

INNOVATION AND ACCEPTABILITY OF SEAWEED INTO ICE CREAM WITH AND WITHOUT MORINGA

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ABSTRACT: Ice cream, a universally beloved frozen dessert, is prone to variations in both physical characteristics and sensory attributes due to its complex composition. Nowadays, functional ice cream is a response to customers' evolving preferences as their quest for products that combine enjoyment and health advantages has been spurred by increased knowledge of wellness and health concerns. Thus, this study investigated the acceptability of seaweed into ice cream, with and without moringa. This study aimed to assess the level of acceptability for this innovative culinary product in terms of (a) appearance, (b) color, (c) texture, (d) aroma, and (e) palatability. An experimental research design was employed that involved a total of thirty (30) semi-trained panelists composed of faculty members and students at Agusan National High School (ANHS), school year 2022-2023, in the Philippines, using the purposive sampling technique. In the collection of data, the 9-point hedonic rating scale sensory evaluation questionnaires were utilized, and data were treated with the mean and standard deviation. Based on the study's findings, the overall acceptability of ice cream made from seaweed with moringa ($M = 6.77$ $SD = 1.45$) is moderately acceptable while ice cream made from seaweed without moringa ($M = 7.41$ $SD = 1.31$) and basic ice cream ($M = 7.57$, $SD = 1.24$) are very much acceptable. While seaweed-infused ice cream demonstrates promise as a novel flavor option, the addition of moringa presents challenges in balancing nutritional benefits with sensory appeal. Also, seaweed-infused ice cream can compete with the overall acceptability of the basic ice cream. Recommendations for further research include formulation optimization, consumer education, continuous sensory testing, and consumer feedback sessions to enhance the acceptability and market potential of seaweed-infused ice cream.

Keywords: Acceptability, Ice cream, Moringa Oleifera, Seaweed

INTRODUCTION

The widespread availability of unhealthy food and drinks in schools has become a notable concern [1]. Children and adolescents, who typically spend a significant portion of their waking hours in school, often consume a substantial portion of their daily caloric needs while there, leading to apprehensions regarding public health [2]. The regular consumption of nutrient-deficient snacks is worrisome, as these items may displace healthier food choices or fail to contribute adequately to overall well-being, as outlined by the 2015 Dietary Guidelines Advisory Committee. Consequently, there has been a push to implement nutrition policies in public schools aimed at curbing the consumption of such unhealthy snacks and beverages.

In the Philippines, schools play a vital role in providing students with access to nutritious food available in school canteens [3]. At the public elementary and secondary school levels, the Department of Education has implemented regulations governing the operation and management of school canteens, aiming to address malnutrition among students. These regulations serve as a framework for schools to establish and maintain canteens that cater to students' nutritional needs by offering affordable, wholesome snacks and meals, while also ensuring compliance with the Department of Education's directives regarding food, beverages, sanitation, and canteen finances [4].

Ice cream, a sweetened frozen dairy product composed of milk and milk products, is commonly available in schools and enjoyed by children and adolescents, particularly during hot weather due to its cooling properties [5]. It serves as a significant addition to the typical diet, with evolving consumer perceptions recognizing it as a functional food with potential health benefits, especially when enriched with fruits and protein-rich ingredients.

In response to changing consumer preferences, ice cream innovation prioritizes establishing connections with consumers, recognizing its unique components that offer a deeply satisfying eating experience. Ice cream's complex composition makes it susceptible to changes in sensory qualities and physical features, highlighting the importance of each ingredient in shaping consumer response [6]. Recent studies emphasize ice cream's versatility as an ideal medium for incorporating beneficial substances, leading manufacturers to

enhance functionality to cater to diverse lifestyles and dietary needs, thereby driving ongoing experimentation with formats and ingredients to remain competitive in the global market [7].

Seaweed, a marine macroalgae characterized by its high nutritional

value and bioactive components stand out as promising ingredients for enhancing the nutritional profile of ice cream [8][9]. In the Philippines, seaweed, particularly *Eucheuma cottonii*, ranks among the most significant aquaculture products alongside milkfish and tilapia, highlighting its importance in local food systems [10]. With its rich content of biological substances, vitamins, minerals, fiber, and antioxidants, seaweed is garnering considerable attention for its potential health benefits [11].

Alternatively, another nutrient-rich plant that holds promise for creating healthy ice cream is *Moringa oleifera*, commonly known as "malunggay" in the Philippines [12]. Belonging to the *Moringaceae* family, *Moringa oleifera* is a fast-growing tropical deciduous plant characterized by its long, pendulous fruits, seeds, thick tuberous roots, and light-green leaves [13]. In fact, there is a promising acceptability of *moringa* when used in food snacks like doughnuts [12]. Renowned for its remarkable adaptability and capacity to yield edible food and essential nutrients vital for human physiological requirements, *moringa oleifera* serves as a rich source of macro- and micronutrients as well as other bioactive compounds essential for optimal health [14]. Hence, *Moringa oleifera* presents a valuable reservoir of essential macronutrients and micronutrients crucial for supporting human health and well-being.

While numerous studies have explored the sensory qualities of ice cream and its enhancement with additional nutrients or bioactive substances using descriptive analyses, there is currently a gap in research concerning the innovation and acceptability of seaweed-infused ice cream with and without *moringa*, particularly in Northern Mindanao. It remains uncertain whether the sensory changes noted by semi-trained panelists accurately reflect variations in product acceptability among uninformed consumers. To address this gap, the researcher aimed to investigate the innovation and acceptability of seaweed-infused ice cream, both with and without

moringa, with a key focus on determining the acceptability of these novel food products. Thus, this study sought to answer the question: What is the level of acceptability of ice cream mixtures in terms of (a) appearance, (b) color, (c) texture, (d) aroma, and (e) palatability?

METHODOLOGY

This study aimed to evaluate the acceptability of seaweed into ice cream with and without *moringa*, based on appearance, color, texture, aroma, and palatability. To achieve this goal, an experimental research design was employed. Experimental research involves the manipulation of two sets of variables within a scientific methodology, where one set serves as a constant to determine differences between the two sets. Widely regarded as the "gold standard" in research designs, experimental research is known for its rigor and transparency in allowing researchers to achieve their objectives [15].

Thirty (30) semi-trained panelists composed of faculty members handling food subjects and students taking food subjects at Agusan National High School (ANHS) school year 2022-2023 were employed as respondents of the study. Semi-trained panelists are typically knowledgeable about various food categories and possess the capacity for discrimination and effective communication of distinctions [16]. In addition, the purposive sampling technique in determining the study's sample size was used. The term "purposive sampling" refers to a group of non-probability sampling approaches in which respondents were chosen because they possess properties that the sample needs [17].

The following are the inclusion criteria used to participate in the study:

Inclusion Criteria

1. Must be a faculty member handling food subjects at Agusan National High School.
2. Must be a bona fide student taking food subjects at Agusan National High School.
3. Must approve the consent letter in answering the questionnaire.

The research instrument used in the study was the 9-point hedonic rating scale sensory evaluation form to gather data on the level of acceptability of the innovative seaweed into ice cream with and without *moringa*. The 9-point hedonic scale is the one that is most frequently used to gauge how well food is accepted. A Hedonic scale, which is derived from the word "hedonic," which means "connected to pleasure," assesses how much something makes or does not make a person satisfied [18]. Additionally, comprehensive food preference surveys and food acceptance tests performed on soldiers in the field and lab proved the validity, reliability, and discriminative capacity of the scale [19]. Each item in the questionnaire was measured where 1 as the lowest, which means "Didn't like it at all" and 9 as the highest which means "Like it a lot".

In the school's culinary building, the evaluation was held. Because these factors have an impact on one's judgment, the evaluation environment should be kept in good physical and psychological condition [20]. In addition, the area should be quiet and odor-free, with a comfortable ambient temperature and relative humidity. Considering that nearby odors may alter how food tastes. The International Organization for

Standardization (ISO) 1998, also recommends that the color and lighting in the sensory environment be planned to allow for adequate observation of food samples while limiting distractions.

Additionally, the researcher should ensure that the member of the tasting panel is a nonsmoker, avoids foods that are abrasive to the tongue's taste buds and alcoholic beverages, and has eaten at least two hours before the evaluation [21]. Following that, each respondent was given one serving of basic ice cream, innovative seaweed-infused ice cream without *moringa*, and seaweed-infused ice cream with *moringa*. To ensure that the quality of the product being tested was the same across all panelists, food samples were provided to them all at the same time of day. For semi-trained panelists who evaluated the samples anonymously, should be neutrally coded [22].

To prevent bias from presentation order effects, the serving order should be varied when testing multiple samples. Food samples should ideally be served at the standard serving temperature and should be cooled to the necessary temperature for testing. Samples should be displayed in identically sized, shaped, and colored containers or on plates. Typically, white, or clear containers are used to avoid affecting panelists' impressions of the color of the items [23]. The napkin, sensory analysis questionnaire (evaluation form), and pen were included with the food samples. To avoid any misunderstanding, the assessment forms were printed clearly and explained before the actual food testing [24]. Then, using a modified 9-point hedonic rating scale evaluation form, the respondents were asked to rate the samples for appearance, color, texture, aroma, and palatability.

In addition, panelists were given access to room temperature water [25] or plain bread or crackers [26] between samples for cleaning or refreshing their palates and to prevent carryover tastes. A 30-second rest interval was also arranged in between samples. Moreover, paper towels were offered, and little receptacles into which samples may be spit were offered because swallowing food samples affects the flavor of subsequent samples [23]. Traditionally, sensory tests were conducted in a specially constructed space with a controlled environment and dividers reducing responders' visual contact with the researcher or server [27]. This was done to ensure that no one else could see the evaluation forms and prevent them from influencing how other panelists evaluate.

The panelists were not permitted to speak to other evaluators or sit next to each other. Furthermore, respondents had the choice to submit remarks about the products [26]. A respondent was also asked to leave the location right away after completing the evaluation in order to avoid conflicts with anyone else's judgment. The assessment forms were then gathered, and the data were totaled. The collected data were prepared for statistical processing or data analysis. After that, the evaluation forms were collected, and all the data were tallied and analyzed using Mean and Standard Deviation. Table 1 was used for scoring and verbal interpretation of the level of acceptability of the innovative ice cream products.

Table 1- Scoring and Verbal Interpretation of the Level of Acceptability of the Innovative Ice Cream Products

Scale	Range	Remarks	Verbal Interpretation
9	8.20-9.00	Like it a lot	Highly Acceptable
8	7.30-8.19	Like it very much	Very Acceptable
7	6.40-7.29	Like it moderately	Moderately Acceptable
6	5.50-6.39	Like it slightly	Slightly Acceptable
5	4.60-5.49	Neither like nor dislike it	Neither Acceptable/Unacceptable
4	3.70-4.59	Didn't like it slightly	Slightly Unacceptable
3	2.80-3.69	Didn't like it moderately	Moderately Unacceptable
2	1.90-2.79	Didn't like it very much	Very Unacceptable
1	1.00-1.89	Didn't like it at all	Highly Unacceptable

RESULTS AND DISCUSSION

Mean and standard deviation were calculated to ascertain the level of acceptability of the three ice cream samples in terms of appearance, color, texture, aroma, and palatability. First, food appearance refers to the visual aspect or presentation of food and this may impact on perception and enjoyment of eating it. It can be noted that among the three samples, sample 3 ($M= 7.63$, $SD= 1.07$) got the very much acceptable while sample 1 ($M= 7.17$, $SD= 1.34$) and sample 2 ($M= 7.03$, $SD= 1.25$) got moderately acceptable. Second, color is one of

the primary sensory properties that significantly influences the perception of food on how it looks like, whether to try or reject it. It can be that among the three samples, sample 1 ($M= 7.60$, $SD= 1.30$) and sample 3 ($M= 7.50$, $SD= 0.94$) got very much acceptable while sample 2 ($M= 6.70$, $SD= 1.26$) got only moderately acceptable. Third, texture refers to the physical feel or consistency of the ice cream when it is consumed. It can be noted that among the three samples, sample 1 ($M= 7.37$, $SD= 1.27$) got the very much acceptable while sample 2 ($M= 6.57$, $SD= 1.59$) and sample 3 ($M= 7.03$, $SD= 1.54$) got only moderately acceptable. Fourth, aroma refers to the distinctive pervasive, and savory smell of the ice cream. It can be noted that among the three samples, sample 1 ($M= 7.90$, $SD= 1.06$) and sample 3 ($M= 7.60$, $SD= 1.35$) got very much acceptable while sample 2 ($M= 6.90$, $SD= 1.35$) got only the moderately acceptable. Fifth, palatability refers to the tastiness or agreeableness of the ice cream, indicating whether it is acceptable to the taste. It can be noted that among the three samples, sample 1 ($M= 7.83$, $SD= 1.23$) and 3 ($M=7.30$, $SD=1.34$) are very much acceptable compared to sample 2 ($M=6.63$, $SD=1.79$) which is only moderately acceptable. Finally, among the three samples overall acceptability, sample 1 ($M= 7.57$, $SD= 1.24$) and sample 2 ($M= 7.41$, $SD= 1.31$) got very much acceptability. This means that even the ice cream is made of seaweed, with and without *moringa*, it can compete its overall acceptability to the basic ice cream formulation. Presented in Table 2 is the acceptability of the three ice cream samples in terms of appearance, color, texture, aroma, and palatability.

Table 2- The Acceptability of Three Ice Cream Samples in terms of Appearance, Color, Texture, Aroma, and Palatability.

Criteria	Sample 1			Sample 2			Sample 3		
	M	SD	Verbal Interpretation	M	SD	Verbal Interpretation	M	SD	Verbal Interpretation
Appearance	7.17	1.34	Moderately Acceptable	7.03	1.25	Moderately Acceptable	7.63	1.07	Very Much Acceptable
Color	7.60	1.30	Very Much Acceptable	6.70	1.26	Moderately Acceptable	7.50	0.94	Very Much Acceptable
Texture	7.37	1.27	Very Much Acceptable	6.57	1.59	Moderately Acceptable	7.03	1.54	Moderately Acceptable
Aroma	7.90	1.06	Very Much Acceptable	6.90	1.35	Moderately Acceptable	7.60	1.35	Very Much Acceptable
Palatability	7.83	1.23	Very Much Acceptable	6.63	1.79	Moderately Acceptable	7.30	1.64	Very Much Acceptable
Overall	7.57	1.24	Very Much Acceptable	6.77	1.45	Moderately Acceptable	7.41	1.31	Very Much Acceptable

Legend:

Sample 1- Basic Ice Cream

Sample 2- Seaweed into Ice Cream with *Moringa*

Sample 3- Seaweed without *Moringa*

The findings of this study are corroborated by Kabir *et al.*, [28], claiming that ice cream is a widely recognized and highly accepted sensory product. Ice cream's delightful flavor, smooth texture, and cool, and refreshing texture are the reasons behind its enormous popularity. Consumers of ice cream have recently shown a preference for functional food, and ice cream with seaweed or *moringa* will play a major role

in this growing trend. Lomartire, S. *et al.* [29] mentioned that seaweeds are receiving a lot of attention because of the advantages they offer for human health, including their high nutritional content and the potent qualities that their bioactive components provide. While it may seem unusual at first, adding seaweed to ice cream offers a chance to experiment with different flavor profiles and textures. As stated by Wells, M.L. *et al.*, [30], the food industries are interested in seaweeds since they are renewable sources of compounds with high added value. Furthermore, seaweed possesses qualities that enable its integration into products like ice

cream, preserving or enhancing their sensory, nutritious, and healthful qualities [31]. Therefore, in terms of their overall acceptability, samples 1 (basic ice cream) and sample 3 (seaweed without *moringa* ice cream) are identical.

Furthermore, the inclusion of *Moringa* affected the ice cream's overall acceptability. In the study of Anjani *et al.*, [32] on the physicochemical and organoleptic properties of ice cream products by the addition of *Moringa* leaf powder, it was found that ice cream containing 3% *moringa* leaf powder is the most acceptable formula and ice cream containing 12% *moringa* leaf powder was sampled with the most unacceptable formula. Hence, this suggests that the higher percentage of *moringa* leaf powder negatively impacted the overall acceptability of the ice cream, possibly due to changes in taste, texture, or other factors.

CONCLUSION

This study explored the acceptability of seaweed into ice cream, with and without *moringa*, shedding light on its potential as a novel culinary innovation. Ice cream is globally beloved for its sensory appeal, making it an ideal vehicle for introducing functional ingredients like seaweed and *moringa*. Seaweed's nutritional value and bioactive compounds offer health benefits, aligning with consumer preferences for functional foods. The incorporation of seaweed into ice cream presents an opportunity to explore unique and enhanced sensorial qualities while maintaining nutritional and healthy characteristics. Moreover, the addition of *moringa* influenced the overall acceptability of the ice cream. A higher amount of *moringa* leaf powder added to ice cream may adversely impact taste, texture, or other sensory attributes. While seaweed-infused ice cream shows promise, careful consideration of *moringa* proportions is crucial to maintaining consumer acceptability.

RECOMMENDATION

To optimize the acceptability of seaweed-infused ice cream, further research should focus on formulation refinement, aiming to strike a balance between innovative flavors and widespread consumer appeal. This could involve experimenting with various seaweed varieties and concentrations, as well as exploring complementary ingredients to enhance sensory experiences. Educating consumers about the nutritional benefits and sustainability aspects of seaweed and *moringa* is essential to fostering acceptance among individuals and those with adventurous palates. Moreover, continuous sensory testing and consumer feedback sessions will provide valuable insights into consumer preferences, guiding product development efforts.

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