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SENSORY CHARACTERISTICS AND CHEMICAL PROPERTIES OF COFFEE LEAF TEA (*Coffea sp*) AS A FUNCTIONAL BEVERAGES

Karakteristik Sensoris dan Sifat Kimia Teh Daun Kopi (Coffea sp) sebagai Minuman Fungsional

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Abstract*: Coffee leaves can be processed into functional beverages because they have a fairly high tannin content and a taste that is no less delicious than coffee beans so that they can be used as a substitute for tea leaves in the processing of coffee leaf tea. Red ginger can be added to coffee leaf tea because it is beneficial for health as an antioxidant and can increase endurance. This study aims to: (1) Examine the effect of the concentration of coffee leaf comparison with red ginger on coffee leaf tea processing and (2) Examine the sensory characteristics of coffee leaf tea with the addition of red ginger. The research treatment was coffee leaves with concentrations (100%, 70%, 60%, 50%) and red ginger powder with concentrations (0%, 30%, 40%, 50%). The results of study obtained the best treatment with a ratio of coffee leaves 50%: red ginger 50% in terms of aroma 3.87 (likes), color 3.31 (likes), flavors without sugar 3.08 (likes), flavors of sugar addition 3.93 (likes), water* content *3.46%, and ash content 5.26 %, The water content, ash content and color of coffee leaf tea with the addition of red ginger produced in this study meet SNI 03-3836-2012.*

Keywords*: coffee leaf tea, red ginger, sensory, functional beverages*

Abstrak*: Daun kopi dapat diolah menjadi minuman fungsional karena memiliki kadar tanin yang cukup tinggi dan rasa yang tidak kalah nikmat dari biji kopi sehingga dapat dimanfaatkan sebagai pengganti daun teh. Jahe merah ditambahkan pada teh daun kopi karena bermanfaat bagi kesehatan sebagai antioksidan dan dapat meningkatkan daya tahan tubuh. Penelitian ini bertujuan: (1) Mengkaji pengaruh konsentrasi perbandingan daun kopi dengan jahe merah pada pengolahan teh daun kopi dan (2) Mengkaji karakteristik sensoris teh daun kopi dengan penambahan jahe merah. Perlakuan penelitian yaitu daun kopi dengan konsentrasi (100%, 70%, 60%, 50%) dan bubuk jahe merah dengan konsentrasi (0%, 30%, 40%, 50%). Hasil penelitian ini diperoleh perlakuan terbaik dengan perbandingan daun kopi 50%: jahe merah 50% ditinjau dari aroma 3.87 (suka), warna 3.31 (suka), citarasa tanpa gula 3.08 (suka), citarasa penambahan gula 3.93 (suka), kadar air 3.46%, dan kadar abu 5.26%, Kandungan kadar air, kadar abu dan warna teh daun kopi dengan penambahan jahe merah yang dihasilkan dalam penelitian ini memenuhi SNI 03-3836-2012.*

Kata kunci*: teh daun kopi, jahe merah, sensoris, minuman fungsional*

INTRODUCTION

Coffee leaves trimmed from coffee trees that are usually wasted can processed into functional beverages that can fight free radicals in the body with their antioxidant content. Pruning is carried out so as not to complicate it when harvesting and not to inhibit the growth of coffee plants. Coffee leaves contain flavonoids, alkaloids, saponins, caffeine, and polyphenols (Setiawan et al., 2015). Phenolic acids contained in coffee leaves are antioxidant compounds that can function to eliminate free radicals in the body (Suena and Ni Putu, 2020). According to Pristiana et al., (2015), that the old coffee leaf has the potential to be used

for food fortification because it contains a lot of antioxidants. In addition, coffee has a fair tannin content and a taste that is no less delicious than coffee beans (Siringoringo et al., 2012).

Coffee leaf tea is processed from coffee leaf raw materials that are no longer used and have a lower caffeine content than coffee and a high antioxidant content (Lazuardina et al., 2022). Coffee leaf tea can be used as one of the choices of health beverages and will be even more efficacious if added with spice plants that have health benefits. One of the spices that are useful as an antioxidant and can increase endurance is red ginger which belongs to the Zingiberaceae species (Lukita et al., 2021). Red ginger (*Zingiber officinale Roscoe*) is one of the varieties of ginger that is widely circulated in the community (Srikandi et al., 2020). Red ginger can be used as a functional beverages (Ranggawati, 2018) with advantages in the chemical content that is applied to ginger rhizomes, namely; (1) Gingerol substance that has anticoagulant properties, which can launch blood flow and prevent blood clots, so that it can anticipate heart disease, stroke and other degenerative diseases (Hasanah et al., 2021) and (2) Oleoresin is a ginger content that provides spicy, bitter, and provides antioxidant effects (Ibrahim et al., 2015). Furthermore, red ginger also contains essential oil in the form of a thick liquid and has a green to yellow color that gives a distinctive fragrant aroma to red ginger (Widiyana et al., 2021). Thus, the presence of various ingredients in coffee leaves and red ginger that are beneficial for health, it can be processed into functional beverages.

Functional beverages have the potential to be developed because they can double function in addition to providing nutritional intake can also provide sensory satisfaction and consuming functional beverages regularly can maintain a healthy body (Fortin et al., 2021; Sharma et al., 2021). The content of active compounds in functional beverages raw materials can increase the activity of antioxidant compounds so that they can improve the immune system. Comparison formulation or mixing raw materials in the processing of functional beverages is the most important part so that the flavor produced can be accepted by the public and its function for health can be accounted for (Widyantari, 2020). According to Ryadha et al., (2021), functional beverages from spices have the potential to be a source of antioxidants. Furthermore, according to Dwiyanti et al., (2021), the ginger beverage has an antioxidant activity of DPPH of 82,89% so it has the potential to be developed as a functional beverages.

The tea processing includes the withering, fermentation and drying. These three processes will affect the quality of the coffee leaf tea produced, especially the aroma. The fermentation of coffee leaf tea will result in an oxidation process where catechins change into various simpler compounds, namely flavonoid polyphenol compounds. The drying process is used to stop the fermentation. Fermentation duration can affect the tea quality. Fermentation process that ended too early will result in rudimentary tea quality, while prolong, fermentation will result in very poor tea quality (Fibrianto, 2020; Steger et al., 2022). Furthermore, coffee leaf tea produced with the addition of red ginger was analyzed for sensory characteristics by organoleptic testing using hedonic and description tests (Afrianto et al., 2017) and the chemical properties, namely water content and ash content.

Organoleptic testing includes color, aroma, flavor, and texture. Color greatly affects consumer interest in a food product, so the color is one of the important variables when consumers assess the quality of a food product (Maligan et al., 2018). Aroma is one of the important factors to determine the level of consumer acceptance of a food product. This is because before consuming usually consumers first smell

the aroma of the product to assess whether the product is suitable for consumption. Furthermore, the aroma of a food product determines the flavor, therefore the aroma is categorized as the flavor of a food product (Winarno, 2004). Flavor plays an important role in determining whether a product is accepted or rejected by consumers (Berenstein, 2017). Moreover, in the manufacture of a new product, consumers assessment of flavor largely determines the quality of the product (Tarwendah, 2017).The flavor is an important factor for panelist to accept or reject a food product. Further, although other parameters are of good value, if the flavor is unpleasant or unwelcome, then the product will be rejected or not accepted.

Coffee will be trimmed periodically every year so that it will produce coffee leaf waste that can be further utilized to have functional properties and economic value. One alternative to its use is processed as a functional beverages and to further improve its functional properties, red ginger can be added. Tea and coffee with the addition of red ginger are very beneficial for health. Coffee leaf tea products in packaged form can be more practically consumed by the public so that tea bag products are made. The problem of this study is how the sensory characteristics (color, aroma, and flavor) and the chemical properties of coffee leaf tea with the addition of red ginger. Thus, this study aims to: (1) Assessing the effect of the concentration of the ratio of coffee leaves with red ginger on the processing of coffee leaf tea and (2) Assessing the sensory characteristics and chemical properties of coffee leaf tea with the addition of red ginger.

METHODOLOGY

Time and Place

This research was carried out on April-June 2022 at the Laboratory of Agricultural Sciences, State University of Makassar and the Laboratory of the Center for Standardization of Industrial Services for Plantation Products, Minerals, Metals and Maritime Products.

Tools and Materials

The tools used in this study were basins, stainless steel knives, cutting boards, bamboo trays, blenders, analytical balance, ovens, and organoleptic test equipment. The ingredients used in this study were young coffee leaves and red ginger.

Procedure

Red Ginger Powder Processing

Red ginger was washed, stripped, and cut before dried in the oven at a temperature of 105^{o}C for three hours. Dried red ginger was then grinding using a blender and sifted to obtained red ginger powder.

Coffee Leaf Tea Processing

Prior to tea processing, coffee leaves were picked in the morning at 07.00– 08.00 am based on the topmost shoot followed by three strands below. The coffee leaves then sorted to remove stems that are included in the picking process. The leaves were chopped to reduce its size and then withered for six hours before heated in an oven at 90°C for one hour. Subsequently, the coffee leaves were roasted for eight minutes at 40°C then crushed until they are slightly smooth and sifted using a 20 mesh sieve. Next, the coffee leaves concentrations of 100%, 70%, 60%, and 50% were mixed with red ginger powder concentrations of 0%, 30%, 40%, and 50%. Finally, the coffee leaf tea was packed with osmofilter paper with one package contains a net weight of one gram. Organoleptic testing was carried out by first brewing the coffee leaf tea with hot water and then testing the brewing color, aroma, and flavor as well as testing of chemical properties. Coffee leaf tea processing flow chart as presented in Figure 1.

Organoleptic Test

xSensory characteristics were carried out by organoleptic tests aausing hedonic methods including taste, color,

and aroma to test the degree of liking for the coffee leaf tea produced or the feasibility of a product to be accepted by untrained panelist. In this test, 25 panelist were asked to give an assessment based on likert scales. The panelist criteria are students aged 19-21 years. The scores used were 5 for very like, 4 for like, 3 for somewhat like, 2 for dislike, and 1 for very disliked (Rampengan et al., 1985).

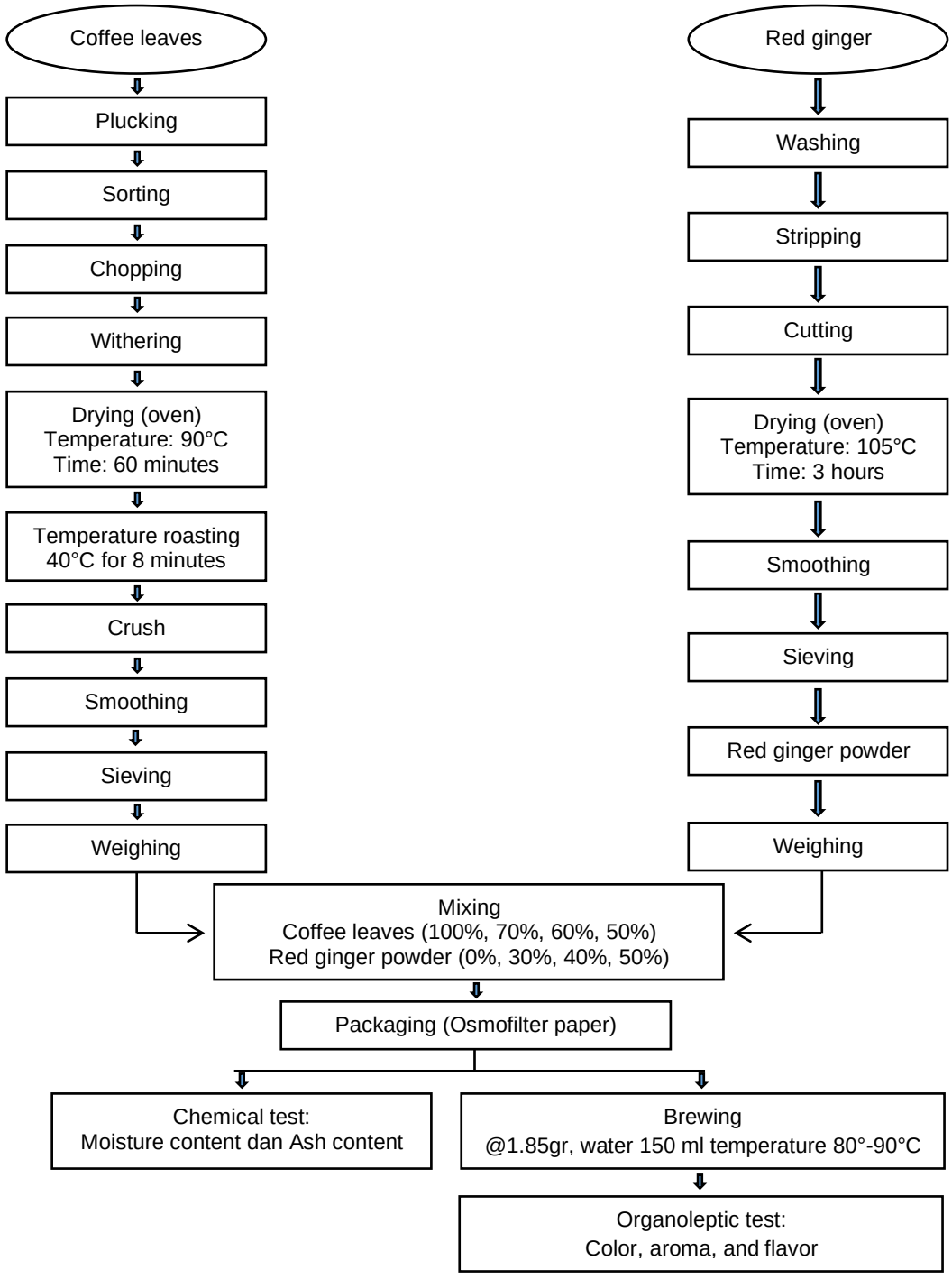

Figure 1. Flow chart of processing coffee leaf tea with the addition of red ginger powder

Moisture Content

The analysis of the moisture content used an oven method. The empty saucer was first dried in the oven at a temperature of 100 – 105°C for 30 minutes. The saucer was then cooled in

the desiccator for 30 minutes. The heating and cooling processes were repeated until a constant weight obtained. A sample of coffee leaf tea was weighed as much as five grams in the saucer (w_1). The sample was heated in the oven a temperature of 100 -105°C (8 – 12 hours). Furthermore, it was cooled in a desiccator for 30 minutes and weighed (w_2). The moisture content was calculated using equation (1) (Abriana, 2018):

$$\text{Moisture Content (\%)} = \frac{(W1-W2}{W} \times 100\% \quad (1)$$

Where: w is the sample weight, w_1 is the sample weight plus saucer before drying, and w_2 is the sample weight plus saucer after drying

Ash Content

Drying porcelain clouds at 525°C for 30 minutes. Cooling in desiccator for 15 minutes and weighing the weight of empty containers (w_1). Next, weighing the sample 5 –10 grams in a porcelain dish (w_2). Heating the saucer and samples by oven at 100°C for 30 minutes and continued by rinsing on an electric furnace with a temperature of 525°C for two hours. Cooling in desiccator and weighing (w_3). Calculation of ash content by the formula (Abriana, 2018):

$$\text{Ash Content} = \frac{Incandescent\ residual\ \ weight}{Sample\ weigth} \times 100\% \quad (2)$$

Where: the incandescent residual weight is w_3-w_1 and the sample weight is w_2-w_1

Data Analysis

Coffee leaf tea with the addition of red ginger was carried out in laboratory experiments. The analysis was carried out using ANOVA (Analysis of Variance) to test the influence of each factor and continued with further testing of LSD (Least Significance Difference) with four levels of treatment, namely coffee leaves with concentrations of 100%, 70%, 60%, and 50% as well as red ginger powder with concentrations of 0%, 30%, 40%, and 50% and three repetitions. The confidence level used is 95% (α 0.05).

RESULTS AND DISCUSSION

Sensory Characteristics

Functional beverages are an important part of functional processed products due to their health benefits and attractive sensory characteristics, the suitability of consumer tastes and the affordability of people's purchasing power (Males et al. 2022). Sensory testing is carried out organoleptically using a hedonic method against three parameters, namely color, aroma, and flavor. In this test, panelists were asked to express feedback about like or dislike for the parameters tested on a hedonic scale. The results of the organoleptic test of coffee leaf tea with the addition of red ginger powder as presented in Figure 2.

Color

The results for color of coffee leaf tea ranged from 3.31 – 4.11 on average. The lowest color score of 3.31 was shown by the comparison of coffee leaves 50%: red ginger 50% treatment while the highest score of 4.11 was obtained by the comparison of coffee leaves 100%: red ginger 0% treatment. Based on the results of the color organoleptic test, it indicated that the best panelist favorability level was found in the comparison treatment of 100% coffee leaves: 0% red ginger (4.11) with the results of the likes assessment of 20 panelist. The lowest result of panelist favorability level towards the comparison treatment of 50% coffee leaves: 50% red ginger with the results of the likes assessment of five panelist as presented in Figure 2.

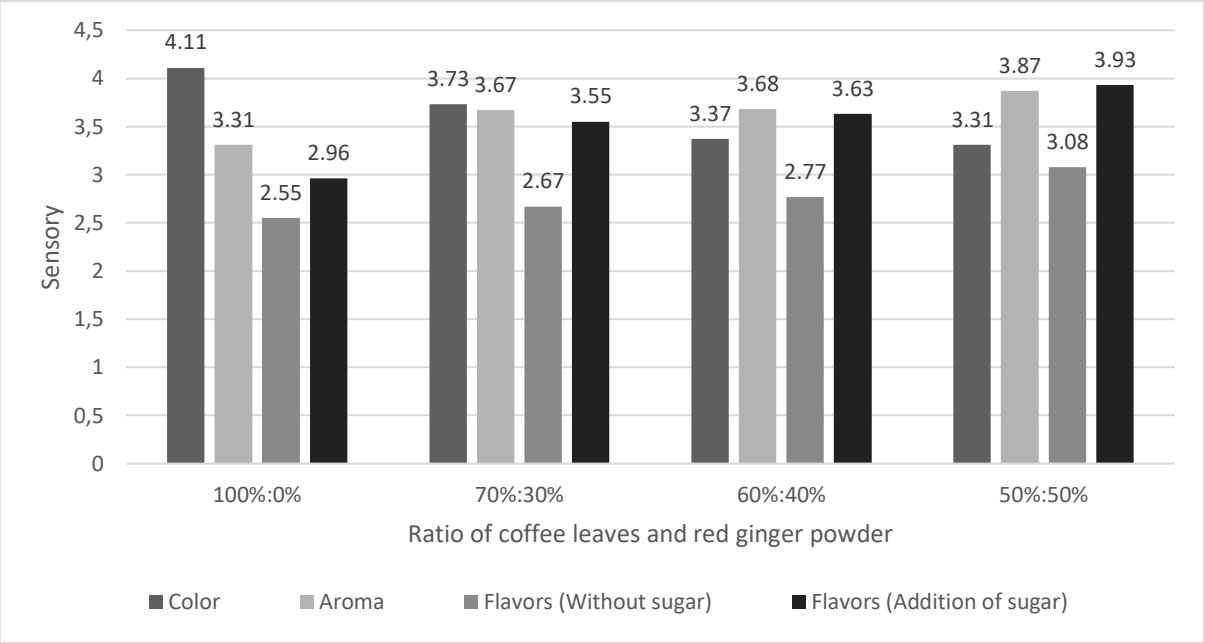

Figure 2. Organoleptic test results of coffee leaf tea with the addition of red ginger powder

Figure 3. The color of coffee leaf tea

The reddish color of the coffee leaf tea after extracted with hot water will be preferred by the panelist without adding red ginger. This is because the redder ginger was added, which will reduce the characteristic color of the tea (a reddish color). This is in parallel with the results of Siringoringo et al., (2012). During the tea making process (the fermentation process) there was a process of changing catechins into simpler compounds, i.e., flavonoid polyphenol compounds that gave a red color to the coffee leaf tea steeping water. Ginger will give a red color which is the typical color of red ginger (Lukita et al., 2021) and if mixed with coffee leaves will produce coffee leaf tea with dark red in color. Thus, the addition of red ginger will produce tea with a different color from the typical color of tea.

The analysis of variance results shows that coffee leaves and red ginger concentration comparison treatments significantly affected the color of coffee leaf tea produced (sig value $p<0.05$). Based on the LSD tests coffee leaves tea with the addition of red ginger showed that between the treatment (100%: 0%) against (70%: 30%), (60%: 40%), and (50%: 50%) were significantly different (sig value $p<0.05$. The ANOVA results is shown in Table 1.

Table 1. ANOVA Test Results Sensory Characteristics and Chemical Properties of Coffee Leaf Tea with the Addition of Red Ginger

Sensory Characteristics	Comparison Coffee Leaves: Red Ginger			
	100:0	70:30	60:40	50:50
Color	4.11 ± 0.1007*	3.73 ± 0.0231*	3.37 ± 0.0231*	3.31 ± 0.0231*
Aroma	3.31 ± 0.0611*	3.67 ± 0.0462*	3.68 ± 0.0400*	3.87 ± 0.0611*
Flavors (Without sugar)	2.55 ± 0.0231*	2.67 ± 0.0231*	2.77 ± 0.0833*	3.08 ± 0.0400*
Flavors (Addition of sugar)	2.96 ± 0.0000*	3.55 ± 0.0611*	3.63 ± 0.0231*	3.93 ± 0.0231*
Moisture Content (%)	1.54 ± 0.0551*	2.76 ± 0.0681*	3.09 ± 0.0608*	3.46 ± 0.7564*
Ash Content (%)	4.50 ± 0.6413*	5.27 ± 0.0639*	5.28 ± 0.0219*	5.26 ± 0.2422*

*ns = non-significant at 5% level of significance, * = Significant at 5% level of significance*

Aroma

The score for aroma of coffee leaf tea with the addition of red ginger ranged on average from 3.31–3.87. The lowest aroma score of 3.31 was shown by the 100% coffee leaf: 0% red ginger comparison treatment. While the highest aroma score of 3.87 was obtained on the coffee leaf treatment of 50%: red ginger 50%. The results of measuring the aroma of various treatments on coffee leaf tea with the addition of the resulting red ginger are presented in Figure 2.

The best panelist favorability level was found in the comparison treatment of 50% coffee leaves: 50% red ginger with a value of 3.87. In this treatment, 20 panelist like the product. The lowest result of the panelist favorability level was found in the comparison treatment of 100% coffee leaves: 0% red ginger with a value of 3.31 and the likes assessment of five panelist. The aroma of coffee leaf tea with the addition of red ginger is given by the product with the same ratio between coffee leaf tea and red ginger because it produces a fragrant aroma. This is in accordance with the results of Srikandi et al., (2020). The typical of red ginger is fragrant with a spicy flavor. According to Malligan et al., 2018, aroma is one of the key variables, because in general the consumer's flavor of food products is largely determined by aroma. Thus, aroma is related to flavor and can determine the flavor of coffee-leaf tea with the addition of red ginger.

The analysis of variance results on coffee leaves and red ginger concentration comparison treatments show that the treatment had a significant effect on the aroma of coffee leaf tea (sig value $p<0.05$). Based on the LSD tests, coffee leaves tea with the addition of red ginger showed that between the treatment (100%: 0%) against (70%: 30%), (60%: 40%), and (50%: 50%) were significantly different (sig value $p<0.05$) as presented in Table 1.

Flavor

Flavor is a sensory attribute that cannot be separated from the overall taste of food products. Flavor plays an important role in the taste of food. Furthermore, the enjoyment of flavors in processed food products is impossible to obtain without a taste in it. Flavor is a sensation received by taste buds located in the oral cavity and caused by compounds that dissolve in water and interact with receptors on the tongue and taste buds in the oral cavity. Furthermore, there are four basic tastes that can be recognized by the human tongue namely sweet, bitter, sour, and salty (Berenstein, 2017). The results of measuring the flavor of various treatments on coffee leaf tea with the addition of red ginger produced as presented in Figure 2.

The flavor of coffee leaf tea without sugar and the addition of sugar on average ranges from 2.55 – 3.93. The lowest taste score in the flavor

without sugar is at a ratio of 100% coffee leaves: 0% red ginger obtained a value of 2.55. While the lowest flavor with the addition of sugar is the same as the flavor without sugar, namely the ratio of 100% coffee leaves: 0% red ginger obtained a value of 2.96. Furthermore, the highest unsweetened flavor score at the 50% coffee leaf comparison treatment: 50% red ginger obtained a value of 3.08 and the flavor score with the highest addition of sugar as well as the flavor without sugar, namely the comparison treatment of 50% coffee leaves: 50% red ginger obtained a value of 3.93.

Based on the results of the organoleptic test of flavors without sugar, the best level of panelist favorability was found in the comparison treatment of 50% coffee leaves: 50% red ginger with a value of 3.08 and the like assessment of 18 panelist, while the lowest result of the panelist favorability level was found in the comparison treatment of 100% coffee leaves: 0% red ginger with a value of 2 and the likes assessment of seven panelist. Furthermore, the flavor with the addition of sugar showed that the best panelist favorability level in the comparison treatment of 50% coffee leaves: 50% red ginger with a value of 3.93 and of 22 panelist, while the lowest result of the panelist favorability level was found in the comparison treatment of 100% coffee leaves: 0% red ginger with a value of 2.96 and the likes assessment of three panelist. The taste of coffee leaf tea with the addition of red ginger was preferred by the panelist because it was influenced by the combination of red ginger which gave a spicy taste to the product, so the comparison in each assessment treatment increased that the panelist felt. It is appropriate (Lukita et al., 2021), that there is oleoresin consisting of zingerone, shogaol, and gingerol components in ginger and the flavor contained in oleoresin is what causes a spicy and bitter taste. Furthermore, the high oleoresin content makes a spicier taste in ginger extract and provides a higher antioxidant effect (Ibrahim et al., 2015). Based on these antioxidant benefits, coffee leaf tea is used as an herbal tea beverages (Lagawa et al., 2020). Thus, the ratio of the concentration of coffee leaves and red ginger is balanced, so the resulting spicy, bitter, and astringent taste is not so sharp that the panelist liked.

The analysis of variance results on coffee leaves and red ginger concentration comparison treatments show that the treatment had a significant effect on the flavor of coffee leaf tea. A significant difference found for the taste in the addition of sugar and without the addition of sugar. The ratio of coffee leaves with red ginger had a significant effect on flavor of the coffee leaves tea both with addition of sugar (sig value $p<0.05$) and on the flavor without addition of sugar sig value $p<0.05$). Based on the LSD tests, coffee leaves tea with the addition of red ginger showed that between the treatment (100%: 0%) against (70%: 30%), (60%: 40%), and (50%: 50%) were significantly different (sig value $p<0.05$) as presented in Table 1.

Based on SNI 03-3836-2012 (BSN, 2012), a good tea flavor is a typical tea that has taste of astringent. In addition, with the presence of high enough caffeine levels in the coffee leaves tea resulted in tea taste that is no less delicious than coffee beans (Dado et al., 2019). Thus, the flavor of the coffee leaf tea has an astringent and spicy taste due to the addition of red ginger.

Chemical properties

Moisture Content

Moisture content is an important parameter to know, especially for dry matter. The moisture content of coffee leaf tea with the addition of red ginger on average ranges from 1.54% - 3.46%. The lowest moisture content was obtained at a 100% coffee leaf comparison treatment: 0% red ginger with a yield of 1.54%; while the highest moisture content was obtained at the coffee leaf ratio treatment of 50%: red ginger 50% with a yield of 3.46%. The

higher the concentration of red ginger used, the higher the moisture content of coffee leaf tea. This shows that there is an increase in the value of water content along with the increase in the concentration of ginger added. The results of measuring the moisture content of various treatments on coffee leaf tea with the addition of red ginger as presented in Figure 4.

The results of the fingerprints of the various moisture content of coffee leaf tea showed that the ratio of coffee leaves with red ginger had a very noticeable effect with sig value ($p<0.05$). This finding is influenced by the addition of red ginger powder which has the largest concentration of the ratio of the others as much as 50%. The drying temperature of red ginger was 105^0C heated for three hours, while the drying temperature of coffee leaves was 90°C heated for one hour. This result is in accordance with the results of Sasmita et al., (2018), that the higher the temperature and the longer the drying used, the higher of heat transfer rate and the greater the evaporation of water. Furthermore, according to Mawardi et al., (2016), the water content of foodstuffs processed into functionary beverages was getting higher along with the increasing concentration of the ratio of added ingredients. Dried red ginger has a high moisture content, resulting in an increase in the moisture content of the coffee leaf tea functional beverages. Based on the results of the ANOVA, it has a very significant effect, therefore a further test of LSD was carried out. Based on the results of the LSD test, the water content of coffee leaf tea with the addition of red ginger obtained a ratio and treatment (100%:0%) to (70%:30%), (60%: 40%), (50%:50%) the results were very different, as well as the treatment (70%: 30%) against (60%: 40%), (50%: 50%) with sig value ($p<0.05$) as presented in Table 1.

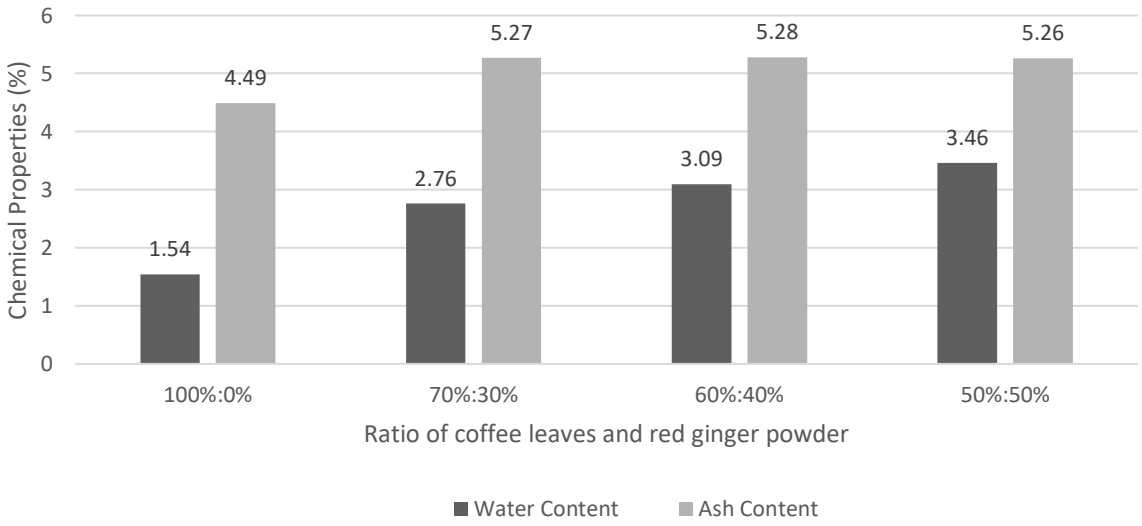

Figure 4. Chemical properties of coffee leaf tea with the addition of red ginger powder

Figure 4 shows that the higher the concentration of red ginger powder, the higher the moisture content of coffee leaf tea. The highest water requirement was in the coffee leaf ratio treatment of 50%: 50% red ginger as much as 3.46%. Based on the SNI tea quality standard 03-3836-2012 (BSN, 2012) shows that the water content of coffee leaf tea with the addition of red ginger produced meets the quality requirements of tea water content around a maximum of 8%.

Ash Content

Ash content indicates the total minerals contained in a food ingredient.

Most foodstuffs consist of organic and water ingredients (96%), the rest consists of mineral elements (Winarno, 2004). Various organic matter in the combustion process will burn but its inorganic components (minerals) will not. The inorganic components will produce ash and being expressed as ash content. Conventional drying is based on the combustion of samples at high temperatures of 500-600^{0}C (Harris and Marshall, 2017)

The ash content of coffee leaf tea with the addition of red ginger on average ranges from 4.49% – 5.26%. The lowest ash content was obtained at a 100% coffee leaf ratio treatment: 0% red ginger by 4,49%; While the highest moisture content was obtained at the coffee leaf ratio treatment of 50%: red ginger 50% at 5.26%. The results of measuring ash content from various treatments on coffee leaf tea with the addition of red ginger as served in Figure 4.

The results of ANOVA on the ash content of coffee leaf tea with the addition of red ginger show that the comparison of coffee leaves and red ginger has a very significant effect with the sig value of $p<0.05$ as presented in Table 1. This is influenced by the addition of red ginger which is quite large, which is as much as 50% with the drying temperature of red ginger which is 60^{0}C for three hours, while the drying time of coffee leaves is for one hour with a temperature of 90^{0}C. This is because the greater the concentration of red ginger, the minerals contained in red ginger affect the ash content of the resulting product. This is in accordance with the opinion Agustina et al., (2020) which states that ash content has something to do with the minerals of a material. The increase in ash content is caused by a higher decrease in water content so that inorganic materials that are left behind will increase, one of which is minerals (Lisa et al., 2015).

CONCLUSION

Coffee leaves can be processed into functional beverages with the addition of red ginger to increase their utilization for health. The comparison treatment of coffee leaves with the addition of red ginger has a noticeable effect on the sensory characteristics of color, aroma, and flavor with the addition of sugar and without the addition of sugar as well as on water content and ash content. Coffee leaf tea products are produced in the form of teabags and meets the Indonesian National Standard SNI 03-3836-2012.

REFERENCES

1. Abriana, A. 2018. Analisis Pangan Teori dan Metode (Food Analysis Theory dan Method). CV Sah Media. Makassar.
2. Afrianto, R., Restuhadi, F., and Zalfiatri, Y. 2017. Analisis Pemetaan Kesukaan Konsumen Pada Produk Bolu Kemojo di Kalangan Mahasiswa Fakultas Pertanian Universitas Riau (Analysis of Mapping Consumer Preferences on Bolu Kemojo Products Among Students of The Faculty of Agriculture, Riau University*)*. 4 (2): 15.
3. Agustina, R., Sunartati, R., Ermaya, D, and Yulia, R. 2020. Pemanfaatan abu pelapah kelapa sebagai pengawet alami ikan kembung (Utilization of coconut sheath ash as a natural preservative for mackerel. *Jurnal Biologica Samudra, 2(2): 137– 144* https://doi.org/10.33059/jbs.v2i1.2975.
4. Berenstein, N. 2017. Flavor Added: The Sciences of Flavor and The Industrialization of Taste In America. 558. Publicly Accessible Penn Dissertations. 2715. https://repository.upenn.edu/edissertations/2715.
5. BSN. 2012. Standard Mutu Teh Kering (Dry Tea Quality Standards). SNI 03-3836-2012. Dewan Standarisasi Nasional. Jakarta.
6. Dado, A. T., Asresahegn, Y.A, and Goroya.K.G. 2019. Comparative Study of Caffeine Content in Beans and Leaves of Coffea Arabica Using UV/Vis Spectrophotometer. *Int. J. Phys. Sci.*, 14(14): 171-176. https://ojs/index.php/10.5897/IJPS2019.4814.
7. Dwiyanti, H., Setyawati, R., Siswantoro,S, and Krisnansari, D. 2020. Formulasi Minuman Fungsional Tinggi Antioksidan Berbasis Gula Kelapa Dengan Variasi Jenis dan Konsentrasi

Ekstrak Rimpang (Formulation of High Antioxidant Functional Drink Based on Coconut Sugar with Variation in Types and concentration of Rhizome Extract). *Media Pertanian,* 4 (2). https://doi.org/10.37058/mp.v4i2.1362.

8. Fibrianto, K., Phil, M., Septiana, N. A, dan Wardani, J. E. 2020. Manfaat Teh Daun Kopi (Benefits of Coffee Leaf Tea). Modul TTG.
9. Fortin, G. A., Asnia, K.K.P., Ramadhani, A.S, and Maherawati, M. 2021. Minuman Fungsional Serbuk Instan Kaya Antioksidan dari Bahan Nabati (Antioxidant-Rich Instant Powder Functional Drink from Plant-Based Ingredients). *Agrointek : Jurnal Teknologi Industri Pertanian* 15 (4): 984–91. https://doi.org/10.21107/agrointek.v15i4.8977.
10. Harris, G.K, and Marshall, M.R. 2017. Ash Analysis. In: Nielsen, S.S. (eds) Food Analysis. Food Science Text Series. Springer, Cham. https://doi.org/10.1007/978-3-319-45776-5_16.
11. Hasanah, H., Ustifina, and Pane, H. W. 2021. Pemanfaatan Daun Kopi (Kawa Daun) Sebagai Penurun Tekanan Darah Tinggi pada Akseptor KB Suntik (Utilization of Cofee Leaves (Kawa Leaves) as a Reduction of High Blood Pressure in Injecting KB Acceptors). *Jurnal Kesehatan Komunitas,* 6 (3): 292–97. https://doi.org/10.25311/keskom.Vol6.Iss3.584.
12. Ibrahim, A.M., Yunianta, and Sriherfyna, F.H. 2015. Pengaruh Suhu dan Lama Waktu Ekstraksi Terhadap Sifat Kimia dan Fisik pada Pembuatan Minuman Sari Jahe Merah (*Zingiber officinale var. Rubrum*) dengan Kombinasi Penambahan Madu Sebagai Pemanis (Effect of Temperature and Length of Extraction Time on Chemical and Physical Properties in the Manufacture of Red Ginger Essence Drink (Zingiber officinale var. Rubrum) with a Combination of Honey Additions as a Sweetener). *Jurnal Pangan dan Agroindustri*, 3(2): 530-541.
13. Lagawa, I Nyoman C., Kencana, P.K.D, and Aviantara., I Gusti N. A. 2020. Pengaruh Waktu Pelayuan dan Suhu Pengeringan terhadap Karakteristik Teh Herbal Daun Bambu Tabah (*Gigantochloa nigrociliata* Buse-Kurz) (Effect of Withering Time and Drying Temperature on the Characteristics of Steadfast Bamboo Leaf Herbal Tea (*Gigantochloa nigrociliata* Buse-Kurz)). *Jurnal Beta (Biosistem* dan Teknik Pertanian). Program Studi Teknik Pertanian, Fakultas Teknologi Pertanian Universitas Udayana, 8(2): 223. https://ojs.unud.ac.id/index.php/beta.
14. Lazuardina, B. A., Farah, D., Purba, W., Rusindiyanto, and Defri, I. 2022. Pemanfaatan Limbah Daun Kopi Sebagai Minuman Kesehatan (Utilization of Coffee Leaf Waste as a Health Drink). Abdi-Mesin: *Jurnal Pengabdian Masyarakat Teknik Mesin*, 2(1):72-80. https://doi.org/10.33005/abdi-mesin.v2i1.35.
15. Lisa, M., Lutfi, M, and Susilo, B. 2015. Pengaruh Suhu dan Lama Pengeringan terhadap Mutu Tepung Jamur Tiram Putih (*Plaerotus ostreatus*) (Effect of Temperature and Drying Time on the Quality of White Oyster Mushroom Flour (*Plaerotus ostreatus*), 3 (3): 10.
16. Lukita, S. I., Kristiastuti, D, and Astuti, N. 2021. Pengaruh Proporsi Jahe (*Zingiber Officinale Rosc*) dan Daun Jambu Biji Terhadap Mutu Organoleptik dan Kesukaan Minuman Instant (Effect of Proportion of Ginger (Zingiber Officinale Rosc) and Guava Leaves on Organoleptic Quality and Instant Drink Preferences). 10 (2): 11. . https://ejournal.unesa.ac.id/index.php/jurnal-tata-boga/.
17. Maleš, I, Pedisić, S., Zorić,Z., Elez-Garofulić, I., Repajić, M., You,L., Vladimir-Knežević, S., Butorac, D, and Dragović-Uzelac, V. 2022. The Medicinal and Aromatic Plants as Ingredients in Functional Beverage Production. *Journal of Functional Foods*. 105210. https://doi.org/10.1016/j.jff.2022.10521.
18. Maligan, J.M., Amana, B.M, and Putri, W.D.R. 2018. Analisis Preferensi Konsumen Terhadap Karakteristik Organoleptik Produk Roti Manis Di Kota Malang (Analysis of Consumer Preferences Towards the Organoleptic Characteristics of Sweet Bread Products in Malang City). *Jurnal Pangan dan Agroindustri*, 6 (2): 86–93. https://doi.org/10.21776/ub.jpa.2018.006.02.9.
19. Mawardi, Y.S. A., Pramono. Y.B, and Setiani, B.E. 2016. Kadar Air, Tanin,

Warna dan Aroma *Off-Flavour* Minuman Fungsional Daun Sirsak (*Annona Muricata*) dengan Berbagai Konsentrasi Jahe (*Zingiber Officinale) (*Moisture Content, Tannin, Colour and Off-flavour Aroma of Functional Drink Made from Soursop Leaves (*Annona muricata*) using Several Concentration of Ginger *(Zingiber officinale)*. Jurnal Aplikasi Teknologi Pangan 5 (3) 2016. http://dx.doi.org/10.17728/jatp.179.

20. Pristiana, D.Y., Susanti,S., and Nurwantoro. 2017. Antioksidan dan Kadar Fenol Berbagai Ekstrak Daun Kopi (*Coffea sp*.): Potensi Aplikasi Bahan Alami untuk Fortifikasi Pangan (Antioxidants and Phenol Levels of Various Coffee Leaf Extracts (Coffea sp.): Potential Applications of Natural Ingredients for Food Fortification). *Jurnal Aplikasi Teknologi Pangan*, 6 (2):89. https://doi.org/10.17728/jatp.205.
21. Rampengan, V.J. 1985. Dasar- Dasar Pengawasan Mutu Pangan (Basics of Food Quality Control). Badan Kerja Sama Perguruan Tinggi Negeri Indonesia Bagian Timur, Ujung Pandang.
22. Ranggawati, M. 2018. Karakteristik Organoleptik dan Sifat Kimia Minuman Fungsional Liang Teh. Daun Karamunting (*Rhodomyrtus tomentosa*) dengan Penambahan Kayu Manis (Organoleptic Characteristics and Chemical Properties of The Functional Drink Liang Tea Karamunting Leaves *(Rhodomyrtus tomentosa)* with The Addition of Cinnamon). *J. Sains dan Teknologi Pangan (JSTP)*, 3(1) :1111-1118.
23. Ryadha, R.S., Aulia, N, and Batara, A. 2021. Potensi Rempah-Rempah sebagai Minuman Fungsional Sumber Antioksidan dalam Menghadapi Pandemi Covid-19 (Potential of Spices as Functional Drinks, a Source of Antioxidants in Facing the Covid-19 Pandemic). Jurnal ABDI, 3 (1).
24. Sasmita, S., Jamaluddin, P, and Syam, H. 2018. Laju Pindah Panas Secara Konduksi dan Penguapan Air Selama Proses Pengeringan Gabah Menggunakan Cabinet Dryer (Conduction and Water Evaporation Heat Transfer Rate During the Grain Drying Process Using Cabinet Dryer. *Jurnal Pendidikan Teknologi Pertanian*,1 (1): 77. https://doi.org/10.26858/jptp.v1i1.6221.
25. Setiawan, E. A and Rahadian, D. A. 2015. Karakteristik Kimia dan Sensory Minuman Penyegar (Chemical and Sensory Characteristics of Refreshing Drinks). *Jurnal Teknosains Pangan*, 4(2): 9. www.ilmupangan.fp.uns.ac.id
26. Sharma, S., Singh, A., Sharma, S., Kant, A., Sevda, S., Taherzadeh, M.J, and Garlapati, V.K. 2021. Functional Foods as a Formulation Ingredients in Beverages: Technological Advancements and Constraints. *Bioengineered*. 12 (2): 11055–75. https://doi.org/10.1080/21655979.2021.2005992.
27. Siringoringo, F.H.T., Lubis, Z, and Nainggolan, R.J. 2012. Studi Pembuatan Teh Daun Kopi (Study of Tea Making from Coffee Leaves). *J.Rekayasa Pangan dan Pert*., 1 (1).
28. Srikandi, S., Humaeroh, M, and Sutamihardja, R. 2020. Kandungan Gingerol dan Shogaol dari Ekstrak Jahe Merah (*Zingiber Officinale Roscoe*) dengan Metode Maserasi Bertingkat (Gingerol and Shogaol Content from Red Ginger Extrac*t (Zingiber officinale roscoe)* by Multilevel Maceration method). *al-Kimiya* 7 (2): 75–81. https://doi.org/10.15575/ak.v7i2.6545.
29. Suena, Ni Made. D. S and Ni Putu U. A. 2020. Uji Aktivitas Antioksidan Maserat Air Biji Kopi (*Coffea canephora*) Hijau Pupuan dengan Metode DPPH (2,2-difenil-1-pikrilhidrazil). (Test of Antioxidant Activity of Pupuan Green Coffee Bean Water Maserie (Coffea canephora) with dpph method (2,2-difenil-1-pikrilhidrazil)). *Jurnal Ilmiah Medicamento* 6 (2): 111–17. https://doi.org/10.36733/medicamento.v6i2.1106.
30. Steger, Marc C., Rigling, M., Blumenthal, P., Segatz, V., Quintanilla-Belucci, A., Beisel, J.M., Rieke-Zapp,J., Schwarz,S., Lachenmeier, D.W, and Zhang, Y. 2022. Coffee Leaf Tea from El Salvador: On-Site Production Considering Influences of Processing on Chemical Composition. *CHEMISTRY*. https://doi.org/10.20944/preprints202206.0321.v1.
31. Tarwendah, I.P. 2017. Jurnal Review: Studi Komparasi Atribut Sensoris dan Kesadaran Merek Produk Pangan (Journal Review: A Comparative Study of Sensory Attributes and Brand Awareness of Food Products). 8.

32. Widiyana, I Gede, Ni Made Yusa, and I Made Sugitha. 2021. Pengaruh Penambahan Bubuk Jahe Emprit (*Zingiber officinale var. Amarum*) Terhadap Karakteristik Teh Celup Herbal Daun Ciplukan (*Physalis angulata* L.) (Effect of Emprit Ginger Powder Addition (Zingiber officinale var. officinale). Amarum) Against the Characteristics of Ciplukan Leaf Herbal TeaBags *(Physalis angulata L.)*). *Jurnal Ilmu dan Teknologi Pangan (ITEPA)* 10 (1): 44. https://doi.org/10.24843/itepa.2021.v10.i01.p05.
33. Widyantari, A.A.A.S. 2020. Formulasi Minuman Fungsional Terhadap Aktivitas Antioksidan. Widya Kesehatan (Functional beverage formulations against antioxidant activity). Widya Health 2 (1): 22-29. https://doi.org/10.32795/widyakesehatan.v2i1.604.
34. Winarno, F.G. 2004. Kimia Pangan dan Gizi (Food and Nutrition Chemistry). Cetakan ke-XI. PT. Gramedia Pustaka Utama. Jakarta.