Effect of particle size on sensory attributes of sapodilla tea (*Manilkara zapota*) using E-tongue

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Abstract. Tea is the second most consumed beverage after water, due to its distinctive aroma and the benefit as an antioxidant. This study aims to determine the sensory attributes of sapodilla tea using e-tongue. The method was an experimental descriptive by using three variations of slicing size and drying temperature of 70°C in a food dehydrator for 21 hours. The results showed that the sourness, bitterness, astringent, umami, and after-taste of sapodilla tea gave the value of 0.04 to 0.63 mmol. The moisture content of the drying results with three slicing size variations (3 mm, 5 mm, and 8 mm) were 3.63%, 4.47%, and 6.36%. Powder yield of brown tea powder with three slicing size variation (3 mm, 5 mm, and 8 mm) was 20.35%, 21.79%, and 22.4%.

Keywords: sapodilla, Tea, E-Tongue, Sensory

1. Introduction
Tea has been widely known in various countries and is the most widely consumed beverage by humans after water [1]. Tea has a distinctive aroma and preferred flavor. In addition, because the substances contained in tea have many benefits, especially as an antioxidant and anticancer [1].

Initially, the designation of tea was only aimed at the results of the infusion of the Camellia sinensis L. Kuntze plant, such as black tea, green tea, and oolong tea. The types of tea aside from Camellia sinensis are herbal teas. Herbal tea does not contain caffeine, so it is suitable to be used as a body detox [2]. Lately there is growing research on the manufacture of teas made from herbal plants. These materials come from dried leaves, seeds, roots, stems, flowers, bark, dried fruit [3].

Herbal tea is one drink in the form of a single or a mixture of tea and herbal plants that have properties in helping the treatment of an illness or as a body refreshing drink. The efficacy of each herbal tea varies depending on the raw materials used [4].
When harvesting sapodilla fruit, sapodilla fruit was taken. When sorting by farmers there is brown fruit that is not used anymore so it is immediately disposed of because the sapodilla fruit is still very small in size, 2 cm in diameter, brownish green so that it has an off grade quality because it cannot be consumed directly in fresh conditions, if it does ripening the resulting fruit will not be as sweet as the diameter of 4.7–4.9 cm as a fruit worthy of sale to producers. So the use of raw materials off grade sapodilla as an alternative to making tea. Where sapodilla off grade contains tannin which can function as an alternative to natural diarrhea medicine [5].

Particle size of sample can influence and control the mass transfer kinetics and the access of solvent (water) into the soluble components. Particle size has been shown to play a role in the extraction of antioxidants [6], where the antioxidant properties of the aqueous extract tend to increase as the particle size is reduced, including tannin. A smaller particle size can also led a higher yield of extraction [7]. Tannin are astringent that causes the dry and puckery feeling in the mouth following the consumption of strong tea, or an unripened fruit [8].

Taste is detected by the human sense of taste, namely the tongue. Current technological developments allow sense to be detected using physical features: electronic tongue (E-Tounge). E-Tongue is composed of sensors array, a signal receiving and sending device and a pattern recognition device that capable to distinguish very similar liquids [9]. The difference in electrical response of the sample liquid component is utilized like a fingerprint. By using E-Tongue for assessment of food products characteristics allows any food or drink to be evaluated for its organoleptic qualities in a manner similar to food assessment as performed by humans. Based on the description above, it is necessary to determine the sensory attributes of sapodilla tea using E-tongue.

2. Research method
The experiment was conducted by applying a descriptive experimental study using sapodilla fruit from Tasikmalaya, West Java. This research was carried out through direct experiments with variations in slicing sizes of 3 mm, 5 mm and 8 mm using a food dehydrator with a temperature of 70 °C for 21 hours. The data obtained will be analyzed descriptively graphical and tabular presentations to determine the yield, water content using an oven and sensory evaluation using an E-tongue sensory device.

The stage of this research is the processing of sapodilla fruit which is done by three variations of slicing, namely 3 mm, 5 mm, and 8 mm, then washed and then dried, crushed using a grinder, sifting using 30 mesh so that the powder produced is uniform. In this process, sapodilla powder is brewed at 850°C at a ratio of 1:10 (w/v) for 8 minutes, filtering to produce sapodilla tea filtrate. The sapodilla tea filtrate was put into an E-tongue device to measure the taste quality based on its sensitivity, selectivity, intensity, and interaction.

3. Result and discussion
3.1. Water content
Water content is one of the important parameters for powder products because it will affect the stability and storage of the product. Moisture content that is too high will make the product shelf life becomes low because it is easy to be a mushroom growth media. The moisture content of the drying results with three variations of slicing (3 mm, 5 mm, and 8 mm) is found in figure 1, with a moisture content of 3, 63%, 4, 47%, and 6, 36%.

The effect of slicing size on drying is that the smaller the size of the cutting done, the smaller the moisture content produced. This is because the size of the slicing is 3 mm so thin that the moisture content in the material will evaporate faster and the thicker the 8 mm size of the slicing, the more slowly the evaporation process takes place. The surface area of the material influences the difference in water content produced [10]. The percentage of water content of the research results is in accordance with the quality standards of dry tea which has a maximum moisture content of 8% based on SNI (Indonesian National Standard).
Figure 1. Water content of sapodilla tea.

3.2. Yield
Yield tea powder was calculated based on the initial mass of brown compared with the final mass of sapodilla drying. The yield of sawo tea powder based on the variation of the slicing size is 3 mm, 20, 35%; 5 mm, 21, 79%; and 8 mm, 22.49%. The following complete results are in figure 2.

Figure 2. Yield of sapodilla tea.

The yield value of sapodilla tea is influenced by several factors. one of which is the slicing size in the drying process. Where the size of the sliced 8 mm sawo tea powder yield increased from the slicing size of 5 mm and 3 mm. Thin layers of material can reduce the distance of heat traveled to the center of food so that water evaporation from the material will be faster [11].

3.3. Sensory evaluation by e-tongue
Electronic tongue evaluates the quality of taste in food products not from the analysis of its chemical content, but rather the sensitivity, selectivity, intensity, and interaction; where the combination of these four factors forms the response of basic taste [12]. - Sensory in brown tea with the use of e-tongue devices with the results obtained in the form of quantitative values. The input signal is then adjusted by a buffer solution and then the signal is amplified with an amplifier so that it can be read by an electronic tongue system consisting of polyaniline oligomer and polypyrrole which can distinguish the five types of taste (basic taste), namely salty, sweet, bitter, acid, and savory (umami). Testing of the quality of each
A type of taste using an electronic sensor consisting of a mixture of dioctyl phosphate membrane and trioctyl methyl ammonium chloride with five different test samples [12]. The following sensory results obtained can be seen in table 1.

**Table 1. Sensory evaluation result by E-tongue.**

| Slicing size | Sourness | Bitterness | Astringent | Umami | After-taste |
|--------------|----------|------------|------------|-------|-------------|
| 3 mm         | -19.11   | 5.37       | 3.77       | 11.73 | 1.04        |
| 5 mm         | -18.56   | 5.21       | 3.73       | 11.12 | 1.12        |
| 8 mm         | -19.19   | 5.12       | 3.77       | 11.26 | 1.08        |

E-tongue tests the value of sourness, bitterness, astringency, umami, and after taste. Based on the E-tongue test results, the value of the flavor characteristics obtained was 0.04–0.63. When two variables or sensory attributes are far from the center and then close to each other, then the same quadrants have a positive correlation with each other while the attributes that are in the opposite direction have a negative correlation. The following sensory attributes of sapodilla tea can be seen in figure 3.

![Figure 3. Sensory attributes of sapodilla tea.](image)

The taste of tea is strongly influenced by chemical components in it, such as polyphenols, caffeine, organic acids, and volatile terpenes [13]. The flavor characteristics of tea are a mixture of bitter, astringent, umami, sweet, and slightly sour. Compounds that play a role in the tea's flavor characteristics are polyphenols, amino acids, and caffeine [14].

4. **Conclusion**

E-tongue is able to determine sourness, bitterness, astringency, umami, and after taste of sapodilla tea. The value of the flavor characteristics obtained was 0.04–0.63 compare to brown tea as control.

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