Characteristics and sensory properties of lemongrass, roselle, and ginger formulation herbal tea

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Abstract. Herbal tea is a general term used for beverages that are not derived from *Camellia sinensis* tea leaves. Herbal teas are made from the flowers, seeds, and roots of various plants. Lemongrass, roselle, and ginger are plants that have the potential to be used as herbal tea ingredients. This study aims to obtain the best formulation of lemongrass, roselle, and ginger herbal teas. This research was conducted using a single Completely Randomized Design (CRD) with 4 concentrations of dried lemongrass, roselle, and ginger treatments. the lemongrass, roselle and ginger formulations used in this study were 1:1:1; 2:1:1; 1:2:1; and 1:1:2. The best formulation is the ratio of lemongrass, roselle, and ginger 1:2:1 with total phenol characteristics of 11.159 mg GAE/g; antioxidant activity 79.7%; acidity 3.24; and the description of the colour Dark Moderate Orange with organoleptic test results showed a rather like result on overall acceptance.

1. Introduction

Tea is a drink that is widely consumed by all walks of life because in addition to being economical, tea is also considered to provide health benefits, because it contains bioactive substances that ward off free radicals [1]. Herbal tea is a general term used for beverages that are not derived from Camellia sinensis tea leaves. Many herbal teas are made from the flowers, seeds, and roots of various plants [2].

Antioxidants can inhibit free radicals contained in the body, which are produced from the body's metabolism, air pollution, food contamination, and sunlight. Antioxidants are also useful for preventing oxidative stress. There are many plants that have potential as a source of antioxidants, including lemongrass, roselle and ginger.

Lemongrass contains natural antioxidants and anti-inflammatory which can prevent free radicals in the human body by consuming lemongrass as a daily drink. Lemongrass plants contain active compounds including alkaloids, flavonoids, saponins, quinones, and tannins. These compounds have benefits as antibacterial, antioxidant, pain reliever, relieve joint pain, relieve cough and cold, reduce stomach acid, and as aromatherapy because of its distinctive and fresh aroma (lemongrass) [3].

Roselle flower (*Hibiscus sabdariffa* L.) contains vitamins, minerals, and bioactive components such as organic acids, phytosterols and polyphenols that have antioxidant activity. The important content that acts as an antioxidant in roselle flower petals is anthocyanin pigment which belongs to the flavonoid group [4]. The stability of anthocyanins is also influenced by the temperature where drying is carried out at an oven temperature above 60 °C which results in antioxidant activity, total phenolics,

total flavonoids and the concentration of anthocyanins in roselle flower petal extract will decrease [5]. Roselle flowers are widely used as fresh drinks due to their distinctive aroma, containing citric and malic acids so that they have a fresh and distinctive mild sweet-sour taste with attractive natural colours [6].

Ginger (*Zingiber officinale*) is a native Indonesian rhizome that has the highest antioxidant potential compared to other rhizomes [7]. Ginger has several uses in traditional medicine, including treating headaches, colds, and increasing appetite (stimulants) [8]. Ginger has a spicy taste because it contains a ketone compound called zingerone. Ginger contains oleoresin which acts as an antioxidant and functions as an aroma and flavour carrier [9]. Processed ginger can usually be found in fresh or dried form. Antioxidant compounds in herbs and spices in ginger, namely shogaol and gingerol [10]. The addition of ginger powder in soursop leaf functional drink will increase the ash content and antioxidant activity, as well as increase the aroma and taste organoleptic scores. The increase in antioxidant activity obtained from the soursop leaf functional drink which was given the addition of ginger powder is because ginger has phenol components (gingerol and shogaol) contained in oleoresin, which is useful for preventing the oxidation process by closing or capturing free radicals [11].

Based on the description above, lemongrass, roselle and ginger have the potential to be combined into health-based food products. This is seen from the benefits, chemical content and shortcomings contained in these materials. The combination of roselle, ginger and lemongrass will have its own characteristics and the three ingredients are able to cover each other's lack of taste, aroma, and colour. This is evidenced by the results of a study [9] which made a functional drink of katuk-roselle leaves with the addition of ginger extract. The research shows that the ratio of katuk:roselle 70:30 with the addition of 8% ginger produces the greatest antioxidant activity (51.18%), and vitamin C is also greater (63.72 mg/100mL). Therefore, the research was conducted on lemongrass, roselle, and ginger herbal teas with different formulation treatments to determine the best formulation based on chemical, physical and organoleptic properties.

2. Materials and methods

2.1. Materials

Materials used in the research include materials for beverage manufacture and analysis. The ingredients used for making the drink are water, fresh lemongrass stalks, fresh roselle flowers and fresh ginger. The materials used for the analysis were *aquadest*, DPPH, ethanol, mineral water, Na_2CO_3, gallic acid, and *Folin-Ciocalteau*.

2.2. Method

The process of making herbal tea from lemongrass, roselle, and ginger is done by drying the ingredients at a temperature of 50 C to a constant weight. The dried material was then crushed and sieved using an 18mesh sieve. Lemongrass, roselle and dried ginger that have been sifted are then mixed using a predetermined treatment, namely 1:1:1; 2:1:1; 1:2:1; and 1:1:2. Mix the ingredients in a closed container until combined. 2 g of herbal tea then brewed with hot water at 100 °C for 5 minutes, then filtered and analysed.

2.3. Degree of acidity (pH)

Testing the degree of acidity was carried out using a standardized pH meter with a pH 4 buffer solution then the pH 7 buffer was turned on, left to stabilize. The electrodes are rinsed with distilled water and then dried with a tissue. The electrode is immersed in 10 mL of the sample solution and is left for a while until a reading is obtained then the pH of the sample is recorded.

2.4. Colour analysis [12]

Colour measurement using Colour Reader. Place the devise sensor onto the sample solution of lemongrass, roselle and ginger herbal teas with the colour reader and then press the button on the colour reader. The measurement method used is the absolute colour system measurement L*, a* and b*. The L* value indicates a change in brightness or lightness with a value range of 0 (black) to 100 (white). The a* value indicates the chromatic colour of the red-green mixture with a value of +a from the range of 0-100 for red, and the value of -a* in the range of 0 to -80 for green. Meanwhile, b* represents the chromatic colour of the blue-yellow mixture with -b* values from 0 to +70 blue and -b* values from 0 to -70 yellow. Colour description testing using colourhexa.com

2.5. Determination of total phenolic content

Analysis of total phenol levels was carried out using the spectrophotometric method [13]. 1 mL of the sample is put into a test tube and 1 mL of 95% ethanol and 5 mL of ion-free water are added. Furthermore, 0.5 mL of *Folin-Ciocalteu* reagent 50% (v / v) was added to each sample and then diluted with ion-free water. After 5 minutes, 1 mL of 5% (w / v) Na_2CO_3 was added and diluted again with ion-free water (if it was too concentrated). After that it was vortexed and stored in a dark room for 60 minutes. The sample was then homogenized (vortexed) again, and the absorbance was measured at 725 nm. The content of total phenolics in each extract was determined using a standard curve prepared for gallic acid and expressed as milligrams of gallic acid equivalents (GAE) per gram of sample.

2.6. Determination of antioxidant activity (DPPH radical scavenging assay)

Determination of antioxidant activity was carried out by spectrophotometric method [14]. A total of 0.2 mL of hibiscus leaves drink solution was piped using a micro pipette into the vial, then added 3.8 mL of 0.05 µL DPPH solution. The solution mixture is then homogenized and left for 30 minutes in a dark place. The absorption was measured using a Uv-Vis spectrophotometer with a wavelength of 517 nm. Ascorbic acid was used for positive control, as a comparison to determine the antioxidant activity of the sample, the treatment was the same as the sample. The absorbance data obtained, or the amount of antioxidant activity were used to determine the% inhibition.

$$\text{Percent Inhibition (\%)} = \frac{\text{blank absorbance} - \text{sample absorbance}}{\text{blank absorbance}} \quad (1)$$

2.7. Sensory evaluation

Sensory analysis was carried out on lemongrass, roselle and ginger herbal teas that had been added with sugar The sensory evaluation was carried out using a hedonic scale. This test was conducted by 25 semi-trained panellists consisting of students from Technology of Agricultural Product Study Program, Jambi University. The assessment was carried out hedonic where the panellists gave a value to each tea treatment for the parameters of colour, aroma, taste and overall acceptance. Panellists were asked to taste and give a score. The score for the organoleptic test can be seen in the Table 1.

Table 1. Parameters of hedonic testing.

Score	Hedonic scale
1	Very dislike
2	Do not like
3	Rather like
4	Like it
5	Really like

2.8. Data analysis

To find out the effect of the treatment given, the data obtained were analysed statistically by using variance at the 5% and 1% levels, if significantly different, then proceed with the Duncan's New Multiple Range Test (DNMRT) at the 5% level.

3. Results and discussion

3.1. Degree of acidity (pH)

Based on the pH test or the degree of acidity carried out on the steeping water of lemongrass, roselle, and ginger herbal teas, the average pH value was between 3.24 to 3.63. The results of analysis of variance showed that the treatment of lemongrass, roselle and ginger formulations had no significant effect on the pH of the resulting herbal tea.

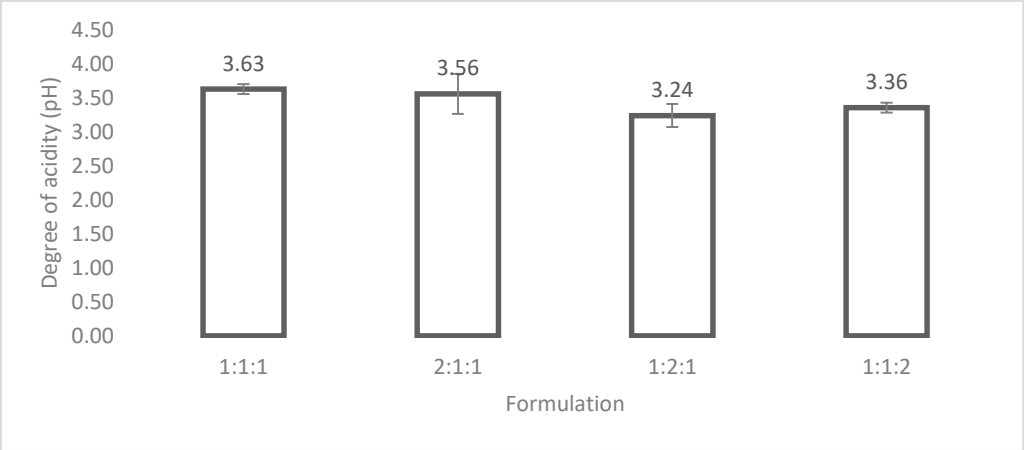

Figure 1. Degree of acidity (pH) of lemongrass, roselle, and ginger herbal tea.

According to Figure 1, lemongrass, roselle and ginger herbal teas in various formulations produce an acidic pH. The treatment that had the highest pH value was the treatment with the lemongrass, roselle, and ginger (1:1:1) formulation, while the lowest was the treatment with the lemongrass, roselle, and ginger (1:2:1) formulation with the most roselle formulation. The high treatment of roselle formulation resulted in a low acidity value, because roselle contributed to lowering the pH value.

3.2. Colour

Colour testing of lemongrass, roselle, and ginger herbal tea using a colour reader by measuring the values in the notation L, a*, and b* can be seen in Table 2. Each notation shows a different value, where the notation L represents brightness, a * represents the red chromatic colour, and b* represents the blue and yellow chromatic colour. Based on the results, the formulation of lemongrass roselle ginger did not significantly affect the colour of the brewed water produced, both in the notation L (brightness), a* (degree of redness) and b* (yellowness).

Table 2. Colour characteristics of lemongrass, roselle, and ginger herbal tea.

Formulation	L	A	B	Colour Description
1:1:1	40.61±0.14	6,85±0.19	19.65±0.29	Dark Moderate Orange
2:1:1	40.57±0.31	6.73±0.33	19.55±0.26	Dark Moderate Orange
1:2:1	40.32±0.14	6.85±0.10	19.73±0.05	Dark Moderate Orange
1:1:2	40.79±0.34	6.48±0.13	19.35±0.13	Mostly Desaturated Dark Orange

The L value describes the brightness of a product where the smaller the L value, the lower the brightness value, while the larger the L value, the higher the brightness value[15]. The range of L

values is from 40.32 to 40.79 which can be seen in Table 2. The highest level of brightness is herbal tea steeped water with the formulation of lemongrass: roselle: ginger (1:1:2) with the highest addition of ginger while the brightness level The lowest was in the lemongrass, roselle, and ginger (1:2:1) formulation, with the most addition of roselle.

The value of a* (degree of redness) of lemongrass: roselle: ginger herbal tea steeped water has a range of values between 6.48 to 6.85. The highest level of redness was obtained by steeping lemongrass, roselle, and ginger herbal tea with 1:1:1 and 1:2:1 formulation with the highest addition of roselle. The higher the degree of redness, the higher the colour density or the higher the anthocyanin levels. The value of the degree of yellowness (b*) has a range of values between 19.35 to 19.73, with the highest value belonging to herbal tea steeped water with the highest addition of roselle (1:2:1) which is 19.73.

3.3. Total phenolic content

Determination of total phenolic content was carried out by spectrophotometer method using *Folin-Ciocalteu* reagent. The principle of this method is the formation of a blue complex compound due to the reaction between phenolic compounds and *Folin-Ciocalteu*. The phenolic compound used as a comparison is gallic acid.

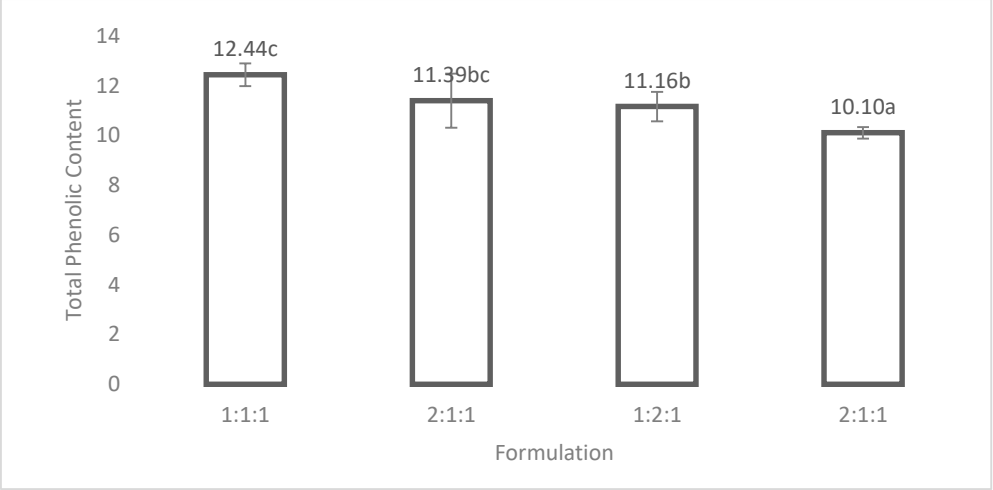

Figure 2. Total Phenolic Content (TPC) of lemongrass, roselle, and ginger herbal tea.

Based on Figure 2, the treatment that produced the largest total phenol was the 1:1:1 lemongrass, roselle, and ginger steeping water formulation of 12.437 mg GAE/g. While the lowest was 10,102 mg GAE/g in the 1:1:2 formulation, which was the most addition of ginger. Based on the analysis of variance, it shows that there is a significant difference (levels of 1% and 5%) between treatments.

3.4. Antioxidant activity

Antioxidants are compounds that are useful in overcoming oxidative damage caused by free radicals in the body so that they play a role in preventing various diseases. Testing of antioxidant activity in water steeped in lemongrass, roselle, and ginger herbal teas using the DPPH method. This method is based on the discolouration of the DPPH radical (purple) caused by the reaction between the free radical DPPH and one hydrogen atom released by the compound contained in the test sample to form a yellow compound 1,1-diphenyl 2-picrylhydrazil.

Antioxidant activity in tea is influenced by phenolic compounds contained in tea-making ingredients [16]. The phenolic compounds in each ingredient such as roselle petals include flavonoids, polyphenyls, citric acid, saponins, tannins and anthocyanins. Lemongrass contains alkaloids, tannins, saponins, flavonoids, steroids and essential oils and ginger contains oleoresins, flavonoids, terpenoids, and essential oils.

Table 3. Antioxidant activity (%inhibition) of lemongrass, roselle, and ginger herbal tea.

Formulation	Antioxidant activity (%inhibition)
1:1:1	$79,7^{ns}\pm2,22$
2:1:1	$75,9^{ns}\pm3,21$
1:2:1	$79,7^{ns}\pm1,10$
1:1:2	$75,2^{ns}\pm1,36$

Based on the results of the antioxidant activity test, the value of antioxidant activity is between 75.2 to 79.9, it can be seen in Table 3. From the results of the variance, it shows that there is no significant difference at the 1% level to the value of % activity obtained from herbal tea steeping water with various formulations of lemongrass, roselle and ginger. The value of % activity was greatest in the formulation of lemongrass, roselle, ginger 1:1:1 and 1:2:1 which were the same formulation and the formulation with the highest addition of roselle. The results of this study are in line with research on aloe vera drinks with the highest addition of roselle extract having the largest antioxidant activity, namely 79.83%, this is because roselle contains anthocyanins [17]. While the smallest antioxidant activity was found in the 1:1:2 formulation with the highest amount of ginger.

3.5. Sensory evaluation

The sensory test that was carried out for the steeping water of lemongrass, roselle, and ginger herbal teas was a hedonic test (preference). The hedonic test was used to determine the panellists' preference for lemongrass, roselle and ginger herbal teas including colour, aroma, taste and overall acceptance. In the assessment of the hedonic and hedonic quality tests used a numerical scale of 1 to 5. Where 1 (dislike very much), 2 (dislike), 3 (rather like), 4 (like) and 5 (like very much).

Table 4. Sensory evaluation of lemongrass, roselle, and ginger herbal tea.

Formulation	Colour	Aroma	Taste	Overall Acceptance
1:1:1	$3,04^{b}$	$3,2^{ns}$	$3,2^{ns}$	$3,24^{ns}$
2:1:1	$2,8^{ab}$	$2,76^{ns}$	$3,24^{ns}$	$3,4^{ns}$
1:2:1	$3,88^{c}$	$3,16^{ns}$	$3,6^{ns}$	$3,68^{ns}$
1:1:2	$2,2^{c}$	$2,96^{ns}$	$3,24^{ns}$	$3,24^{ns}$

The results show that the range of values for the panellists' preference for the colour of the lemongrass, roselle and ginger herbal teas is 2.2 to 3.88 (dislike to like). The average preference value that the panellists liked the most was in the 1:2:1 treatment, namely with the addition of the most roselle, which was 3.88 (like), while the one with the average colour value that the panellists disliked the most was in the treatment (1: 1:2) with the most addition of ginger with a score of 2.2 (dislike). The highest addition of roselle treatment resulted in the most preferred colour by panellists, this is because roselle contains anthocyanins which cause red pigment. The part of the roselle flower that can be used as a dye is the petals. The important content contained in roselle flower petals is anthocyanin pigment which forms flavonoids that act as antioxidants. This anthocyanin pigment forms a purple colour in roselle flower petals [18].

Based on Table 4. The treatment that has the most preferred aroma value by the panellists is 1:1:1, while the lowest treatment is 2:1:1, namely with the addition of the most lemongrass, this is because the aroma produced by lemongrass does not preferred panellists. Lemongrass has a quite sharp aroma because it contains essential oils with the main components being citronellol and graniol. The nutritional content of the lemongrass plant supports its use as an aromatic drink and traditional dishes, including its use in tea. However, most of the panellists used did not like the distinctive aroma caused by lemongrass.

The treatment that had the most preferred average taste value by the panellists was 3.6 with the most addition of roselle in the 1:2:1 formulation, while the average taste preference which had the lowest value was 3.2 in the 1:1:1 formulation. . This is due to the sour taste caused by roselle, so that the formulation with the concentration of roselle petals is preferred by the panellists. This result is in line with the study of adding roselle extract to the manufacture of jelly candy with the addition of roselle extract to roselle jelly candy and seaweed, resulting in a higher value (sweet slightly sour) [19]. This is in accordance with the pH of the herbal tea steeping water which increases the concentration of roselle petals used, the pH and the resulting sour taste increase.

Overall acceptance is the panellist's assessment of the lemongrass, roselle and ginger herbal tea which includes all parameters, namely colour, aroma and taste. The results of the analysis of variance showed that the treatment of herbal tea had no significant effect on the overall assessment of herbal tea steeping water.

The average value of the overall sensory test assessment ranged from 3.24 to 3.68 (rather like to like). The treatment preferred by the panellists as a whole was 1:2:1 with the highest concentration of roselle petals. This is closely related to the panellists' acceptance of the colour, aroma, and taste of the resulting herbal tea. The higher the panellist's assessment of colour, aroma and taste, the higher the panellist's assessment of the overall acceptance of lemongrass, roselle and ginger herbal teas.

4. Conclusions

The best formulation of lemongrass, roselle and ginger herbal teas was the formulation treatment with the most addition of roselle (1:2:1) with the best sensory properties in terms of colour, aroma, taste and overall acceptance, colour with an L value of 40.32, a value of 6, 85, and b value 19.73, pH 3.24, total phenol 11.159 mg GAE/g herbal tea and had antioxidant activity of 79.7%.

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