



The Effect of Powder Form and Sample Weight on the Acceptability of Yellow Melinjo (*Gnetum gnemon* L.) Peel Tea

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ABSTRACT

Tea is one of the nutritious drinks that are popular with the Indonesian people. Recently, researchers have developed various new types of tea beyond the traditional tea plant (*Camelia sinensis*). One potential ingredient for tea development is melinjo peel, particularly the yellow melinjo peel, due to its strong antioxidant activity and superior α -glucosidase inhibitory activity. This study aims to investigate the influence of the powder form and sample weight on the acceptability of yellow melinjo (*Gnetum gnemon* L.) peel tea. The research employed an experimental method with a factorial completely randomized design (CRD) involving two factors. The first factor was the powder form of the tea (fine, semi-fine, and coarse), and the second factor was the sample weight (2.5 grams, 3 grams, and 5 grams). A hedonic test was conducted to assess the acceptability of yellow melinjo peel tea, involving 40 semi-trained panelists using a scale from 1 to 7 (strongly dislike to very much like). Data were analyzed using IBM SPSS 25.0 Statistics for Windows, with Kruskal-Wallis and Mann-Whitney tests at a significance level of $P < 0.05$. The results showed that both the powder form and sample weight of yellow melinjo peel tea significantly affected ($P < 0.05$) taste, aroma, clarity, intensity, astringency, flavor, and overall acceptability, but did not significantly affect ($P > 0.05$) color and taste intensity. The most preferred formulation by panelists was yellow melinjo peel tea with a sample weight of 2.5 grams and a fine powder form, with an average score of 4.23 (like slightly).

Key Messages:

- Researchers investigated how powder fineness and amount of melinjo peel affect the taste and overall acceptability of the tea.
- The study found that both factors significantly influence taste, aroma, clarity, intensity, astringency, flavor, and overall preference.
- Panelists favored fine powder at a 2.5-gram serving size, indicating this combination creates the most enjoyable yellow melinjo peel tea.

Introduction

Tea is the second most consumed beverage globally, with its production increasing at an annual rate of 4%, positioning Indonesia among the foremost global tea producers (1). Currently, various new types of tea are being developed, such as teas made from rosella flowers, butterfly pea flowers, fruits, and spices. One promising alternative base material for tea is melinjo peel. Melinjo, a horticultural plant extensively cultivated in Banten, Indonesia, reached a production volume of 476,802.36 quintals in 2021 (BPS, 2021). Despite its abundance, the utilization of melinjo in Banten remains limited, predominantly being used as a vegetable or processed into emping crackers. This limited use results in substantial melinjo peel waste, which can adversely affect soil pH (2).

Melinjo peel extract contains phenolic compounds, flavonoids, β -carotene, lycopene, carotenoids, and vitamin C, all of which contribute to its antioxidant properties (1). According to research conducted by Apriliyanti, Ardiansyah, and Handayani (2018), melinjo peel tea demonstrates significant potential as a herbal tea due to its total phenol content of 2.02–2.52 mg/g and antioxidant activity ranging from 32.47% to 48.47% (3). Specifically, yellow melinjo peel exhibits very strong antioxidant activity, with an IC₅₀ value of 20.316 ppm (4,5).. Furthermore, yellow melinjo peel shows superior α -glucosidase inhibitory activity compared to green and red melinjo peels, with a value of 223.92 ppm.

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Several quality attributes influence consumer acceptance of tea products. To evaluate whether a tea product is acceptable to consumers, hedonic testing is conducted, where panelists express their personal preferences and aversions towards a product (6). Research conducted by Bohari and Ansori (2022) demonstrated that the powder form affects the color, taste, aroma, intensity, clarity, and astringency of red melinjo peel tea, whereas sample weight influences color, clarity, intensity, and overall acceptability. However, no prior research has focused on the development of yellow melinjo peel in terms of texture and weight (7). Therefore, this study aimed to investigate the influence of powder form and sample weight on the acceptability of yellow melinjo peel tea and to identify the formulation most preferred by panelists.

Methods

The experiment was laid out in a factorial, completely randomized design (CRD). The first factor was the powder form of yellow melinjo peel tea, categorized into three treatment levels: fine, semi-fine, and coarse powder. The second factor was the sample weight of yellow melinjo peel tea, consisting of three treatment levels: 2.5 grams, 3 grams, and 5 grams. This design resulted in a total of nine experimental combinations, as outlined below:

- Formula 1 (602) : 2.5 grams of fine yellow melinjo peel powder
- Formula 2 (931) : 3 grams of fine yellow melinjo peel powder
- Formula 3 (049) : 5 grams of fine yellow melinjo peel powder
- Formula 4 (035) : 2.5 grams of semi-fine yellow melinjo peel powder
- Formula 5 (439) : 3 grams of semi-fine yellow melinjo peel powder
- Formula 6 (278) : 5 grams of semi-fine yellow melinjo peel powder
- Formula 7 (704) : 2.5 grams of coarse yellow melinjo peel powder
- Formula 8 (496) : 3 grams of coarse yellow melinjo peel powder
- Formula 9 (351) : 5 grams of coarse yellow melinjo peel powder

A hedonic test was performed with 40 semi-trained panelists who met the inclusion and exclusion criteria. The panelists used a hedonic scale from 1 (strongly dislike) to 7 (very much like). The data collected underwent a series of steps, including editing, coding, processing, and cleaning. Subsequently, the data were analyzed using IBM SPSS Statistics 25.0 for Windows with Kruskal-Wallis and Mann-Whitney tests due to the non-normal distribution of the data.

Results

Table 1. Characteristics of respondents

Characteristics	n	%
Gender		
Male	2	5
Female	38	95
Field of study		
Nutrition	31	77,5
Food Technology	9	22,5
Age (years)		
< 20	8	20
≥ 20	32	80
Total	40	100

Based on Table 1, it can be seen that the majority of the panelists were female, comprising 95% of the total, with only 5% being male. Most of the respondents were from the nutrition field of study, accounting for 31 individuals (77.5%), while those from the food technology field made up more than a fifth. Regarding the age characteristics, four-fifths of participants were 20 years old or older, whereas only 20% were younger than 20 years.

Furthermore, the results of the hedonic rating test for yellow melinjo peel tea, which assessed parameters such as color, taste, aroma, clarity, intensity, astringency, flavor, and overall acceptability, are detailed in Table 2. Each formulation varies in sample weight and powder form, affecting the sensory qualities perceived by the panelists.

Table 2. The hedonic rating test of yellow melinjo peel tea

Formulation	Attributes							
	Color	Taste	Aroma	Clarity	Intensity	Astringency	Flavor	Overall acceptability
F1	3,60± 1,429 ^a	4,10± 1,355 ^a	4,33± 1,207 ^a	4,40± 1,297 ^a	3,60± 1,429 ^a	4,18± 1,259 ^a	3,83± 1,318 ^a	4,23± 1,250 ^a
F2	3,55± 1,108 ^a	3,68± 1,163 ^{ab}	3,88± 1,159 ^b	4,70± 0,992 ^a	3,38± 1,170 ^a	4,05± 1,339 ^{ab}	3,75± 1,354 ^{ab}	4,05± 1,218 ^{ab}
F3	3,03± 1,405 ^a	3,43± 1,375 ^{bc}	3,63± 1,372 ^{bc}	3,68± 1,542 ^{bc}	3,20± 1,285 ^a	3,40± 1,105 ^c	3,45± 1,260 ^{cd}	3,53± 1,086 ^c
F4	3,88± 1,114 ^a	2,70± 1,203 ^d	3,43± 0,958 ^{cd}	3,58± 1,059 ^{bd}	3,33± 0,829 ^a	2,85± 0,975 ^{def}	2,88± 0,939 ^{ef}	3,05± 1,037 ^{def}
F5	3,93± 0,971 ^a	3,43± 1,375 ^{bc}	3,43± 1,152 ^{cd}	3,58± 1,035 ^{bd}	3,48± 1,012 ^a	2,93± 1,118 ^{dh}	2,93± 1,118 ^{ce}	3,33± 1,269 ^{cd}
F6	3,68± 1,023 ^a	2,35± 1,210 ^d	2,15± 1,027 ^e	3,28± 1,154 ^b	3,15± 1,051 ^a	2,40± 0,982 ^{ei}	2,38± 1,234 ^{fg}	2,70± 1,181 ^e
F7	3,63± 1,055 ^a	2,90± 1,172 ^{cd}	3,75± 1,214 ^{bc}	4,25± 1,256 ^{ac}	3,45± 1,108 ^a	3,60± 1,392 ^{bc}	3,38± 1,314 ^{bdh}	3,63± 1,192 ^{bc}
F8	3,53± 1,154 ^a	3,03± 1,165 ^{cd}	3,43± 1,299 ^{bcd}	3,95± 1,061 ^{cd}	3,25± 1,080 ^a	3,18± 1,035 ^{ch}	2,98± 1,078 ^{ceh}	3,38± 0,952 ^{cf}
F9	2,65± 1,075 ^a	2,80± 1,018 ^d	2,98± 1,121 ^d	3,68± 1,023 ^{bd}	3,15± 0,770 ^a	2,85± 1,075 ^{ghi}	2,88± 0,939 ^{eg}	3,23± 0,947 ^{cf}

Note:

* Data are presented as mean ± standard deviation

* Values with different superscripts within a column differ significantly (p < 0.05)

* Hedonic scoring: 1 = dislike extremely; 2 = dislike moderately; 3 = dislike slightly; 4 = like slightly; 5 = like moderately; 6 = like very much; 7 = extremely like

Table 2 displays that the sample weight and powder form of melinjo peel tea significantly influenced (p < 0.05) the taste, aroma, clarity, intensity, astringency, flavor, and overall acceptability of yellow melinjo peel tea. However, these factors did not significantly affect (p > 0.05) the color and clarity of the tea.

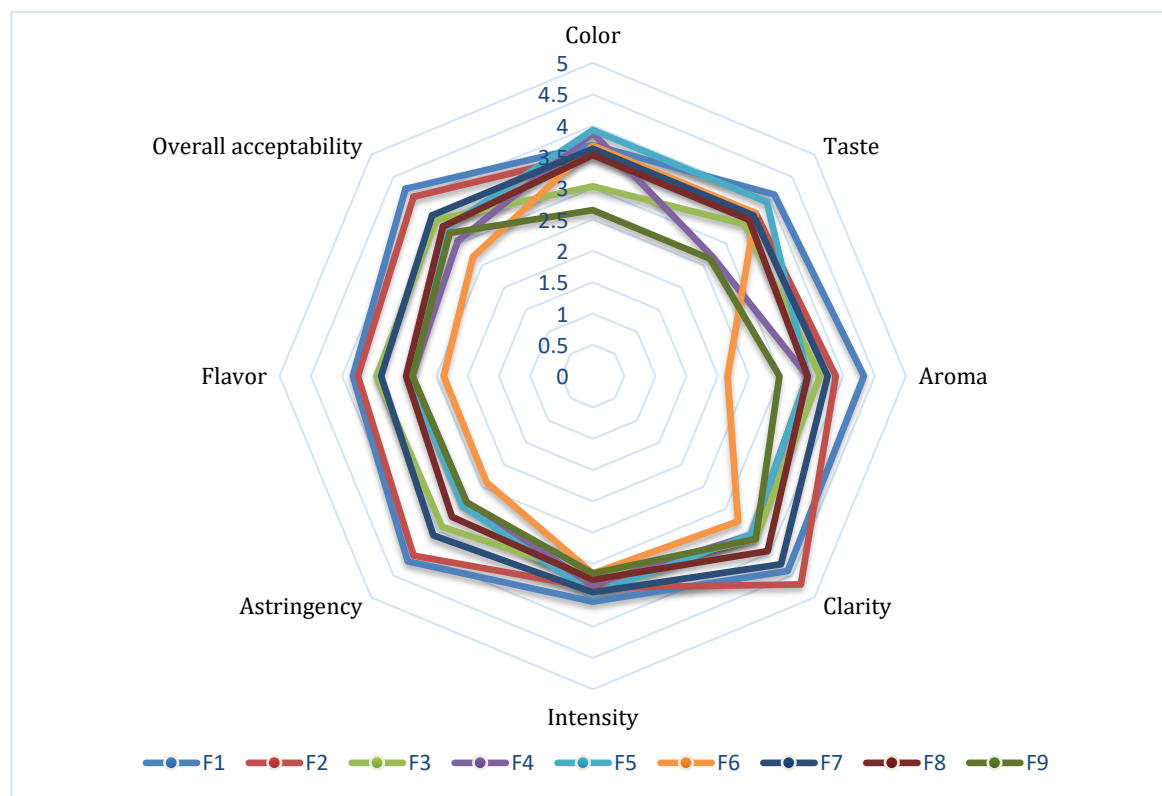


Figure 1. Spider diagram of hedonic rating test for yellow melinjo peel tea

To further clarify the results presented in Table 2 regarding the hedonic test of yellow melinjo peel tea, a figure is provided that visually illustrates the panelists' evaluations of various tea formulations. From the diagram, we can clearly see which formulations were most preferred by the panelists for each attribute, Formula 1 (F1), with a sample weight of 2.5 grams and a fine powder form, tends to have the highest rating for taste, aroma, clarity, and overall acceptability, indicating that this formulation was most liked by the panelists overall.

Discussion

Color is a crucial parameter, as it provides the initial impression of a food or beverage's appeal to consumers (8). The most favored melinjo peel tea formula among the panelists was F5, consisting of 3 grams of semi-fine yellow melinjo peel powder, which received a score of 3.93 (like slightly). As depicted in Figure 2, the tea prepared with 3 grams of semi-fine powder had a bright yellow-brown color that was not overly intense. This finding is consistent with Aryadi *et al.* (2017), who stated that panelists preferred a yellow-brown tea color (9). The yellow-brown hue in melinjo peel tea is attributed to the presence of anthocyanins and carotenoids in the melinjo peel (2). Additionally, color can have a psychological effect on consumer behavior when selecting food or beverages. Most consumers associate darker or more intensely colored foods and beverages with stronger flavors (10).

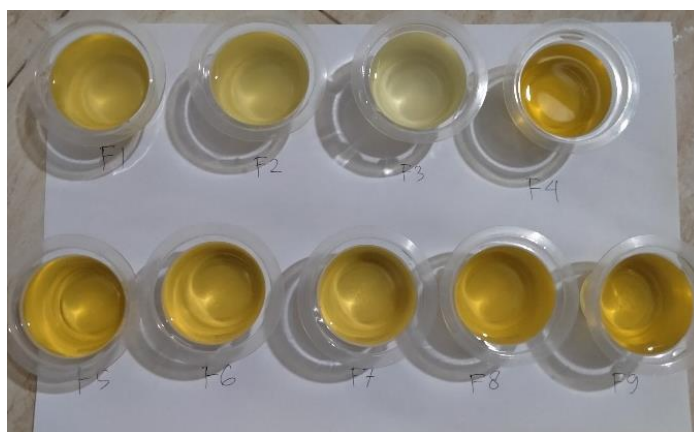


Figure 2. Color of yellow melinjo peel tea

Taste is a critical characteristic influencing the consumer's ultimate decision to accept or reject a tea product. The hedonic rating test indicated that the panelists' most preferred tea formulation was F1, which was 2.5 grams of fine yellow melinjo peel powder, receiving an average score of 4.10 (like slightly). Conversely, the formulation with the lowest average score was F6, which consisted of 5 grams of semi-fine yellow melinjo peel powder, with an average score of 2.35 (dislike moderately). The preference for tea made with fine powder can be attributed to the increased extraction of phenolic compounds. This is in accordance with Nugraheni *et al.* (2022), who noted that a larger surface area (smaller particle size) enhances the interaction between tea and solvent, thereby facilitating the dissolution of phenolic compounds in the tea (11).

Aroma is one of the most easily recognized quality characteristics of tea and plays a pivotal role in consumer acceptance (12). In this study, the highest aroma score was given to the formulation with 2.5 grams of fine yellow melinjo peel powder (F1), whereas the lowest was for the formulation with 5 grams of semi-fine yellow melinjo peel powder (F6). The lower score for the latter could be attributed to its sharper aroma compared to the former. Ginting *et al.* (2015) explained that panelists' aroma evaluations are influenced by the concentration of extracts in the tea infusion and the weight of the tea (13). The finer or heavier the tea, the more volatile compounds like polyphenols and essential oils dissolve in the infusion, leading to a stronger aroma that panelists found less appealing. This observation aligns with Mastuti *et al.* (2018), who reported that a higher concentration of melinjo peel extract produces a more intense off-flavor aroma (5).

Tea clarity can be affected by two factors: the color of the tea infusion and the sediment of the tea powder. The formulations with the lowest clarity scores were the 2.5 grams and 3 grams semi-fine yellow melinjo peel powder (F4 and F5), while the highest clarity score was observed for the 3 grams of fine yellow melinjo peel powder (F2). The clarity of the tea's color is influenced by the theaflavin content, which gives a reddish-yellow hue to the tea (7). Theaflavin is produced through the polymerization of catechins during enzymatic oxidation. A higher theaflavin content in the tea infusion results in a more

intense color (14). The yellow melinjo peel tea in this study appeared clear because it did not undergo enzymatic oxidation, thus preventing the formation of theaflavin.

Tannin is an essential component of tea that contributes to its astringency properties. Tannins can induce a bitter and astringent sensation in tea (15). Based on Table 2, neither the sample weight nor the powder form of melinjo peel tea had a significant effect ($p > 0.05$) on the astringency of the tea. This lack of significant effect could be attributed to the tea not undergoing enzymatic oxidation, as well as the high drying temperature of 65 °C for 4 hours used during the production of yellow melinjo peel tea, which likely influenced the tannin content. Tannins are known to contribute to the bitterness and astringency of tea (16). This finding aligns with Sari *et al.* (2020), who concluded that increased drying time and temperature result in lower tannin levels in tea.

Astringency in tea arises from the precipitation of proteins in the mouth and on the tongue by tannins (13). Catechin, a polyphenol derivative, is another compound that affects tea's astringency. As indicated in Table 2, the highest average astringency score was recorded for the 2.5 grams of fine yellow melinjo peel powder (F1), with an average score of 4.18 (like slightly). On the other hand, the lowest score was for the 5 grams of semi-fine yellow melinjo peel powder (F6), with an average score of 2.40 (dislike moderately). This variation can be attributed to the greater amount of tannins and polyphenols extracted into the infusion from heavier tea samples. This finding is consistent with Ulandari *et al.* (2019) finding that increased astringency in tea reduces panelist preference (17). Thus, the more astringent the tea infusion, the less it is favored by the panelists.

Flavor in a food product is discerned through its aroma, taste, and aftertaste attributes (6). In tea, flavor is primarily attributed to the flavonoid content within the infusion (18). Among the formulations tested, the 2.5 grams of fine yellow melinjo peel powder (F1) achieved the highest average flavor score, with an average rating of 4.18 (like slightly). In contrast, the 5 grams of semi-fine yellow melinjo peel powder (F6) received the lowest average score of 2.40 (dislike moderately). This difference can be explained by the fact that the 2.5 grams fine powder tea avoids dissolving excessive alkaloids. Moreover, melinjo peel contains off-flavor compounds such as resveratrol, an antioxidant (Hartanto *et al.*, 2021). Excessive use of tea can result in an overly intense flavor where the off-flavor compounds fail to mask the undesirable taste and aroma.

Regarding overall acceptability, the formulation with 2.5 grams of fine yellow melinjo peel powder (F1) received the highest rating of 4.23 (like slightly). This finding is consistent with Bohari and Anshori (2022), who similarly identified 2.5 grams of fine red melinjo peel powder as the most preferred formulation for red melinjo peel tea (7).

Conclusion

The study on "The effect of powder form and sample weight and the acceptability of yellow melinjo (*Gnetum gnemon L.*)" revealed that both the powder and sample weight significantly influenced ($p < 0.05$) the tea's taste, aroma, clarity, intensity, astringency, flavor, and overall acceptability. However, these factors did not significantly affect ($p > 0.05$) the tea's color and intensity of taste. The formulation with the highest overall acceptability was the tea made with 2.5 grams of fine powder, achieving an average score of 4.23 (like slightly).

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Conflicts of Interest: The authors declare no conflict of interest

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