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Sensory Evaluation and Physical Characteristics of Ice Cream with The Comparison of Soy Whey and Moringa Leaves Puree

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Abstract

Soy whey is one of the byproducts of tofu processing industry that has not been widely utilized until now, potentially causing environmental pollution. One of the efforts to manage tofu waste is to transform it into an innovative food product such as ice cream. However, this endeavor undoubtedly requires the addition of other ingredients to enhance the quality of the product's appearance, such as natural colorants, one of which is moringa leaves. Moringa leaves were rich in chlorophyll and other bioactive components, making them suitable for used as a natural colorant in the form of puree. This study aimed to determine the influence of the comparison between soy whey to moringa leaves puree on the sensory characteristics of ice cream and to obtained the appropriate formulation for the production of ice cream with the best sensory characteristics. The study used a Randomized Complete Block Design (RCBD) with treatments consisting of different comparison of soy whey and moringa leaves puree (10:90; 30:70; 50:50; 70:30; 90:10). The best sensory results will be followed by testing the physical characteristics of the ice cream. The research showed that the comparison of soy whey to moringa leaves puree (30:70) was the best treatment in terms of sensory characteristics for color (4.15), aroma (4.22), texture (4.48), taste (4.19), and overall acceptances (4.48) with a preference category of slightly liked, along with physical characteristics included 41.63% overrun, 53.8 minutes melting time, and color characteristics of L* 60.23; a* -7.4; b* 20.43 categorized as bitter green.

Keywords: Ice Cream, Moringa, Soy Whey

1. Introduction

One of the fundamental needs of humanity is food. However, food can generate waste that may pollute the environment (food waste). Food waste referred to food that is produced or processed initially for human consumption but ultimately goes unconsumed [8]. Tofu industry is one of the food industry that can produced food waste. Tofu industry easily flourishes rapidly due to its used of conventional methods [3]. The waste from the tofu industry was known as soy whey.

Soy whey is the liquid waste product from tofu production that is typically discarded into the environment, leading to pollution. According to [2], soy whey is the soybean essence that can be utilized as a substitute for plant-based protein and contained bioactive components such as isoflavones, oligosaccharides, peptides, and saponins. Isoflavones belong to the group of bioactive flavonoid compounds and possess anti-cancer, anti-tumor, antiviral, and anti-cholesterol properties [24]. Recognizing the potential of soy whey and aiming to reduce environmental pollution, efforts are required for the management of tofu waste, one of which is to transform soy whey into ice cream. The nature of soy whey resembles that of milk, thus enabling it to substitute for milk in ice cream products. However, the utilization of soy whey in ice cream resulted a less appealing color, necessitating the addition of other natural ingredients such as moringa leaves as a natural food colorant.

Moringa is a type of tropical plant found in Indonesia. The utilized part of the plant is its leaves. Moringa leaves contain bioactive components such as vitamins, polyphenols, phenolic acids, flavonoids, alkaloids, glucosinolates, isothiocyanates, tannins, and saponins [12]. Similar findings

were also reported by [20] in 100 grams of Moringa leaves contains vitamin C equivalent to 7 times the existing vitamin C in citrus fruits, 4 times vitamin A in carrots, 4 times calcium in milk, 3 times potassium in a banana, and 2 times the protein in an egg. The bioactive components in moringa lead to its functional effects on the body. [16] reported that moringa has pharmacological effects as an anti-inflammatory, antibacterial, and antioxidant. Similarly, it has been reported according to [11][19] moringa plants are beneficial in treating 24 chronic metabolic diseases, one of which is stunting. The used of moringa leaves as a natural food colorant can be in the form of moringa leaves puree. One of the products that can be innovated with soy whey and moringa leaves puree is ice cream.

Ice cream is a semi-solid processed product typically made from milk, served as a dessert or snack. However, due to its milk-based composition, it is not recommended for consumption by individuals with lactose intolerance. Furthermore, its sweet taste also serves as a deterrent for individuals with diabetes. In light of these considerations, there is a need for innovation in transforming ice cream into a healthy delicacy enjoyed by all, one approach being the diversification of ingredients using moringa leaves and soy whey, and substituting the sugar with alternative sweeteners such as honey. It is also essential to consider the ratio of soy whey to moringa leaves puree used in the ice cream production. An excessive amount of soy whey may result an unappealing color and slightly bland taste. Moreover, an increased proportion of moringa leaves can lead to a deep green color in the ice cream, potentially reducing consumer acceptance, as moringa leaves contain chlorophyll [4].

Based on that, it is imperative to conduct research to determine the appropriate formulation for the comparison of soy whey and moringa leaves puree in order to produced ice cream with the best sensory characteristics.

2. Material and Methods

2.1. Research Design

This research was conducted from the 8th of November to the 2nd of December 2023 at the Laboratory of Food Processing and the Laboratory of Food Analysis, Department of Food Technology, Faculty of Agricultural Technology, Udayana University.

The materials used in this study were puree moringa leaves with the specific characteristic of a deep green color obtained from the Luk-luk Indah Housing Complex Block B no.60, Mengwi-Badung, soy whey acquired from the Mekar Jaya tofu factory located in Jimbaran, South Kuta District, honey (TJ honey), cornstarch, vanilla, and Super Polymer (SP) (koepoe koepoe).

Equipment used in this study included a basin, hand mixer (Miyako), spoon, saucepan, stove, small cup, analytical scale (Shimadzu), blender (Phillips), freezer (GEA), and sieve.

This study used a Randomized Complete Block Design (RCBD) with treatments comparing soy whey and puree moringa leaves, consisting of 5 levels: P1 (10:90); P2 (30:70), P3 (50:50), P4 (70:30), and P5 (90:10). The best treatment from sensory evaluation was then followed by testing physical characteristics such as overrun [22], melting time [25], and color characteristics included L*, a*, and b* [21].

The research data obtained was subsequently analyzed using the assistance of Minitab 19 software. If there was a significant effect on the observed variables ($P<0.05$), then it will be followed by Tukey's post hoc test.

2.2. Research Implementation

2.2.1. Preparation of moringa leaves puree

The preparation of moringa leaves puree, as referenced in [14] with modification. The preparation of moringa leaves puree started with the separation of mature moringa leaves from their

stems, followed by a thorough washing with clean water. Subsequently, the leaves are blanched at 85°C using hot water for 5 minutes, then rinsed and strained to retained the moringa leaves. Next, the moringa leaves are finely ground using a blender with the addition of water at a ratio of 1:20 (w/v). This is followed by a filtration process until moringa leaves puree is obtained.

2.2.2. Process of making soy whey ice cream

The process of making Soy whey ice cream referenced to [23] with modifications. The process started by weighing all the ingredients used and adjusting them according to the formulation outlined in Table 1. The soy whey utilized is obtained from the Mekar Jaya tofu factory located in Jimbaran, South Kuta District, which has been boiled at a temperature of 85ºC for 5 minutes. Subsequently, mix vanilla, honey, and cornstarch into a bowl, then mix using a hand mixer for 3 minutes. Pour the mixture into cups, seal, and freeze at temperature of -19ºC for 24 hours. Removed the ice cream from the freezer, crush it in a bowl, and add SP as stabilizing agent. The ice cream mixture was then stirred using a mixer until it expanded and transferred into cups. The expanded mixture was then frozen in the freezer at a temperature of -19ºC for 24 hours.

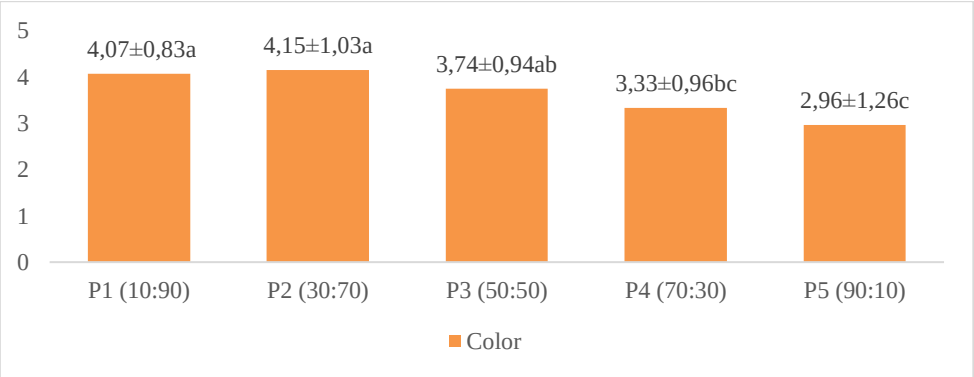
Table 1.
The Formulation of Soy Whey Ice Cream

No	Ingredients	P1 (10 : 90)	P2 (30 : 70)	P3 (50:50)	P4 (70 : 30)	P5 (90 : 10)
1	Soy Whey (g)	10	30	50	70	90
2	Moringa Leaves Puree	90	70	50	30	10
3	Madu (g)	40	40	40	40	40
4	Vanili (g)	7	7	7	7	7
5	Tepung Maizena (g)	3	3	3	3	3
6	SP (g)	2.5	2.5	2.5	2.5	2.5

3. Results and Discussion

3.1. Color

The results showed that the comparison between soy whey and moringa leaves puree had a very significant effect (P<0.01) on the hedonic test for color of the ice cream, can be seen in Figure 1. Figure 1 showed that the panelist`s assessment of the hedonic test of the soy whey and puree moringa leaves color attribute ranged from 2.96 (neutral) to the highest at 4.15 (slightly liked). The highest score was obtained for the ice cream with a comparison of soy whey and moringa leaves puree treatment P2 (30:70) which was 4.15 (slightly liked), while the lowest acceptances value at the comparison of soy whey and puree moringa leaves treatment P5 (90:10) which was 2.96 (neutral).



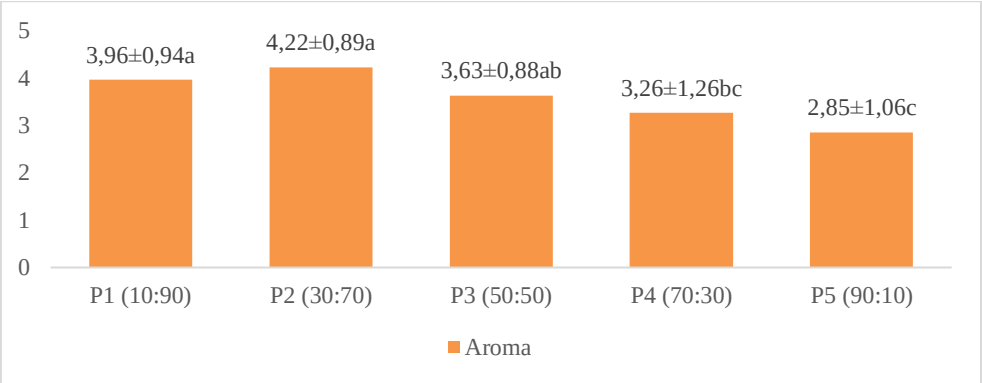
Note : Different letters behind the mean value indicate a very significant difference (P<0,01). Hedonic test criteria: 1= disliked, 2= slightly disliked, 3= neutral, 4=slightly liked, 5 = liked.

Figure 1.
The Results of the hedonic test of color soy whey ice cream

The concentration of moringa leaves significantly influences the green color of ice cream. The greater amount of used puree moringa leaves will affect more intense the green color on the product. The green color is attributed to the chlorophyll present in moringa leaves [6]. Based on this range of values, it can be inferred that the panelists are still acceptable to the ice cream color across all treatments.

Aroma

The results showed that the comparison between soy whey and moringa leaves puree had a very significant effect (P<0.01) on the hedonic test for aroma of the ice cream, can be seen in Figure 2.



Note : Different letters behind the mean value indicate a very significant difference (P<0,01). Hedonic test criteria: 1= disliked, 2= slightly disliked, 3= neutral, 4=slightly liked, 5 = liked.

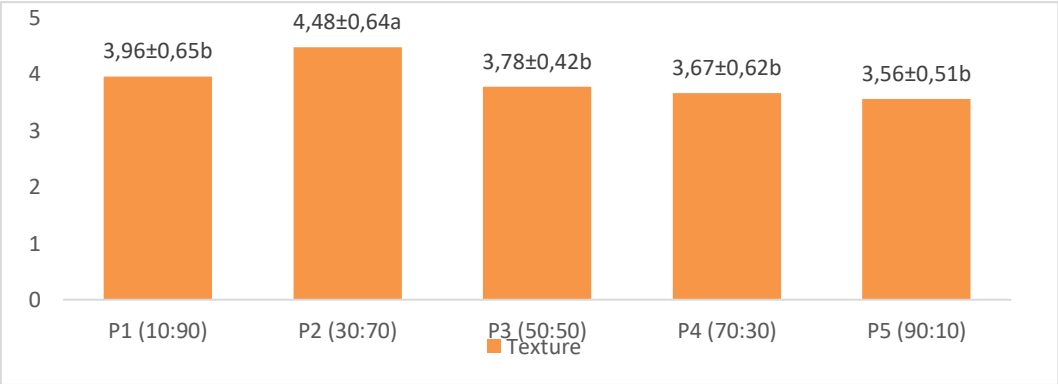
Figure 2.
The Results of the hedonic test of aroma soy whey ice cream

Figure 2 showed that the panelist`s assessment of the hedonic test of the soy whey and moringa leaves puree aroma attribute ranged from 2.85 (neutral) to 4.22 (slightly liked). The highest score was achieved in the ice cream with a comparison of soy whey and puree moringa leaves P2 (30:70) at 4.22 (slightly liked), while the lowest score was obtained in the ice cream with a comparison of soy whey and puree moringa leaves P5 (90:10) at 2.85 (neutral). According to [26], the aroma produced from the ice cream was influenced by the comparison of moringa leaves puree and soy whey. This can be compared to a study reported by [5], which found the product with more addition of moringa leaves can affect the aroma of the product, so further away from the desired aroma criteria. Based on the range of values, it can be indicated that the panelists are still acceptable to the aroma of ice cream in all treatments.

Texture

The results showed that the comparison between soy whey and moringa leaves puree had a very significant effect (P<0.01) on the hedonic test for texture of the ice cream, can be seen in Figure 3. Figure 3 showed that the panelist`s assessment of the hedonic test of the soy whey and moringa leaves puree ice cream texture attribute ranged from 3.56 (slightly liked) to 4.48 (slightly liked). The highest score was achieved in the ice cream with the comparison of soy whey and moringa leaves puree treatment P2 (30:70) at 4.48 (slightly liked), while the lowest value was found in the comparison of soy whey and moringa leaves puree treatment P5 (90:10) at 3.56 (slightly liked). The preference level of the panelists for the texture of ice cream made from moringa leaves puree and soy whey is superior than ice cream made from similar ingredients. This can be compared to a study reported by [1], which found that the preference level for the texture of soy milk and purple sweet potato ice cream is

average. This may indicate that ice cream products made from soy whey and moringa leaves have a texture that can still be considered superior and acceptable to panelists across all treatments.

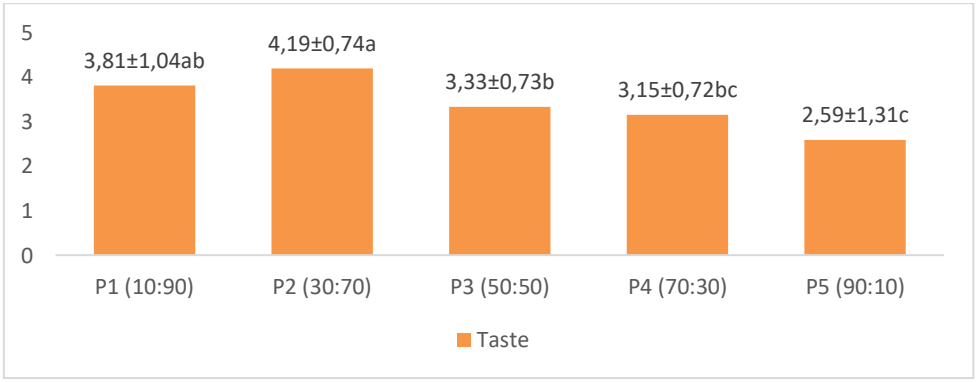


Note : Different letters behind the mean value indicate a very significant difference (P<0,01). Hedonic test criteria: 1= disliked, 2= slightly disliked, 3= neutral, 4=slightly liked, 5 = liked.

Figure 3.
The Results of the hedonic test of texture soy whey ice cream

Taste

The results showed that the comparison between soy whey and moringa leaves puree had a very significant effect (P<0.01) on the hedonic taste for taste of the ice cream, can be seen in Figure 4. Figure 4 showed that the panelist`s assessment of the hedonic test of the soy whey and moringa leaves puree taste attribute ranged from 2.59 (neutral) to 4.19 (slightly liked). The highest score was achieved for ice cream with the comparison of soy whey and moringa leaves puree in a treatment of P2 (30:70), which is 4.19 (slightly liked). Meanwhile, the lowest score was obtained for ice cream with the comparison of soy whey and moringa leaves puree in the treatment of P5 (90:10), which is 2.59 (neutral).



Note : Different letters behind the mean value indicate a very significant difference (P<0,01). Hedonic test criteria: 1= disliked, 2= slightly disliked, 3= neutral, 4=slightly liked, 5 = liked.

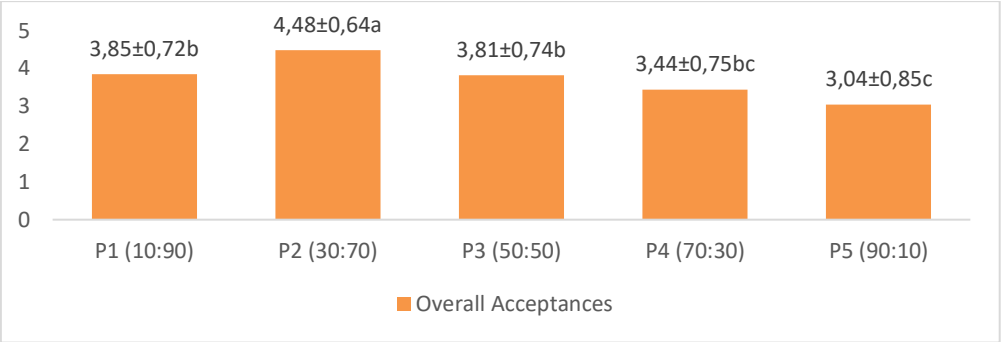
Figure 4.
The Results of the hedonic test of taste soy whey ice cream

This is because the more soy whey in the ice cream will give a languid and bittersweet aftertaste, it because soywhey is derived from soybeans which contain off-flavor compound [9], but the more moringa leaves puree will give a bitter aftertaste to the ice cream because moringa leaves contain essential oil and lipoxadic enzymes [5]. This is in line with the reported from [13] that moringa leaves

can give a bitter after taste to the product. Based on the resulted of values, it can be indicated that the panelists are still acceptable to the taste of ice cream in all treatments.

Overall Acceptances

The results showed that the comparison between soy whey and moringa leaves puree had a very significant effect (P<0.01) on the hedonic test for overall acceptances of ice cream, can be seen in Figure 5.



Note : Different letters behind the mean value indicate a very significant difference (P<0,01). Hedonic test criteria: 1= disliked, 2= slightly disliked, 3= neutral, 4=slightly liked, 5 = liked

Figure 5.
The Results of the hedonic test of overall acceptances soy whey ice cream

Figure 5 showed that the panelist`s assessment of the hedonic test of the soy whey and moringa leaves puree overall acceptances attribute ranged from 3.04 (neutral) to 4.48 (slightly liked). The highest score was obtained in ice cream with the comparison of soy whey and moringa leaves puree in a P2 treatment (30:70), which is 4.48 (slightly liked), while the lowest score was obtained for ice cream with the comparison of soy whey and moringa leaves puree in a P5 treatment (90:10), which is 3.04 (neutral). This indicates that ice cream in all treatments is still acceptable to the panelists. Furthermore, the overall acceptance score of a product is also influenced by the characteristics of color, taste, aroma, and texture of the product.

3.2 Physical Characteristics

The physicochemical characteristics of the soy whey and moringa leaves puree ice cream with the best treatment were tested the overrun (%), melting times (minuets), and color criteria with L*, a*, and b* using colorimeter. The results of the physical characteristics of ice cream can be seen in Table 2.

Table 2.Physical characteristic of ice cream

No	Treatment	Overrun (%)	Melting time (minuets)	Color analysis			Color criteria
				L*	a*	b*	
1.	P2 (30 : 70) (soy whey : moringa leaves puree)	41,63 ± 9,51	53,8 ± 8,91	60,23±2,31	-7,4±0,00	20,43±0,11	*Bitter Green*

Based on Table 2, the physical characteristics resulted from the best sensory evaluation with treatment P2 (comparison of 30 soy whey : 70 moringa leaves puree) with an overrun of 41.63%;

melting times of 53.8 minutes; and color characteristics including L* value of 60.23; a* -7.4; b* 20.43 with the color criteria being bitter green.

Overrun is a crucial parameter for determining the increase in ice cream volume caused by the presence of trapped air in the ice cream mixture due to the agitation process [18]. As the amount of trapped air increases, it has a greater impact on the texture, stability, and durability of the ice cream [10][22]. Based on the test results, the overrun value of ice cream made from puree of moringa leaves and soy whey was 41.63%. An optimal ice cream quality typically ranges from 70-80% overrun, while household ice cream usually falls between 30-50% overrun [18]. This indicated that the ice cream made from 30% soy whey and 70% moringa leaves puree the standards and can be classified as household ice cream.

The melting time refers to the duration required for ice cream to melt at room temperature [15]. Melting time is closely related to overrun; the greater of ice cream overrun, the longer its melting times. According to SNI No. 01-3713-1995 regarding ice cream melting time, it is approximately 15-20 minutes, whereas the melting time test results for soy whey and moringa leaves puree ice cream were 53.8 minutes. The factor that can cause the melting times of ice cream to be longer than standard ice cream is the crystalline nature of the ice [17]. This is in line, because the production of the soy whey and moringa leaves puree ice cream does not involve an ice cream maker and caused in coarser ice crystals.

Quantitative color analysis conducted on ice cream with the best hedonic test results based on Table 2. The values listed are based on the L value taken from the indication of light from black to white on a scale of 0-100, where a indicates red color (+) or blue (-), and b indicates yellow color (+) or green (-). Based on the color analysis test that has been conducted, the values of L*, a*, and b* are 60.23, -7.4, and 20.43 respectively, with the color description being Bitter Green, classified under the green color category based on CIElabThis is because the presence of chlorophyll in the moringa leaves puree [7].

4. Conclusion

This study concluded the comparison of soy whey to moringa leaves puree has a very significant effect on the sensory characteristics of ice cream produced. The comparison of 30% soy whey to 70% moringa leaves puree was the best treatment to produced ice cream with sensory characteristics in hedonic test criteria included Color 4.15 (slightly liked); Aroma 4.22 (slightly liked); Texture 4.48 (slightly liked); Taste 4.19 (slightly liked); and Overall acceptance 4.48 (slightly liked) with physical characteristics of overrun 41.63%; Melting times 53.8 minutes and color characteristics L* 60.23; a* -7.4 and b* 20.43 with the color criteria of bitter green.

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