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PHYSICAL CHARACTERISTICS AND SENSORY EVALUATION OF ROSELLE (*HIBISCUS SABDARIFFA L.*) BUTTERFLY PEA (*CLITORIA TERNATEA L.*) CORDIAL

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Abstract
The purpose of this research is to explore the application of rosella extract and butterfly pea as the main ingredient in cordial. This research focuses on physical characteristics and sensory evaluation. This study used a completely randomized design method with two extraction treatments and 10 replications. The results of this study indicate that cordial roseela telang flowers in color measurement using a refractometer have results in which treat A has the most superior color L (21.04), a (14.10), and b* (6.10), and viscosity measurement using a viscometer tool gets the most superior results (41.74), pH measurement gets the most superior results (2.66), and TSS Brix measurement (56.24%). Taste test results and overall acceptance show that cordial with formulations A and B have the best physical properties.*

Keywords: Butterfly pea, Color, pH, Rosella, Sensory.

1. Introduction

Rosella flowers and butterfly pea have become popular in recent times among various circles. Both types of plants are used to make a wide variety of products, including coffee blends. This is due to the many health benefits of Roselle flowers and butterfly pea. The Roselle plant, a member of the Malaccan family, is well-loved by the public and is often used as a refreshing drink due to its unique fragrance. It also has a light, sour, and fresh taste due to the presence of citric and Mali acids, as well as an attractive natural color. The strong antioxidant properties and red color of Roselle petals are attributed to natural pigments called anthocyanins (Hastuti, 2012).

Hibiscus sabdariffa L., or Roselle, is a plant that contains anthocyanins, naturally occurring antioxidants that can fight free radicals. Antioxidants are substances with the capacity to transfer electrons to oxidant substances to inhibit oxidant activity (Mohamed, 2016). Rosella flowers contain bioactive compounds with a high anthocyanin content. A class of flavonoids called anthocyanins can function as natural antioxidants by scavenging free radicals, preventing disease, and stopping cell damage (Maria Ingrid et al., 2018). The compounds found in Roselle flowers are known as flavonoids, or more broadly, anthocyanins. Parts of the Roselle plant, including roots, stems, leaves, seed petals, and so on, contain secondary metabolite compounds called flavonoids. Flower leaves that change color from red to blue contain pigments called anthocyanins (Sri Rahayu et al., 2009). Besides its role as an antioxidant, Roselle anthocyanins can be utilized as a natural colorant. Plants, fruits, and vegetables often contain substances called anthocyanins. Anthocyanins are natural dyes that produce red, orange, blue, and purple colors. The class of flavonoids known as anthocyanins has two benzene rings connected by three carbon atoms. The structure of Roselle anthocyanins is cyanidin-3-glucoside (Sipahil, 2016).

With so many health benefits, butterfly pea (Clitoria ternatea L.) is gaining popularity in Indonesia. Telang flower drinks are increasingly popular as appetizers in restaurants. Butterfly pea are increasingly popular for purchase, both fresh and dried. Butterfly pea are used as ornamental plants and in traditional medicine (Purba, 2020).

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Mirisetin glycosides, quercetin glycosides, kaempferol glycosides, flavonoid glycosides, and anthocyanins are known to be present in butterfly pea (Clitoria ternatea L.) (Kazuma et al., 2013).

According to Suebkhampet and Sotthibandhu (2019), anthocyanins, which are present in bay flowers (Clitoria ternatea L.), produce blue pigment, one of the natural pigments. Besides just providing color to the plant, anthocyanins are also a good source of antioxidants (Vankar et al., 2010). In addition, the pharmacological qualities of bay flowers include antimicrobial, antidepressant, anthelmintic, anti-cancer, and anti-diabetic effects (Purba, 2020).

Water dissolves anthocyanin pigments, resulting in various shades ranging from red to blue (Jackman, 1996). Pigment concentration is a key element in color determination. Winarno (2007) states that anthocyanins at low concentrations produce shades of blue. On the other hand, anthocyanins produce two different colors: red at high concentrations and purple at medium concentrations.

According to Duta and Ray (2014), polyphenols may be the substances that give bay flowers their antiradical properties. This is due to the positive correlation that exists between antioxidant activity and phenolic compounds. In the literature of yusof and Chiong (1997), syrup is a concentrated, clear fruit juice or syrup made by removing pulp and other suspended particles. After consumption, syrup needs to be diluted.

2. Methods

2.1 Material and Tools

The period of this study was carried out in September 2023. The laboratory of the Malaysian Agricultural Research and Development Institute (MARDI) was the location of this study. The following ingredients were used in this study: sodium benzoate, citric acid, sugar, ascorbic acid, Roselle extract, and butterfly pea extract. The Roselle and butterfly pea extracts were obtained from MARDI Serdang Food Science and Technology Research Center, Malaysia. Analytical balance, blender, thermometer, measuring cup, Erlenmeyer flask, spatula, funnel, gas stove, stainless steel pot, glass jar, knife, gloves, fine cotton cloth, pH meter, viscometer, colorimeter, and refractive index are some of the other devices used in this study. Meanwhile, the following equipment was used for the organoleptic test: plastic cups, two-layer Peipa brand tissues, stationery, and questionnaire paper.

2.1 Research Methods

a. Rosella Extract

A total of 600 grams of Roselle simplicia was crushed and then filtered through sieve number 44 and 60 to obtain Roselle extract. The Roselle was obtained in Serdang, Malaysia. Next, using a 1:3 ratio of 96% ethanol and maceration method, the extraction was carried out and covered with aluminum foil. It was allowed to rest for three days, covered from light, and stirred occasionally. Paper filters were then used to filter (Ana Estikomah et al., 2018).

b. Butterfly Pea Extract

The butterfly pea petals were dried in a drying oven (55 degrees Celsius, with a

water content of 5%). After adding 1500 ml of filtered water and cooking for 20 minutes, 16 grams of dried butterfly pea flowers were weighed. Next, filter the extract from the butterfly pea.

Tabel 1. Formulation Treatment A

Treatment A	**(%)**	**10**
Ekstrak Rosella	50	500
Ekstrak Bunga Telang	0	0
Gula	48	480
Asid Sitrik	0.3	3
Askorbik Asid	0.04	0.4
	98.34	983.4
Natrium Benzoat	0.07	0.7

Tabel 2. Formulation Treatment B

Treatment B	**(%)**	**10**
Ekstrak Rosella	37.5	375
Ekstrak Bunga Telang	125	125
Gula	48	480
Asid Sitrik	0.3	3
Askorbik Asid	0.04	0.4
	98.34	983.4
Natrium Benzoat	0.07	0.7

Tabel 3. Formulation Treatment C

Treatment C	**(%)**	**10**
Ekstrak Rosella	25	250
Ekstrak Bunga Telang	25	250
Gula	48	480
Asid Sitrik	0.3	3
Askorbik Asid	0.04	0.4
	98.34	983.4
Natrium Benzoat	0.07	0.7

Tabel 4. Formulation Treatment D

Treatment D	**(%)**	**10**
Ekstrak Rosella	125	125
Ekstrak Bunga Telang	37.5	375
Gula	48	480
Asid Sitrik	0.3	3
Askorbik Asid	0.04	0.4
	98.34	983.4
Natrium Benzoat	0.07	0.7

Tabel 5. Formulation Treatment E

Treatment E	**(%)**	**10**
Ekstrak Rosella	0	0
Ekstrak Bunga Telang	50	500
Gula	48	480
Asid Sitrik	0.3	3
Askorbik Asid	0.04	0.4
	98.34	983.4
Natrium Benzoat	0.07	0.7

c. Preparation of Roselle Butterfly pea Cordial

Prepare and mix 200 grams of Roselle extract with 2000 milliliters of water, heat for fifteen minutes, then filter using a cotton cloth. Weigh the butterfly pea extract (100 grams), then add 1000 milliliters of water, bring to a boil, and wait for 15 minutes before filtering with a cotton cloth.

After that, stir the sugar and extract until the temperature reaches 90°C. Once the temperature is reached, add the preservatives, ascorbic acid, and citric acid. Stir, cool, then pour the mixture into PET bottles, seal, and label.

d. Color Analysis

Use the Precise Color Reader (WR-10) to determine the color of the Roselle flower syrup formulation. The parameters measured in this syrup are brightness value (L*), red-green brilliance (a*), and yellow-green brilliance (b*) (Luo et al., 2019).

e. pH analysis

This test was conducted using a pH meter. The syrup sample was put into a container, and the on button on the pH meter was turned on. After it was turned on, the syrup sample was dipped into the ginger drink. Wait until the number decreases, then record the pH on the digital pH meter screen (Umu Mukaromah et al., 2010).

f. Viscosity Analysis

The viscosity of the syrup was measured using a Brookfield viscometer with spindle number two because the viscosity of the juice and syrup products can be seen with the naked eye. When cold extracted, the average viscosity of Roselle syrup was 0.11 poiseuille; when heated, the average viscosity became 0.12 poiseuille. There are various spindle rotation speeds available: 10, 20, 30, 50, and 100 rpm. As described by Umu Mukaromah et al (2010).

g. TSS Analysis

Total dissolved solids (TSS), sugars, and other solids dissolved in the same solution were calculated using a refractometer in TSS analysis. A digital refractometer such as oBrix was used to measure the TSS of the sample. A blank solution made of distilled water was used (Amizan and Loo, 2020).

h. Sensory Analysis

Thirty panelists evaluated the organoleptic properties of this Roselle syrup in its thickened and diluted state. Each sample had a code. To reduce the influence of flavor, the panelists were given mineral water. According to Umu Mukaromah et al. (2010), the following characteristics were tested: aroma, texture, taste, color, and overall.

i. Statistical Analysis

To calculate the color concentration, TSS brix, viscosity, and pH tests, statistical analysis was required. T-TEST analysis was performed using SPSS version 15 for Windows. Mann Whitney test was used to process the sensory quality data and determine the level of liking. Hedonic quality data was scored, averaged, and then compiled as a percentage of the highest rating.

3. Results and Discussion

Based on the results of the study, it was found that the results of the analysis of raw materials such as Rosella extract and butterfly pea extract are pH levels found in Roselle extract are 2.09. While in Butterfly pea extract, as much as 4.496. Rosella extract viscosity level 2.35 m.pa.s Butterfly pea extract 0.807 m.pa.s. Rosella extract TSS level 1.7 Brix%. Butterfly pea extract 0.82 Brix%. And the color content of Roselle extract L*19.71, a*7.82, b*3.40. Butterfly pea extract L*18.90, a*1.69 and b*3.13.

a. Color

Tabel 6. Color Cordial Rosella Bunga Telang

Formulasi	L	a*	b*
Treat A	21.04 [a]	14.10 [a]	6.10 [a]
Treat B	19.64 [cd]	10.30 [b]	3.80 [ab]
Treat C	20.62 [ab]	6.39 [c]	2.24 [b]
Treat D	19.87 [c]	5.08 [d]	1,84 [b]
Treat E	19.68 [c]	4.55 [d]	1,72 [b]

Table 2 shows that the color value of L in the treatment of Roselle cordial has a higher brightness value compared to the treatment of the addition of Roselle extract in formulations A, B, C, D and E, in accordance with the opinion of deMan (1997) that anthocyanin pigments are easily damaged when processing at high temperatures, increased sugar content, pH and ascorbic acid can affect damage. After being treated, it can be obtained that treat A has a higher value than treat B, C, and E, this is because treat A only uses Roselle extract as much as 50%. Anthocyanins contained in Roselle function as natural dyes (Ummu Mukharomah, et.al., 2010).

b. pH

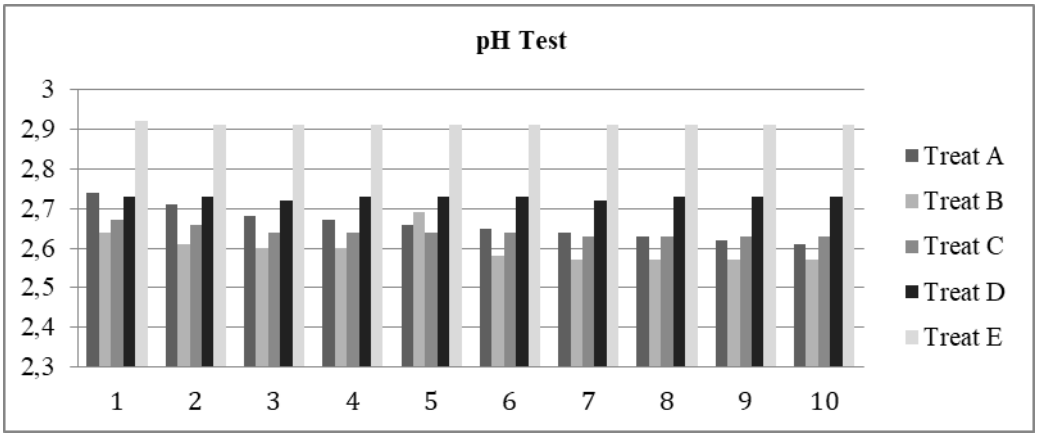

Figure 1. pH in Rosella Butterfly Pea Cordial

pH has a significant impact on anthocyanins, especially in terms of determining their color; at low pH (acidic), anthocyanins are red. In addition, heating will damage anthocyanins (Astawan and Kasih, 2008). The heat generated causes the formation of dark pigments resulting from sugar caramelization (Mansor et al., 2020).

Figure 1 shows the pH difference in cordial where the largest pH is in cordial treatment E, where the pH of treatment E is 2.91. The pH in treatment E is different from the pH in treatment A, which is 2.66, while the pH in treatment B is 2.60, while in treatment C it is 2.64.

pH treatment D 2.72. The degree of acidity (pH) of a product increases with the addition of sugar. The greater the concentration of sugar added, the juice has a high degree of acidity (pH). This is because the [H+] ions that form acid will decrease (Dari & Junita, 2021).

The pH of treat E is 2.91 because only Butterfly pea extract formulation is used. The pH of Butterfly pea extract itself is 4.96, which is in accordance with the research of Rizka et al. (2019) which shows that the raw materials used affect the pH value of sour syrup. In addition, the use of sweeteners affects the pH of the syrup.

The pH value of sweetener ingredients is different before combining with other raw materials. The hydroxyl groups on the sugar attract particles (OH-), or negatively charged particles, around the sugar, which increases the H+ in the syrup. This happens because the hydroxyl groups affect the pH of the sweetener, which causes it to become acidic (Susanti et al., 2023).

c. Viscosity

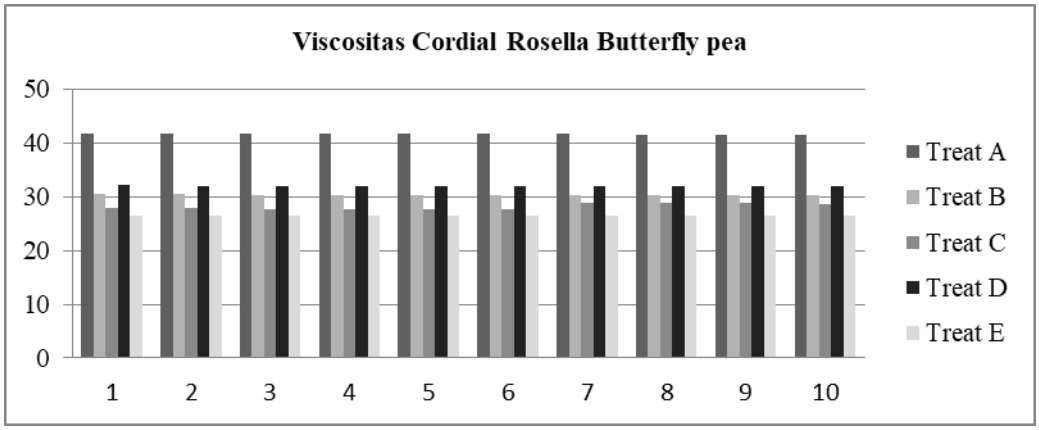

Figure 2. Viscosity in Rosella Butterfly Pea Cordial

Figure 2 shows the highest viscosity value in formulation A. Viscosity is a way of expressing how much resistance to flow is given to a liquid, or expressing the viscosity of a liquid. The amount of main ingredients added to the suspension also affects the viscosity (Nursal et al., 2022). Where the amount of viscosity in treat A is 41.74 m.Pa.s, the viscosity value also gets higher with the addition of sucrose (Kusmawati et al., 2020). Adding sugar at higher concentrations reduces water content. Sucrose content can bind free water, causing water to evaporate faster during cooking, resulting in higher water content (Suseno et al., 2019).

The viscosity value is influenced by the amount of sugar added to the beverage. The higher the sugar concentration, the higher the viscosity of the solution. This happens because the dissolved sugar component also affects the solute so that the total amount of dissolved sugar increases (Dari & Junita, 2021).

According to the literature presented by Buckle (1985) the solubility of high sugar will reduce the balance of relative humidity (ERH) and bind water, if the heating process is too long caramelization will occur. The higher the heating temperature the higher the solubility of the sugar.

Sugar content affects the viscosity and shelf life of the product, and the greater the glucose and fructose compared to sucrose, the lower the syrup crystallization. In addition, increasing with increasing sugar concentration, the total soluble solids component measured is very small because there is no sucrose content so the resulting value is also very small compared to other natural sweetener treatments (Suseno et al., 2019).

The higher the sugar content, the higher the viscosity. The presence of high sugar has a high Brix level that increases viscosity due to the presence of solids that can bind water, sucrose and citric acid. (Yanto et al., 2015) The percentage of total soluble solids tss decreases with increasing concentration of starch, molasses, glucose and crystal formation is undesirable for the food industry (Abdel-Aleem, 2020).

d. TSS

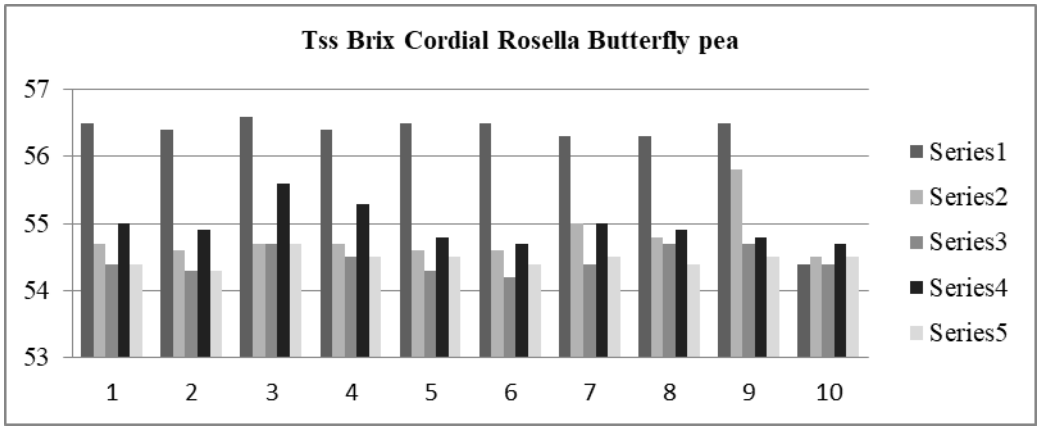

Figure 3. Viscosity in Rosella Butterfly Pea Cordial

It can be seen from Figure 3 that the highest TSS value is found in conditioner composition A, which is 56.24%. Total dissolved solids (TSS) is equal to the percentage of sugar and other dissolved or soluble solids in solution (Amizan and Loo, 2020). Total dissolved solids are usually distilled water (Damto, 2019).

The decrease in sucrose content increases with increasing amounts of acid added and heat treatment of the juice before syrup is produced (Abdel-Aleem, 2020). Suyitno (1989) showed that extraction and aqueous solution of other material components were also provided. The heating process did not affect the solid concentration of the resulting syrup.

According to Indonesian National Standard (SNI) 01-3544-1994, the minimum sugar content in syrup is quality I 65% and quality II 55%, thus the soluble solids of roselle syrup have met the SNI requirements. For aroma, treats A and D have the same level of correlation.

e. Sensory Organoleptic

Based on the organoleptic sensory results on the butterfly pea Roselle cordial, the results are as in the table below.

Tabel 3. Uji Sensory Cordial Rosella Butterfly pea

Minuman	Warna	Bau	Rasa	Kemanisan	Kemasaman	Keseluruhan
Treat A	6.16 [a]	5.90 [a]	6.03 [a]	5.80 [a]	6.10 [a]	6.00 [a]
Treat B	6.16 [a]	5.60 [a]	6.10 [b]	5.73 [a]	5.96 [a]	6.00 [a]
Treat C	5.66 [ab]	5. 53 [a]	5.50 [a]	5.23 [a]	5.46 [a]	5.43 [a]
Treat D	5.6 [ab]	5.90 [a]	5.90 [a]	5.56 [a]	5.86 [a]	5.70 [a]
Treat E	5.1 [b]	5.46 [a]	5.36 [a]	5.20 [a]	5.50 [a]	5.36 [a]

In Table 7. The results of this subjective assessment have a correlation with objective results using a chroma meter that shows the same color level where the panelists really like the color in the treat A formulation, where in this formulation the main ingredient used is Roselle extract alone without any mixture of butterfly pea extract. Which Roselle flowers have chemical content in the form of flavonoids or more commonly called anthocyanins.

Anthocyanins are pigments found in flower leaves that are red to blue in color (Sri Rahayu et all., 2009). Panelists really liked the color of treat A formulation because the color of this cordial traet A has an eye-catching red color. Where Roselle itself has anthocyanins that function as natural dyes, anthocyanins can provide red, orange, blue, and purple colors (Sipahil, 2016).

The aroma in Roselle syrup based on the extraction method is because Roselle does not have a distinctive aroma like other fruits and flowers such as clouds, jasmine and so on which have a sharp aroma so that when processing produces a fragrant aroma and is liked by panelists (Umu Mukaromah et al., 2010). Changes in aroma can be caused by the composition of the food itself (Willy, 2021).

The taste sensory test that is of interest to panelists is the taste of treat formulation B where the cordial drink formula consists of 37.5% Roselle extract and 12.5% Butterfly pea extract, sweeteners and other ingredients. The higher the starch content given, the higher the total sugar value (Ayuratri et al., 2017). Panelists' taste preferences increased as the sugar content increased. Treatment B showed the best flavor characteristics among the panel because honey contains fructose. Fructose is the sweetest type of sugar compound (1.12 times sweeter than sucrose (Suseno et al., 2019).

For acceptance, the best results are because it has the highest physical properties in cordial color. Overall, in the sensory test of this Roselle Butterfly pea cordial, panelists chose to treat A formulation where this formulation has a superior level of color, smell, taste, sweetness, acidity compared to the others.

4. Conclusion

The results of this study indicate that cordial Rosella Butterfly pea on color measurements using a refractometer tool has results which in treat A has the most superior color L (21.04), a * (14.10), b * (6.10), and viscosity measurements using a viscometer tool get the most superior results (41.74), pH measurements get the most superior results (2.66), and

TSS Brix measurements (56.24%), The results of taste tests and overall acceptance show that cordial with formulations A and B have the best physical properties.

The anthocyanin content contained in Roselle and Butterfly pea has a function as a natural color-forming pigment. Anthocyanins, a class of flavonoids, are natural antioxidants that function to inhibit free radicals and prevent disease and cell degeneration. Rosella flowers have high levels of anthocyanins as bioactive compounds. Rosella and Butterfly pea have high antioxidants, so they are very good for human health. The taste test results and overall acceptance showed that cordials with formulations A and B had the best physical properties.one (based on the results and discussion).

The limitations of this study are that, with the limited number of roselle flowers in North Sumatra, especially the city of Medan, it is a limitation to conduct research on this roselle. and the limited time to do research becomes a bit of an obstacle for the author to conduct research. The hope is for further research to find out where the place that produces more roselle plants is so that it does not make it difficult for the researcher to find roselle flowers and do this research with a relaxed and free time so as not to rush to complete the research.

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