we compete with nori effectively, but we can also offer enhanced nutritional value and cater to a wide range of user preferences and dietary needs.

Furthermore, this study demonstrates a clear solution to the identified problem statement, namely the lack of diversity in moringa utilization within food products. It achieves this by successfully meeting the study's objectives. The sensory evaluation findings further underscore consumer acceptance of moringa sheet products, indicating a promising market response. Looking ahead, there is immense potential to further develop and market these products beyond Malaysia, targeting international markets. This expansion could significantly contribute to the global food industry while promoting the nutritional benefits and versatility of moringa-based products on a broader scale.

Although the product that has been developed is well received by the respondents in terms of texture. However, further research can be carried out by conducting laboratory studies such as texture analysis to measure the level of crispiness of the products developed in line with the crispiness of nori products that are already on the market.

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Author Contributions

N.H.N Hairul: contributed to the conceptualization, formal analysis, and drafting of the original manuscript; **N.H. Palal:** was responsible for developing the methodology and contributed to reviewing and editing the manuscript; **N.A.M. Pitri:** carried out the data curation efforts. **J. Astina:** Validation, Writing-Reviewing and Editing. All authors have reviewed and approved the final version of the manuscript for publication.

Conflicts of Interest

The manuscript has not been published elsewhere and is not under consideration by other journals. All authors have approved the review, agree with its Submission and declare no conflict of interest in the manuscript.

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