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The Different of Processing Method Against Polyphenol and Antioxidant Activity of Moringa Herbal Tea

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Abstract. Moringa leaves are known contain many types of antioxidants such as ascorbic acid, flavanoids, phenolic compounds and carotenoids. Moringa leaves have the potential to be processed into herbal tea. This study investigated the different of tea processing methods against polyphenol, antioxidant activity and panelist level on moringa leaf herbal tea, and also to get the appropriate processing method of moringa herbal tea. The study was conducted based on 4 types of tea processing methods including black tea, green tea,oolong tea and fragrant tea with 3 replications. The data were reported as average. This study showed that the tea processing method gives a different to the chemical components and tea characteristics produced. The results of the processed moringa leaf tea with different tea processing methods showed that the appropriate of processing method was fragrant tea method with the value of moisture content 6.36%, total polyphenol 2.43%, antioxidant activity 71.58%, and the sensory test of color, aroma and taste were 4.13 (like), 4.13 (like) and 3.2 (regular), respectively.

Keywords: Moringa leaf, herbal tea, antioxidant, polyphenol

1. Introduction

Tea is a drink made from processed young leaves of tea plants (*Camellia sinensis*) which ranks second after water as the most consumed beverage in the world and is known to have many health benefits. Tea leaves contain caffeine compounds which are known to have a refreshing effect on the body. Tea is rich in vitamins such as vitamin C and B especially thiamin and riboflavin which can help the process of absorption of protein in the body and is believed to relieve headaches. In addition, polyphenol compounds in tea function as antioxidants that can slow down and prevent the oxidation process by free radicals so that cell damage can be avoided and can help prevent various chronic diseases [1].

Increasing public awareness of health encourages increasing consumption patterns of herbal products. Not only in Eastern countries, WHO data shows that demand for herbal products in European countries in the period 1999-2004 is estimated to reach 66% of world demand. This also encourages research on herbal products to grow rapidly [2].

Herbal tea comes from the processing of flowers, seeds, leaves, skin and roots of plants other than tea plants (*Camellia sinensis*). Basically, the processing of herbal tea is almost the same as processing tea in general as well as the way it is presented. Herbal tea can be consumed in single or herbal



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mixtures. Herbal tea is a product that is currently widely consumed and is preferred by the community because the raw material is easier to obtain and the benefits are more varied depending on the raw materials used. Some herbal teas that are now known by the public such as cocoa leaf tea, girlfriend water leaf tea, bay leaf tea and leaf tea [2].

Moringa oleifera is a type of plant that is often found in Indonesia, knows no season, can grow in a variety of climates and in some regions it is usually processed for consumption. *Moringa oleifera* is known as different in every country including benzolive, drumstick tree, kelor, marango, mlonge, mulangay, nebeday, saijhan, and [3]. Analysis of the nutritional content of *Moringa oleifera* leaves shows that Moringa leaves have extraordinary nutritional content. Leaves of moringa are believed to cure various diseases Even in the history of moringa plants have been used by Indian tribes as medicine since 5000 years ago [4].

The chemical content of moringa leaves is phenol, hydroquinine, steroid flavonoids, triterpenoids, alkaloid tannins and saponins. Various studies have proven that the bioactive content in Moringa leaves has the potential as a medicinal compound including anti-inflammatory, antifungal, anticancer, and antioxidant. Moringa leaves are supported as a good source of nutrients because they contain proteins including all essential amino acids, iron, calcium, vitamins, carotenoids, other complementary minerals and other phytochemical compounds [3].

Moringa leaves have the potential as tea because they have good antioxidant activity. Moringa leaves contain antioxidant compounds such as flavonoids, vitamin C, and vitamin [5]. Based on the research conducted by [6], in 1 gram of green tea Moringa leaf powder brewed in 100 ml of water, Moringa leaf green tea contains 42 mg EGCG (epigallocatechin-3-gallate). In the same ratio, green tea from the *Camelia sinensis* plant contains 70.2 mg EGCG (epigallocatechin-3-gallate). EGCG (epigallocatechin-3-gallate) is the most commonly found type of polyphenol constituent in tea.

To facilitate its use in the community and increase the shelf life, Moringa leaves can be processed into herbal Moringa leaf tea. Based on the method of processing, tea in Indonesia is divided into three groups, namely black tea (fermented tea), green tea (unfermented tea) and fragrant tea. Black tea is made with a full enzymatic oxidation process whereas green tea is made without enzymatic oxidation, while fragrant tea is green tea which is mixed with fragrances such as jasmine flowers to produce a distinctive taste. Jasmine flowers are chosen because they have a good aroma and are favored by consumers so they are commonly used in making fragrant tea. While in Taiwan there is one more type, namely oolong tea (semifermented tea) which is the result of a transitional processing between green tea and black tea [7].

The different methods of processing tea based on the enzymatic oxidation process will affect the physical and chemical properties of tea leaves due to the enzymatic oxidation process resulting in the overhauling of certain compounds. Catechins can be oxidized to thearubigin compounds that can give a brownish red color to the tea and theaflavin which can provide fresh taste [8].

Based on research conducted by [9], it is known that processing methods can affect the quality of the cocoa leaf tea produced. Green tea from cocoa leaves turned out to have the highest antioxidant activity and in terms of organoleptic cocoa leaf green tea is the most preferred tea by panelists compared to cocoa leaf tea which is processed by the method of making black tea, oolong tea and fragrant tea. Whereas in Moringa leaves, the effect of tea processing method on the condition of pre-processing tea and organoleptic reception of the produced Moringa leaf herbal tea is unknown.

Based on the description above, the author conducted a study on "The Different of Processing Method Against Polyphenol and Antioxidant Activity of Moringa Herbal Tea" to determine the relationship between different tea processing methods to the chemical components and panelists level of Moringa tea.

2. Materials and Methods

2.1. Materials

The material used in this study was Moringa leaves obtained from Pasir, Pariaman city. The ingredients for reagents used were distilled water, methanol solution, DPPH (0.2 M) solution, reagenfolin-ciocalteu, Na₂CO₃, gallic acid, 0.05 N ammonia chloroform, H₂SO₄, and Mayer, Bouchardat and Ragendorf reagents. The equipment used in this study included a blender (Miyako BL152GF), oven (Maspion MOT600), aluminum cup, aluminum foil, erlenmeyer, UV-Vis spectrophotometry (Shimadzu UV-1800), desiccator, funnel, teat, measuring cup, dropper cups, test tubes, and equipment for sensory testing.

2.2. Design and Data Analysis

The research is explorative to find out the type of herbal tea that is the most preferred Moringa leaf organoleptically based on processing methods. The study was conducted based on 4 types of tea processing methods including black tea, green tea, oolong tea and fragrant tea with 3 replications and the data werereportedas average.

2.3. Processing Methods of Moringa Tea

The stages of making Moringa green tea: Moringa leaves are picked and sorted. Then moringa leaves were carried out at a temperature of 70°C for 20 minutes. Then grinding using a blender until tea powder is obtained. Then drying in an oven with a temperature of 80°C for 30 minutes. The product is ready to be packed [10].

The stages of making Moringa black tea: Moringa leaves are picked and sorted. After that the moringa leaves are carried out for 16 hours at room temperature (27-30°C). Then grinding using a blender until tea powder is obtained. After that enzymatic oxidation is carried out at room temperature (27-30°C) for 18 hours (until the entire leaf turns black. Then drying in an oven with a temperature of 80°C for 30 minutes. The product is ready to be packed [10].

The stages of making Moringa oolong tea: Moringa leaves are picked and sorted. Then the moringa leaves are carried out for 16 hours at room temperature (27-30°C). Then grinding using a blender until tea powder is obtained. After that enzymatic oxidation is carried out at room temperature (27-30°C) for 9 hours (until the entire leaf turns black. Then drying in an oven with a temperature of 80°C for 30 minutes. The product is ready to be packed [9].

The stages of making Moringa Fragrant tea: Moringa leaves are picked and sorted. Then rub it in the oven at 90-100°C for 1-2 hours until the moisture content is around 0%. Moisture is then carried out by giving water until the water content is 30-35% of the weight of the material. Then do fragrances by mixing tea powder with jasmine flowers with ratio of 1: 1. Then mix and stir the tea that has been moistened with jasmine for 18 hours. Then drying in an oven with a temperature of 80°C for 30 minutes. The product is ready to be packed [10].

2.4. Observation

Observation on Moringa leaves includes observing water content [11], total polyphenols [12] and qualitative testing of alkaloids [13].

The observation of herbal tea leaves produced by Moringa leaves in the form of observing the chemical content including water content [11], antioxidant activity [1], and total polyphenols [12] then observing tea steeping water was tested against the level of preference of the panelists [15]. The best products are chosen based on the best content of polyphenols and antioxidants and the level of preference of the panelists.

3. Results and Discussion

3.1. Raw Material

Moringa leaves have an ovoid leaf shape, 1 - 2 cm long, 1-2 cm wide, blunt tip and base, flat edge, pinnate and compounded reinforcement arrangement in one stalk. Young moringa leaves are light green with a soft and weak texture while old Moringa leaves are dark green with a rather stiff and hard

texture [16]. The analysis carried out on the raw material of young leaves of Moringa plants includes water content, ash content, total polyphenol content and qualitative testing of alkaloids. The average value of the chemical components of the raw material for Moringa leaves can be seen in Table 1.

Table 1. shows that the moisture content of the fresh leaves of *Moringa oleifera* is 73.94%. The moisture content of the Moringa leaves is slightly lower than the moisture content of Moringa leaves according to the Ministry of Health (1995), which is equal to 75%.

Table 1. The Average Value of Chemical Components of Moringa Leaf Raw Materials

Analysis Component	Result ± SD
Moisture Content (%)	73,94 ± 0,62
Polyphenol Content (%)	1,24 ± 0,26
Alkaloid (+/-)	+

Note: SD (Standard Deviation)

The total polyphenol in fresh Moringa leaves is 1.24%. The total polyphenols in Moringa leaves are higher than the total polyphenols found in cocoa leaves which are equal to 0.8% [9].

After qualitative testing of alkaloid compounds, it was obtained that the positive fresh Moringa leaves contain alkaloid compounds. In accordance with the research conducted by [17], the phytochemical test results on Moringa leaves showed the presence of alkaloid compounds, flavonoids, phenolics, triterpenoids / steroids and tannins. According to research conducted by [18], Moringa leaves contain alkaloid compounds, tannins, saponins, steroids, triterpenoids and trigonelin compounds that can increase the quantity of breast milk.

3.2. Moringa Herbal Tea

After Moringa leaves processed into 4 types of tea including black tea, oolong tea, green tea and fragrant tea, then the analysis of the four types of herbal Moringa tea was carried out. The analysis included water content, total polyphenols, antioxidants, and panelists' preference test for Moringa herbal tea. The average value of the herbal tea content of Moringa leaves with various processing methods can be seen in Table 2.

Tabel 2. The Average Value of Chemical Components Moringa Herbal Tea

Processing Method	Analysis Component		
	Moisture Content (%)	Polyphenol Content (%)	Antioxidant Activity (%)
Black Tea	7.31±0.23	1.14±0.07	32.77±0.58
Oolong Tea	7.10±0.79	1.42±0.09	34.09±2.31
Green Tea	6.36±0.36	1.61±0.04	44.87±2.51
Fragrant Tea	6.36±0.18	2.43±0.26	71.58±1.80

Note: SD (Standard Deviation)

3.2.1. *Moisture Content.* The data in Table 2. show that the moisture content in herbal Moringa tea ranges from 6-7%. This is in accordance with the maximum limit of moisture content tea in Indonesian National Standards which is 8% so that the moisture content of herbal Moringa tea with various processing methods can meet the requirements. The difference in moisture content in tea products can be caused by differences in processing in each method. Green tea undergoes twice the process of decreasing moisture content, namely in the process of drying at 70°C for 20 minutes and the drying process at 80°C for 30 minutes. Black tea and oolong tea have greater moisture content than green tea and fragrant tea because the process of black tea and oolong tea is carried out at room temperature and the drying temperature of tea in each method is the same, namely 80°C for 30 minutes. The drying process of green tea at 70°C for 20 minutes can reduce the moisture content of tea leaves to around 60-70% [10]. Fragrant tea has the lowest moisture content, allegedly because fragrant

tea undergoes several drying processes, namely drying during the process of making green tea, grinding process until the moisture content of tea powder approaches 0% and the drying process when processing fragrant tea. Moisture content in food is a very important component because it will affect the physical properties and shelf life of a food ingredient. If the moisture content of a food is too high, then the food will be easily overgrown by mold/fungus so that the shelf life is shorter. Whereas if the moisture content of a food is too low, the food will become fragile, affecting the physical properties of food. This can reduce consumer acceptance of these foods [19].

3.2.2. Polyphenol Content. The data in Table 2 shows that Moringa fragrant tea has the highest total polyphenol content which is equal to 2.43%. Green tea is 1.61%, oolong tea is 1.42% and black tea is 1.14%. The total content of polyphenols in herbal tea with Moringa leaves is higher than the total polyphenols found in cocoa leaf tea which ranges from 0.3-0.7% [9]. This value is still much lower than the total content of polyphenols in green tea made from tea plants according to Indonesian National Standards number 3945-2016 which is a minimum of 15%. According to research conducted by [6], young Moringa leaves dried to 13% moisture content containing EGCG (epigallocatechin-3-gallate) of 0.76%.

The oxidation process for making black tea and oolong tea is 18 hours and 9 hours respectively. The oxidation process of herbal tea with Moringa leaves is much longer than the oxidation process of tea made from tea plants which only ranges from 45-90 minutes. During the tea oxidation process, most of the catechins are converted to theaflavin and tearubigin. Theaflavin gives a touch of fresh taste in steeping tea and gives a reddish yellow color. Whereas tearubigin plays a role in giving a brownish red color to steeping water of black tea. The longer the oxidation process takes place, the more polyphenol compounds are broken down into other compounds so that the levels of polyphenols are lower [8].

Jasmine flowers contain phenolic compounds [20]. The process of mixing jasmine flowers in the processing of fragrant tea affects the total polyphenols in fragrant tea. This is because the process of imbibition of phenolic compounds found in jasmine flowers into herbal tea leaves Moringa so that the total value becomes higher than other Moringa herbal tea.

The phenol compound is a compound containing a hydroxyl (-OH) group that is bound directly to the aromatic hydrocarbon ring group. Classification of phenol compounds contained in plants are simple phenol, benzoquinone, phenolic acid, acetophenone, naphthoxinone, xanton, carinar bioflavonoids, stilben, derivatives tyrosine, cinnamic hydroxy acids, flavonoids, lignans, and tannins [21].

3.2.3. Antioxidant Activity. Antioxidants are compounds that can counteract or reduce the negative effects of oxidants in the body by complementing the lack of electrons possessed by free radicals. DPPH radicals are widely used as radical models for antioxidant testing. Phenol compounds in plants can capture radicals. The mechanism of phenol compounds in reducing DPPH radicals is through proton donation. In the form of purple DPPH radicals, this color will become light yellow after receiving protons [1].

Moringa leaves are a rich source of beta-carotene, protein, vitamins, calcium, potassium, iron and natural sources of antioxidants. Moringa leaves are known to have good antioxidant activity because they are rich in ascorbic acid, flavanoids, phenolic compounds and carotenoids [22].

The data in Table 2. Shows that in a concentration of 10,000 ppm, the highest antioxidant activity was in fragrant tea, which amounted to 71.58%. Moringa leaf black tea has antioxidant activity of 32.77%, oolong tea by 34.09% and green tea is 44.87%.

The longer the enzymatic oxidation process in the tea processing process, the antioxidant activity will be lower. Green tea and fragrant tea processed without enzymatic oxidation processes have higher antioxidant activity than black tea and oolong tea which have lower antioxidant activity because of enzymatic oxidation processes. This is because the oxidation process results in the loss of several antioxidant components due to the enzymatic oxidation reaction [1]. In line with total polyphenols,

antioxidant activity of Moringa leaves fragrant tea is higher than other teas due to imbibition of phenolic compounds from jasmine flowers to Moringa leaf herbal teas. According to research conducted by [20], the antioxidant activity of jasmine flower extract was 71.48%.

The high antioxidant activity in fragrant tea can occur due to the maillard reaction. Maillard reaction is a reaction that occurs between an amino group from a free amino acid, a residue of a peptide chain or protein with a carbonyl group from a carbohydrate if both are heated or stored for a relatively long time. The processing of fragrant tea uses high temperature in the process of rubbing which is 100°C for 1 hour and continued with drying at a temperature of 80°C for 30 minutes can cause a reaction between carbonyl groups and amino groups that produce Maillard reaction products namely melanoidin compounds. This melanoidin compound has benefits especially in the food industry, namely increasing the intensity of brownish color, increasing the content of antioxidants and increasing aroma [23].

3.2.4. Sensory Evaluation. To find out the consumer acceptance of Moringa herbal tea products produced by various processing methods, the sensory evaluation of Moringa herbal tea produced included color, aroma and flavor of steeping Moringa herbal tea. The sensory evaluation of Moringa herbal tea with various processing methods can be seen in Table 3.

Table 3. The Sensory Evaluation of Moringa Herbal Tea

Processing Method	The Value of Sensory Evaluation		
	Color	Aroma	Taste
Black Tea	4.20	2.96	2.77
Oolong Tea	3.10	3.23	2.83
Green Tea	3.16	3.03	2.97
Fragrant Tea	4.13	4.13	3.20

Note: SD (Standard Deviation)

The data above shows the results of sensory evaluations on a scale of 1 to 5. The scale in this study are (1) Very Dislike, (2) Dislike, (3) Ordinary, (4) Likes and (5) Very Like.

The data in Table 3 show that the level of acceptance of panelists on the color of herbal tea with Moringa leaves with various processing methods is on a scale of 3 (normal) to 4 (likes). The color of steeping Moringa herbal tea which is most preferred by panelists is the color of steeping black tea with an average value of 4.2 (likes). The longer the enzymatic oxidation process, the color of steeping herbal tea leaves Moringa becomes darker. Green tea has a steaming color that is slightly greenish yellow, steeping oolong tea is reddish yellow while black tea has a steaming color that is brownish red. The color difference is due to the enzymatic oxidation process, the catechin compounds are overhauled into theaflavin and tearubigin. The aflavin gives a touch of fresh taste in steeping tea and gives a reddish yellow color while the tearubigin plays a role in giving a brownish red color. Color changes in Moringa leaves can also occur due to the overhaul of the chlorophyll compound into black feophytin [8].

Steeping colored fragrant tea is much darker than green tea but brighter than black tea. Color changes in fragrant tea can be caused because in the process of processing, fragrant tea warms up with high temperatures during the process of grinding. Color changes that occur in dried food products are Maillard and caramelization reactions. Changes that occur due to maillard reactions are reactions that occur between carboxyl from carbohydrates with primary amino groups from proteins.

The data in Table 3 show that the level of acceptance of panelists on the aroma of herbal tea with Moringa leaves with various processing methods is on a scale of 3 (normal) to 4 (likes). The aroma of Moringa leaf herbal tea which is most preferred by panelists is the aroma of fragrant tea with an average value of 4.13 (likes). This is due to the aroma of jasmine produced by fragrant tea. In addition, according to [23], melanoidin compounds formed due to maillard reactions can have an effect on increasing the aroma of tea.

The aroma of tea products plays a very important role. The term aroma is interpreted as an odor sensation caused by the chemical stimulation of volatile compounds which are smelled by different oily nerves in the nasal cavity when food enters the mouth. The sensation or stimulation will always cause delicacy, which can then affect the level or acceptability of the panelist or consumer of a particular food product [19].

The taste is different from the smell and more often involves the five senses of the tongue. Taste is a parameter that is no less important in determining whether a product can be accepted by consumers or not. Components that can cause a sense of dependence on its constituent compounds. Generally food stuffs do not only consist of one taste but a combination of various kinds of flavors that are integrated so as to create a complete taste of food [19].

The data in Table 3 show that the level of acceptance of panelists on the taste of Moringa herbal tea with various processing methods is on a scale of approximately 3 (normal). This is because the steeping of Moringa leaves herbal tea has a tight taste. The flavor of the steamed herbal tea leaves Moringa leaves can be formed due to the content of polyphenol and alkaloid compounds in Moringa leaves. In addition, during the organoleptic testing of herbal tea, Moringa leaves are not added sugar so that most panelists did not like steeping the Moringa leaf herbal tea. However, Moringa leaf fragrant tea has the most preferred taste by panelists with an average value of 3.2 (usual). Overall, the most preferred Moringa leaf herbal tea products by panelists can be seen in the organoleptic radar graph found in Figure 1.

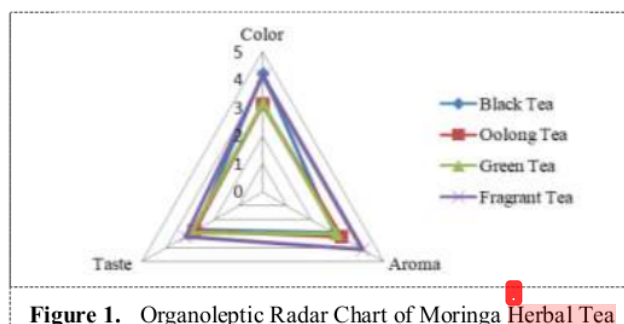


Figure 1. Organoleptic Radar Chart of Moringa Herbal Tea

From Figure 1 it can be seen that the whole Moringa fragrant tea is most preferred by consumers because it has the largest organoleptic radar area. The color organoleptic value of Moringa fragrant tea is on a scale of 4.13 (likes), the organoleptic value of aroma of fragrant tea from Moringa leaves is on a scale of 4.13 (likes), and the organoleptic value of steeping flavor of Moringa leaves is on a scale of 3, 2 (normal).

4. Conclusion

The tea processing method gives a difference to the chemical components and the characteristics of the Moringa leaf herbal tea produced. The longer the enzymatic oxidation process in tea takes place, the lower the antioxidant and polyphenol content in tea. Fragrant tea processing method is a herbal tea product with Moringa leaves with the best characteristics with a water content of 6.36%, total polyphenols 2.43%, antioxidant activity 71.58%, where the color organoleptic value of steeping Moringa fragrant tea is on a scale of 4.13 (likes), the organoleptic value of aroma of fragrant tea from Moringa leaves is on a scale of 4.13 (likes), and the organoleptic value of steeping flavor of Moringa fragrant tea is on a scale of 3.2 (normal).

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