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Article

The Effectiveness of Long-Time Blanching on the Quality of Avocado Leaf Herbal Tea Added with Cinnamon Powder

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ABSTRACT

Herbal tea is a beverage prepared from plant materials other than *Camellia sinensis* and has gained attention due to its functional properties. Avocado (*Persea americana*) leaves are a potential raw material for herbal tea because they contain bioactive compounds with antioxidant activity. This study evaluated the effect of blanching time on the quality of avocado (*Persea americana*) leaf herbal tea and determined the optimal treatment. A randomized controlled experiment was conducted using four blanching durations (0, 5, 10, and 15 min) with 16 experimental units. Moisture content, ash content, antioxidant activity, tannin content, and sensory acceptance were analyzed. Statistical analysis was performed using ANOVA followed by Duncan's Multiple Range Test at a 5% significance level. Blanching time significantly affected the physicochemical and sensory properties of the herbal tea. The 15-minute blanching treatment produced the best quality, with moisture content of 4.11%, ash content of 6.46%, antioxidant activity of 41.66 ppm (very strong), and tannin content of 0.0121%. Sensory evaluation showed a yellow color, a slightly stale aroma, a non-bitter taste, and moderate overall acceptance. These results indicate that 15-minute blanching is optimal for producing high-quality avocado leaf herbal tea.

1. Introduction

Tea is a widely consumed beverage in Indonesia and many other countries. Traditionally, tea is produced from the leaves of the *Camellia sinensis* plant. However, tea beverages are not limited to *Camellia sinensis*, as various herbal plants can also be processed into refreshing and functional drinks. Different parts of herbal plants, particularly the leaves, have the potential to be developed into herbal tea products due to their beneficial bioactive compounds. These compounds contribute to various health benefits, making herbal leaves a valuable raw material for herbal tea production.

The consumption of herbal tea, either as a single ingredient or in combination with other herbs, has been associated with various health benefits (Wicaksono et al., 2020). In addition to their functional properties, tea beverages prepared from leaf extracts are characterized by distinctive aroma and flavor attributes (Sayuti and Yenrina, 2015). Among the various plant materials that can be utilized, avocado leaves represent a potential raw material for herbal tea production.

Avocado leaves are one of the plant parts that can be utilized in the production of herbal tea. In Indonesia, decoctions prepared from fresh avocado leaves are traditionally consumed as natural remedies for various health conditions, including hypertension. Avocado leaves are known for their strong antioxidant and anti-inflammatory properties (Felicia et al., 2016). Studies have shown that avocado leaves contain bioactive compounds such as flavonoids, quercetin, and polyphenols. The enhanced antioxidant activity is closely associated with increased levels of bioactive compounds, particularly total phenols and flavonoids, which play a key role as antioxidants.

Younger leaves exhibited higher tannin concentrations than older leaves, resulting in a slightly astringent and bitter sensory profile that was more favorably perceived by the panelists (Amanto et al., 2020). Blanching may be employed as a processing strategy to enhance overall sensory quality.

Blanching is a brief thermal pretreatment conducted at relatively low temperatures to prepare food materials for extended storage at higher temperatures (Safrina & Supriadi, 2020). This process aims to inactivate enzymes that

could otherwise induce undesirable changes in color, texture, and flavor. Optimal blanching outcomes are achieved when appropriate temperature and time conditions are carefully controlled (Safrina & Supriadi, 2020).

According to Amanto et al. (2020), a study investigating the effects of blanching duration and leaf harvesting techniques on the physical, chemical, and sensory characteristics of fig leaf tea (*Ficus carica*) demonstrated that longer water-bath blanching times improved the flavor quality of the final product. The findings indicated that a blanching duration of 15 minutes was optimal, as it resulted in the lowest tannin content and consequently reduced the bitterness of the herbal tea. In addition, the incorporation of cinnamon was found to effectively mask bitterness while enhancing the overall aromatic profile.

Cinnamon is commercially available in both whole and powdered forms. Nasir et al. (2020) investigated the incorporation of cinnamon (*Cinnamomum lumbini* L.) in the production of herbal tea bags derived from dragon fruit peel (*Hylocereus polyrhizus*) and reported that increasing levels of cinnamon powder significantly reduced the bitterness of the herbal tea. Furthermore, Hastuti (2014) demonstrated that cinnamon addition imparted a dark reddish hue, along with a distinctive and pleasant cinnamon aroma and flavor, which elicited favorable responses from sensory panelists.

Despite the growing body of research on herbal teas, previous studies have primarily focused on single processing variables, specific plant materials, or sensory improvement strategies without comprehensively evaluating their combined effects on both functional and sensory qualities. In particular, limited information is available regarding the integrated application of blanching pretreatment and cinnamon incorporation in avocado leaf herbal tea. Therefore, this study positions itself to address these gaps by systematically investigating the effects of blanching conditions and cinnamon addition on the physicochemical properties, antioxidant activity, and sensory characteristics of avocado leaf herbal tea. The specific scientific objective of this study is to determine the optimal processing conditions that enhance bioactive compound retention while improving sensory

acceptability, thereby supporting the development of functional and consumer-acceptable avocado leaf herbal tea products.

2. Literature Review

2.1 Potential of Avocado Leaves as Herbal Tea Raw Material

Avocado leaves (*Persea americana* Mill.) contain various bioactive compounds, including flavonoids, tannins, alkaloids, and polyphenols, which function as natural antioxidants. Several studies have reported that avocado leaf infusions exhibit considerable antioxidant activity and potential as functional beverages (Rauf et al., 2017). This antioxidant capacity is closely associated with total phenolic content, which plays a key role in free radical scavenging. Compared with other commonly used herbal tea leaves such as moringa (*Moringa oleifera*), fig (*Ficus carica*), and kenikir (*Cosmos caudatus*), avocado leaves demonstrate comparable antioxidant potential but tend to exhibit higher tannin levels, which contribute to stronger bitterness and astringency (Pasaribu et al. 2025).

However, the utilization of avocado leaves as herbal tea remains limited by sensory constraints, particularly bitterness and a slightly unpleasant odor associated with tannins and alkaloids. In contrast, moringa and fig leaves are generally more acceptable sensorially due to lower tannin content and the presence of milder flavor compounds, while kenikir leaves possess distinctive aromatic volatiles that enhance consumer acceptance. Felicia et al. (2016) reported that the sensory characteristics of avocado leaf herbal tea are strongly influenced by leaf maturity and processing methods. This comparison highlights that, despite their high functional potential, avocado leaves require appropriate processing strategies to achieve sensory qualities comparable to other established herbal teas. Therefore, pre-treatment processes such as blanching are necessary to reduce undesirable sensory attributes while preserving bioactive compounds.

2.2 Effects of Blanching Duration and Cinnamon Addition on Herbal Tea Quality

Blanching is a thermal pre-treatment process aimed at enzyme inactivation, reduction of bitter compounds, and improvement of color and aroma. Previous studies have reported that blanching duration significantly influences tannin content, antioxidant activity, and sensory properties of herbal teas (Amanto et al., 2020). Prolonged blanching facilitates the degradation and leaching of tannins into the blanching medium, thereby reducing bitterness in the final product. In addition, thermal treatment can disrupt plant cell walls and inactivate oxidative enzymes, promoting the release of bound phenolic compounds and enhancing the extractability of antioxidants. However, excessive blanching may also accelerate the degradation of heat-sensitive bioactive compounds, leading to a decline in nutritional quality.

The addition of cinnamon (*Cinnamomum burmannii*) serves not only as a natural flavoring agent but also as an additional source of antioxidants. Cinnamon contains cinnamaldehyde and eugenol, which contribute to its distinctive aroma and enhance consumer acceptance. These volatile compounds play a key role in masking undesirable grassy and astringent notes associated with avocado leaves while simultaneously contributing antioxidant activity. The release and interaction of cinnamon-derived volatile compounds with phenolic compounds from avocado leaves may result in a synergistic effect on both aroma intensity and functional properties. The combination of blanching treatment and cinnamon addition has been shown to improve the sensory acceptance of herbal tea compared to untreated products, although the characteristic aroma of avocado leaves may not be completely eliminated when blanching intensity is limited to preserve bioactive compounds (Nasir et al., 2020).

3. Research Methodology

3.1 Materials and Tools

The avocado leaves used in this study were harvested from the first to third leaves of apical shoots of avocado trees in Marpoyan Damai District, Pekanbaru City, Indonesia.

Cinnamon was obtained from a local supplier in Binawidya District, Pekanbaru City. Other materials included potable and distilled water, paper tea bags (5.5×7 cm), labeling materials, aluminum foil, filter paper, and analytical-grade reagents, namely DPPH, ferric chloride (FeCl_3), and potassium ferricyanide ($\text{K}_3\text{Fe}(\text{CN})_6$).

Sample preparation was conducted using standard laboratory equipment. Key analytical instruments included an analytical balance (Ohaus, USA), a laboratory drying oven (Memmert, Germany), a muffle furnace (Nabertherm, Germany), a UV-Vis spectrophotometer (Shimadzu, Japan), a 40-mesh sieve, a blender, and a controlled sensory evaluation chamber.

The avocado leaves used in this study were collected from the first to third leaves from the apical shoots of avocado trees located in Marpoyan Damai District, Pekanbaru City. Cinnamon was obtained from Kedai Upu, Binawidya District, Pekanbaru City. Other materials included potable water, distilled water, 5.5×7 cm paper tea bags purchased from the online marketplace Ohanaofficial, label paper, aluminum foil, filter paper, DPPH reagent, ferric chloride (FeCl_3), and potassium ferricyanide ($\text{K}_3\text{Fe}(\text{CN})_6$).

The equipment utilized comprised an analytical balance, cutting tools, an electric oven, bowls, droppers, spoons, a laboratory drying oven, cooking pots, a thermometer, a stove, a 40-mesh sieve, a blender, airtight containers, porcelain crucibles, a desiccator, a muffle furnace, a UV-Vis spectrophotometer, test tubes, stationery, and a controlled testing chamber.

3.2 Research Design

This study employed a Completely Randomized Design (CRD) consisting of 16 experimental units, with four blanching time treatments and four replications. The blanching procedure followed the method described by Amanto et al. (2020), with variations in blanching duration applied as the experimental treatments. The selected blanching times (0, 5, 10, and 15 minutes) were intended to represent control conditions and progressive thermal exposure commonly applied in herbal tea processing. Four replications were used to improve the reliability of the data and to allow

adequate statistical analysis of treatment effects.

3.3 Experimental Procedure

Sample Preparation

Sample preparation was conducted in accordance with the method described by Rauf et al. (2017). Avocado leaves were collected by harvesting the apical portions of the leaves. The harvested leaves were subsequently sorted and thoroughly washed to remove adhering impurities, followed by draining to eliminate excess surface moisture.

Blanching Process

The blanching process was initiated with the preparation of steaming media. Water was heated in a pot to approximately half of its capacity using a stove, and the generated steam temperature inside the pot was monitored until it reached $\pm 60^\circ\text{C}$, as measured using a thermometer. The selected blanching temperature was based on previous studies indicating that mild steam blanching at temperatures around 60°C is sufficient to partially inactivate oxidative enzymes and reduce undesirable sensory compounds while minimizing thermal degradation of heat-sensitive phenolic compounds.

The blanching procedure followed the method described by Amanto et al. (2020) and was conducted using steam blanching at a temperature of approximately 60°C . During the blanching process, the temperature inside the pot was continuously monitored and maintained at $\pm 60^\circ\text{C}$ by adjusting the heating intensity to ensure consistent thermal conditions throughout each treatment. Cleaned avocado leaves were weighed to obtain 100 g per experimental unit and then placed into the pot, which was subsequently covered. The blanching treatments consisted of four blanching durations, namely 0 min (control), 5 min, 10 min, and 15 min. After blanching, the leaves were allowed to cool at room temperature for approximately 10 min, followed by a rolling process for an additional 10 min. The leaves were then dried using an oven at 50°C for 8 h.

Preparation of Avocado Leaf Powder

The processing of avocado leaves was conducted according to the method described by Aprilia et al. (2020). Dried avocado leaves were ground using a blender and subsequently

sieved through a 40-mesh screen to obtain a uniform powder. The resulting avocado leaf powder with a particle size of 40 mesh was weighed according to the experimental treatments and stored in airtight containers until further use.

Preparation of Cinnamon Powder

The preparation of cinnamon powder followed the method described by Nasir (2020). The prepared cinnamon was cut into pieces of approximately 1 cm in length and dried in a drying oven at 60 °C for 8 h. After drying, the cinnamon was ground into a powder and sieved through a 40-mesh screen to obtain a uniform cinnamon powder.

Incorporation of Cinnamon Powder into Avocado Leaf Herbal Tea

Cinnamon powder was incorporated into avocado leaf herbal tea at a level of 6% (w/w) based on a total tea bag content of 2 g. The avocado leaf powder and cinnamon powder were thoroughly mixed to ensure homogeneity and subsequently filled into paper tea bags. Tea bag packaging followed the procedure described by Haras et al. (2017). Each paper tea bag (5.5 × 7 cm) was filled with 2 g of the powder mixture, labeled, and stored in airtight containers prior to analysis.

3.4 Data Collection and Analysis

Observations

The observed variables in this study included moisture content, ash content, antioxidant activity, and tannin content. In addition, both descriptive and hedonic sensory evaluations were conducted to assess the sensory characteristics of the herbal tea.

Data Analysis

The collected data were subjected to statistical analysis using analysis of variance (ANOVA) with IBM SPSS Statistics version 23, except for antioxidant activity data. Antioxidant activity (IC₅₀) was analyzed using linear regression because it is a continuous response variable that changes progressively with blanching time, and regression analysis allows evaluation of the relationship and trend between blanching duration and antioxidant activity. In contrast, ANOVA is primarily used to compare mean differences among discrete treatments. When the calculated F value was greater than or equal to the tabulated F value, further analysis was conducted using Duncan's

Multiple Range Test (DMRT) at a 5% significance level.

4. Results and Discussion

4.1 Moisture Content

Moisture content refers to the percentage of water present in a substance.

Table 1. Mean Moisture Content of Avocado Leaf Herbal Tea Supplemented with Cinnamon Powder

Note: Values followed by different superscript letters

Treatment	Blanching time (min)	Moisture content (%)
L1	0	7.55 ^d
L2	5	6.58 ^c
L3	10	4.81 ^b
L4	15	4.11 ^a

within the same column indicate significant differences at $p < 0.05$ based on Duncan's Multiple Range Test (DMRT).

The results indicated considerable variation in the moisture content of the herbal tea samples, with values ranging from 4.11% to 7.55% (Table 1). The highest moisture content (7.55%) was observed in the control treatment without blanching (L1), while the lowest value (4.11%) was obtained after 15 min of blanching (L4). Longer blanching durations resulted in lower moisture content. This phenomenon is associated with thermal degradation of cell wall structures during blanching, which increases tissue porosity and accelerates moisture diffusion during drying. Heat treatment has been reported to enhance cell membrane permeability, thereby reducing the ability of plant tissues to retain water (Damodaran et al., 2017).

Moisture content in blanched samples was consistently lower than in unblanched samples. Damayanti and Suwita (2018) reported that steam-blanched materials generally exhibit lower moisture content than those blanched in hot water due to greater tissue damage and enlarged pores, which limit water absorption. Differences in moisture content compared with the study of Amanto et al. (2020) on fig leaf herbal tea may be attributed to variations in raw material composition. Nevertheless, the moisture content obtained in this study

complied with the Indonesian National Standard for green tea (SNI 4324:2014), which specifies a maximum moisture content of 10%.

4.2 Ash Content

Ash content represents the total inorganic residue and mineral constituents present in a food material. Table 2 shows that the ash content of avocado leaf herbal tea supplemented with cinnamon powder differed significantly among treatments. The ash content increased from 3.98% in the unblanched treatment (L1) to 6.46% in the 15 min blanching treatment (L4).

Table 2. Mean Ash Content of Avocado Leaf Herbal Tea with Cinnamon Powder

Treatment	Blanching time (min)	Ash content (%)
L1	0	3.98 ^a
L2	5	4.82 ^b
L3	10	5.54 ^c
L4	15	6.46 ^d

Note: Values followed by different superscript letters within the same column indicate significant differences at $p < 0.05$.

The results demonstrated that the ash content of avocado leaf herbal tea supplemented with cinnamon increased significantly with blanching duration. This increase may be attributed to structural and chemical changes during blanching that concentrate inorganic mineral components in the dried material.

The elevated ash content observed in this study is therefore mainly influenced by the intrinsic mineral composition of the raw materials. Avocado leaves are known to contain substantial amounts of essential minerals, while cinnamon contributes additional mineral elements, collectively increasing the ash content of the herbal tea formulation (Molan et al., 2009).

Ash content is strongly affected by the proportion of dry matter in raw materials, including proteins, lipids, carbohydrates, and inorganic residues. The relatively high dry matter content of avocado leaves and cinnamon likely contributed to the increased ash content in the herbal tea. Notably, the ash content obtained in treatments L2, L3, and L4 complied with the Indonesian National Standard for

green tea (SNI 4324:2014), which specifies an ash content range of 4–8%.

4.3 Antioxidant Activity

The antioxidant activity of herbal tea prepared from avocado leaves and supplemented with cinnamon powder was evaluated. Table 3 shows that the mean antioxidant activity (IC_{50}) of avocado leaf herbal tea supplemented with cinnamon powder ranged from 41.66 to 82.08 ppm. The L4 treatment (15 min blanching) exhibited the lowest IC_{50} value (41.66 ppm), indicating very strong antioxidant activity. In contrast, treatments L1, L2, and L3 showed IC_{50} values of 82.08, 63.42, and 56.66 ppm, respectively, which are classified as strong antioxidant activity.

Table 3. Mean Antioxidant Activity (IC_{50}) of Avocado Leaf Herbal Tea Supplemented with Cinnamon Powder

Treatment	Blanching time (min)	IC_{50} (ppm)
L1	0	82.08
L2	5	63.42
L3	10	56.66
L4	15	41.66

Antioxidant activity increased with longer blanching duration, as indicated by decreasing IC_{50} values. Lower IC_{50} values reflect stronger radical scavenging capacity in the DPPH assay, indicating higher antioxidant effectiveness (Thaipong et al., 2006). In this study, avocado leaf herbal tea supplemented with cinnamon powder exhibited varying antioxidant activities depending on blanching time. The lowest IC_{50} value (41.66 ppm), corresponding to very strong antioxidant activity, was observed in the 15 min blanching treatment (L4).

The enhancement of antioxidant activity with prolonged blanching can be explained by the increased release of bound phenolic compounds resulting from thermal disruption of plant cell walls and inactivation of oxidative enzymes. Mild to moderate heat treatment promotes the liberation of phenolics and flavonoids that are otherwise bound to cell wall matrices, thereby increasing their availability and stability during extraction (Kim et al., 2020)

Heat-induced inactivation of polyphenol

oxidase may further prevent phenolic degradation, contributing to higher antioxidant retention. Similar observations have been reported by Dewanto et al. (2002), who demonstrated that thermal processing can enhance antioxidant activity by increasing the extractability of bioactive compounds.

The relative contribution of avocado leaves and cinnamon to the observed antioxidant activity is primarily attributed to avocado leaves as the main raw material, which provide a substantial amount of phenolic compounds and flavonoids. Cinnamon powder, added at 6% (w/w), likely contributed additional antioxidant capacity through bioactive compounds such as cinnamaldehyde and eugenol; however, its role was mainly complementary rather than dominant. The interaction between phenolic compounds from avocado leaves and antioxidant constituents from cinnamon may result in a synergistic effect, enhancing overall radical scavenging activity.

However, antioxidant activity does not always directly correlate with total phenolic content, as other non-phenolic antioxidants may also contribute to radical scavenging capacity. Compounds such as vitamins C and E and certain thermally stable flavonoids may play a significant role in maintaining antioxidant activity during blanching (Mahardani & Leny, 2021). In addition to blanching duration, the proportion of avocado leaves and cinnamon also influenced antioxidant activity, as both ingredients are known sources of antioxidant compounds (Rauf et al., 2017). Overall, these results suggest that controlled blanching time is critical for maximizing phenolic release while maintaining antioxidant stability, thereby enhancing the functional quality of avocado leaf herbal tea supplemented with cinnamon.

4.4 Tannin Content

Tannins are bioactive plant compounds commonly found in fruits, leaves, and stems. They belong to the polyphenol group and are responsible for the characteristic bitter and astringent taste of plant-based materials (Mutmainnah, 2018).

The results indicated that the L4 treatment (15 min blanching) produced the lowest tannin content. Overall, tannin levels decreased with

increasing blanching duration, with mean values ranging from 0.012% to 0.019% (Table 4). The lowest tannin content (0.012%) observed in L4 represents the most favorable treatment.

Table 4. Mean Tannin Content of Avocado Leaf Herbal Tea Supplemented with Cinnamon Powder

Treatment	Blanching time (min)	Tannin content (%)
L1	0	0.019 ^d
L2	5	0.017 ^c
L3	10	0.015 ^b
L4	15	0.012 ^a

Note: Values followed by different superscript letters within the same column indicate significant differences at $p < 0.05$.

The reduction in tannin content may be attributed to the oxidation and leaching of polyphenolic compounds during steam blanching. Prolonged blanching facilitates tannin dissolution into the blanching medium and promotes the breakdown of complex tannin molecules into simpler phenolic compounds. In addition, thermal treatment disrupts plant cell wall structures and inactivates polyphenol oxidase enzymes, thereby enhancing the release and extractability of bound phenolic compounds while preventing enzymatic browning reactions. Recent studies have reported that controlled blanching improves phenolic availability and antioxidant stability through these mechanisms, supporting the observed decrease in tannin content and improvement in product quality (Zayed, et al. 2025). Similar trends were reported by Amanto et al. (2020), who observed decreased tannin levels in fig leaves with longer blanching times, with 15 min identified as the optimal duration.

From a practical perspective, the reduction in tannin content through controlled blanching is beneficial for minimizing astringency and bitterness, thereby improving the sensory acceptability of avocado leaf herbal tea. This finding is particularly relevant for product development, as lower astringency can enhance consumer preference and support the formulation of functional herbal tea products with improved palatability and market potential.

4.5 Color

Color is a key attribute of product appearance and plays an important role in sensory evaluation, as it is the first quality parameter perceived by consumers.

Table 5. Average Sensory Evaluation Scores for the Color of Avocado Leaf Herbal Tea with Added Cinnamon Powder

Treatment	Blanching time (min)	Descriptive score	Hedonic score
L1	0	1.57 ^a	3.74 ^b
L2	5	1.83 ^{ab}	3.29 ^a
L3	10	2.20 ^{bc}	3.11 ^a
L4	15	2.33 ^c	3.25 ^a

Note: Different superscript letters within the same column indicate significant differences at $p < 0.05$ based on Duncan's Multiple Range Test (DMRT).

Color descriptive scale:

- 1 = brownish yellow,
- 2 = yellow,
- 3 = yellowish green,
- 4 = slightly green,
- 5 = green

Color hedonic scale:

- 1 = dislike extremely,
- 2 = dislike,
- 3 = slightly like,
- 4 = like,
- 5 = like extremely

Table 5 shows that panelists assigned descriptive color scores ranging from 1.57 to 2.33, corresponding to brownish yellow to yellow hues. No significant differences were observed between treatments L2 and L3, whereas the L4 treatment differed significantly from the shorter blanching treatments. The visual appearance of avocado leaf herbal tea supplemented with cinnamon powder is presented in **Figure 1**.

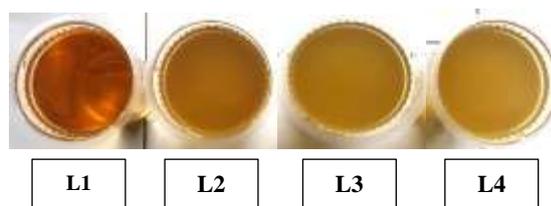


Figure 1. Color of Avocado Leaf and Cinnamon Herbal Tea

Blanching influenced the color of avocado

leaf herbal tea infusion, resulting in brighter yellow hues with increasing blanching duration. This effect is consistent with previous findings indicating that blanching enhances infusion brightness. During blanching, partial chlorophyll loss and degradation lead to the formation of carotenoids and pheophytin, producing yellow to brownish tones in the infusion (Amanto et al., 2020).

Thermal processing accounted for the color differences observed among treatments L1–L4, with blanched leaves producing brighter infusions than unblanched samples, in agreement with earlier studies (Amanto et al., 2020). Although excessive blanching may cause nutrient losses, insufficient blanching can result in greater enzymatic degradation. Overall, the infusion color across treatments was consistent with the typical appearance of properly brewed green tea as defined by SNI 4324:2014.

Hedonic color scores ranged from 3.11 to 3.74 (slightly like to like), with the unblanched treatment (L1) receiving the highest preference score (3.74). Panelists most preferred the yellow infusion color, which closely resembled that of commercially available tea products.

4.6 Aroma

Aroma is a key parameter in sensory (organoleptic) quality evaluation, as it is closely associated with the function of the olfactory senses and plays an important role in determining the overall palatability of a beverage.

Table 6. Average Sensory Scores for Aroma of Avocado Leaf Herbal Tea Added with Cinnamon Powder

Treatment	Descriptive Aroma Score	Hedonic Aroma Score
L1 (Blanching time 0 minutes)	2.83	2.90
L2 (Blanching time 5 minutes)	2.77	2.90
L3 (Blanching time 10 minutes)	2.70	3.13
L4 (Blanching time 15 minutes)	2.67	3.14

Note: Different letters following the values in the same column indicate statistically significant differences at the 5% level, as determined by the DNMRT test.

Descriptive aroma scale:

- 1 = Very not musty,
- 2 = Not musty,
- 3 = Slightly musty,
- 4 = Musty,
- 5 = Very musty.

Hedonic aroma scale:

- 1 = Strongly dislike,
- 2 = Dislike,
- 3 = Slightly like,
- 4 = Like,
- 5 = Strongly like.

Table 6 shows that the descriptive aroma scores ranged from 2.67 to 2.83, indicating a slightly grassy aroma across all treatment. No significant differences were observed among treatments, suggesting that blanching duration did not significantly influence the aroma profile of avocado leaf herbal tea supplemented with cinnamon powder. This condition is likely related to the use of identical proportions of avocado leaf powder and cinnamon powder in all treatments, resulting in relatively similar volatile profiles.

The slightly grassy aroma detected in all samples is mainly attributed to volatile compounds naturally present in avocado leaves, such as aldehydes (e.g., hexanal), alcohols (e.g., 1-hexanol), and terpenoid compounds. These volatile compounds are commonly associated with green, leafy, and grassy notes and are released during drying and infusion processes. Mahendran. (2009) reported that recent studies have shown that avocado (*Persea americana*) contains numerous volatile compounds, including alcohols, aldehydes, and terpenoids, which contribute to its characteristic aroma profile.

Hedonic aroma scores ranged from 2.90 to 3.14 (slightly liked) and showed no significant differences among treatments, which is consistent with the descriptive evaluation indicating similar aroma characteristics. The addition of cinnamon powder improved aroma acceptability due to its high cinnamaldehyde and eugenol content, which provide a pleasant and distinctive aroma (Nasir et al., 2020). However, the amount of cinnamon added was insufficient to completely mask the grassy aroma. Consequently, although cinnamon addition improved aroma acceptability to some

extent, the overall aroma profile remained slightly grassy and did not fully meet the aroma characteristics of green tea as specified in SNI 4324:2014.

4.7 Taste

Taste is an organoleptic attribute evaluated through sensory perception during consumption, with the tongue as the primary organ involved.

Table 7. Average Sensory Scores for Taste of Avocado Leaf Herbal Tea with Cinnamon Powder

Treatment	Descriptive Taste Score	Hedonic Taste Score
L1 (Blanching time 0 min)	3.27 ^b	2.51 ^a
L2 (Blanching time 5 min)	3.17 ^b	2.51 ^a
L3 (Blanching time 10 min)	2.93 ^b	2.72 ^a
L4 (Blanching time 15 min)	2.47 ^a	3.23 ^b

Notes: Different lowercase letters in the same column indicate significant differences at the 5% level (DNMRT test).

Descriptive taste scale:

- 1 = very not bitter,
- 2 = not bitter,
- 3 = slightly bitter,
- 4 = bitter,
- 5 = very bitter.

Hedonic taste scale:

- 1 = strongly dislike,
- 2 = dislike,
- 3 = slightly like,
- 4 = like,
- 5 = strongly like.

Table 7 shows that descriptive taste scores ranged from 2.47–3.27, indicating slightly bitter to not bitter. Treatment L4 (15-minute blanching) differed significantly from the others and produced the least bitterness, indicating that longer blanching reduces bitter taste. Bitterness arises from alkaloids, flavonoids, and tannins in avocado leaves and cinnamon. Increasing blanching time lowers

tannin content, thereby reducing bitterness.

Hedonic scores ranged from 2.51 to 3.23 (disliked to slightly liked), with L4 receiving the highest preference. The reduced tannin level after 15 minutes of blanching, combined with the addition of cinnamon, resulted in a less bitter and more acceptable taste. This aligns with previous findings that cinnamon improves flavor acceptability in herbal teas.

4.8 Overall Hedonic Evaluation

Color, aroma, and taste collectively determine the overall acceptability of avocado leaf herbal tea with added cinnamon.

Table 8. Average Overall Hedonic Scores of Avocado Leaf Herbal Tea with Added Cinnamon Powder

Treatment	Blanching Time	Overall Hedonic Score
L1	0 minutes	3.12 ^{bc}
L2	5 minutes	2.91 ^a
L3	10 minutes	2.99 ^{ab}
L4	15 minutes	3.18 ^c

Note: Values followed by different lowercase letters indicate a significant difference ($p < 0.05$).

Hedonic scale:

- 1 = strongly dislike,
- 2 = dislike,
- 3 = slightly like,
- 4 = like,
- 5 = strongly like.

Based on Table 8, the average overall hedonic score ranged from 2.91 to 3.18, indicating that the product was **slightly liked** by panelists. The highest overall preference was observed in treatment **L4 (15-minute blanching)**, which differed significantly from L2 and L3 ($p < 0.05$).

Panelists' acceptance was mainly influenced by a **yellow infusion color, slightly grassy aroma, and less bitter taste**. Longer blanching reduced bitterness and off-flavors, improving overall liking. Lower overall scores in some treatments were likely associated with residual bitterness caused by tannins from avocado leaves and cinnamon.

4. Conclusion

Blanching time had a significant effect on the quality of avocado leaf herbal tea with added cinnamon powder. Treatment L4, with a blanching time of 15 minutes, was selected as the best treatment, yielding a moisture content of 4.11%, ash content of 6.46%, the highest antioxidant activity with an IC_{50} value of 41.66 ppm (classified as very strong), and a tannin content of 0.012%. The descriptive sensory scores of the herbal tea were 2.33 (yellow) for color, 2.67 (slightly grassy) for aroma, and 2.47 (not bitter) for taste. The hedonic scores preferred by panelists were 3.74 (like) for color, 3.14 (slightly like) for aroma, 3.23 (slightly like) for taste, and an overall hedonic assessment of slightly like. These findings indicate that optimization of blanching time has potential practical application in the herbal tea industry to produce avocado leaf tea with improved functional properties and acceptable sensory quality. Further studies are recommended to evaluate different drying methods to improve sensory quality and antioxidant stability.

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