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ACCEPTABILITY OF SOY MILK AND DRAGON FRUIT ICE CREAM AS AN ALTERNATIVE SNACK FOR ANEMIA PREVENTION

TINGKAT PENERIMAAN ES KRIM SUSU KEDELAI DAN BUAH NAGA SEBAGAI CAMILAN ALTERNATIF UNTUK PENCEGAHAN ANEMIA

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Abstract

Anemia remains one of the major nutritional problems among adolescent girls in Indonesia, partly due to inadequate iron intake. One approach to supporting anemia prevention is the development of nutritious snack foods with high acceptability. This study aimed to determine the acceptability of soy milk and dragon fruit ice cream as an alternative snack for anemia prevention and to analyze its nutritional content. This experimental study employed a Completely Randomized Design consisting of four formulations: F0 (0% soy milk and 0% dragon fruit), F1 (90% soy milk and 10% dragon fruit), F2 (70% soy milk and 30% dragon fruit), and F3 (50% soy milk and 50% dragon fruit). The acceptability test involved 30 untrained panelists who were female students of the Nutrition Study Program, Class of 2024, Faculty of Sports and Health Sciences, Universitas Negeri Makassar. The data were analyzed using the Kruskal-Wallis test, followed by the Mann-Whitney test. The results showed significant differences in aroma, taste, and texture ($p<0.05$), whereas no significant difference was found in color ($p>0.05$). The Mann-Whitney test showed no significant differences among F1, F2, and F3 in terms of aroma, taste, and texture ($p>0.05$). However, significant differences were found between F0 and each of the intervention formulations (F1, F2, and F3) ($p<0.05$). The nutritional content of the selected formulation, F1, per serving was 177.19 kcal of energy, 7.45 g of protein, 0.60 g of fat, 35.40 g of carbohydrates, 1.17 mg of iron, and 19.36 mg of vitamin C. No soy milk and dragon fruit ice cream intervention formulation was more acceptable to the panelists than the control formulation.

Keywords : Anemia, Dragon Fruit, Acceptability, Ice Cream, Adolescent Girls, Soy Milk.

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Abstrak

Anemia masih menjadi salah satu masalah gizi utama di kalangan remaja putri di Indonesia, yang sebagian disebabkan oleh asupan zat besi yang tidak memadai. Salah satu upaya untuk mendukung pencegahan anemia adalah pengembangan camilan bergizi dengan tingkat penerimaan yang tinggi. Penelitian ini bertujuan untuk mengetahui tingkat penerimaan es krim susu kedelai dan buah naga sebagai camilan alternatif untuk pencegahan anemia serta menganalisis kandungan gizinya. Penelitian eksperimental ini menggunakan Rancangan Acak Lengkap yang terdiri dari empat formulasi: F0 (0% susu kedelai dan 0% buah naga), F1 (90% susu kedelai dan 10% buah naga), F2 (70% susu kedelai dan 30% buah naga), dan F3 (50% susu kedelai dan 50% buah naga). Uji penerimaan melibatkan 30 panelis tidak terlatih yang merupakan mahasiswi Program Studi Gizi angkatan 2024, Fakultas Ilmu Keolahragaan dan Kesehatan, Universitas Negeri Makassar. Data dianalisis menggunakan uji Kruskal-Wallis, yang dilanjutkan dengan uji Mann-Whitney. Hasil penelitian menunjukkan adanya perbedaan yang signifikan pada aspek aroma, rasa, dan tekstur ($p<0,05$), sedangkan pada aspek warna tidak ditemukan perbedaan yang signifikan ($p>0,05$). Uji Mann-Whitney menunjukkan tidak ada perbedaan signifikan antara F1, F2, dan F3 dalam hal aroma, rasa, dan tekstur ($p>0,05$). Namun, ditemukan perbedaan yang signifikan antara F0 dengan masing-masing formulasi intervensi (F1, F2, dan F3) ($p<0,05$). Kandungan gizi dari formulasi terpilih, yaitu F1, per porsi adalah 177,19 kkal energi, 7,45 g protein, 0,60 g lemak, 35,40 g karbohidrat, 1,17 mg zat besi, dan 19,36 mg vitamin C. Tidak ada formulasi intervensi es krim susu kedelai dan buah naga yang lebih dapat diterima oleh panelis dibandingkan dengan formulasi kontrol.

Kata Kunci : Anemia, Buah Naga, Tingkat Penerimaan, Es Krim, Remaja Putri, Susu Kedelai.

1. INTRODUCTION

Anemia remains a serious global health problem, and to date, the world has not yet achieved the target of reducing the prevalence of anemia by 50% by 2030 (WHO, 2025). Iron deficiency anemia is one of the nutritional problems that continues to have a high prevalence in Indonesia (Renita et al., 2025). Data from the 2023 Indonesian Health Survey (SKI) showed that the prevalence of anemia among adolescents and young adults aged 15–24 years was 15.5%, with a prevalence of 18% among adolescent girls and 14.4% among adolescent boys (Ministry of Health of the Republic of Indonesia, 2023). Anemia can cause symptoms such as fatigue, weakness, dizziness, and blurred vision (Surtimanah, 2023). These symptoms may contribute to decreased concentration (Lianti, 2025).

Anemia not only affects concentration and physical endurance but can also reduce productivity and quality of life (Sya'bani et al., 2025). Adolescent girls are at a higher risk of anemia, particularly during late adolescence (Lubis & Angraeni, 2022). This risk is further increased among those living in rural areas, having parents with lower educational attainment, experiencing poor socioeconomic conditions, having larger family sizes, experiencing menstrual disorders, and having inadequate micronutrient intake, particularly iron (Ariana & Fajar, 2024). The average daily iron intake among adolescent girls is 14 mg (Sari et al., 2025), whereas the recommended dietary allowance for this group is 15 mg per day (Ministry of Health of the Republic of Indonesia, 2019). Therefore, anemia prevention efforts are needed, particularly through innovative approaches that are appropriate to adolescents' preferences.

One promising strategy is the development of ice cream as a snack based on locally available food ingredients, as ice cream is widely enjoyed by people across different age groups, from children to older adults (Hassan et al., 2021). The potential for developing this product is also supported by data showing that younger age groups consume ice cream more frequently than older age groups, and that females tend to prefer ice cream more than males (Statista, 2022). Consistent with these findings, another study reported that the majority of ice cream consumers were between 15 and 25 years of age (Pramatia et al., 2022). Local food-based ice cream has also been reported to have high acceptability,

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suggesting its potential as a nutritious supplementary food (Mardona et al., 2025). In addition, the development of ice cream containing sources of dietary fiber or probiotics may enhance its nutritional value and appeal to health-conscious consumers (Raksesi et al., 2023).

The nutritional value of ice cream depends on the nutritional composition of its raw materials. Soy milk is a plant-based beverage made from soybeans (Glycine max) and does not contain lactose, making it an alternative for individuals with lactose intolerance (Maris & Radiansyah, 2021). Soybeans have a high nutritional value, with protein content that is relatively high compared with other types of legumes (Rahman et al., 2021). Soy milk contains non-heme iron and protein, which contribute to hemoglobin formation and may support the fulfillment of nutritional needs related to hemoglobin synthesis (Kurniati, 2020). Meanwhile, dragon fruit contains organic acids, protein, minerals such as potassium, magnesium, and iron, as well as vitamin C (Ministry of Health of the Republic of Indonesia, 2020). Vitamin C, folate, and protein are among the nutrients that play important roles in supporting the absorption and utilization of non-heme iron (Azkiyah et al., 2021).

A study conducted at the Lepo-Lepo Community Health Center in Kendari City in 2020 reported an effect of soy milk consumption on hemoglobin levels among pregnant women with anemia. In the intervention group, hemoglobin levels increased from 9.84 g/dL to 10.71 g/dL (Valentina et al., 2021). Another study reported that consumption of 200 mL of soy milk increased hemoglobin levels by 0.6 g/dL (Nurhaliza et al., 2023). Meanwhile, another study reported an increase in the number of women achieving normal hemoglobin levels after consuming dragon fruit juice (Astriana et al., 2023). Consumption of 200 mL of dragon fruit juice was also reported to increase hemoglobin levels by 1.8 g/dL (Rohanah et al., 2023).

These findings indicate that the combination of locally available food ingredients, namely soy milk and dragon fruit, has considerable potential to support efforts to prevent anemia. To date, the development of ice cream made from soy milk and dragon fruit as a snack, particularly in the context of supporting anemia prevention, has not been reported in previous studies. Therefore, the development of soy milk and dragon fruit-based ice cream may provide a nutritious and innovative alternative snack with good acceptability, particularly for adolescent girls, who are a vulnerable group for anemia.

2. RESEARCH METHOD

This study was an experimental study using a Completely Randomized Design (CRD) consisting of four ice cream formulations. The treatments involved the substitution of soy milk and red dragon fruit at different ratios to determine their effect on product acceptability. The formulations consisted of F0 (0% soy milk and 0% dragon fruit), F1 (90% soy milk and 10% dragon fruit), F2 (70% soy milk and 30% dragon fruit), and F3 (50% soy milk and 50% dragon fruit).

Tabel 1. Ingredients for the Preparation of Soy Milk and Dragon Fruit Ice Cream

Ingredients	Formulations			
	F0	F1	F2	F3
Soy Milk Preparation				
Dried soybeans (g)	0	900	700	500
Pandan leaves (leaves)	0	1	1	1
Water (L)	0	±2,7	±2,1	±1,5
Ice Cream Preparation				
Soy milk (g)	0	2.700	2.100	1.500
Dragon fruit (g)	0	300	900	1.500
Fresh milk (ml)	3.000	0	0	0
Sugar (g)	300	300	300	300
Cornstarch (g)	75	75	75	75
Sp emulsifer (g)	75	75	75	75
Salt (g)	2,5	2,5	2,5	2,5

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The preparation of the ice cream began with the production of soy milk. The soybeans were soaked for approximately 9 hours, then boiled until fully cooked. The soybean skins were removed, and the soybeans were blended with water and filtered to obtain soy milk. The soy milk was then cooked with pandan leaves until boiling to reduce the characteristic beany odor (Alarif et al., 2024). Subsequently, the soy milk was mixed with sugar and cornstarch and heated until the mixture thickened. After cooling, the mixture was frozen for approximately 8 hours. The frozen mixture was then crushed using a mixer, followed by the addition of chilled SP emulsifier. Red dragon fruit was added according to the respective formulation during the mixing process. The mixture was then whipped using a mixer for approximately 45 minutes until it increased in volume. The mixture was transferred into ice cream cups and refrozen until the final ice cream product was obtained and ready for testing (Mita & Herawati, 2024).

An organoleptic test was conducted to assess the acceptability of the ice cream based on color, aroma, taste, and texture. The organoleptic test data were analyzed using IBM SPSS Statistics. Data normality was assessed using the Shapiro–Wilk test. Normally distributed data were analyzed using One-Way Analysis of Variance (ANOVA), followed by a *post hoc* test when a significant difference was observed. In contrast, non-normally distributed data were analyzed using the Kruskal–Wallis test, followed by the Mann–Whitney test as a post hoc analysis. The significance level used in this study was $p < 0.05$.

Nutritional analysis was conducted on the ice cream formulation that had the highest acceptability based on the results of the organoleptic test. The nutritional analysis was performed at the Makassar I Public Health Laboratory. The parameters analyzed included moisture content using the oven-drying method, ash content using the dry ashing method, protein content using the Kjeldahl method, fat content using the Mojonnier method, carbohydrate content using the *by difference* method, iron content using Atomic Absorption Spectrophotometry (AAS), and vitamin C content using the spectrophotometric method.

3. RESULT AND DISCCUSSION

The acceptability of the ice cream formulated with the addition of soy milk and dragon fruit was evaluated using an organoleptic test based on four attributes, namely color, aroma, taste, and texture. The panelists' assessment data were subsequently analyzed statistically using the Kruskal–Wallis test, followed by the Mann–Whitney test as a post hoc analysis. The results of the Kruskal–Wallis test showed significant differences in the aroma, taste, and texture attributes among the four formulations of soy milk and dragon fruit ice cream ($p<0.05$), whereas the color attribute did not show a significant difference ($p>0.05$). The complete results of the panelists' acceptability test of the soy milk and dragon fruit ice cream are presented as follows.



F0 F1 F2 F3

Table 2. Sensory Evaluation Results of Soy Milk and Dragon Fruit Ice Cream

Assessment	P-Value	F0 (0%:0%)	F1 (90%:10%)	F2 (70%:30%)	F3 (50%:50%)
Color	0,623	7,73	7,47	7,60	7,77
Odor	<0,001	8,03[a]	6,50[b]	6,17[b]	6,37[b]
Taste	<0,001	8,37[a]	6,87[b]	6,27[b]	6,50[b]

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Texture	<0,001	8,00[a]	7,00[b]	6,63[b]	6,87[b]

Note: Different superscript letters in the same column indicate a significant difference ($p < 0.05$) based on the results of the Mann–Whitney post hoc test. The hedonic scale was as follows: extremely like (9), very like (8), like (7), slightly like (6), neither like nor dislike (5), slightly dislike (4), dislike (3), very dislike (2), and extremely dislike (1).

Based on Table 2, the results of the Kruskal–Wallis test for the color parameter showed that H_0 was accepted ($p>0.05$), indicating that there was no significant difference in panelists' acceptability of the color among the ice cream formulations. All formulations were categorized as "liked." The absence of a significant difference may be attributed to the fact that the color produced by each formulation remained within a range that was acceptable and preferred by the panelists. The addition of dragon fruit to F1, F2, and F3 resulted in different colors according to the proportion added; however, these differences were not sufficient to significantly affect the panelists' level of preference.

The aroma, taste, and texture parameters showed that H_0 was rejected ($p<0.05$), indicating significant differences in panelists' acceptability of aroma, taste, and texture among the ice cream formulations. The results of the Mann–Whitney post hoc test showed significant differences ($p<0.05$) between F0 and F1, F2, and F3. However, no significant differences were found ($p>0.05$) among F1, F2, and F3. The differences in the acceptability of aroma, taste, and texture between F0 and F1, F2, and F3 may be attributed to the use of soy milk in F1, F2, and F3, which has a characteristic beany aroma. Soy milk also has a distinctive flavor that may affect the taste, viscosity, and smoothness of the ice cream texture. In contrast, F0 used cow's milk, resulting in a milk aroma, taste, and ice cream texture that were more familiar to the panelists.

In this study, the nutritional content of the soy milk and dragon fruit ice cream was determined at the Makassar I Public Health Laboratory. The parameters analyzed included moisture, ash, crude fiber, protein, fat, carbohydrate, iron, and vitamin C. Nutritional analysis was conducted on formulation F1, which was selected based on the results of the acceptability test. Based on the study findings, although formulation F0 obtained the highest overall acceptability score, F0 served as the control formulation and was not included among the treatment formulations (Nurhamidah, 2022). Therefore, formulation F1 was selected for nutritional analysis because it was the most preferred treatment formulation among the other treatment formulations containing soy milk and dragon fruit.

Table 3. Nutritional Analysis Results and Percentage of Snack Requirements Fulfilled per Serving

Nutrients	AKG/ Hari	Snack Requirement (10% AKG)	Content per serving	Percentage of Requirement Fulfilled (%)
Energy (kkal)	2.100	210	177,19	84,3
Protein (g)	65	6,5	7,45	114,6
Fat (g)	70	7	0,6	8,5
Carbohydrate (g)	300	30	35,4	118
Vitamin C (mg)	75	7,5	19,36	258
Iron (mg)	15	1,5	1,17	78

Table 3 shows that one serving of soy milk and dragon fruit ice cream weighing 230 g contributes to meeting the nutritional requirements for snacks among adolescent girls aged 16–18 years. Regarding macronutrients, the protein content of 7.45 g contributes 114.6% of the protein requirement for a snack, while the carbohydrate content of 35.4 g contributes 118%. Based on the Ministry of Health (*Depkes*) cut-off points (1996), the adequacy of macronutrient intake is categorized as severe deficit (<70%), moderate deficit (70–79%), mild deficit (80–89%), normal (90–119%), and excess (>120%). The contributions of protein and carbohydrates from one serving of ice cream are categorized as normal because they fall within the range of 90–119%. Meanwhile, the fat content of 0.6 g contributes 8.5% and is categorized as a severe deficit.

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Regarding micronutrients, the vitamin C content of 19.36 mg contributes 258%, while the iron content of 1.17 mg contributes 78% of the micronutrient requirements for snacks among adolescent girls aged 16–18 years. Based on the cut-off points for micronutrient adequacy, nutrient contributions are categorized as insufficient (<77%) and sufficient (≥77%) (Gibson, 2005). The contributions of vitamin C and iron from one serving of ice cream are categorized as sufficient.

DISCUSSION

Color

The results of the Kruskal–Wallis test showed a significance value of 0.623 ($p>0.05$), indicating that there was no significant difference in the panelists' level of preference for the color attribute among formulations F0, F1, F2, and F3. This indicates that the conventional ice cream formulation and the soy milk and dragon fruit ice cream formulations did not significantly affect panelists' acceptance in terms of color.

Although there was no statistically significant difference, there was a tendency for the mean color preference score to increase with an increasing proportion of dragon fruit. Formulation F3 obtained the highest mean score of 7.77, followed by F0 at 7.73, F2 at 7.60, and F1 at 7.47. All formulations were categorized as "liked," indicating that the color changes resulting from the addition of dragon fruit were still well accepted by the panelists. This finding is consistent with a study reporting that increasing the amount of red dragon fruit and reducing the proportion of soy milk resulted in a redder ice cream color that was more preferred by panelists (Simanjuntak et al., 2022). The increasing color intensity was attributed to the higher content of betalain pigments, particularly betacyanin, which is the main natural pigment in red dragon fruit (Harni et al., 2022).

The absence of a significant difference in color preference indicates that the color changes resulting from the addition of dragon fruit remained acceptable to the panelists. The purple color produced did not create an appearance that deviated from the typical characteristics of ice cream and even provided a more attractive appearance compared with the conventional ice cream formulation (F0). Color is the first sensory attribute observed by consumers before evaluating aroma, taste, and texture; therefore, visual appearance is an important factor in determining the initial acceptance of a food product (Adawiyah et al., 2024).

This finding is consistent with a study reporting that the addition of red dragon fruit to food products increased color intensity without significantly reducing panelists' preference. In that study, the color acceptability of all formulations was categorized as "liked" (Burhan et al., 2024). Betalain pigments in red dragon fruit produce an attractive and relatively stable color, making them potentially useful as natural colorants in various food products (Rini Utami & Ifadah, 2025). Therefore, the use of red dragon fruit in ice cream not only enhances the functional value of the product but also provides an attractive appearance that remains acceptable to consumers.

Odor

The results of the Kruskal–Wallis test showed a significant difference in panelists' acceptability of the odor attribute of the ice cream ($p<0.001$). The results of the Mann–Whitney post hoc test showed that the control formulation (F0) differed significantly from F1, F2, and F3 ($p<0.05$), whereas no significant differences were found among F1, F2, and F3 ($p>0.05$). Formulation F0 obtained the highest mean acceptability score for odor, namely 8.03, which was categorized as "very much liked." Meanwhile, F1 obtained a mean score of 6.50, F2 obtained 6.17, and F3 obtained 6.37, all of which were categorized as "liked." These results indicate that the control formulation, namely conventional ice cream, had a higher level of acceptance than the soy milk and dragon fruit ice cream formulations.

The higher level of panelists' acceptance of the odor of conventional ice cream F0 (control) may be attributed to its characteristic milk odor, which is commonly found in ice cream products and is therefore more familiar to the panelists. This finding is consistent with a study showing that panelists had higher acceptance of animal milk-based ice cream than soy milk-based ice cream (Manurung et al., 2023). In contrast, the soy milk and dragon fruit ice cream formulations (F1, F2, and F3) altered the characteristic odor of the ice cream. Based on the characteristics of the products, F1 had a distinct

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pandan leaf odor, F2 had a less intense pandan odor, whereas F3 had a more pronounced characteristic dragon fruit odor. The addition of pandan leaves during the preparation of soy milk can mask the characteristic soy odor, thereby improving panelists' acceptance of the odor attribute (Arif & Damarsiwi, 2022).

The characteristic beany odor of soy milk is caused by the activity of the lipoxygenase enzyme, which oxidizes unsaturated fatty acids and produces volatile compounds, such as aldehydes and alcohols, that contribute to the beany odor. This characteristic odor can be one of the factors that reduce consumer acceptance of soy-based products if processing methods are not applied to reduce the activity of this enzyme (Natanael et al., 2026).

Taste

The results of the Kruskal–Wallis test showed a significant difference in panelists' level of preference for the taste attribute of the ice cream ($p<0.001$). The results of the Mann–Whitney post hoc test showed that the control formulation (F0) differed significantly from F1, F2, and F3 ($p<0.05$), whereas no significant differences were found among F1, F2, and F3 ($p>0.05$). Formulation F0 obtained the highest mean taste preference score of 8.37, which was categorized as "very much liked," while F1 obtained a score of 6.87, F2 obtained 6.27, and F3 obtained 6.50, all of which were categorized as "liked."

The high level of panelists' preference for conventional ice cream F0 (control) may be attributed to its vanilla flavor, which is commonly found in ice cream products and is therefore more familiar and preferred by the panelists. A study reported that vanilla- and strawberry-flavored ice cream were among the most preferred ice cream products (Sustaningrum & Sitompul, 2023). In contrast, the soy milk and dragon fruit ice cream formulations resulted in variations in taste among the formulations. Based on the product characteristics, F1 had a sweet taste with a slightly savory taste from the soy milk, F2 had a sweet and savory taste with an increasingly noticeable dragon fruit flavor, while F3 had a slightly less sweet taste with a more dominant dragon fruit flavor. This finding is consistent with a study showing that the greater the amount of dragon fruit used, the more pronounced the dragon fruit flavor became (Simanjuntak et al., 2022).

Formulation F1 obtained a mean taste preference score of 6.87, which was higher than F2 (6.27) and F3 (6.50). This result may be attributed to the proportion of soy milk and dragon fruit in F1, which resulted in a better balance of taste. The sweetness of the ice cream remained dominant and was complemented by a slightly savory taste from the soy milk, resulting in a more harmonious flavor profile. This finding is consistent with a study showing that panelists preferred ice cream containing dragon fruit when the concentration was not excessively high (Simanjuntak et al., 2022).

Tekstur

The results of the Kruskal–Wallis test showed a significant difference in panelists' acceptability of the texture of the ice cream ($p<0.001$). The results of the Mann–Whitney post hoc test showed that the control formulation (F0) differed significantly from F1, F2, and F3 ($p<0.05$), whereas no significant differences were found among F1, F2, and F3 ($p>0.05$). Formulation F0 obtained the highest mean texture preference score of 8.00, which was categorized as "very much liked," while F1 obtained a score of 7.00, which was categorized as "liked." Formulations F2 and F3 obtained scores of 6.63 and 6.87, respectively, which were categorized as "liked." These results indicate that the addition of soy milk and dragon fruit affected the panelists' level of preference for the texture of the ice cream.

The high level of panelists' preference for the texture of conventional ice cream F0 (control) may be attributed to its smoother, softer, and more homogeneous texture. This finding is consistent with a study reporting that ice cream made with animal milk had a softer texture than ice cream made with soy milk (Manurung et al., 2023). Among the soy milk and dragon fruit ice cream formulations, F1 contained a higher proportion of soy milk than dragon fruit, which may have contributed to a more stable and softer ice cream structure. The proteins in soy milk are known to have emulsifying and water-binding properties that can help form a smoother ice cream structure and improve emulsion

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stability (Hou et al., 2025). In contrast, the higher proportion of dragon fruit in F2 and F3 increased the water and fiber content of the mixture, potentially promoting ice crystal formation and resulting in a slightly less smooth texture. This finding is consistent with a study reporting that ice cream containing a relatively high amount of grape juice resulted in a coarse texture (Zahro & Nisa, 2020).

Red dragon fruit contains dietary fiber, particularly insoluble fiber, which can affect the physical characteristics of food products when used in larger amounts. This fiber content may reduce texture smoothness by interfering with the homogeneity of the ice cream mixture (Nurwahidah et al., 2024). In addition, the water content derived from fresh fruit may increase ice crystal formation if it is not balanced by an adequate increase in total solids, resulting in a less smooth ice cream texture compared with the control formulation (Rista & Komala, 2026).

Nutritional Analysis

Based on Table 1.3, one serving of soy milk and dragon fruit ice cream (230 g) provides 177.19 kcal of energy, equivalent to 84.3% of the energy requirement for a snack among adolescent girls aged 16–18 years (210 kcal). These results indicate that the developed product almost meets the recommended energy requirement for a single snack. Adequate energy intake from snacks is important to help meet adolescents' daily energy requirements while preventing the utilization of protein as an energy source, allowing protein to be optimally utilized for body tissue formation and repair, including hemoglobin synthesis (Craven et al., 2021).

In terms of protein content, one serving of the ice cream contains 7.45 g of protein, fulfilling 114.6% of the protein requirement for a snack (6.5 g). Based on the Ministry of Health (Depkes) cut-off point (1996), this contribution is categorized as normal because it falls within the range of 90–119%. The high protein contribution is primarily derived from the use of soy milk as a main ingredient. Protein is an essential nutrient involved in hemoglobin formation because it is required for the synthesis of globin, the protein component of hemoglobin. In addition, protein functions in iron transport through the formation of transferrin; therefore, adequate protein intake influences iron metabolism in the body (Xing et al., 2022). Therefore, the protein content exceeding the recommended snack requirement is one of the advantages of this product in supporting efforts to prevent anemia among adolescent girls. Research has shown that adequate protein intake is associated with the occurrence of anemia among adolescent girls; therefore, increasing the consumption of protein-rich foods is one strategy for anemia prevention (Ni'ma & Fauziah, 2024).

The ice cream also contains 19.36 mg of vitamin C, fulfilling 258% of the vitamin C requirement for a snack (7.5 mg). Based on the cut-off point, this value is categorized as adequate, namely ≥77% (Gibson, 2005). The high vitamin C content is derived from the addition of red dragon fruit as one of the main ingredients. Vitamin C plays an important role in enhancing the absorption of non-heme iron by reducing ferric iron (Fe^{3+}) to ferrous iron (Fe^{2+}), which is more readily absorbed in the small intestine (Moustarah & Daley, 2024). The high amount of vitamin C provides an additional benefit because most of the iron in this product is derived from plant-based food sources, namely soy milk and dragon fruit. Thus, although the iron present is non-heme iron, which has lower bioavailability than heme iron, the presence of vitamin C may help enhance its absorption (Rohanah et al., 2023). Research among adolescent girls has also shown that consuming foods containing vitamin C together with iron sources contributes to increased hemoglobin levels (Lucin & Herlinadiyaningsih, 2024).

The iron content of 1.17 mg per serving fulfills 78% of the iron requirement for a snack (1.5 mg). Based on the cut-off point, this value is categorized as adequate because it reaches the threshold of ≥77% (Gibson, 2005). The iron content is derived from soy milk and red dragon fruit, which naturally contain iron. The iron contained in soy milk plays a role in the formation of red blood cells (Rizki et al., 2022). A study reported that consumption of dragon fruit juice had a positive effect on increasing hemoglobin (Hb) levels in pregnant women with anemia (Astriana et al., 2023). This finding suggests that dragon fruit consumption may help prevent and improve anemia, particularly among vulnerable groups such as adolescents and pregnant women (Sari & Widyanti, 2023).

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In addition to protein, vitamin C, and iron, the product contains 35.4 g of carbohydrates, fulfilling 118% of the carbohydrate requirement for a snack. Based on the Ministry of Health (Depkes) cut-off point (1996), this value is categorized as normal because it falls within the range of 90–119%. Carbohydrates function as the primary source of energy and therefore have a protein-sparing effect, allowing the protein contained in the ice cream to be utilized more optimally to support hemoglobin formation and other physiological functions (Xing et al., 2022). Meanwhile, the relatively low fat content of 0.6 g, equivalent to only 8.5% of the fat requirement for a snack, indicates that the product is low in fat. This characteristic may provide an additional benefit by producing a snack with adequate energy content without contributing excessive fat (Nourmohammadi et al., 2023).

Overall, the results of this study indicate that soy milk and dragon fruit ice cream has potential as a functional snack to support anemia prevention among adolescent girls. This potential is not solely based on its iron content but also on the synergistic roles of protein, vitamin C, and iron in supporting hemoglobin formation. Protein plays a role in hemoglobin synthesis and iron transport, vitamin C enhances the absorption of non-heme iron, while iron is a major component required for hemoglobin formation. The combination of these three nutrients may provide an advantage over snacks that focus solely on increasing iron content. Consumption of soy milk and dragon fruit ice cream should nevertheless be accompanied by a balanced diet containing other sources of both heme and non-heme iron to obtain optimal nutritional benefits in supporting anemia prevention.

4. CONCLUSION

Based on the acceptability test and nutritional analysis conducted in this study, it can be concluded that none of the soy milk and dragon fruit ice cream intervention formulations was more acceptable to the panelists than the control formulation. The nutritional content per serving of the selected formulation (F1) was 35.4 g of carbohydrates, 7.45 g of protein, 0.6 g of fat, 1.17 mg of iron, and 19.36 mg of vitamin C.

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