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Organoleptic Quality Characteristics And Fiber Content Of Seaweed Ice Cream With The Red Dragon Fruit (*Hylocereus Polyrhizus*) Addition

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ABSCTRACT

Dietary fiber consumption in Indonesia is much as 98% less fruit and vgetables based on Riskesdas 2018. In an effort to increase the consumption of dietary fiber in the community, it is necessary to modify food products with the addition of fiber sources. One of the ingridients that can be used is red dragon fruit (*Hylocereus polyrhizus)* whisch is one of the sources of dietary fiber that with a sweeth taste, has a strong natural color pigment, and is rich in antioxidants. One of the processed products that can be modified is seaweed ice cream. In this study, an overview of the caracteristics of seaweed ice cream with the addition of the red dragon fruit was carried out using an expetimental method with a Randomized Block Design (RBD) consisting of 5 treatments of adding red dragon fruit as much as 20%, 30%, 40%, 50%, and 60% per volume of milk. These caracteristics are obtained from organoleptic test on aroma, taste, color, texture, and overall acceptance as well as hedonic ualities of the colour and texture. The result of the organoleptic test showed that the best treatment in this study was the third treatment with the red color quality and very soft texture quality. The energy content in one portion is 477.83 kcal of energy, 1.8 g of protein, 1.82 g of fat, 5.88g of carbohydrates, 0.56 g of fiber content, and 0.8 mg of GAE antioxidants.

Keywords: Ice Cream, Red Dragon Fruit, Seaweed, Fibre, Antioxidants.

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INTRODUCTION

The low prevalence of dietary fiber consumption remains a major public health concern in Indonesia. Data form the Ministry of Health of the Republic of Indonesia (2018 indicate that among individuals over 10 years of age, 96.8% consume inadequate amounts of fruits and vegetables at the national level (Mukti et al., 2022). Similarly, the 2018 Riskesdas report shows that 95.4% of Indonesians have insufficient intake of fruits and vegetables. Dietary fiber, composed of carbohydrate compounds abundantly found in fruits and vegetables, plays a crucial role in maintaining digestive health. Insufficient fiber intake is associated woth various metabolic and digestive disorders, including cardiovascular disiease, diabetes, cancer, and obesity (Prita et al., 2021).

Survey findings saddest that the main cause of low fiber intake is the inadequate consumption of fruit and vegetables, particulary among children. This is often due to perceptions of fruits and vegetables as having less appealing taste and appearance when consumed directly. Consequently, the processing of fruits and vegetables into functional foods has been proposed to increase their attractiveness and encourage greater consumption among children (Kotrunnada et al., 2022). One potential approach is the utilization of dragon fruit as a natural source of dietary fiber.

Red dragon fruit (*Hylocereus polyrhizus)* is a species of tropical cactus (Utami et al., 2020). It contains carbohydrates (9.1%), protein (1.7%), and fat (3.1%). According to the Indonesian Food Composition Table (TKPI 2019), 100 grams of red dragon fruit provides 3.2 grams of dietary fiber. Additionally, it is rich in antioxidants, such as lycopene and hydroxycinnamates, which reduce cancer risk; betacyanin, which aids in dengue fever treatment; as well as other compounds including betaxanthin, carotenoids, betalains, and polyphenols (Aryanta, 2022). Red dragon fruit is also widely used as a natural coloring agent due to the pigments found in both its peel and pulp (Harni et al., 2023). A promising application of this fruit is its incorporation into ice cream formulation.

Ice cream widely consumed snack that continues to grow in popularity. In Indonesia, ice cream consumption increased by 51.9% between 2013 and 2018, with an average intake of 0.63 L/person/year, rising further to 0.73 L/person/year in 2020 (Ilmi et al., 2023). Conventionally, ice cream consist of non-fat milk solids, stabilizers or emulsifiers, sugar, and fat (Nurwahidah et al., 2024). Previous research by Magdalena (2012) attempted to enhance

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the fiber contents of ice cream by incorporating seaweed at 4% w/v, but the increase in fiber content reached only 0.57%. Thus, further modification is necessary by integrating other fiber rich ingridients such as fruits and vegetables. Red dragon fruit offers a promising alternative, not only as a natural source of dietary fuber but also as a means to improve the sensory appeal of ice cream though its vibrant color, thereby enhancing consumer acceptance.

METHOD

This study employed an experimental design using a Randomized Block Design (RBD) with five treatments: T1 (20%), T2 (30%), T3 (40%), T4 (50%), T5 (60%) addition of red dragon fruit per volume of milk. The uality assessment was conducted at the Organoleptic Testing Laboratory, Departement of Nutrition, Health Polytechnic of the Ministry of Health, Denpasar, in March 2025. A total of 30 semi trained panelist, consisting of students from the nutrition Departement, participated in the evaluation.

The equipment used in this study included measuring cups, stainless steel and plastic bowls, cloths, spatulas, mixers, thermometers, cooler boxes, blenders, standard pots, handled pans, stoves, ladles, knives, weiging scales, and ice cream cups. The ingredients consisted of fresh *Eucheuma cottonii* seaweed, full-cream vanilla milk, skim milk, refined sugar, chicken eggs of good quality, whipped cream, and red dragon fruit puree (*Hylocereus polyrhizus).*

The production procedure included the preparation of seaweed porridge, red dragon fruit puree, and seaweed-based ice cream enriched with dragon fruit. To prepare the seaweed porridge, fresh *Eucheuma cottonii* was cleaned, cut into small pieces, and blended until smooth. For the dragon fruit puree, the peel of *Hylocereus polyrhizus* was remover, the flesh cut into small pieces, and blended without additional ingredients. Ice cream preparation began by mixing eggs and sugar until the mixture became foamy, pale, and increased in volume, Whipped cream was then prepared by mixing it with water at a 1:2 ration using a mixer at medium speed before chilling. Fresh milk and skim milk were pasturized in a saucepan over low heat at maximum temperature of 80°C for up to 30 minutes.

All ingredients were then gradually combined, starting with the pasteurized milk, followed by the egg-sugar mixture, and the seaweed porridge. The mixture was stirred continuously over low heat for 30 minutes to prevent clumping while maintaining pasteurization temperature. The mixture was frozen at 0°C for 3-4 hours, the churned and

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combined with whipped cream and red dragon fruit puree. The mixture was condusted over an ice cooler box for 30 minutes before the ice cream was placed in cups and stored at freezing temperature until serving.

Subjective quality parameters were assessed through a hedonis organoleptic test covering aroma, taste, texture, color, and overall acceptance, using a five-point scale (1 + strongly dislike, 2 + dislike, 3 = neutral, 4 = like, 5 strongly like). Texture quality was further categorized as coarse, slightly smooth, or smooth, while color quality was describe as purplish red, red, or pale red.

Objective quality assesment was carried out in the laboratory to determine the fiber content of the ice cream through proximate analysis. This test was performed on the most preferred treatment based on hedonic evaluation. Nutritional composition, including energy, protein, fat, and carbohydrate content per serving, was estimated using the Indonesian Food Composition Table.

Data processing was performed using calculators and Microsoft Excel. Descriptive analysis was applied based on mean hedonic scores. The treatment with the highest average score and frequency was determined as the most preferred product.

RESULTS

The following are the result of the product evaluation based on the five treatments.

Picture 1. Processed Ice Cream Products from All Treatments of Seaweed-Based Ice Cream with Red Dragon Fruit Addition

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VOLUME 3, No 1. Tahun 2025 , ISSN 3032-4408 (Online)
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Result of Hedonic Test

The hedonic test assessed the aroma, taste, color, texture, and overall acceptability of the ice cream products. Evaluations were conducted using a numerical scale ranging from 5 (highest preference) to 1 (lowest preference). The detailed results are presented in Table 1.

Table 1. Cumulative Percentage of "Like" and "Strongly Like" Responses in the Hedonic Test of Ice Cream Characteristics

Characteristic	T1 (%)	T2 (%)	T3 (%)	T4 (%)	T5 (%)
Aroma	90,00	86,67	81,11	73,33	83,33
Taste	77,78	76,67	80,00	58,89	60,00
Color	57,78	80,00	81,11	74,44	75,56
Texture	81,11	78,89	76,67	78,89	77,78
Overall Acceptability	85,56	80,00	86,67	78,89	77,78

Based on assessment of aroma across the five treatments, cumulative percentages of "like' and "strongly like" were used to determine product preference. Treatments were considered considered acceptable when the cumulative score reached ≥50%. According to this criterion, all treatments were acceptable, with the highest preference recorded for T1 (90%).

For taste, all treatments received more than 50% in the "like" and "strongly like" categories, indicating overall acceptability. Among them, T3 was the most preferred, with a score of 80%.

In terms of color, all treatments also exceeded the 50% threshold, showing that the products were generally well-accepted. The highest preference was observed for T3 (81.11%).

Regarding texture, the cumulative scores again showed acceptability across all treatments. T1 was identified as the most preferred treatment with 81.11%.

Finally, the evaluation of overall acceptability revealed that all treatments were acceptable, with T3 receiving the highest score at 86.67%.

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Results of Hedonic Quality Test

The hedonic quality test was conducted on two product characteristics: texture and color. The results are presented in Table 2.

Table 2. Percentage Distribution of Hedonic Quality Test Results for Ice Cream Texture and Color

Category	T1 %	T2 %	T3 %	T4 %	T5 %
Texture					
Very smooth	77,78	61,11	67,78	58,89	62,22
Smooth	20,00	36,67	30,00	35,56	30,00
Coarse	2,22	2,22	2,22	5,56	7,78
Color					
Pale red	77,78	36,67	12,22	11,11	4,44
Red	8,89	34,44	52,22	32,22	26,67
Purplish red	13,33	28,89	35,56	56,67	68,89

Based on the hedonic quality test results for texture, the best texture quality was observed in treatment P1 (77.78%), while the lowest was in P4 (58.89%). Nevertheless, all treatments met the quality criteria for ice cream texture.

For color, the highest quality score was recorded for P1 (77.78%), whereas the lowest was observed in P5 (4.44%). Among the treatments, only P1 fully met the quality criteria for ice cream color.

Determination of the Best Treatment

Based on the organoleptic evaluation (hedonic test) of aroma, taste, color, texture, and overall acceptability, the best treatment was determined by calculating the cumulative percentage of ice cream samples most preferred by the panelists. Since all treatments achieved an acceptance rate above the minimum threshold of ≥50%, the identification of the most

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preferred product was based on treatments with cumulative preference scores of ≥80%. The results of this analysis are presented in Figure 2.

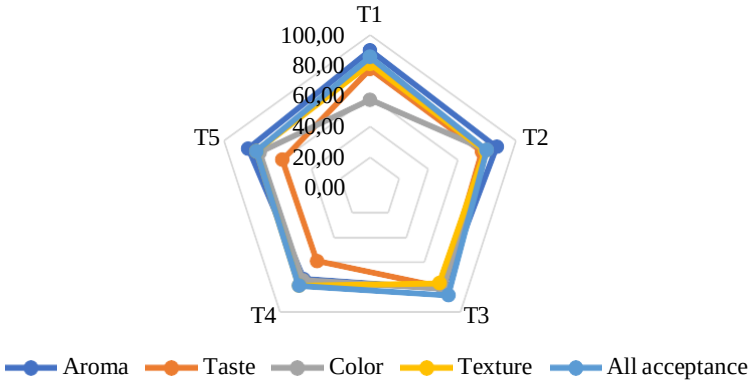

Figure 2. Cumulative Percentage of "Like" and "Strongly Like" Responses

Nutritional Value Analysis

One formulation of seaweed-based ice cream with red dragon fruit addition produced approximately 12 cups, with each cup weighing 50 g (1 serving). The nutritional values per serving, based on the Indonesian Food Composition Table (TKPI, 2019), are presented in Table 3.

Table 3. Nutritional Value per Cup (50 g) of Ice Cream According to TKPI (2019)

Treatment	Nutritional value			
	Energy (kcal)	Protein (g)	Fat (g)	Carbohydrates (g)
T1	44,78	1,73	1,68	5,49
T2	46,30	1,77	1,75	5,68
T3	47,83	1,80	1,82	5,88
T4	49,36	1,84	1,88	6,07
T5	50,88	1,88	1,95	6,27

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Among the treatments, T5 contained the highest nutritional values, with 50.88 kcal energy, 1.88 g protein, 1.95 g fat, and 6.27 g carbohydrates per serving.

Results of Objective Quality Test

Objective quality testing was conducted through laboratory analysis of fiber content and antioxidant capacity in the most preferred treatment. The best-performing formulation (T3) demonstrated a crude fiber content of 1.1192% and an antioxidant capacity of 16.08 mg GAE/L.

DISCUSSION

The research results show that the addition of red dragon fruit in each treatment can affect several aspects of ice cream characteristics, both subjective and objective quality characteristics. For subjective quality, this includes acceptance of the aroma, color, taste, and texture of the ice cream, which was determined based on organoleptic tests of the product. Based on the results of panelists' hedonic test assessments of aroma (Figure 1), it was found that overall, the treatments received an average acceptance percentage above 50%. Thus, it can be said that the aroma of the ice cream in all treatments with the addition of red dragon fruit was acceptable. In terms of aroma, the most preferred treatment was the first treatment, with 90% preference. A higher concentration of added ingredients in ice cream can affect the product's aroma (Purwasih et al., 2021). The first treatment was formulated with the smallest amount of dragon fruit, namely 20% of the milk volume, which also had the highest milk content among the treatments. The first treatment with 20% dragon fruit was the most preferred by panelists because the addition did not mask the aroma produced from the mixture of milk and whipped cream. In contrast, the fourth treatment, with 73.33% acceptance, involved 50% red dragon fruit addition and obtained the lowest score, though it was still acceptable. This shows that the addition of dragon fruit to seaweed ice cream can influence the ice cream's aroma.

Taste is the main determinant of whether a food product is acceptable (Surahman & Winarti, 2022). From the panelists' assessments, the percentage of acceptance of the ice cream taste in all treatments is shown in Table 1. The highest taste acceptance score was in the third treatment, with 80%, while the lowest was in the fourth treatment, with 58.89%. In the third treatment, dragon fruit was added at 40% of the milk volume. Compared to other treatments,

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the third treatment used less than half of the milk volume for dragon fruit addition, so the creamy impression of seaweed ice cream was not overpowered, but the red dragon fruit taste was still recognizable. In contrast, the fourth treatment, with a higher percentage of dragon fruit addition, produced a more dominant fruit taste.

Assessment of the seaweed ice cream color with the addition of red dragon fruit was carried out using hedonic and hedonic quality tests. The most preferred treatments were the second (80%) and third (81.11%). Meanwhile, in the hedonic quality test, the treatment that met the best color quality criteria was the first treatment, with 77.78% scoring pale red. Treatments four and five, however, were purple-red. The anthocyanin content in red dragon fruit functions as a natural coloring agent, producing purple-red pigmentation (Aprilia et al., 2022). Thus, the addition of red dragon fruit affects the color of seaweed ice cream in each treatment. Treatments with less dragon fruit showed paler colors, while those with higher concentrations were more intensely colored. Based on preference tests, the third treatment was the most liked, indicating that adding 40% dragon fruit gave the most attractive color, although in terms of quality, it was not yet ideal.

Based on the texture preference tests, Table 1 shows that the texture of ice cream in all treatments was acceptable to panelists, with cumulative acceptance values above 50%. The highest preference percentage was in the first treatment, at 81.11%. The expected texture quality of seaweed ice cream with red dragon fruit addition was dense yet very soft. Based on the hedonic quality test using three categories, all treatments scored above 50% in the "very soft" category, with the highest being the first treatment (77.78%) with 20% red dragon fruit addition. Dragon fruit contains water, which can affect ice cream texture; the more dragon fruit is added, the lower the total solids content becomes (Ferdiansyah & Winarti, 2023). The effect when the ice cream is frozen is a rougher texture caused by the crystallization of this water.

Overall, the evaluation of all aspects of ice cream characteristics shows that all treatments were acceptable, with scores above 50%. The most preferred treatment overall was the third treatment (86.68%). Furthermore, based on the determination of the best treatment, the third treatment had the highest preference scores for aroma, taste, color, and overall acceptance: aroma (81.11%), taste (80%), color (81.11%), and overall acceptance (86.67%).

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Based on nutritional value calculations using the 2019 TKPI, the addition of red dragon fruit to seaweed ice cream increased its nutritional content. The best treatment, the third treatment with 40% dragon fruit addition, contained 47.83 kcal energy, 1.8 g protein, 1.82 g fat, and 5.88 g carbohydrates. According to the 2019 AKG, the average daily energy requirement for adolescents and adults is 2,220.8 kcal, with 10% (222.08 kcal) expected from snacks. Based on this reference, one serving of seaweed ice cream with 40% red dragon fruit provides 21.53% of the total daily snack energy requirement.

Based on the objective quality test results of the best treatment, the fiber content was 1.1192% and 16.08 mg GAE/L. Thus, in one 50 g cup of seaweed ice cream with 40% red dragon fruit addition, there was 0.56 g fiber. This means one portion of ice cream can meet 17.5% of the daily fiber requirement from snacks and contains 0.8 GAE.

CONCLUSIONS

The addition of red dragon fruit significantly influenced the aroma, taste, color, and texture of seaweed ice cream, with overall product acceptance above 50%. The best formulation was obtained from the third treatment (40% dragon fruit addition), which provided 47.83 kcal energy, 1.8 g protein, 1.82 g fat, 5.88 g carbohydrates, 0.8 GAE antioxidant capacity, and 0.56 g dietary fiber, fulfilling 17.5% of the daily fiber requirement from snacks for adolescents and adults. Further research is recommended to enhance fiber content by incorporating high-fiber ingredients and to improve texture quality through optimized seaweed and dragon fruit proportions

Conflict of Interest

The authors declare no conflict of interest regarding the publication of this article.

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