Journal of Applied Food Technology

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Effect of Cascara Proportion on Melting Time and Hedonic Toward Color Preference of Ice Cream

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Abstract

The aim of this research was to determine the effect of adding different concentrations of cascara extract on the melting time and color of ice cream. The material used in this study was cow's milk as raw material for making ice cream with different extract concentration treatments. The research method used was a Completely Randomized Design (CRD) with 5 treatments and 4 repetitions. Variations in extract concentration were 0%, 10%, 20%, 30%, 40%. The melting time test data were analyzed using Analysis of Variance (ANOVA) with a confidence level of 95% and if there is a real influence then proceed with the Duncan Multiple Range Test (DMRT). Data of ice cream color test results were analyzed using the Kruskal Wallis non-parametric test with a confidence level of 95% and if there is a real influence, then proceed with the Mann-Whitney test. The results showed that different concentrations of Cascara Arabica extract had a significant effect ($p<0.05$) on the melting time and color of ice cream products. The increased concentration of cascara extract, the longer the melting time. Ice cream with an extract concentration of 40% was the product with the best treatment because it had the longest melting time and the color of the ice cream was favored by panelists.

Article information:
Received: 10 July 2020
Accepted: 1 November 2021
Available online: 14 November 2021

Keywords:
cascara
ice cream
melting time

doi: 10.17728/jaft.8454

Introduction

Cascara is a beverage made from the outer layer of coffee skin, distinct from traditional coffee. People prepare cascara by steeping it in hot water, resulting in a tea-like brownish beverage, hence the name cascara tea. It contains high levels of flavonoids, functioning as antioxidants, and is rich in vitamins C and E, beneficial for the skin. Due to its antioxidant properties, cascara shows potential for use in food as a source of antioxidants. Brewed cascara has a unique sour taste and fruity aroma (Nafisah and Widyaningsih, 2019), attributed to its chlorogenic acid and caffeic acid content (Rohdiana, 1999). When brewed, cascara tea exhibits a dark brown color due to its tannin content (Mawardi et al., 2017). Despite its numerous benefits, cascara is rarely consumed by the public due to its bitter and fruity taste, as well as its less appealing color. To enhance its appeal, there is a need for product innovation. One such innovation that has gained popularity across various demographics is cascara-infused ice cream. Traditional ice cream is typically white, but with the addition of cascara, a natural brown color is obtained, making the ice cream more visually appealing. This innovation not only enhances the ice cream's aesthetic but also provides health benefits. Cascara naturally contains crude fiber (Arinda et al., 2020), a factor influencing the melting time of food products Ice cream is a frozen food product that is made through a combination of freezing and agitation processes in ingredients consisting of milk and milk products, sweeteners, stabilizers, emulsifiers, and flavor enhancers. Ice cream according to SNI (1995) is a type of semi-solid food made by freezing ice cream flour or from a mixture of milk, animal or vegetable fats, sugar, with or without other food ingredients, and food additives that are permitted. The use of milk aims to form a soft body ice cream due to the small size of the ice cream crystal particles, the source of flavor and calories, increase

thickness and maintain stability. Milk contains complete nutrition including milk fat, CO_2, calcium, vitamins, phosphate, citrate, and protein (casein and whey protein) (Zain, 2013). The process of making ice cream includes the processes of pasteurization, homogenization, maturation or aging, storage in the refrigerator, freezing, and stirring.

The management and utilization of cascara products beyond its use in tea remain largely unexplored in related research. This area presents an opportunity for further investigation. The objective of this research is to study the impact of cascara on the melting time and color of ice cream. This study holds significant value as it aims to introduce new products, making cascara more accessible to the public. Additionally, it seeks to assess the quality of cascara ice cream by evaluating its physical properties, specifically focusing on the melting time and color, both of which are crucial factors that capture consumers' attention

Materials and Methods

Materials

The ingredients used were 'greenfileds' pasteurized milk, Cascara from Temanggung, sugar, egg yolks, water, whipped cream, CMC, methanol, and DPPH reagents. The tools used were measuring cups, Bekker glass, spoons, forks, plates, stoves, analytical scales, mixers, ice cream makers, refrigerators, freezers, thermometers, ice cream containers, plastic cups, label, plastic wrap, stopwatches, filter paper.

Methods

The study was conducted from January to February 2020 in the Laboratory of Food Engineering and Agricultural Products the Laboratory of Chemistry and Food Nutrition, Faculty of Animal Husbandry and Agriculture, and the Integrated Laboratory of Diponegoro University, Semarang. The analysis included the melting time and color of the ice cream

Preparation of Cascara Extract

Cascara extract was prepared following the method described by Yuwanti et al. (2018). Cascara was first placed in a dry blender and weighed according to the following treatments: T0 (0% concentration = 100 ml water), T1 (10% concentration = 10g cascara, 90 ml water), T2 (20% concentration = 20g cascara, 80 ml water), T3 (30% concentration = 30g cascara, 70 ml water), and T4 (40% concentration = 40g cascara, 60 ml water). The cascara was extracted for 10 minutes using water at 90°C. Subsequently, the extracted liquid was filtered using filter paper, and 15 ml of cascara extract was measured and placed into a container. The extract was then cooled to room temperature for further analysis.

Preparation of Ice Cream

Ice cream production was carried out following the procedure outlined by Sahadi et al. (2018). The ingredients were accurately weighed according to the specified formulation. Milk, sugar, egg yolk, whipped cream, carboxymethyl cellulose (CMC), and cascara extract (15 ml) corresponding to the treatments T1 (0%), T2 (10%), T3 (30%), and T4 (40%) were combined. The mixture was homogenized using a hand mixer until uniform. The resulting mixture was transferred to an ice cream container and aged in a refrigerator at 4°C for 24 hours. Afterward, the mixture was processed in an ice cream maker for 30 minutes. The prepared ice cream was then portioned into cups and placed in a freezer at -4°C for 24 hours. Subsequently, the cascara ice cream was examined. The detailed ice cream formulation can be found in Table 1.

Table 1. Ice Cream Formulation with of Cascara Proportion Addition

Materials	Amount of Ingredients				
	T0	T1	T2	T3	T4
Milk	96	96	96	96	96
Egg Yolk	10	10	10	10	10
CMC	1	1	1	1	1
Sugar	28	28	28	28	28
Whip Cream	65	65	65	65	65
Cascara Extract 15ml	0	10	20	30	40

Melting Time Measurement

The analysis of melt time was conducted using a modified method based on Koxbolt (2001). In this procedure, a sample weighing 5 grams of ice cream was placed into a container and allowed to melt at room temperature. The time taken for complete melting was measured using a stopwatch. The melting time was calculated from the moment the ice cream was removed from the freezer and placed in the container until it completely melted at room temperature.

Color Measurement

The evaluation of ice cream color, based on a hedonic test, was conducted following a modified method as described by Yuliani and Fahriansyah (2011). For this evaluation, 25 semi-trained panelists were involved. The ice cream samples were presented in plastic cups, each labeled with a unique three-digit code. Each plastic cup contained 10 grams of ice cream. The panelists used a scoring system ranging from 1 (very dislike) to 5 (very like) to assess the ice cream

color. Specifically, the scores were as follows: 1 (very dislike), 2 (dislike), 3 (somewhat like), 4 (like), and 5 (very like).

Data Analysis

The melting time results were analyzed by ANOVA with a significance level of 5% and continued with Multiple Region test *Duncan's* if there were significant results. Color test data results were analyzed by *Kruskal-Wallis* with a significance level of 5% and continued with *Mann-Whitney* if there were significant results.

Result and Discussion

Melting Time of Ice Cream

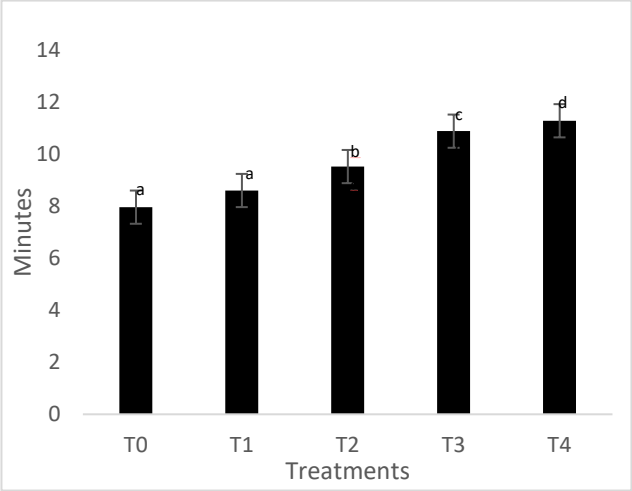

Figure 1. Effect Addition of cascara extract on the melting time of ice cream

The results indicated that the melting time of ice cream with cascara additions ranged from 7.96 to 11.28 minutes, as illustrated in Figure 1. The test results displayed in Figure 1 reveal a significant effect ($p<0.05$) of different cascara concentrations on ice cream melting time. It is evident that the incorporation of cascara led to a longer melting time for the ice cream. This can be attributed to the high fiber content in cascara. Fibers act as viscosity enhancers, slowing down the melting process of ice cream. This finding aligns with the findings of Nafisah et al. (2018), who reported that the 30.8% fiber content in cascara arabica can thicken the ice cream mixture. An increased amount of fiber reduces the freezing point of the mixture, allowing more water to be trapped, which in turn restricts free water mobility. A higher amount of trapped free water results in ice cream that melts more slowly. This observation is supported by the statement of Flores and Goff (1999), indicating that melting time is influenced by the number of ice crystals and the formation of fat globule tissues during freezing. Additionally, Nelson and Trout (1975) suggested that the duration of ice cream melting is linked to its body, texture, and sweetness intensity.

The melting time of cascara ice cream ranged from 7.92 to 11.28 minutes, indicating a relatively faster melting process. However, this melting time was not considered optimal. This finding aligns with the perspective of Susilorini and Sawitri (2006), who suggested that an ideal melting speed falls between 15-20 minutes. Several factors influenced this melting time, one of which was the room temperature, maintained at approximately 30°C for testing. This temperature choice was consistent with the recommendation of Soad et al. (2014), who stated that room temperature for ice cream melting tests ranged from 25°C, making it an optimal testing environment. Another factor affecting ice cream melting time was the inclusion of other ingredients, notably CMC (carboxymethyl cellulose), utilized as a thickener in the ice cream mixture. CMC exhibits excellent water solubility in cold temperatures, maintaining its binding function even in chilly conditions. Geovani et al. (2013) noted that the addition of CMC in food products, such as ice cream, functions as a water binder and gel maker, improving texture. Furthermore, the addition of fats from milk and whipped cream influenced the melting time. According to Roland et al. (1999), lower fat content results in a faster melting time for ice cream. However, Padaga and Sawitri (2005) pointed out that ice cream that melts too quickly is unfavorable, as it tends to lose its form rapidly at room temperature. Conversely, ice cream with a very slow melting speed might not appeal to consumers due to its fixed shape, giving the impression of excessive solid content.

Color of Ice Cream

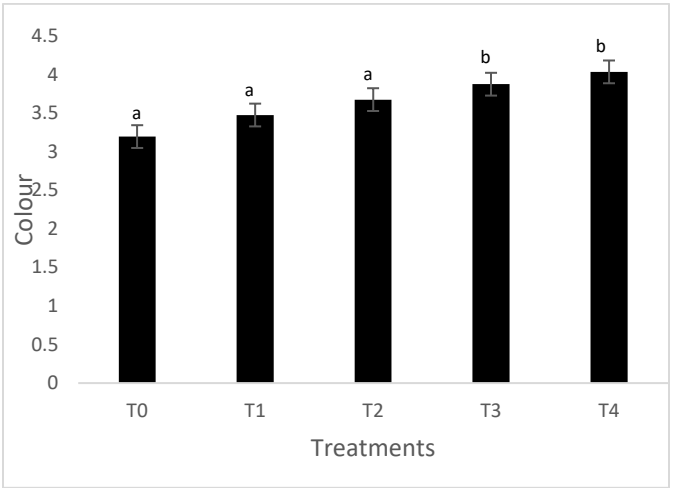

Figure 2. Effect Addition of cascara extract on the hedonic color preference of ice cream

The results indicated that the hedonic color preference of ice cream with cascara additions ranged from 3.2 to 4.04, reflecting varying degrees of color preference among participants. As shown in Illustration 2, the incorporation of cascara significantly influenced the color of the ice cream ($p<0.05$). The color intensity of the cascara ice cream increased with higher

concentrations of cascara. The control group (T0) exhibited the lowest color intensity, rated at 3.2%, while the T4 treatment (40% cascara) had the highest color intensity, rated at 4.04%. The natural color of ice cream without cascara additives was white, owing to the presence of ingredients like sugar, eggs, and milk, which naturally impart a yellowish-white hue. This observation is consistent with Arbuckle's findings in 1986, stating that milk possesses a bluish white to brownish-yellow color as one of its physical and chemical properties. The brownish color of the cascara ice cream resulted from the compounds in cascara, including catechins, epicatechins, and ferulic acid. Although these compounds were not in extremely high amounts, they contributed to the brownish hue. Nafisah et al. (2018) supported this, explaining that oxidized catechins in cascara produce theaflavin and thearubigin, which influence the color of steeping water. Therefore, the higher the levels of theaflavin and thearubigin in brewing water, the darker or more brownish red the cascara extract becomes. Additionally, the tannin content in cascara also affected the ice cream color. Tannin, as a water-soluble polyphenol compound, plays a role in the color of cascara tea. According to Khasnabis et al. (2015), the higher the tannin concentration, the darker the color of cascara tea, as the tannin component evaporates and lowers the overall tannin content.

The color of a food product significantly impacts consumer acceptance, as the physical appearance of the product influences consumers' preferences. This observation is supported by Wahyuni (2010), who emphasizes that unattractive colors can deter consumers from enjoying a product. In the case of cascara ice cream, the color is influenced by the cascara extract process. The color alteration occurs during the extraction process, particularly when water is heated to 100°C for cascara extraction. Excessive heat can intensify the chemical reactions within the tea, affecting its color. This aligns with the findings of Nida et al. (2019), who noted that factors such as pH, temperature, light, oxygen, and metal ions can influence the oxidation process during cascara brewing, ultimately affecting the resulting color of the extract.

Conclusion

Based on the research results investigating the impact of varying concentrations of cascara extract on ice cream's melting time and hedonic color preference, it can be concluded that higher concentrations of cascara extract led to an increase in both melting time and the color intensity of the ice cream. The ice cream exhibited a more chocolate-like color due to the addition of cascara extract, which was favored by the panelists.

Acknowledgment

The authors would like to thank all colleagues for their support in this research.

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