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

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Abstract. Rosella have anthocyanins can act as natural colour on milk candy production. The purpose of this study was to determine the best percentage of rosella powder addition on antioxidant activity, colour and yield of milk candy. The material used in the present study were fresh milk, sugar, and rosella powder. The study was conducted in laboratory experimental and arranged using a Completely Randomized Design with 4 treatments and 4 replications. The treatments were P0 (without rosella powder addition), P1 (1% addition of rosella powder on milk candy production), P2 (3%) and P3 (5%). The data were analysed using Analysis of Variance and continued by Duncan’s Multiple Range Test. The results of this study showed that the addition of rosella powder had significant effect (P<0.01) on antioxidant activity, lightness, redness, yellowness and yield of milk candy. The antioxidant activity of candy milk were 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 77% - 80.74%. It can be concluded that addition of rosella powder 5% on milk candy gave the best treatment.

1. Introduction

Milk is a product that contains a complete nutrition which can play a role in improving public’s nutrition. Milk processing business is diversification of products which has additional value and a longer shelf life. Milk processing is aimed to produce products more preferred by consumers. Milk processing business with appropriate technology which is efficiently and economically performed by processing milk into several products, namely yoghurt, cheese, kefir and milk candy.

Candy is a popular thing made from sugar, one of candy types on the market is soft milk candy. Milk candy is generally known so far made from milk, and it has a less attractive colour as a result of high temperature heating causing caramelization process, therefore it is necessary to add flavour and colour. Processed products of milk candy currently uses a variety of synthetic food dyes to colour improve the less attractive milk candy. Today, colour in foods is one of the things that consumers consider in selecting a product. The use of synthetic food colour of additive can cause health and environmental problems [1]. The use of synthetic dyes in foods and beverages is harmful to health, therefore it is necessary to add natural dyes to replace synthetic dyes. Natural dye is a non-toxic alternative dye, renewable, degradable and environmentally friendly. The efforts to improve the flavour and colour of the milk candy naturally is by the addition of rosella powder (Hibiscus sabdariffa L.).
Rosella flower powder contains anthocyanins compound, which serves as very beneficial colorants and antioxidants in the human body. Utilization of rosella (Hibiscus sabdariffa L.) is expected to increase the additional value of processed products of milk candy. Anthocyanin is pigments which is soluble in water and the colours are orange, red and blue, naturally presenting in grapes, strawberries, raspberries, apples, rosella flowers, and other plants belong to the very colour flavonoid [1]. Based on the fact, the objective of this study was to determine the best percentage of rosella powder addition (Hibiscus sabdariffa L.) on antioxidant activity, colour and yield of milk candy.

2. Materials and methods

The materials used in this study were the fresh milk obtained from Bhakti Cooperative Partners Junrejo Batu, rosella flower powder, and white sugar. The equipment used were pan, wooden stirrer, analytic scale, measuring cup, tray, cake paper, candy wrapper and plastic knife. Materials and equipment used for the analysis of the quality of the milk candy were samples of milk candy, 0.1 mM DPPH solution and an analytic scale, colour reader.

The method of the study was experimental in a laboratory using completely randomized design (CRD), consisting of 4 treatments and 4 replications in order to obtain 16 experimental units. Analysis of antioxidant was performed using DPPH method [2]. The colour analysis using L a* b* CIELAB method (L*, a*, and b*) [2]. The method for yield was level analysis [3]. The data were analysed using Microsoft Excel program, followed by analysis of variance (ANOVA). Significant effect of the treatments was subsequently analysis using Duncan Multiple Range Test.

3. Results and discussion

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

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.

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

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

There was an increase in the average values of antioxidant activity in the milk candy with the increasing percentage of rosella powder addition. The range value of milk candy antioxidant activity was 7.69-10.28%. The different treatments; T0 (control treatment), T1 (1%), T2 (3%) and T3 (5%) in the present study had significant different each other. It has been reported that the antioxidant activity of chocolate candy with ginger extract fortification was 4.8% [4]; lower than found in this study. This indicated that the use of rosella powder in the milk candy production is better than using the red ginger extract and the addition of carrageenan, because it generates a higher antioxidant activity, i.e. from 7.69 to 10.28%. The total anthocyanin content in the rosella flower was 7.92% [5]. Levels of antioxidants found in rosella flowers would increase in line with the percentage increase of rosella powder.

The antioxidant activity of the milk candy increases along with the addition of percentage of rosella powder, this is caused by the activity of the anthocyanin. The role of anthocyanin is as an antioxidant. Anthocyanin is natural pigment which gives red colour on the rosella flower petals. Besides functioning as a drug, anthocyanin of rosella also serves as natural food colorant. The rosella
anthocyanin also can provide health benefits as a good source of antioxidants and natural food colorant [6].

3.2. The Effect of rosella powder addition (Hibiscus sabdariffa L.) on milk candy colour

Colour is one of the main attraction, and an important criterion for acceptance of products such as textiles, cosmetics, food and so on. The dye is absolutely needed to improve the artistic value and it is used to vary the product [1].

3.2.1. Lightness (L)
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 2. Average value of colour L

| Treatment | L       |
|-----------|---------|
| T0        | 47.63±0.48<sup>a</sup> |
| T1        | 48.33±0.49<sup>b</sup> |
| T2        | 50.05±0.44<sup>c</sup> |
| T3        | 52.53±0.51<sup>d</sup> |

<sup>a, b, c, d</sup> at different superscript in the same column differed significantly (P<0.01).

Table 2 shows that there is an increase in the average value of colour brightness (L) in the milk candy with the increasing number of percentage after treated by rosella powder. The average value of colour brightness (L) of milk candy ranged from 47.63 to 52.53. The colour brightness (L) of caramel sweets with the addition of syrup sorbitol and salatrim was 40.96 [7]. This study revealed that the milk candy producing higher colour brightness (L) i.e. 52.53. The total concentration of rosella flower colour lightness was 40 to 45 [8]. The concentration of colour L contained in rosella flowers had increase with the addition of rosella powder. The average value of the brightness (L) obtained was 47.63 to 52.53 where along with increasing the percentage of rosella powder to milk candy the higher the level of brightness in the milk candy was achieved. The mailard reaction formed in the milk candy resulted the brightness level (L) in the milk candy more diminished so that the basic colour of milk candy with the control treatment (T0) had a low brightness and tended to brownish yellow, so the best treatment obtained was 5%.

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

Table 3. Average value of colour a*

| Treatment | a*       |
|-----------|----------|
| T0        | 12.68±0.56<sup>a</sup> |
| T1        | 15.00±0.55<sup>b</sup> |
| T2        | 17.15±0.60<sup>c</sup> |
| T3        | 19.10±0.65<sup>d</sup> |

<sup>a, b, c, d</sup> at different superscript in the same column differed significantly (P<0.01).

Table 3 shows that there is an increase in the average value of the redness (a*) in the milk candy with the increasing percentage of rosella powder addition. Each treatment; T0 (control treatment), T1 (1%), T2 (3%) and T3 (5%) differed significantly. It has been reported that redness (a*) of caramel sweets with the addition of sorbitol and salatrim syrup was 16.18 [7]. The total concentration of redness (a*) on rosella was 15 to 20 [8]. The concentration of redness (a*) contained in rosella flower
would increase along with the percentage of rosella powder addition. The average value of redness (a*) obtained was 12.68 to 19.10 where along with the increase of rosella powder percentage given to milk candy, the higher the level of redness (a*) in the milk candy. The red colour (a*) resulted in this study was due to the anthocyanin activity as the red pigment giver in rosella, so the colour (a*) was increasing, the bright red colour of the rosella extract under certain conditions is because it is influenced by the anthocyanin level [9]. The anthocyanin is a natural pigment that gives the red colour to the steeping rosella flower petals and antioxidants [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*).

**Table 4. Average value of colour b**

| Treatment | b*          |
|-----------|-------------|
| T0        | 12.68 ± 0.56a |
| T1        | 15.00 ± 0.55b |
| T2        | 17.15 ± 0.60c |
| T3        | 19.10 ± 0.65d |

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

The total concentration of yellowness colour (b*) on rosella is 12.00 to 14.00 [11]. The concentration of yellowness colour (b*) contained in rosella flowers increase with the addition of rosella powder percentage.

Notation b*: chromatic colour of blue-yellow mixture with a value + b* (positive) from 0 to +70 for the yellow colour and a value - b* (negative) from 0 to -70 for the blue colour [12]. The average value of a yellowness colour (b*) obtained was 14.75 to 20 wherein with the increasing percentage of Rosella powder added to milk candy the higher the level of the yellowness colour (b*) in the milk candy, so the best treatment obtained was 5%.

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 average value of yield are shown in Table 5.

**Table 5. average value of yield**

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

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

The total content of the yield in rosella flower extract was relatively high, as much as 90.00% to 99.20% [13] and the content of the extract yield of rosella was 55.88% [8].The yield of milk candy (caramel) with the addition of ginger and turmeric was 40.65 to 41.62%, [13]. Yield level contained in rosella flower will increase in line with the increasing percentage of rosella powder. The yield on the milk candy increased along with the percentage addition of rosella powder, this is caused by the anthocyanin activity during each percentage are increase, the role of anthocyanins its self is as an antioxidant in the milk candy, and has a water-binding properties. The higher temperature and the shorter the drying time, it results the dried rosella with the higher anthocyanin yield [6]. This is due to
the longer drying times the more anthocyanins oxidized because the nature of the anthocyanin is easily oxidized and damaged. Yield results of dried rosella of the market is lower than the dried rosella of a controlled drying process, this is due to the oxidation of anthocyanins which is not controlled well. The anthocyanin stability is affected by temperature. The higher temperature, the greater the possibility of anthocyanins degradation is. The damage will be even greater with the heating temperature. Temperature and prolonged heating cause the decomposition and structural changes of pigment that it results in bleaching.

Changes in colour intensity is presumably caused by the presence of the enzyme. Enzymes that affect the anthocyanin colour change are glycosidase and fenolase enzymes. Glycosidase enzyme will hydrolyze glycoside bond producing sugar and aglycone group. The yield increases with increasing ratio of rosella with water and decreasing the extraction temperature [8]. The more solvent (water) is used it will extract more organic compounds contained in more materials. The more solvents the greater the concentration difference between materials with solvent is, because the solvent will be easier to get into the less concentration material, and in this case, dissolving the organic compound. The anthocyanins will run faster than the number of solvent slightly. 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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