Improvement of Antioxidant Activity and Quality of Coffee Milk using *Rosa* sp. Petal Powder

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Abstract. Coffee has become a favorite drink worldwide for centuries, and demand for healthier coffee has increased. Rose coffee milk is a novel innovation combining coffee and rose flavor with its anthocyanins, known for their antioxidant properties. This study aimed to investigate the effect of different milk and coffee concentrations on rose milk coffee’s physicochemical and sensorial evaluation. The research has shown that the combination of milk types and coffee concentrations significantly affected the physicochemical properties of coffee milk. Furthermore, the type of milk and coffee concentration also significantly influenced the coffee milk’s color and aroma. On the contrary, the coffee concentration determined the coffee milk taste. Panelists preferred higher coffee concentrations, and the best rose milk coffee was obtained on UHT milk and 30% coffee concentration. The sensorial properties of the sensorial evaluation showed that the coffee milk was engaging, with a slightly dark color, aromatic aroma, and delicious taste. Overall, rose milk coffee is a promising innovation in the coffee industry, and this study provides important insights into the effects of milk type and coffee concentration on coffee milk characteristics.

Keywords: Anthocyanin, antioxidant, *Coffea canephora* Pierre ex A. Froehner, healthy drink, physicochemical

1 Introduction

Coffee has been one of the most popular beverages appreciated for centuries due to its hedonistic and stimulating properties [1, 2]. Indonesia is the fourth largest coffee-producing country in the world after Brazil, Vietnam, and Colombia and the second largest coffee-
consuming country after Brazil [3, 4]. Data compiled by the International Coffee Organization (ICO) in 2019 showed increased coffee consumption in Indonesia, with an average increase of 2.5 % yearly since 2010. In 2021, the ICO also reported that coffee consumption increased during the pandemic by 4 % from 2020 to 2021 due to Indonesians consuming $5 \times 10^6$ amount of 60 kg coffee bags annually.

Using coffee as a derivative product of beverages is currently an alternative to increasing selling value. One of the products from coffee, namely coffee-brewed drinks, is becoming a trend among young people today. Demand for coffee is shifting to Sugar Sweetened Coffee (SSC), including 3-in-1 coffee (mixed coffee) with sugar and creamer [5] or the mixture of coffee, sugar, and milk called coffee milk that has become popular in the younger generation in Indonesia. High amount intake of SSC could increase blood glucose and lead to diabetes mellitus. Coffee milk circulating on the market generally has low antioxidant activity. According to statements by several researchers [6, 7], it is known that coffee contains many active substances that benefit for health. Consuming coffee in the appropriate amount and with the correct processing can positively impact health. Coffee beans contain active substances that prevent cardiovascular disease and other degenerative diseases [8, 9].

The raw material for coffee milk, like robusta (Coffeea canephora Pierre ex A. Froehner) powder, has an antioxidant activity of about 32 % [7]. Robusta coffee powder is preferred as a raw material for milk coffee due to its affordable price, easy access, and higher antioxidant activity than arabica coffee powder. It is reported that robusta coffee powder had a higher antioxidant activity than arabica coffee powder [10]. Milk addition in coffee affected antioxidant capacity and phenolic bioaccessibility, about 28 % to 30 % lower than the water-coffee combination. Casein and whey protein contained in milk can also interact with polyphenols in coffee that act as antioxidant agents [11].

An alternative way to overcome this situation that could increase the nutritional value of coffee milk is by rose petal powder, which is abundant in anthocyanin pigments. Anthocyanin pigments contain antioxidants that control excess free radicals [12, 13]. Therefore, it is expected that coffee, which contains antioxidants, will be enhanced with the fortification of rose flower powder, which also contains antioxidants, and thus will be able to fulfill antioxidant needs daily to prevent free radicals in the human body.

## 2 Materials and method

### 2.1 Materials

The raw material used in this study was red rose (Rosa sp.) powder purchased from the manufacturer of Seduh Tisane, Bekasi, Indonesia. Roasted robusta coffee powder was purchased from Ngantang Coffee, Malang, East Java, Indonesia. Bovine whole milk was obtained from the Animal Husbandry Training Center (BBPP - Balai Besar Pelatihan Peternakan), Batu, East Java, Indonesia. Whole cream UHT milk was purchased from PT. Diamond Cold Storage, Bekasi, West Java, Indonesia. This study used palm sugar, commercial coffee milk, and water obtained from the local market in Malang, Indonesia. Chemicals that were used are KCl, HCl, DPPH, ethanol, methanol, benzene, H$_2$SO$_4$, NaOH, H$_3$BO$_4$, protein catalyst (Na$_2$SO$_4$H$_2$O), anthrone reagent, and phenolphthalein indicator. All chemicals in this research use pro-chemical analysis.
2.2 Experimental design

This experiment was arranged in a simple randomized block design with two repetitions. The treatment used four formulations with different pasteurized (P) and UHT (U) milk types, with the coffee concentration added at 20 % and 30 %. The physicochemical research variables observed included analysis of protein content by the Kjeldahl method and fat content by determining fatty acid hydrolysis, pH, total anthocyanin, antioxidant activity, and color intensity. The sensorial evaluation of sensorial parameters, including color, aroma, and taste.

The commercial coffee milk obtained from the local market in Malang, Indonesia was used as a control treatment in this study. The ready-to-drink variant of coffee milk was chosen with aroma, color, and taste that is nearly the same as other treatments. The control was also measured of the physicochemical and sensorial variables.

2.3 Statistical analysis

The results of all experiments were presented as mean ± SD and performed in duplicate. SPSS 23.0 version was used to analyze data through a one-way Analysis of Variance (ANOVA). Duncan’s Multiple Range Test (DMRT) measured a multiple comparison procedure of the treatment. The significance of the differences was defined if the $P$ value result was less than 0.05 ($P < 0.05$).

3 Results and discussion

3.1 Raw material analysis

Table 1 indicates that rose flower powder has an antioxidant activity of 85.06 %, whereas robusta coffee powder has an activity of 61.54 %. Rose flower powder has higher antioxidant activity than robusta coffee powder. The presence of anthocyanins influences rose flower powder’s antioxidant activity. In contrast, coffee’s phenol compounds influence robusta coffee powder’s antioxidant activity. The differences in the compounds in the two types of materials also affect the percentage of activity produced. The antioxidant activity of robusta coffee powder in this study differed from the previous study [14, 15, 10]. The difference between the high and low levels of antioxidant activity in robusta coffee powder can be caused by the difference in the robusta coffee used, and the roasting method [10]. The amount of coffee concentration also causes this during brewing. The percentage of antioxidant activity in roses is relatively high. This value showed the same result in previous research, which stated that there was an increase of 8 % to 21 % and 8 % to 34 % in the antioxidant activity (TEAC and FRAP) of strawberries with the addition of rose flower extract as a result of anthocyanin pigments which can act as antioxidants [17].

<table>
<thead>
<tr>
<th>Raw materials</th>
<th>Antioxidant activity (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red rose petal powder</td>
<td>85.06</td>
</tr>
<tr>
<td>Robusta coffee powder</td>
<td>61.54</td>
</tr>
<tr>
<td>Commercial coffee powder (control)</td>
<td>30.74</td>
</tr>
</tbody>
</table>
3.2 Physicochemical properties of coffee milk

3.2.1 Protein content

The analysis of variance at the 5 % level showed that adding coffee concentrations and different types of milk had no significant effect ($P > 0.05$) on the protein content of the coffee milk product. The average protein content in coffee milk products is shown in Figure 1. It is shown that the average protein content ranges from 3.66 % to 5.18 %. The commercial coffee used as a control had the lowest protein content at 2.55 %. All treatments comply with market control standards and Standard National of Indonesia (SNI) for protein content in UHT milk of at least 2.4 % and in pasteurized milk of 2.5 % in coffee milk drinks. Several things can cause the insignificant differences in protein content in coffee milk products. One is due to the similarity in the protein composition of milk.

![Protein content of rose coffee milk in several treatments.](image)

**Fig. 1.** Protein content of rose coffee milk in several treatments.

Protein content that was not significantly different indicated that the treatment of pasteurized milk using a combination of low heat and a long time and the treatment of UHT milk using high heat and a short time did not affect the product. The two heating processes used with the right combination of time and heat in UHT and pasteurized milk aim to kill all microorganisms and spores. In addition, it also prevents damage to nutritional value. This study’s results suit Hanum and Wanniatie’s work in that the protein content in pasteurized milk is not different from UHT milk [18]. Pasteurized milk contains 2.9 % to 3.4 % protein. Meanwhile, Apriantini’s research shows that UHT milk protein content ranges from 3.69 % to 8.99 % [19]. According to the average composition of the treatment with the type of milk factor, the average protein content is above the SNI standard for bovine milk.

Janwar [20] found that different coffee concentrations do not affect milk coffee’s protein content. Milk coffee with 3 % coffee concentration produces a protein content of 2.78 %, while 2 % coffee concentration produces a protein content of 2.48 %. Another study by Holkar et al. [21] also demonstrated that milk protein in coffee milk drinks ranged from 2.2 % to 6.5 %. Thus, all formulations are within the appropriate value range and do not cause differences. The encouraging thing is that the results of tests on the antioxidant power of the two raw materials show that they have a higher antioxidant capacity than commercial coffee.
3.2.2 Fat content

The results of ANOVA with a level of 5 % indicated a significant effect for the average fat content contained in rose coffee milk products ($P < 0.05$). The average fat content in the product is shown in Table 2. According to the table, the average fat content of rose coffee milk products ranges from 6.75 % to 13 %. The fat content of commercial coffee is 9.05 %. Treatment P20 using pasteurized milk had a higher fat content of 13 % and was not significantly different from P30. Based on Indonesian standards, milk fat content generally meets standard requirements of about 2 % in UHT milk and 1.5 % in pasteurized milk. Fat content in coffee milk must be at least 6 % according to the Indonesian standard. Due to the concentration of acetic acid in pasteurized fresh milk, which is higher than UHT milk, there are differences in fat composition in coffee-milk drinks due to different types of milk.

Table 2. Parameter of fat content in rose milk coffee.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Fat content (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P20 (Pasteurized milk + 20 % Coffee)</td>
<td>9.05 ± 1.20c</td>
</tr>
<tr>
<td>P30 (Pasteurized milk + 30 % Coffee)</td>
<td>13.00 ± 0.14bc</td>
</tr>
<tr>
<td>U20 (UHT milk + 20 % Coffee)</td>
<td>12.25 ± 0.35ab</td>
</tr>
<tr>
<td>U30 (UHT milk + 30 % Coffee)</td>
<td>7.73 ± 2.65ab</td>
</tr>
<tr>
<td>Commercial coffee (control)</td>
<td>6.75 ± 1.91</td>
</tr>
</tbody>
</table>

Notes: Numbers followed by different letters show statistically significant differences ($\alpha = 0.05$) according to the DMRT test.

Pestana et al. [22] reported that pasteurized fresh milk had a similar fat content to UHT milk. The different results of this study could happen because of the difference in specification between bovine milk in each country. The other reason is that UHT milk in this study undergoes a heating process that could have reduced the fat in its products. This research is also supported by Theveneau and Nicaud [23], who state that pasteurized milk can have a higher fat content than UHT milk because pasteurized milk uses a lower temperature than UHT milk. Hence, it is still possible for microbes to synthesize fat [23].

Milk fat content is affected by the concentration of acetic acid content in the fat. A lack of fiber feed will produce milk with low-fat content. The higher the acetate production, the fattier acid is synthesized, which causes an increase in milk fat content. High fat content will lower levels of other components such as protein, lactose, and minerals. This study’s results differ from research conducted by Kiyat et al. [24], which states that the fat content in coffee drinks can reach 17 %. In addition, Lee et al. [25] also stated that research results related to creamer coffee milk drinks had a fat content of up to 28 %. The difference in results with previous studies could be due to differences in the types of coffee and other raw materials, such as the absence of creamer in rose coffee milk products.

3.2.3 Value of pH

The results of ANOVA at the 5 % level showed that the addition of different concentrations of coffee and types of milk had no significant effect ($P > 0.05$) on the pH value of the product. The average product pH is shown in Figure 2. Based on the diagram above, it is known that the average product pH ranges from 6.00 to 6.16. The commercial coffee pH is 6.38. The four treatments for rose coffee milk products with pH variables followed the Indonesian standard (SNI 01-3141-1998) of quality requirements for milk products, ranging from 4.5 to 7.

Diastari and Agustina [26] in the previous study, state that the acidity level of milk and milk products can range from 6 to 7, a range for normal pH. There is a pH difference between rose coffee milk products based on different types of milk. The pH of milk is
typically determined by the presence of casein, buffers, phosphates, and citrate. Lactose can also be converted to lactic acid by microorganisms with enzymatic activity, resulting in increases and decreases in pH. The difference in the pH of the product, which has no significant effect, can also be caused by the concentration of coffee added. However, it differs by 10 % but can be neutralized by other ingredients. So, the pH of the product for the four treatments has the same range of values. The research of Budi et al. [27] supports this statement, which states that the pH of coffee powder that has been fermented before being mixed with other ingredients is 5.28. However, adding other food ingredients can also affect coffee’s acidic and alkaline conditions [27].

Fig. 2. The pH parameter of rose milk coffee drink.

### 3.2.4 Determination of total anthocyanin

The results of ANOVA at the 5 % level showed that adding coffee concentrations and different types of milk had no significant effect ($P > 0.05$). The average total anthocyanin is shown in Figure 3. Based on Figure 3, it is known that the average total anthocyanin ranges from 0.84 to 2.46 mg L$^{-1}$. The commercial coffee did not show any anthocyanin content. The four treatments had the same range of total anthocyanin values because each treatment had the same addition of rose flower powder, which is 1 % (w v$^{-1}$). Although coffee contains anthocyanins, they are not in large quantities, and differences in coffee concentrations did not affect total anthocyanin content.

Fig. 3. Total anthocyanin results in various rose coffee milk and control.
The total anthocyanin value in the four rose coffee milk product treatments was higher than in previous studies. This result could happen due to the addition of rose flower powder in each treatment. Previous research by Nalawati and Wardhana [28] stated that the total anthocyanin value in coffee peel extract ranged from 2.23 mg L⁻¹ to 11.38 mg L⁻¹. Another study conducted by Prasetyo [29] also stated that the highest anthocyanin content was found in the skin of the robusta coffee berry, which was 15.74 mg L⁻¹, and in the skin of the arabica coffee berry with the highest anthocyanin content, which was 12.48 mg L⁻¹. The study also stated that the total anthocyanin levels in the previous study were lower than the four rose coffee milk product treatments [29]. The undetected total value of anthocyanins in commercial coffee could be due to the absence of anthocyanin content in control products, or the anthocyanin compounds contained in these market products had been damaged due to the treatment given. Anthocyanin pigments function as coloring agents and free radical scavengers or antioxidants, functional for body health [30].

### 3.2.5 Antioxidant activity

Based on the ANOVA at the 5 % level, it showed that the addition of coffee concentrations and different types of milk had no significant effect ($P > 0.05$). The average percentage of antioxidant activity in rose coffee milk products is shown in Figure 4. It is known that the average antioxidant activity based on differences in coffee concentration ranges from 75.80 % to 76.83 %. The antioxidant activity of commercial coffee control products had the lowest value at about 30.74 %. Several things, such as the composition of the ingredients used, can cause the high value of antioxidant activity in rose coffee milk products. The four treatments added the same concentration of rose flower powder, 1 % (w v⁻¹).

![Antioxidant activity of rose coffee milk.](image)

Milk and coffee in all treatments used also contain high antioxidants. These results also follow Zulueta et al. [30] and Ertan et al. [31], which state that pasteurized milk’s antioxidant capacity is not much different from UHT milk. This result could happen from the proper use of heat treatment and time, which ensures that even if UHT milk is heated to a high temperature for a brief period, the antioxidants are not decomposed. In comparison, commercial coffee control products that did not add rose flower powder show low antioxidant activity. In addition, differences in coffee variants can also affect differences in activity in antioxidants.

According to raw material analysis results, rose flower powder and coffee had a high antioxidant activity percentage. The 1 % rose flower powder concentration resulted in an
average antioxidant activity of 85.06 % and an average antioxidant activity of coffee of 61.54 % [32]. According to Meidina [16] in the previous study, the characteristics of antioxidants affect their mechanisms in the body. An ingredient can be considered active if the percentage of its antioxidant activity is greater than or equal to 50 %. The study also stated that the percentage of antioxidant activity in robusta coffee with a concentration of 12.5 % obtained a yield of 56.95 % [16]. The results obtained in previous studies were not much different from the results of this study.

The results of a previous study conducted by Rahmawati et al. [33] stated that the percentage of antioxidant activity in roses is relatively high, more than 50 %. In this case, rose flower extract produced an antioxidant activity of 69.82 %. The essential ingredients of rose flower powder used in rose coffee milk products get more antioxidants than in previous studies [33]. Therefore, the final result of the antioxidant activity of rose coffee milk products can be higher than that of other beverage products on the market.

### 3.3 Color intensity

#### 3.3.1 Brightness level (L) analysis

Based on the ANOVA at the 5 % level, it showed that the addition of coffee concentrations and different types of milk had no significant effect ($P > 0.05$). The color intensity (L) results indicate the brightness level in the sample. The values range from 0 (black) to 100 (white). The greater the positive value of L, the brighter the resulting color will be. The more negative or smaller the L value, the darker the color tends to be. The average color brightness level for rose coffee milk products is shown in Figure 5.

![Fig. 5. Brightness level or L-value of rose coffee milk in all treatments.](image)

Figure 5 shows that the average L value based on differences in coffee concentration ranges from 54.80 % to 61.60 %. The value of L in commercial coffee control is 53.95 %. The two treatments of adding coffee concentration 10 % different did not show the same results. According to Diastari and Agustina [26], the absence of differences in the brightness level when measuring can be caused by the same material composition, background color, and lighting when the tool is pointed at the sample. According to research by Ansari and Sahoo [34], the brightness of UHT and pasteurized milk is not much different. However, the brightness level of UHT milk is slightly lower than pasteurized fresh milk [34]. This result could be because, during the treatment of UHT milk and more
extended milk storage, the color attribute of UHT milk can change due to the browning reaction. Browning reaction is common in milk and dairy products upon sterilization and subsequent storage periods.

3.3.2 Redness (a+) and yellowness (b+) analysis

Based on the ANOVA at the 5% level, it was shown that adding coffee concentrations and different types of milk had no significant effect ($P > 0.05$) on the degree of redness and yellowness. The average value of redness (a+) and the level of yellowness (b+) in rose coffee milk products is shown in Figure 6. It is known that the average a+ value ranges from 6.50 to 7.05. The results on the color intensity of the reddish level (a+) show the specification of the red-greenish color. The more significant/positive the a+ value, the color tends to be red, and the more negative/smaller the a+ value, the greener the color. The average value of b+ ranges from 15.50 to 18.20. The results at the yellowness level (b+) show the color characteristics of the sample, which is yellow-bluish. The greater the positive b+ value, the resulting color will tend to be yellow. If the b+ value is negative, the color tends to be blue.

![Figure 6](image_url)

**Fig. 6.** The characteristics of a+ and b+ of rose coffee milk.

The average value of the color specification level in the four treatments indicates that the detected color is red-yellow. Along with increasing the concentration of coffee, the level of reddish and yellow color in the sample also increases. The high and low values of a+ and b+ in coffee beverage products are because coffee undergoing a browning reaction will produce a color that tends to be red-yellowish brown. The amount will accumulate if the concentration increases significantly. In addition, these results suit the research of Ansari and Sahoo [34], who stated that UHT milk and pasteurized milk are not much different. Both types of milk can get a browning reaction, which can be the reason the red-yellow color of the two types of milk is similar, making the color detectable toward red tends to be dark brownish yellow [34].
3.4 Sensorial evaluation of coffee milk

3.4.1 Color aspect

Based on the ANOVA at the 5 % level, it showed that the addition of coffee concentrations and different types of milk had a significant effect ($P < 0.05$). The average color sensorial value of rose coffee milk products is shown in Table 3. Based on the table above, it is known that the average color sensorial values in the four treatments ranged from 5.57 to 6.40. This sensorial evaluation used a panel of 100 untrained panelists to grade samples on a scale of 1 to 9. A value that is lower or closer to 1 indicates that the treatment has an extraordinarily unattractive color, and a higher value approaches 9, indicating that the treatment is desirable.

In the four treatments, the average value was around 6. The treatment with the highest score was U30, with a value of 6.40, which means that it is pretty attractive, close to attractive, with a darker color than the other treatments. Treatments P30 and U20 had almost similar colors. Treatments P20 and U30 were significantly different. These results, when associated with color intensity ($L$, $a^+$, $b^+$), will display increasingly attractive colors with a score above 5, getting closer to 9, namely colors that tend to be darker with a higher level of red-yellow.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Color test result</th>
</tr>
</thead>
<tbody>
<tr>
<td>P20</td>
<td>5.57$^a$</td>
</tr>
<tr>
<td>P30</td>
<td>5.85$^{ab}$</td>
</tr>
<tr>
<td>U20</td>
<td>6.03$^{ab}$</td>
</tr>
<tr>
<td>U30</td>
<td>6.40$^b$</td>
</tr>
</tbody>
</table>

*Remarks: The average value, followed by different letters, shows a significant effect according to DMRT’s test at $\alpha = 0.05$.

**Information score: 1 = extremely unattractive; 2 = very unattractive; 3 = quite unattractive; 4 = unattractive; 5 = neutral; 6 = quite interesting; 7 = interesting; 8 = very interesting; 9 = incredibly interesting.

The color parameters correspond to the color intensity measurements ($L$, $a^+$, $b^+$), which stated that the panelists preferred U30 with a darker color. The higher addition of coffee concentration, which resulted in a darker color, also increased the average value of the panelist’s interest in color. In addition, the use of UHT milk also made the panelist’s assessment higher than the use of pasteurized milk. This result indicates that along with the addition of coffee concentration and the use of UHT milk, the color of the rose coffee milk product is increasingly attractive to the panelists. The color parameters in this sensorial evaluation for the four treatments were acceptable to the panelists.

3.4.2 Aroma aspect

Based on the ANOVA with a level of 5% shows that the addition of coffee concentrations and different types of milk has a significant effect ($P < 0.05$). The average sensorial value of aroma in rose coffee milk products is shown in Table 4. It is known that the average sensorial value of aroma in the four treatments ranged from 5.43 to 6.25. This sensorial test uses a panel of 100 untrained panelists to grade samples on a scale of 1 to 9. A score that is lower or closer to 1 indicates that the treatment has an unusually odorless score. The value that is getting higher is closer to 9, indicating that the treatment is amazingly fragrant. In the three treatments, the average value was more significant than 5 and less than 6, indicating that the panelists considered the neutral product aroma quite fragrant. The
The highest aroma based on the aroma parameter is found in U30, indicating that the aroma is quite fragrant.

The U20 treatment produced had the smallest sensorial value of 5.43, and the P20 and P30 treatments had values that were not different, indicating that the two treatments had the same aroma. Treatments U20 and U30 had no similar aroma. Treatment U30 has the highest value, about 6.25. This result indicates that along with the addition of coffee concentration, the aroma of rose coffee milk products is increasingly favored by panelists with a distinctive aroma of coffee. The distinctive aroma that attracts consumers can be caused by organic acids such as oxalic acid, formic acid, lactic acid, acetic acid, and citric acid, as well as volatile compounds in coffee. Adding milk can significantly reduce the intensity of coffee aroma due to a decrease in the release of 2-furfurylthiol aroma, the primary aroma compound of brewed coffee [35]. Milk has a high lactose content, which is closely associated with the preferred fragrance or aroma, along with a decrease in the intensity of the coffee aroma. Thus, adding coffee concentration can help increase the preference of the panelist’s aroma, and the aroma parameters of this sensorial test in the four treatments are acceptable to the panelists.

### Table 4. Sensorial evaluation of the aroma aspect of rose coffee milk.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Aroma test result</th>
</tr>
</thead>
<tbody>
<tr>
<td>P20</td>
<td>5.93&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td>P30</td>
<td>5.95&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td>U20</td>
<td>5.43&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>U30</td>
<td>6.25&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

*Remarks: The average value, followed by different letters, shows a significant effect according to DMR’s test at α = 0.05.

**Information scores: 1 = unusually odorless; 2 = very unscented; 3 = quite unscented; 4 = not fragrant; 5 = neutral; 6 = quite fragrant; 7 = fragrant; 8 = very fragrant; 9 = amazingly fragrant.

#### 3.4.3 Taste aspect

Based on the ANOVA with a level of 5 %, it shows that adding coffee concentrations and different types of milk has a very significant effect (<P < 0.05). The average taste sensorial value of rose coffee milk products is shown in Table 5. It is known that the average taste sensorial scores in the four treatments ranged from 5.65 to 6.90.

### Table 5. Sensorial evaluation of the taste aspect of rose coffee milk.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Taste score result</th>
</tr>
</thead>
<tbody>
<tr>
<td>P20</td>
<td>6.00&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td>P30</td>
<td>6.35&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>U20</td>
<td>5.65&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>U30</td>
<td>6.90&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

*Remarks: The average value, followed by different letters, shows a significant effect according to DMRT's test at α = 0.05.

**Information score: 1 = extremely unpleasant; 2 = very unpleasant; 3 = quite unpleasant; 4 = unpalatable; 5 = neutral; 6 = quite delicious; 7 = delicious; 8 = very delicious; 9 = extraordinary delicious.

The highest sensorial score was found in the U30 treatment, with a score of 6.90, meaning the taste is close to delicious. The difference in the results for the four treatments indicated that the panelists preferred the taste of rose coffee milk products and the addition of coffee concentration. The fat content of the product can influence the sensorial assessment of taste. In addition, pH value affects the sour taste of coffee, and protein can also affect panelists in determining the sensorial score of the product. However, taste
assumptions can sometimes also be invalid due to preference differences. Treatment by adding coffee concentration to the product can improve the taste of coffee, which is considered a positive factor for consumer acceptance. However, it can also increase the bitterness, which can be detrimental to consumer tastes [36].

3.5 Determination of the best formula

Table 6 shows that U30 treatment resulted the highest amount in protein content of 5.19 %, fat content of 6.75 %, pH value of 6.00, antioxidant activity of 76.29 %, total anthocyanin 0.835 mg mL⁻¹, brightness value (L) 54.80, redness value (a⁺) 7.40, yellowness value (b⁺) 17.00 and average color sensorial 6.40 which means it is pretty attractive with slightly dark color; sensorial aroma 6.25 which means close to fragrant; and sensorial taste 6.90 which means close to delicious. Thus, U30 is considered the best formula to produce rose coffee milk.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>P20</th>
<th>P30</th>
<th>U20</th>
<th>U30</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antioxidant activity (%)</td>
<td>76.83*</td>
<td>75.93</td>
<td>75.80</td>
<td>76.29</td>
</tr>
<tr>
<td>Total anthocyanin (mg L⁻¹)</td>
<td>2.01</td>
<td>2.46*</td>
<td>1.88</td>
<td>0.84</td>
</tr>
<tr>
<td>Protein content (%)</td>
<td>3.93</td>
<td>3.67</td>
<td>3.67</td>
<td>5.19*</td>
</tr>
<tr>
<td>Sensorial taste</td>
<td>6.00</td>
<td>6.35</td>
<td>5.65</td>
<td>6.90*</td>
</tr>
<tr>
<td>Sensorial aroma</td>
<td>5.93</td>
<td>5.95</td>
<td>5.43</td>
<td>6.25*</td>
</tr>
<tr>
<td>Sensorial color</td>
<td>5.57</td>
<td>5.85</td>
<td>6.03</td>
<td>6.40*</td>
</tr>
<tr>
<td>Brightness (L)</td>
<td>61.60</td>
<td>55.15</td>
<td>59.85</td>
<td>54.80*</td>
</tr>
<tr>
<td>Redness (a⁺)</td>
<td>7.05</td>
<td>6.60</td>
<td>6.50</td>
<td>7.40*</td>
</tr>
<tr>
<td>Yellowness (b⁺)</td>
<td>18.20*</td>
<td>15.50</td>
<td>16.85</td>
<td>17.00</td>
</tr>
<tr>
<td>Fat content (%)</td>
<td>9.05</td>
<td>13.00*</td>
<td>12.25</td>
<td>7.73</td>
</tr>
<tr>
<td>pH</td>
<td>6.16*</td>
<td>5.94</td>
<td>6.07</td>
<td>6.00</td>
</tr>
<tr>
<td>Total point</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Ranking</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>1</td>
</tr>
</tbody>
</table>

Notes: (*) shows the highest value

4 Conclusion

Adding coffee concentration configuration and different types of milk affected the physicochemical parameters significantly. The different types of milk and coffee concentrations in rose coffee milk products had a significant effect on the sensorial color and aroma; also, the sensorial taste of the product had a very significant effect. Panelists preferred higher concentrations of coffee. The preferred rose coffee milk was U30 (UHT milk + 30 % coffee), giving satisfactory results in sensorial evaluation for all aspects.

References

5. H. Yoo, K. Park, Metabolites, 12,12: 1–11 (2022) https://doi.org/10.3390/metabo12121177


