

(RESEARCH ARTICLE)



Antioxidant activity and physical quality of ice cream with the addition of the coffee extract from local Kotamobagu

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Open Access Research Journal of Science and Technology, 2024, 12(02), 020–026

Publication history: Received on 20 September 2024; revised on 11 November 2024; accepted on 13 November 2024

Article DOI: <https://doi.org/10.53022/oarjst.2024.12.2.0130>

Abstract

The production of local Kotamobagu coffee extract used the ground coffee taken from organic robusta coffee producers in Kotamobagu City, North Sulawesi Province. This study aims to determine the addition of local Kotamobagu coffee extract to the antioxidant activity and physical quality (overrun, pH & melting point) of ice cream. This study used a Completely Randomized Design (CRD) with 5 treatments, namely the addition of local Kotamobagu coffee extract of P0: 0%; P1: 5%; P2: 10%; P3: 15% and P4: 20%. with 4 replications. The variables measured were antioxidant activity, overrun, pH and melting point. The results of the analysis of variance showed that the addition of local Kotamobagu coffee extract had a significant effect ($P < 0.05$) on antioxidant activity and overrun but had the same effect on the pH and melting point of ice cream. It was concluded that the addition of local Kotamobagu coffee extract up to 20% produced ice cream that had increasing antioxidant activity content with physical quality that met the requirements of SNI 01-37131995.

Keywords: Antioxidant activity; Physical quality; Ice cream; Local Kotamobagu coffee extract

1. Introduction

Ice cream is a frozen food product made through a combination of freezing and agitation processes on a mixture of ingredients consisting of milk and milk products, sweeteners, stabilizers, emulsifiers, and flavor enhancers. Ice cream is one of the highly nutritious foods made from dairy products that is liked by all levels of society, so it is necessary to improve the quality of ice cream making through engineering efforts in the ice cream making process [1]. Engineering ice cream making can be done by adding natural ingredients that are beneficial for consumer health [2]. Developing ice cream products by utilizing local ingredients is an effort to increase profits that can reduce the cost of ice cream raw materials [3]. The integration observed with the modification of raw materials is the result of engineering the ice cream product process that is liked by consumers based on the standardization [4].

Many ice cream products are added with other ingredients such as chocolate, vanilla, strawberry, nuts, and other flavors that can enhance the taste of ice cream [5]. Coffee processing has been widely applied to various products such as candy, beverage products and others, but for now there are not many coffee flavors in ice cream products. Coffee has a distinctive taste and is efficacious to refresh the body, can protect the body from free radicals because of the presence of antioxidants and contains polyphenols that can stimulate brain performance, reduce the risk of breast cancer, migraines, gallstones and diabetes [6]. Caffeine consumption is useful for increasing alertness, eliminating drowsiness and improving mood, caffeine also helps physical performance by increasing endurance and increasing muscle contractions [7].

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Therefore, diversification and innovation are carried out in making ice cream by adding robusta coffee. This coffee has a strong aroma and has a bitter taste compared to other types of coffee, so it will be very interesting if diversified with ice cream. The flavor variants of ice cream added with Kotamobagu coffee extract have never been studied. Kotamobagu coffee extract can provide a bitter taste, a distinctive coffee aroma and sourness and provide a different texture to ice cream. Therefore, Kotamobagu coffee extract is a choice of new flavor variations of ice cream that can increase consumer interest. In order to increase the variety of flavors and quality of ice cream produced, it will be studied how the antioxidant activity and physical quality are with the addition of local Kotamobagu coffee extract in making ice cream.

2. Materials and Methods

2.1. Tools and materials

The tools used were gas stove, pan, wooden spoon, container, spatula, knife, marker, ice cream spoon, ice cream cup, measuring glass, mixer, analytical scale, sieve, blender, freezer and organoleptic test tools including tissue, aqua, cucumber, questionnaire paper and stationery. The materials used were UHT milk, granulated sugar, egg yolk, whipped cream, full cream powdered milk, agar-agar, water and local coffee extract from Kotamobagu.

2.2. Research Methods

This research method used a Completely Randomized Design (CRD) with 5 treatments and 4 replications. The treatments in this study were: P0: Without the addition of 0% Kotamobagu local coffee extract; P1: Addition of 5% Kotamobagu local coffee extract; P2: Addition of 10% Kotamobagu local coffee extract; P3: Addition of 15% Kotamobagu local coffee extract; P4: Addition of 20% Kotamobagu local coffee extract. The variables observed were antioxidant activity, physical properties (overrun, pH, melting time) of ice cream added with local Kotamobagu coffee extract.

2.3. Data Statistical Analysis

The data obtained were then processed using analysis of variance to determine the effect of treatment on the observed variables. If there is a real effect, further testing is carried out with the Honestly Significant Difference Test (HSD) [8].

2.4. The Process of Making Local Coffee Extract from Kotamobagu

The process of making local Kotamobagu coffee extract was to use ground coffee taken directly from organic robusta coffee producers from the coffee plantation centers of Bilalang I and Bilalang II Villages in North Kotamobagu District, Kotamobagu City. Then the local Kotamobagu coffee extract (ground coffee) was blended according to the treatment then put in a container and add hot water with a temperature of 92 ° C with a ratio of 2: 1 according to the percentage of treatment. Let this treatment stand for 15 minutes then squeezed using a filter cloth to produce local Kotamobagu coffee extract according to the treatment [9].

2.5. The Process of Making Local Coffee Ice Cream from Kotamobagu

The process of making local coffee ice cream from Kotamobagu can be seen in the flow diagram below [9].

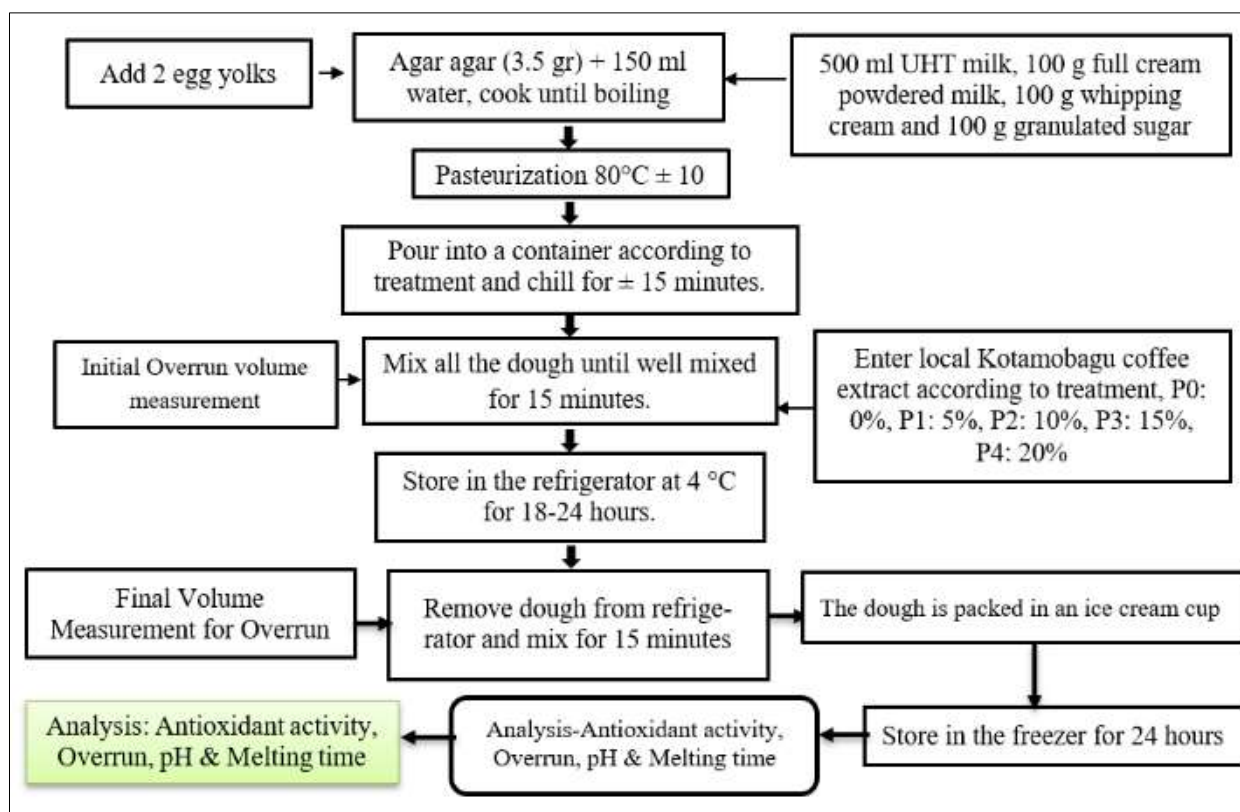


Figure 1 Flow diagram of the process of making ice cream using local coffee from Kotamobagu

3. Result and Discussion

The results of observations of antioxidant activity and physical quality (overrun, pH, melting point) of ice cream with the addition of local coffee extract from Kotamobagu as a healthy ice cream can be seen in the Table below.

Table 1 Average Value of Overrun, pH, Melting Point and Antioxidant Activity of Ice Cream with Local Coffee Extract from Kotamobagu.

Variable	Treatment				
	P ₀	P ₁	P ₂	P ₃	P ₄
Antioxidant Activity (µg/ml)	0.12 ^a	0.47 ^b	0.77 ^b	1.19 ^b	1.56 ^c
Overrun (%)	49.68 ^a	56.41 ^a	66.27 ^a	68.14 ^a	71.50 ^b
pH	6.68	6.54	6.52	6.44	6.43
Melting Point (minutes)	15.16	14.60	14.37	14.05	13.79

Note: Different superscripts in the same row are significantly different ($P < 0.05$).

3.1. Antioxidant Activity of Ice Cream

The observation data of antioxidant activity of ice cream added with Kotamobagu coffee extract showed a range of 0.12 - 1.56. The lowest antioxidant activity was in treatment P₀ (0.12) and the highest in treatment P₄ (1.56). The distribution of data showed that the higher the addition of Kotamobagu coffee extract caused the antioxidant activity of ice cream to increase. The results of the analysis of variance showed that the addition of local Kotamobagu coffee extract had a significantly different effect ($P < 0.05$) on the antioxidant activity of ice cream. This means that the treatment of adding Kotamobagu coffee extract had a different effect on the antioxidant activity of ice cream. The results of the BNJ further test showed that the P₀ treatment was different from P₁, P₂, P₃ and P₄. Treatments P₁, P₂, P₃ were the same but different from P₄. Treatments P₂, P₃ were the same but different from P₄. Treatments P₃ were different from P₄.

The increasing antioxidant activity in ice cream with the addition of Kotamobagu coffee extract, causes local Kotamobagu coffee extract to have a chlorogenic acid content as an antioxidant component of 2% [10].

These results proved that Kotamobagu coffee extract (robusta coffee) was a source of antioxidants and can increase the nutrition of ice cream by increasing antioxidant activity. This is because local Kotamobagu coffee extract contains chlorogenic acid components as antioxidants [11]. The antioxidant activity of robusta coffee is classified as a strong antioxidant so that it can be used as a candidate plant that has antioxidant activity and is developed into a topical preparation [2]. The results of testing the antioxidant activity of ice cream with the addition of local Kotamobagu coffee extract showed an increase in the antioxidant activity of ice cream. The increase in antioxidant activity along with the addition of local Kotamobagu coffee extract also proved that there was a source of antioxidants in local Kotamobagu coffee extract [12]. In this study, the manufacture of local Kotamobagu coffee extract used certified organic robusta coffee produced by farmers of the robusta coffee plantation in the surrounding areas of Kotamobagu city, North Sulawesi Province.

3.2. Ice Cream Overrun

Overrun is an important physical parameter to determine the quality of ice cream. Overrun in making ice cream is the percentage of volume expansion, namely the increase in ice volume between before and after freezing which is expressed in percentage [1]. Data from observations of overrun of ice cream added with Kotamobagu coffee extract showed a range of values 49.68 - 71.50. The lowest overrun value was in treatment P0 (49.68) and the highest in treatment P4 (71.50). The overrun value of this study is in accordance with the Indonesian National Standard (1995) [13], where good quality ice cream has an overrun of 70 - 100% for normal ice cream, and for home industries an overrun of 35 - 50% which is called soft ice cream. The distribution of data shows that the higher the addition of Kotamobagu coffee extract, the higher the overrun value of ice cream.

The results of the analysis of variance showed that the addition of local Kotamobagu coffee extract had a significantly different effect ($P < 0.05$) on the ice cream overrun value. This means that the treatment of adding local Kotamobagu coffee extract had a different effect on the ice cream overrun value. The results of the BNJ further test showed that the P0 treatment was the same as P1, P2, P3 and different from P4 on the ice cream overrun. The amount of overrun value is determined largely by the correct ingredients and mixing techniques, so that it can make the ice cream mixture expand larger. The ice cream overrun value is influenced by the nutritional value contained therein. The standard for good ice cream overrun for household scale is around 35-50% while for industrial scale it is around 70-80% [5].

The addition of local Kotamobagu coffee extract can increase the overrun value of ice cream because the physical properties of coffee can foam when subjected to shaking or agitation, the resulting foam is formed from the reaction between hydrophobic groups and air. Saponin compounds have hydrophilic groups that can bind to water and hydrophobic groups that can bind to air [3].

3.3. pH of Ice Cream

The data from the observation of the pH of ice cream added with Kotamobagu coffee extract showed a range of values 6.43 - 6.68. The lowest pH value was in treatment P0 (6.68) and the highest in treatment P4 (6.43). The distribution of data shows that the higher the addition of Kotamobagu coffee extract causes the pH value of the ice cream to decrease. The results of the analysis of variance showed that the addition of local Kotamobagu coffee extract had a different but not significant effect ($P > 0.05$) on the pH value of ice cream. This means that the treatment of adding local Kotamobagu coffee extract had no different or the same effect on the pH value of ice cream.

The addition of local Kotamobagu coffee extract can reduce the pH value of ice cream because the pH content in coffee is lower than the standard pH found in ice cream. Robusta coffee has a pH of 5.4 and its content consists of sucrose, monosaccharides, chlorogenic acid and nicotinic acid [13].

The pH value is an indicator used to determine the acid and base levels in ice cream. A pH value that is too low will make the ice cream taste sour so that it can reduce the palatability of the ice cream. Too high acidity in ice cream is not desired because it can cause a decrease in the quality of the ice cream, namely increasing its viscosity, reducing development (overrun), and can cause an unpleasant taste [9, 13].

3.4. Ice Cream Melting Point

Melting Point of Ice Cream The observation data of melting point of ice cream added with local Kotamobagu coffee extract showed a range of values 13.79 - 15.16. The lowest melting point value was in treatment P0 (15.16) and the

highest was in treatment P4 (13.79). The distribution of data shows that the higher the addition of Kotamobagu coffee extract, the lower the melting point of ice cream. The results of the analysis of variance showed that the treatment of adding local Kotamobagu coffee extract had a different but not significant effect ($P>0.05$) on the melting point value of ice cream. This means that the treatment of adding local Kotamobagu coffee extract had no different or the same effect on the melting point value of ice cream [14].

Melting point is the length of time it takes for ice cream to melt at room temperature [14]. The melting point of ice cream is related to the characteristics of the body and texture of ice cream. Good quality ice cream should melt easily when left at room temperature for 10-15 minutes and the melting process of the components must take place evenly. The melting point of ice cream is influenced by the amount of air trapped in the ice cream mixture, the ice crystals formed, and the fat content in it [15].

The addition of Kotamobagu coffee extract can accelerate the melting point value of ice cream, although statistically the treatment has the same effect, this is due to the nature of coffee which can foam so that it can affect the overrun and melting point of ice cream [16]. The fat content in ice cream can contribute to producing a creamy and soft texture, increasing viscosity and increasing the resistance of ice cream time to melt [17]. The amount of air that enters the ice cream mixture and the nature of the ice crystals formed during the ice cream freezing process can be other factors that affect the time to melt. The more air that enters the mixture will make the ice cream easier to melt [18, 19].

One of the ingredients used in making ice cream is a stabilizer, the main purpose of using stabilizers in ice cream is to produce good smoothness and texture to reduce the re-formation of ice cream crystals during storage, produce product uniformity and inhibit melting. Quality ice cream shows sufficient resistance to melting. Very slow melting is undesirable because it reflects excessive stabilizer or inadequate dough processing [20]. Good ice cream has a melting time of between 15-20 minutes at room temperature, ice cream that melts easily or is too hard is not liked by consumers analyzed based on the method to determine the level of consumer satisfaction [21].

4. Conclusions

Based on the results and discussion, it can be concluded that the addition of local Kotamobagu coffee extract up to 20% produces ice cream that has an increasing antioxidant activity content with physical quality that meets the requirements of the Indonesian National Standard 01-37131995.

Compliance with ethical standards

Acknowledgments

The financial support of the partnership program of the Sam Ratulangi University Research Center (Dana PNBP-LPPM Unsrat) is gratefully acknowledged.

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

All authors declare and confirm that the version of the submitted manuscript have been read and approved.

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