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The quality of milk candy using rosella powder (*Hibiscus sabdariffa* L.) addition as natural food colouring

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A B S T R A C T

Anthocyanins found in rosella can be used to naturally color milk candies. The goal of this study was to establish the optimal addition rate of rosella powder on milk candy's antioxidant activity, color, and yield. Fresh milk, sugar, and rosella powder were the materials employed in the current investigation. The study was carried out in a lab setting with 4 treatments and 4 replications, and it was completely randomised. Treatments included P0 (no addition of rosella powder), P1 (1% addition of rosella powder on the manufacturing of milk candies), P2 (3%) and P3 (5%). The Analysis of Variance and Duncan's Multiple Range Test were both used to analyze the data. The antioxidant activity of candy milk was 8.58-10.28, lightness (L) 48.33-52.53, redness (a*) 15.00-19.10, yellowness (b*) 16.80-20.00, and the yield was 77% to 80.74%. The results of this study showed that the addition of rosella powder had a significant effect (P0.01) on antioxidant activity, lightness, redness, and yellowness, as well as yield.

1. Introduction

Colorants are added to food in order to improve the flavor, raise the appeal of diverse commodities, and draw in more consumers. Emulsifiers, stabilizers, sweeteners, antioxidants, and preservatives are some of the roles that colorings may play. Carotenoids, chlorophyll, anthocyanin, and curcumin are examples of naturally occurring food colorings [1]. However, Milk is a food item that has a comprehensive nutritional profile and can contribute to the general public's nutrition. The milk processing industry diversifies its product line to provide goods with higher value and longer shelf lives. Processing milk aims to create goods that people will prefer. Milk is processed into a variety of products, including yoghurt, cheese, kefir, and milk candy, using appropriate technology that is carried out effectively and affordably. A common product created from sugar is candy, and one variety of candy available on the market is soft milk candy. It is required to add flavor and color to milk candy since it is often prepared from milk and has a less appetizing color due to the caramelization process caused by high temperature heating. Currently, a range of synthetic food colours are used in processed milk candy goods to color-improve the less alluring milk candy. Food color is now one of the factors that customers take into account when choosing a product. Artificial food coloring and additive usage can have negative effects on human health and the environment [1]. Natural colors must be added in order to replace synthetic dyes because the use of synthetic dyes in foods and beverages is unhealthy. Natural dye is an eco-friendly, non-toxic alternative dye that is renewable and biodegradable. The inclusion of
rosella powder (Hibiscus sabdariffa L.) helps to organically enhance the flavor and color of the milk candy.

Anthocyanins, a chemical found in rosella flower powder, act as powerful antioxidants and colorants in the human body. The added value of milk candy processed goods is anticipated to rise with the use of rosella (Hibiscus sabdariffa L.). Orange, red, and blue anthocyanin pigments, which are naturally present in grapes, strawberries, raspberries, apples, rosella flowers, and other plants, are members of the highly color flavonoid family [1]. Based on this information, the goal of this study was to identify the optimal addition rate of rosella powder (Hibiscus sabdariffa L.) to milk candy in order to maximize its antioxidant activity, color, and yield.

2. Materials and methods

White sugar, rosella flower powder, and fresh milk from

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Bhakti Cooperative Partners Junrejo Batu were the ingredients utilized in this investigation. Pan, wooden stirrer, analytical scale, measuring cup, tray, cake paper, candy wrapper, and plastic knife were among the supplies used. Milk candy samples, 0.1 mM DPPH solution, an analytical scale, a color reader, and other tools were used to analyze the milk candy's quality.

The study was experimental, employing a fully randomized design (CRD) with four treatments and four replications to produce sixteen experimental units. Utilizing the DPPH technique, antioxidant analysis was carried out [2]. The color analysis utilizing the L*, a*, and b* CIELAB methods [2]. Level analysis was the yield calculation method [3]. Analysis of variance (ANOVA) was performed after utilizing the Microsoft Excel application to analyze the data. The Duncan Multiple Range Test was then used to analyze the treatments' significant effects.

3. Results and discussion

3.1. The effect of rosella powder addition (Hibiscus sabdariffa L.) on antioxidant activities of milkcandy

Table 1. The mean values of antioxidant activity of milk candy

Treatments	Antioxidants (%)
T0	7.69 ± 0.22^{a}
T1	8.58 ± 0.15^{b}
T2	9.35 ± 0.11^{c}
T3	10.28 ± 0.14^{d}

$^{a, b, c, d}$ at different superscript in the same column differed significantly ($P<0.01$).

Analysis of variance showed that the use of the rosella powder in the milk candy had significant effect ($P<0.01$) on antioxidant activity. The mean value of antioxidant activity of milk candy are shown in Table 1.

With an increasing amount of rosella powder added, the milk candy's average antioxidant activity levels increased. The antioxidant activity of milk candy ranged from 7.69 to 10.28%. In the current investigation, the various treatments, To (control treatment), T1 (1%), T2 (3%) and T3 (5%) were significantly different from one another.

Table 2. Average value of colour L

Treatment	L
T0	47.63 ± 0.48^{a}
T1	48.33 ± 0.49^{b}
T2	50.05 ± 0.44^{c}
T3	52.53 ± 0.51^{d}

$^{a, b, c, d}$ at different superscript in the same column differed significantly ($P<0.01$).

The antioxidant activity of chocolate candies enhanced with ginger extract was reported to be 4.8% [4], which was lower than the results of our investigation. This showed that utilizing rosella powder instead of red ginger extract and carrageenan when making milk candies is preferable since it produces more antioxidant activity, ranging from 7.69 to 10.28%. The rosella flower has a 7.92% overall anthocyanin content [5].

With an increase in rosella powder content, antioxidant levels in rosella flowers would also rise. With the quantity of rosella powder added, the milk candy's antioxidant activity increases as a result of the anthocyanin's activity. Anthocyanin serves as an antioxidant. Natural substance called anthocyanin gives rosella flower petals their red color. Anthocyanin from rosella also functions as a natural food colorant in addition to being a medicine.

An excellent source of antioxidants and natural food, rosella anthocyanin can also help health pigment [6].

3.2. The Effect of rosella powder addition (Hibiscus sabdariffa L.) on milk candy colour. One of the key draws and a crucial factor for consumer acceptability of goods like textiles, cosmetics, food, and so on is color. The color is used to modify the product and is definitely necessary to enhance the artistic value [1].

3.2.1. Lightness (L)

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Vol-10 Issue-12 No.03 December 2020

The present study showed that the use of the rosella powder in the milk candy had a significant effect($P<0.01$) on colour brightness (L).

Table candies treated with rosella powder increases, the average value of color brightness (L) increases. Milk candy's average color brightness (L) value ranged from 47.63 to 52.53. When syrup sorbitol and salatrim were added to caramel candies, the color brightness (L) was 40.96 [7]. This research showed that milk candies produced the highest color brightness (L), or 52.53. Rosella flower color lightness concentration ranged from 40 to 45 [8]. The amount of color L in rosella flowers had increased. Rosella powder is added and increased.

Table 3. Average value of colour a*

Treatment	a*
T0	12.68 ± 0.56^{a}
T1	15.00 ± 0.55^{b}
T2	17.15 ± 0.60^{c}
T3	19.10 ± 0.65^{d}

$^{a, b, c, d}$ at different superscript in the same column differed significantly ($P<0.01$).

The range of the brightness (L) produced was from 47.63 to 52.53 on average, with the brightness of the milk candy rising as the proportion of rosella powder increased. The milk candy's basic color with the control treatment (T0) had a low brightness and tended toward brownish yellow, therefore the optimal treatment was 5%. As a consequence of the mailard reaction, the milk candy's brightness level (L) became more decreased.

3.2.2. Redness (a)*

The results of analysis of variance showed that the use of the rosella powder in the milk candy had asignificant effect ($P<0.01$) on redness (a*).

Table 3 demonstrates that when the amount of rosella powder added increases, the average value of the redness (a*) in the milk candy increases. The differences between each therapy—To (control treatment), T1 (1%), T2 (3%) and T3 (5%)—were substantial. According to one investigation, the sorbitol and salatrim syrup mixture increased the redness (a*) of caramel candies to 16.18 [7]. The overall amount of redness (a*) on the rosella was between 15 and 20 [8].

Table 4. Average value of colour b*

Treatment	b*
T0	12.68 ± 0.56^{a}
T1	15.00 ± 0.55^{b}
T2	17.15 ± 0.60^{c}
T3	19.10 ± 0.65^{d}

$^{a, b, c, d}$ at different superscript in the same column differed significantly ($P<0.01$).

The rosella flower's (a*) concentration of redness would rise in proportion to the amount of rosella powder. The amount of redness (a*) in the milk candy increased as the proportion of rosella powder added to it increased, ranging from an average value of 12.68 to 19.10. The rosella extract's vivid red color under specific circumstances is because it is controlled by the anthocyanin level [9], and the red color (a*) that was seen in this investigation was owing to the anthocyanin activity as the red pigment provider in rosella.

The natural pigment anthocyanin is what produces the color red to the antioxidants and steeping rosella flower petals [10].

3.2.3. Yellowness (b)*

Analysis of variance showed that the use of the rosella powder in the milk candy had a significant effect ($P<0.01$) on the yellowish colour (b *).

Yellowness color (b*) is present on rosella in an amount ranging from 12 to 14 percent [11]. With the addition of rosella powder %, the amount of yellowness color (b*) in rosella flowers increases. Notation b*: Chromatic color of blue-yellow combination having positive and negative values, respectively, from 0 to 70 for the yellow color and 0 to 70 for the blue color [12]. The degree of the yellowness color (b*) in the milk increased when more Rosella powder was added to the milk candy, with an average value of a yellowness color (b*) obtained ranging from 14.75 to 20 such that 5% was the best outcome sweets.

3.3. Effect of rosella powder addition (Hibiscus sabdariffa L.) on yield milk candy

The use of the rosella powder in the milk candy had a significant effect ($P<0.01$) on the yield. The

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average value of yield are shown in Table 5.

The overall yield in rosella flower extract was rather high, ranging from 90.00% to 99.20%, and the rosella extract yield was 55.88%.With the inclusion of ginger and turmeric, the production of milk candy increased to 40.65 to 41.62%. With an increase in rosella powder content, the yield level in rosella flowers will also rise. The anthocyanin activity during each percentage increase is what enabled the milk candy's yield to increase along with the addition of rosella powder. Anthocyanins itself serve as an antioxidant and have water-binding characteristics in milk candies.

Table 5. average value of yield

Treatment	The Yield (%)
T0	75.23 ± 0.57^{a}
T1	76.69 ± 0.36^{b}
T2	78.38 ± 0.64^{c}
T3	80.74 ± 0.25^{d}

$^{a, b, c, d}$ at different superscript in the same column differed significantly ($P<0.01$).

The dried rosella has a larger anthocyanin output when it is dried at a higher temperature and for a shorter period of time [6]. Because anthocyanins are rapidly oxidized and destroyed by oxygen, the longer the drying durations, the more anthocyanins oxidized. The oxidation of anthocyanins, which is poorly regulated, is the reason why the yield results of dried rosella sold on the market are lower than those of dried rosella produced through a controlled drying process. The temperature has an impact on the stability of anthocyanins. Anthocyanins have a larger chance of degrading at higher temperatures. With the increasing temperature, the damage will be considerably worse. Temperature and sustained heating cause the pigment to break down and alter structurally, which results in bleaching.

Presence of the enzyme is probably what causes variations in color intensity. Glycosidase and fenolase enzymes influence how anthocyanins change color. The glycosidase enzyme will hydrolyze the sugar and aglycone group that produce glycoside bonds. With a higher rosella to water ratio and a lower extraction temperature, the yield rises [8]. More organic chemicals that are present in more materials will be extracted the more solvent (water) is employed. Because it will be simpler for the solvent to penetrate the lower concentration material and, in this example, dissolve the organic component, the concentration difference between materials with and without solvents increases as the number of solvents increases. As a result, it will be more
extracted components which can be dissolved together with the solvent. The more the amount of
extracting water, the filtrate volume of rosella flower resulted is also getting bigger.

4. Conclusion

Based on this study, it can be concluded that the addition of rosella powder with a percentage of 5%
produced the best milk candy

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Vol-10 Issue-12 No.03 December 2020

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