



EFFECT OF HONEY AND *Lactobacillus delbrueckii subsp. bulgaricus* CONCENTRATION ON PROTEIN CONTENT, TOTAL ACIDITY, AND SENSORY QUALITY OF YOGURT

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ABSTRACT

Jackfruit seeds contain high carbohydrates and protein, so it can be used as an alternative mixture of skim milk in the manufacture of ice cream was used sappan wood as natural colour. This experiment was aimed to determine the melting time and organoleptic test of the ice cream with the addition of jackfruit seeds and sappan wood as natural colour. The method used in this experiment was completely randomized design (CRD) with two factors, namely the first factor were the combination of jackfruit seeds:skim milk (0:100; 25:75; 50:50; 75:25) and the second factor were addition of sappan wood (0; 5; 10 g). The results showed that the lowest melting time was a combination of jackfruit seeds:skim milk (75:25) and the addition of 10 g sappan wood extract for 25 minutes. The results of organoleptic test are extremely diverse and can be accepted by society.

ABSTRAK

Biji nangka memiliki kandungan karbohidrat dan protein yang tinggi, sehingga dapat dimanfaatkan sebagai salah satu alternatif bahan campuran susu skim dalam pembuatan es krim. Untuk bahan pewarna pada pembuatan es krim menggunakan kayu secang sebagai pewarna alami. Penelitian ini bertujuan untuk mengetahui kecepatan meleleh dan sifat organoleptik es krim dengan penambahan biji nangka dan ekstrak kayu secang sebagai pewarna alami. Metode yang digunakan dalam penelitian ini adalah penelitian eksperimen dengan Rancangan Acak Lengkap (RAL) dua faktor, yaitu faktor 1 kombinasi biji nangka:susu skim (0:100; 25:75; 50:50; 75:25) dan faktor 2 penambahan kayu secang (0; 5; 10 g). Hasil penelitian menunjukkan bahwa kecepatan meleleh terendah pada kombinasi biji nangka:susu skim (75:25) dan penambahan kayu secang 10 g selama 25 menit.

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INTRODUCTION

Ice cream is a frozen solid food product made from a mixture of ingredients consisting of milk, milk fat, sugar, coloring agents, stabilizers, and flavoring substances. Ice cream is widely favored by the public due to its delicious, sweet taste and soft texture. The main ingredients used in ice cream production include milk fat, non-fat milk solids (skim milk), granulated sugar, stabilizers, emulsifiers, and flavorings (Kalsum, 2012). From a nutritional perspective, ice cream contains calcium, phosphorus, protein, vitamins, and minerals. However, it also contains other nutrients such as fat and carbohydrates, which may become limiting factors, particularly for consumers who are dieting (Hartatie, 2011). Most commercially available ice cream products are made from animal milk, which is high in saturated fat. As a result, some people tend to limit their consumption due to concerns about weight gain associated with the fat content of ice cream.

Therefore, alternative formulations using plant-based ingredients as substitutes or complements to skim milk are needed. One potential alternative is the production of ice cream from jackfruit seeds with natural coloring derived from sappan wood. Jackfruit seeds are obtained from the large, oval-shaped fruit of jackfruit (*Artocarpus heterophyllus*). In most communities, jackfruit seeds are often discarded after the fruit pulp is consumed. Only a small portion of society utilizes them by boiling or roasting for direct consumption. Jackfruit seeds have the advantage of containing lower fat levels compared to cow's milk and soybean milk. According to Astawan (2008), 100 grams of jackfruit seeds contain 36.7 g of carbohydrates, 4.2 g of protein, and provide 165 kcal of energy, indicating their potential as a valuable food ingredient.

In ice cream production, coloring agents are also required to enhance product attractiveness. However, with the rapid development of the food industry, the limited availability and quality of natural colorants have led to increased use of synthetic dyes in the market (Kurniati et al., 2012). Although synthetic colorants are easily obtained and relatively inexpensive, they may have adverse health effects. Therefore, the use of natural colorants is recommended to ensure safety and minimize health risks. One potential natural colorant is sappan wood (*Caesalpinia sappan L.*). Sappan wood has traditionally been used as a herbal remedy for various ailments such as hemoptysis, diarrhea, and eye diseases. However, its utilization as a natural food coloring agent remains limited. The red pigment present in sappan wood is brazilin, a compound belonging to the brazilin group. Brazilin possesses antioxidant properties and contains catechol groups in its chemical structure.

Different concentrations of jackfruit seed and sappan wood extract are likely to produce varying effects on melting rate and organoleptic properties of jackfruit seed ice cream. Therefore, the researcher is interested in conducting a study entitled Melting Rate and Organoleptic Properties of Jackfruit Seed (*Artocarpus heterophyllus*) Ice Cream with the Addition of Sappan Wood (*Caesalpinia sappan L.*) Extract as a Natural Colorant.

METHODS

The research employed an experimental method using a Completely Randomized Design (CRD) with two treatment factors. The first factor was the ratio of jackfruit seed to skim milk (0:100; 25:75; 50:50; and 75:25). The second factor was the addition of sappan wood extract at two levels (5 g and 10 g). Data collection techniques included experimental procedures such as ice cream production, melting rate testing, and organoleptic evaluation. Documentation methods were also applied, including the use of sensory evaluation forms completed by panelists and photographic documentation during the research process. Data were analyzed using Two-Way

Analysis of Variance (Two-Way ANOVA). When significant differences were detected, Duncan's Multiple Range Test (DMRT) was conducted as a post hoc test. Qualitative descriptive analysis was also applied to interpret organoleptic data.

RESULTS AND DISCUSSION

1. Melting Rate

The results of the melting rate test of jackfruit seed ice cream with the addition of sappan wood extract are presented in Table 1. The melting time varied across treatments, indicating that different formulation combinations influenced the melting characteristics of the ice cream. The lowest melting rate (longest melting time) was observed in treatment B3K2, with a melting time of 25 minutes. In contrast, the highest melting rate (shortest melting time) was found in treatment B0K0, with a melting time of 9.5 minutes. These differences suggest that variations in jackfruit seed–skim milk ratio and sappan wood extract concentration affect the structural stability and melting resistance of the ice cream.

Table 1. Melting Rate of Jackfruit Seed Ice Cream with the Addition of Sappan Wood Extract

| Treatment | Replication 1 (min) | Replication 2 (min) | Total (min) | Mean (min) |
|-------------|------------------------|------------------------|----------------|---------------|
| B0K0 | 9 | 10 | 19 | 9.5** |
| B0K1 | 10 | 11 | 21 | 10.5 |
| B0K2 | 12 | 9 | 21 | 10.5 |
| B1K0 | 15 | 17 | 32 | 16.0 |
| B1K1 | 14 | 17 | 31 | 15.5 |
| B1K2 | 17 | 18 | 35 | 17.5 |
| B2K0 | 20 | 19 | 39 | 19.5 |
| B2K1 | 18 | 17 | 35 | 17.5 |
| B2K2 | 20 | 22 | 42 | 21.0 |
| B3K0 | 23 | 20 | 43 | 21.5 |
| B3K1 | 24 | 20 | 44 | 22.0 |
| B3K2 | 23 | 27 | 50 | 25.0* |
| Grand Total | | | 412 | 17.17 |

Notes:

** = Highest melting rate (fastest melting time)

* = Lowest melting rate (longest melting time)

The melting rate results showed variation across treatments. The longest melting time (lowest melting rate) was observed in treatment B3K2, reaching 25 minutes, while the shortest melting time (highest melting rate) occurred in treatment B0K0, with 9.5 minutes. An increase in jackfruit seed concentration resulted in longer melting times. The melting resistance of ice cream is closely related to its texture and viscosity of the ice cream mix (ICM). Viscosity is influenced by the composition of ingredients used in ice cream production, particularly jackfruit seed flour. According to Padaga and Sawitri (2005), the melting rate of ice cream is affected by the formulation and composition of its ingredients. Based on the Indonesian National Standard (SNI No. 01-3713-1995), the acceptable melting time for ice cream ranges from 15 to 25 minutes. In this study, most treatments met the recommended melting range. However, treatments B0K0, B0K1, and B0K2 exhibited melting times that were too rapid. This may be attributed to the absence of jackfruit seed addition in these treatments, resulting in a less dense and less stable ice cream structure.

2. Organoleptic Test

The organoleptic evaluation included assessments of color, aroma, taste, texture, and overall acceptability of jackfruit seed ice cream with the addition of sappan wood extract. The sensory evaluation involved 20 panelists. The assessment was conducted using human sensory perception, including visual (color), tactile (texture), gustatory (taste), and olfactory (aroma) senses. The results of the organoleptic test are presented in Figure 1.

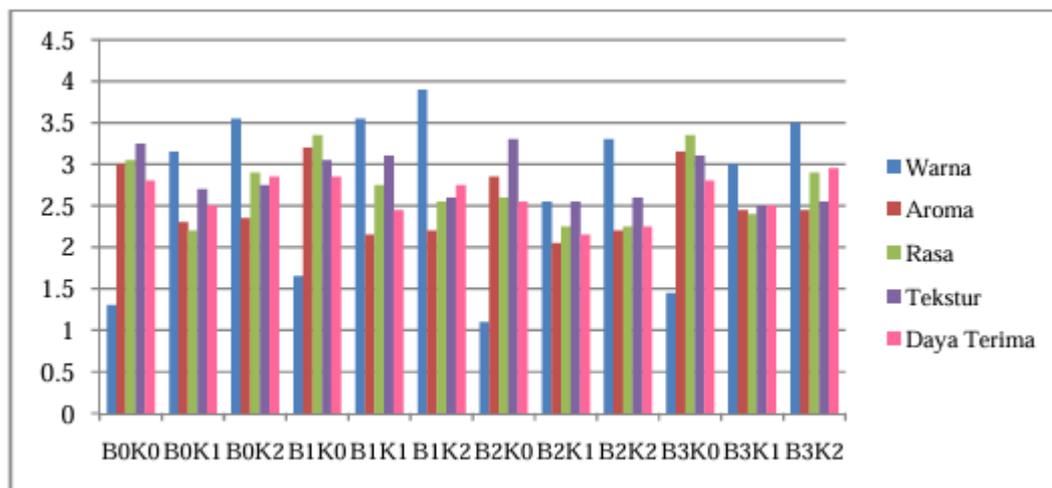


Figure 1. Histogram of Organoleptic Test Results of Jackfruit Seed Ice Cream with the Addition of Sappan Wood Extract

Color

The organoleptic evaluation of color in jackfruit seed ice cream was influenced by the addition of sappan wood extract as a natural colorant. The highest mean color score (3.90) was observed in treatment B1K2, indicating a red color, while the lowest mean score (1.10) was found in treatment B2K0, indicating a white color.

Treatments B0K0, B2K0, and B3K0 obtained mean scores of 1.30, 1.10, and 1.45, respectively, resulting in a white color due to the absence of sappan wood extract. However, treatment B1K0, which was also without sappan wood extract, had a mean score of 1.65 and was described by panelists as yellowish-white. This coloration may be attributed to the natural yellow pigments present in jackfruit seeds and skim milk.

Treatments B0K1, B2K1, B2K2, and B3K1 showed mean scores of 3.15, 2.55, 3.30, and 3.00, respectively, producing a pink color. The K1 treatment (5 g sappan wood extract) produced a pink hue, while the K2 treatment (10 g sappan wood extract) was expected to produce a deeper color. However, prolonged mixing during processing may have reduced pigment intensity, resulting in lighter coloration.

Treatments B0K2, B1K1, B1K2, and B3K2 produced mean scores of 3.55, 3.55, 3.90, and 3.50, respectively, indicating a red color. The red coloration resulted from the addition of sappan wood extract. A lower proportion of jackfruit seed allowed the red pigment from sappan wood to appear more prominently.

The color of jackfruit seed ice cream was strongly influenced by sappan wood extract. This natural colorant contains the red pigment brazilin, which exhibits a bright and vivid red color at neutral pH (6–7) and shifts toward a purplish-red hue as pH increases (Kurniati et al., 2012).

Aroma

Treatments B0K0, B1K0, B2K0, and B3K0 produced mean aroma scores of 3.00, 3.20, 2.85, and 3.15, respectively, indicating a characteristic milky aroma. In contrast, treatments B0K1, B0K2, B1K1, B1K2, B2K1, B2K2, B3K1, and B3K2 had mean scores of 2.30, 2.35, 2.15, 2.20, 2.05, 2.20, 2.45, and 2.45, respectively, indicating a slightly milky aroma. The highest aroma score (3.20) was observed in treatment B1K0, while the lowest score (2.05) was recorded in treatment B2K1. Flavor and aroma are closely interrelated and significantly contribute to overall product quality (Padaga & Sawitri, 2005). The characteristic milky aroma was observed in treatments without sappan wood extract, as the formulation primarily consisted of milk-based ingredients such as skim milk and milk fat. The slightly milky aroma in other treatments may be due to the addition of sappan wood extract, which partially masked the natural milk aroma.

Taste

Treatments B0K0, B0K2, B1K0, B1K1, B1K2, B2K0, B3K0, and B3K2 produced a sweet taste with mean scores of 3.05, 2.90, 3.35, 2.75, 2.55, 2.60, 3.35, and 2.90, respectively. Meanwhile, treatments B2K1, B2K2, and B3K1 were described as slightly sweet, with mean scores of 2.20, 2.25, and 2.40. The highest taste scores (3.35) were observed in treatments B1K0 and B3K0, while the lowest score (2.20) was recorded in treatment B0K1. The slightly sweet taste may be influenced by the presence of saponins in sappan wood. According to Obtra (2009), saponins contain polycyclic aglycone compounds that can form foam when shaken with water. Their amphiphilic structure contributes to a slightly bitter taste, which may reduce sweetness perception. In general, consumers prefer ice cream with an optimal level of sweetness. Sucrose is the most commonly used sweetener in ice cream production, typically in the form of granulated sugar. In addition to added sugar, lactose from milk also contributes to sweetness (Padaga & Sawitri, 2005).

Texture

The highest mean texture score (3.30) was observed in treatment B2K0, while the lowest score (2.50) was recorded in treatment B3K1. Despite differences in scores, all treatments produced a soft texture. Texture refers to the structural arrangement of particles forming the body of the ice cream. It is strongly influenced by fat content, which plays a crucial role in determining smoothness (Hartatie, 2011). Fat contributes to a smooth texture, enhances flavor perception, and improves overall appearance (Ismunandar, 2004). In this study, the formulation contained relatively high milk fat levels (12–16%), resulting in a smooth and soft texture. Proper processing conditions also contributed to desirable texture characteristics.

Overall Acceptability

Most treatments were generally accepted (“liked”) by panelists, except for treatments B1K1, B2K1, and B2K2. The highest overall acceptability score (2.95) was observed in treatment B3K2, while the lowest score (2.15) was found in treatment B2K1. Treatment B3K2, characterized by red color, slightly milky aroma, sweet taste, and soft texture, was the most preferred formulation. In contrast, treatments B1K1, B2K1, and B2K2 were less preferred due to less favorable aroma and slightly sweet taste. Generally, panelists preferred ice cream with attractive color, sweet taste, characteristic milky aroma, and soft texture. Color plays a crucial role in determining food quality and attracting consumers (Winarno, 2004). Furthermore, high-quality ice cream is characterized by smooth texture, appealing appearance, and pleasant flavor, while lower-quality ice cream tends to contain excessive ice crystals and has a coarse texture (Padaga & Sawitri, 2005).

CONCLUSION

Based on the data analysis and discussion, the following conclusions can be drawn the lowest melting rate (longest melting time) was observed in treatment B3K2 (75% jackfruit seed, 25% skim milk, and the addition of 10 g sappan wood extract), with a melting time of 25 minutes. The ice cream from treatment B3K2 (75% jackfruit seed, 25% skim milk, and 10 g sappan wood extract) was the most preferred by the panelists. The addition of jackfruit seed significantly affected the melting rate, whereas the addition of sappan wood extract did not influence the melting rate of jackfruit seed ice cream.

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