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HIGH ANTIOXIDANT ACTIVITY AND CONSUMER-BASED SENSORY PROFILING OF MANGO LEAF HERBAL TEA USING SEVERAL BREWING METHODS

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Abstract

This study, conducted in Bogor, Indonesia from May-July 2024, evaluated the antioxidant activity and sensory characteristics of mango leaf herbal tea based on six tea-brewing techniques, i.e., soft infusion, hard infusion, ambient infusion, chilled green tea, green tea puree, and sun green tea. These were then tested for IC50 antioxidant activity and sensory traits with hedonic and rate-all-that-apply (RATA) tests. Data analysis included Anova and Duncan for IC50 and Friedman and Nemenyi tests, principal component analysis, and preference mapping for sensory profiles. The results showed the antioxidant activity (IC50) of mango leaf herbal tea ranging from 3.57 to 133 ppm. Different brewing methods also affected antioxidant activity values. Tea using the sun green tea brewing method had powerful antioxidant activity, while that using green tea puree had weak activity. The green tea puree technique had the most diverse sensory attributes in terms of leaf aroma, green and watery taste, bitterness, astringency, and oily aftertaste. The ambient infusion and chilled green tea techniques had dominant characteristics of acidic taste with a yellow color. For sensory attributes, the soft infusion and sun green tea techniques produced a dominant brown color with an oily aftertaste, while the hard infusion method did not have any overriding sensory attributes.

Consumer acceptance of these products was 20-60%, indicating that the levels could be improved.

Keywords: Mango leaf tea, Brewing technique, Sensory properties, Consumer preference, Antioxidant activity.

نشاط عالي مضاد للأكسدة وملامح حسية قائمة على المستهلك لشاي أعشاب أوراق المانجو باستخدام طرق تخمير متعددة

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الخلاصة

هدفت هذه الدراسة إلى دراسة النشاط المضاد للأكسدة والخصائص الحسية الموجودة في شاي أوراق المانجو العشبي بناءً على تقنيات تخمير مختلفة. نفذت هذه الدراسة خمس تقنيات لتخمير الشاي: النقع الناعم، والنقع القوي، والنقع المحيط، والشاي الأخضر المبرد، وهريس الشاي الأخضر، والشاي الأخضر المشمس. ثم تم اختبار هذه التقنيات لنشاط مضادات الأكسدة IC50 والحسية باستخدام اختبارات المتعة ومعدل كل ما ينطبق (RATA). تضمن تحليل البيانات اختبار Anova و Duncan لـ IC50 واختبارات Friedman و Nemenyi، وتحليل المكونات الرئيسية، ورسم خرائط التفضيلات للملفات الحسية. أُجري هذا البحث في بوجور بإندونيسيا في الفترة من مايو إلى يوليو 2024. أظهرت النتائج أن النشاط المضاد للأكسدة (IC50) لشاي أوراق المانجو العشبي يتراوح من 3.57 إلى 133 جزء في المليون. كما أثرت طرق التخمير المختلفة أيضًا على قيم نشاط مضادات الأكسدة. كان للشاي باستخدام طريقة تخمير الشاي الأخضر المشمس نشاط مضاد للأكسدة قوي، بينما كان لطريقة تخمير هريس الشاي الأخضر نشاط ضعيف. تميزت تقنية هريس الشاي الأخضر بتنوع كبير في الخصائص الحسية: رائحة الأوراق، وطعم أخضر مائي، ومرارة، وقابضية، وطعم زيتي. أما تقنيات الشاي الأخضر المبرد والنقع في الماء البارد، فقد غلب عليها الطعم الحمضي ذو اللون الأصفر. أما بالنسبة للخصائص الحسية، فقد غلب على تقنيات النقع الخفيف والشاي الأخضر الشمسي اللون البني ذو الطعم الزيتي. في المقابل، لم تتفوق تقنية النقع المركز على الخصائص الحسية السائدة. تراوحت نسبة قبول المستهلكين لهذه المنتجات بين 20% و60%، مما يُفسر حصولهم على مستوى قبول أفضل لهذا المنتج.

كلمات مفتاحية: شاي أوراق المانجو، تقنية التخمير، الخصائص الحسية، تفضيلات المستهلك، النشاط المضاد للأكسدة.

Introduction

Herbal tea is a nutritious drink that provides many health benefits. It is usually made from the parts of various plants' leaves, flowers, seeds, or roots (9). (9) also stated that herbal tea has natural bioactive compounds of phenolic acids, flavonoids, alkaloids, terpenoids, and so on. Among the ingredients that can be used in herbal drinks are the leaves of the mango tree, known to contain active compounds such as mangiferin, phenols, flavonoids, and tannins, that have beneficial health properties, especially as anti-diabetic agents (25, 38 and 42). Research by (38) showed evidence that the ethanol extract in mango leaves contains various compounds such as gallic acid, quercetin, protocatechuic acid, mangiferin, isovitexin, vitexin, iriflophene, isoswertisin, taxifolin, amentoflavone, hypericin, and others. Also, (18) and (30) reported that the aqueous extract of mango leaf contains mangiferin, norathyriol, acetaldehyde, and hydroquinone. These bioactive compounds produce anticancer, anti-diabetic, antimicrobial, anti-obesity, anti-diarrheal, and antioxidant activities (25).

The antioxidant content in mango leaves ranges from 5.02 to 25.91 ppm, which is included in the powerful antioxidant category (43). This aligns with (21) who reported that the leaves were a moderate-to-powerful antioxidant with an IC50 value of ~9 and 117 µg/mL. Methanol extract provides radical scavenging activity with an IC50 value of 13.37 µg/mL (33). (40) also reported high antioxidant activity (IC50 of 6.872 ± 0.512 µg/mL) in mango leaf ethanolic extract. (27) explained that the presence of antioxidants in plants could increase functional properties such as protective effects against several types of diseases.

One way to widely introduce the benefits of mango leaves is by processing them into dry tea, which has sensory attributes, including color, aroma, and taste. Each sensory attribute is influenced by the brewing technique involved such as brewing temperature and time (28). The temperature of the water for brewing tea affects the process of extracting the compounds present in the mango leaves, such as those that produce aroma, color, and taste (2). Research by (10) tested the effect of the drying time of mango leaves on the antioxidant content and the level of panelist acceptance. Further, (41) reported that the antioxidant activity of mango leaf herbal tea was 25.91 ppm, while (31) stated that it contained 80.33 ppm of radical scavenging activity. However, these studies did not explain the effect tea brewing techniques on the antioxidant and sensory characteristics of mango-leaf tea.

This study examined the effect of brewing methods on the antioxidant activity and sensory attributes of mango leaf herbal tea drinks and their level of preference among consumers using the rate-all-that-apply (RATA) method. RATA collects information about the sensory profile of a product based on the intensity of the sensory attributes perceived by consumers (3, 4 and 39). It differs from other methods, such as the check-all-that-apply (CATA), which does not inform on the intensity of the test as (36) did on the sensory profile of coffee drinks.

Materials and Methods

Drying process of the mango leaves (*Mangifera indica* L.): Young leaves from the first to the sixth leaf from the base of the stem were obtained from 20-year-old

Manalagi mango plants in the Bogor area, Indonesia at around 10 am on May 29, 2024. They were washed and dried according to the method described by (6) and withered at room temperature (±27 °C) for approximately 24 hours. After withering, they were cut into small pieces for drying by roasting for approximately 1 hour to obtain a 5-6% water content in mango-leaf tea, within the 8% maximum for dry tea set under the Indonesian National Standard (SNI). The leaves were again crushed with a blender, making the size smaller and smoother.

Brewing of the mango-leaf tea: Mango leaf tea was brewed according to (45) using 2 grams of mango leaf herbal tea and processing with 200 ml water. This study used two brewing techniques, namely infusion by adding water to a container with tea and soaking it for a predetermined period, and decoction involving boiling the tea. For this study, the two techniques were modified using different water temperatures and soaking times, as shown in Table 1.

Table 1: Tea brewing methods.

Sample code	Brewing technique	Temperature (°C)	Time (min)
A1	Soft infusion	75-85	3-5
A2	Hard infusion	75-85	25-30
A3	Ambient infusion	23-27	30-40
A4	Chilled green tea	98-100	3-5
A5	Green tea puree (in fine powder)	70-80	4-5
A6	Sun green tea	Sun-dried (28-33)	180-240

Procedure analysis:

IC50 antioxidant measurement: The antioxidant capacity of the mango leaves was measured using the DPPH method described by (15) involving the insertion of 25, 50, 75, 100, 125, and 150 µL samples into a test tube. Next, the volume was measured to 5 µL with methanol and vortexed. Then 39.24 mg DPPH was weighed and added to 100 µL of methanol. The concentration series made previously was added with 2 µL of DPPH, then vortexed and incubated in a dark room for 30 minutes. After 30 minutes, it was measured using UV-VIS spectrophotometry with a wavelength of 517nm.

$$\%\ inhibiton = \frac{Abs\ control - Abs\ sample}{Abs\ control} \times 100\%$$

The inhibition percentage was plotted against the concentration, and the equation for the line was used to obtain the IC50 value.

Sensory evaluation using RATA: This research was carried out in 2 stages. The first involved focus group discussions (FGD) to formulate sensory attributes and profiles by panelists using the RATA method. The FGDs sought to formulate the best terms and definitions to make it easier for untrained or consumer panelists to understand the concepts and attributes involved. In this study, eight trained panelists determined the sensory attributes (23). They were recruited from the quality control department of a tea beverage company in Indonesia, had received sensory training once every 3-6 months, and had agreed to participate in this research.

In this activity, as many as six samples of mango leaf herbal tea were served alternately or individually to the panelists for them to describe their sensory attributes.

The same was done for the following until the last sample, where every change sample panelist had to neutralize their sense of taste by drinking water and eating crackers to get rid of the astringent taste (26).

Sensory data assessment: After determining the sensory attributes and developing a questionnaire, the research continued by seeking consumer panelists to provide sensory assessments of the mango leaf herbal tea samples. This study conducted hedonic sensory testing and RATA scoring using 52 consumer panelists (34) who had been apprised of the purpose of the research and the procedures for organoleptic tests and completing the questionnaires. The panelists were then asked to provide personal data consisting of name, age, and gender, their consent for participating in this study, as well as their habit of consuming tea without sugar and herbal drinks. Each panelist was provided six samples of mango leaf herbal tea drink of ± 30 ml each, one 150 ml glass of water, and crackers as a flavor neutralizer.

The first testing step was neutralizing the taste buds with water before sampling the drink. Then the panelists were invited to taste the sample and provide an assessment of their preferences through a sensory evaluation with a hedonic rating test on a scale of 1 (totally dislike), 2 (dislike), 3 (like), and 4 (very like). After the preference assessment, they were required to evaluate the sensory attributes that they detected after consuming the sample and given a rating scale, namely, 1 (not felt), 2 (very weak), 3 (felt), and 4 (very strong). This process was conducted for each sample followed by neutralizing their sense of taste by drinking plain water and eating crackers before taking on the next sample. The survey results were then collected for recap and analysis.

Data analysis: The data analysis in this study used the SPSS 24 and XLSTAT 2022 application. In this method, several panelists were involved in assessing the products provided using sensory attributes that the trained panelists had discussed. This study also used Anova and Duncan's post-hoc for antioxidant activity, and the Friedman and Nemenyi post-hoc tests for sensory analysis. Principal component analysis (PCA), and preference mapping also were performed for the sensory analysis.

Results and Discussion

Antioxidant Activity of Mango-leaf Herbal Tea: The IC50 values of the mango leaf herbal tea as shown in Table 2 ranged from 3.57 to 133.04 ppm. (31 and 41) reported that the antioxidant activity range of the tea was 25.91 and 80.33 ppm, respectively. The table shows that the sun green tea method produced very strong antioxidant activity at 3.57 ppm, while the green tea puree had the highest IC50 value with moderate antioxidant activity of 133.04 ppm. (29) stated that IC50 values below 50 ppm have very strong antioxidant activity, and those between 100 – 150 ppm have moderate antioxidant activity.

Table 2: IC50 values for mango-leaf herbal tea brewing techniques.

Brewing technique	Antioxidant activity (IC50)
Soft infusion	17.14[a, b]
Hard infusion	5.72[a, b]
Ambient infusion	10.11[a, b]
Chilled green tea	44.23[b]
Green tea puree (in fine powder)	133.04[c]
Sun green tea	3.57[a]

This result is due to the soaking process, where the sun green tea method had a reasonably long process of around 3-4 hours. Meanwhile, the green tea puree method did not have a soaking process but rather a short filtering phase of about 3 minutes. The soaking process affects antioxidant activity values, with longer soaking durations producing higher levels of phenolic and flavonoid compounds (48). (16) also reported that the soaking process had the highest DPPH inhibition percentage. In addition, the sun green tea brewing method had very strong antioxidant activity due to the long soaking time and relatively warm temperature, namely 28-33 °C. This aligns with (45) that warm ambient temperatures could produce good antioxidant activity because they were suitable for extracting antioxidants in tea.

Table 2 also shows that the infusion brewing methods (soft, hard, and ambient) tend to have higher IC50 values for antioxidant activity than the decoction methods (chilled green tea, green tea puree, and sun green tea), as was also noted by (50). Apart from that, antioxidant activity is affected by higher temperatures that produce more heat energy, and the extracted compounds will contain higher levels of antioxidants. This is supported by (12, 35 and 44), who stated that hot brewing creates much higher antioxidant activity compared to cold brewing. Antioxidant activity is significantly influenced by time and temperature during brewing (22).

The table also shows that ambient infusion has a cold distilled water brewing temperature but extremely strong antioxidant activity because the type of brewing affects its antioxidant activity. (14) stated that brewing with distilled water efficiently extracts antioxidant compounds from herbal ingredients or tea. Distilled water has optimal pH and conductivity to dissolve these compounds. As such, it increases the concentration of antioxidants in the brew and active compounds in the brewed ingredients, such as polyphenols and flavonoids, to dissolve more effectively without interference from other substances that may be in plain water.

Sensory Attributes of Mango-leaf Herbal Tea: The sensory attributes of mango leaf herbal tea drink using different brewing methods are shown in Table 3, where two colors appear, namely yellow and brown. The color difference is due to phenolic compounds such as tannin, flavonoid, and catechin in the extracted mango leaves during brewing (25). (11) stated that oxidation and degradation of catechins play essential roles in the browning of tea infusion. Another compound affecting the browning of mango-leaf tea/leaf-based tea is flavonol, as reported by (11).

Table 3: Sensory attributes of the mango-leaf herbal tea.

Attribute	Description
Color	
Yellowish	The color of the tea appears yellow
Brown	The color of the tea appears brown
Aroma	
Green leaf	The fresh scent of freshly cut leaves
Taste	
Green leaf	Taste like leaves
Watery	Light feeling when consumed (like consuming water)
Acidic	Acid taste
After Taste	
Astringency	Astringent or rough feeling on the tongue that remains after being consumed
Oily	Slippery feeling that remains after being consumed
Bitterness	Bitter taste that remains after being consumed

Table 3 also shows that all tea samples have an aroma of green leaves, with (46) noting that it appeared after the leaves were cut. This aroma is a form of plant defense mechanism where organic compounds in the leaves evaporate due to tissue damage, an occurrence known as green leaf volatiles (GLF). The GLV compound comprises C6 and C9 aldehydes, alcohols, and esters (49). (51) also reported that terpenes and esters group were the dominant compounds in mango leaf, comprising about 62.5 and 33.7%, respectively.

Table 3 shows the sensory attributes of taste, such as green, watery, and acidic. The green attribute describes a leaf-like taste when consuming the mango leaf herbal tea, the watery taste feels light in the mouth and throat, while the acidic taste explains the sour taste of the product. (37) reported that the acidic taste was caused by organic acids such as acetic, oxalic, kojic, and quinic acids. This study also obtained three attributes of sensory aftertaste, namely bitterness, oiliness, and astringency.

The bitterness attribute describes the bitter taste felt by the sense of taste when consuming a food product. The astringency aftertaste describes the sensation received by the sense of taste in the form of a feeling of dryness and shrinkage in the area of the oral cavity or tongue. This sensation can usually be found in food or beverage products containing polyphenolic compounds (20). In addition, flavonoid compounds such as tannin or tannic acid react with proteins and enzymes in the mouth causing the mouth tissues to contract and produce a dry and unpleasant effect. (11) reported that mango leaf was rich in protein content at about 93.2 – 171.4 g/kg dry matter. According to (1), the bitter and astringent taste in green tea is due to the dominant content of polyphenolic compounds (catechins). An oily aftertaste describes a slippery and greasy feeling after consuming certain drinks or foods. (25) reported that mango leaf has essential oil compounds and fatty acids such as myristic, palmitic, oleic, and linoleic acids.

Profiles of the Panelists: Several factors affect the sensory sensitivity of the panelists, including gender, age, physiological and psychological conditions, and genetics. The 52 panelists in this study were aged 22-42 years, 21% of which were above 40 years, 19% between 31-40 years, and 60% between 20-30 years. Twenty-five of them were males (48%) and 27 female (52%). Female participants outnumbered males, which relates to the findings by (32) that gender affects the results of sensory

tests, with females obtaining higher scores on sensitivity to bitter, sour, and sweet sensory attributes. Also, the recruitment of younger panelists is due to the sensory sensitivity factor, enabling a better explanation of the sensory attributes of mango herbal tea. Older panelists tend to experience decreased palate organ sensitivity and have difficulty concentrating on various sensory stimuli simultaneously (24). This result is in line with (47) which stated that several factors affect the sensitivity of panelists, including gender, with females being more sensitive than men, and age, where a person's ability to feel, smell and see decreases over time.

Sensory Profiling of Mango-leaf Herbal Tea:

Friedman and Nemenyi Tests: Each sensory attribute of the mango-leaf herbal tea was evaluated by 52 consumer panelists using RATA. The results for each treatment were first evaluated using the Friedman test at the 5% (0.05) significance level (Table 4).

Table 4: Friedman test for mango-leaf herbal tea attributes.

No	Attribute	p-value
1	Yellowish Color	< 0.0001
2	Brown Color	< 0.0001
3	Green Leaf Aroma	< 0.0001
4	Green Leaf Taste	0.012
5	Watery Taste	0.423
6	Acidic Taste	0.000
7	Astringency Aftertaste	0.185
8	Oily Aftertaste	0.005
9	Bitterness Aftertaste	< 0.0001

The table shows seven sensory attributes that are significantly different, namely yellowish color, brown color, green leaf aroma, green taste, sour taste, oily aftertaste, and bitterness aftertaste. Meanwhile, the sensory attributes for watery taste and astringency aftertaste are similar for each sample when perceived by untrained panelists or consumers.

Then a Nemenyi post-hoc test was conducted to identify differences based on sample intensity, as seen in Table 5. As shown, the yellowish color in the tea samples using the ambient infusion method has the highest average intensity compared to the others.

Table 5: Nemenyi post-hoc test of mango leaf herbal tea attributes.

Attribute	Brewing method					
	A1	**A2**	**A3**	**A4**	**A5**	**A6**
Yellowish Color	2.356^{a}	2.933^{a}	5.683^{b}	5.317^{b}	2.356^{a}	2.356^{a}
Brown Color	4.115^{c}	2.971^{b}	1.413^{a}	1.779^{a}	5.221^{d}	5.500^{d}
Green Leaf Aroma	3.288^{ab}	3.077^{a}	3.279^{ab}	3.529^{ab}	4.269^{b}	3.558^{ab}
Green Leaf Taste	3.673^{ab}	3.327^{ab}	2.827^{a}	3.731^{ab}	3.885^{b}	3.558^{ab}
Watery Taste	3.740^{a}	3.337^{a}	3.635^{a}	3.433^{a}	3.510^{a}	3.346^{a}
Acidic Taste	2.923^{a}	3.567^{ab}	4.038^{b}	3.808^{ab}	3.596^{ab}	3.067^{ab}
Astringency Aftertaste	3.769^{a}	3.433^{a}	3.221^{a}	3.500^{a}	3.673^{a}	3.404^{a}
Oily Aftertaste	3.606^{ab}	3.337^{ab}	3.163^{a}	3.163^{a}	4.269^{b}	3.462^{ab}
Bitterness Aftertaste	3.683^{bc}	2.817^{ab}	2.500^{a}	4.221^{c}	4.337^{c}	3.442^{abc}

A1-A6: soft infusion, hard infusion, ambient infusion, chilled green tea, green tea puree, and sun green tea, respectively.

On the other hand, this brewing method produced a lighter brown color compared to using the green tea puree and sun green tea which have higher brown color intensity. This difference in color intensity is seen more clearly in Figure 1.

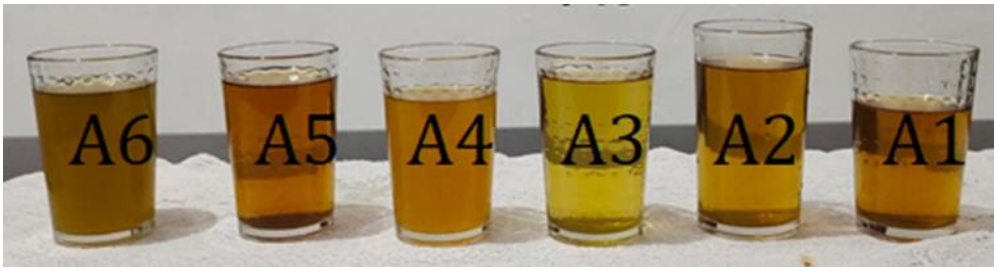

Figure 1: Visual of tea samples color intensity based on brewing method.
A1-A6: soft infusion, hard infusion, ambient infusion, chilled green tea, green tea puree, and sun green tea, respectively.

As (45) stated, the ambient-infusion brewing method uses low temperatures (room temperature, 23-27 °C), the green tea puree powder method uses a higher temperature, and the sun green tea method involves long soaking periods (3-4 hours). (12) reported that high-temperature brewing could produce higher polyphenol content, such as flavonoids and phenolic acids, and vice versa. These compounds are related to the brown color of the mango leaf tea, as (25) stated. Color intensity is influenced by soaking, with longer seeping producing a lighter tea color. The soaking process oxidizes the flavanol compounds into phenol compounds making them produce quinones. These compounds create a darker tea color due to a red-brown effect in the brewed mango-leaf tea. In addition, (53) explained that the smaller the particle size of the materials, the greater the extraction yield.

The intensity of the aroma from green tea puree brewing tends to be the strongest. According to (45), green tea puree brewing is done by converting the tea leaves into powder form with smaller particle sizes or higher surface areas than whole leaves or leaf flakes. Based on (53), the larger mango leaf surface areas facilitates the emanation of volatile components, such as terpenes and esters, thus enhancing the aroma of the tea compared to other brewing methods.

Table 5 also shows that the ambient infusion method tends to produce tea that has the lowest green taste. This relates to the previous explanation by (12) that low temperatures produce lower active compounds in mango leaves. In addition, the acidic taste of this tea is fairly intensive. The active components abundant in mango leaves, such as phenolic compounds, flavonoids, catechins, tannins, and others, strongly associate with the bitter and astringent taste/aftertaste. (54) explained that combining polyphenolic compounds, caffeine, and amino acids causes bitterness and astringency in tea. (52) reported that mango leaves are rich in polyphenolic compounds, especially mangiferin, while (25) reported that amino acids, such as alanine, are also present in them. As seen in Table 5, the lowest aftertaste bitterness intensity of the tea is produced by the ambient infusion method while the highest is with green tea puree brewing.

Principal Component Analysis (PCA) of Mango-leaf Tea Attributes: The biplot graph showing the relationship between sensory attributes and the samples tested in

this study can be seen in Figure 2. (8) stated that samples in the same quadrant have similar sensory characteristics but differ from those in other quadrants.

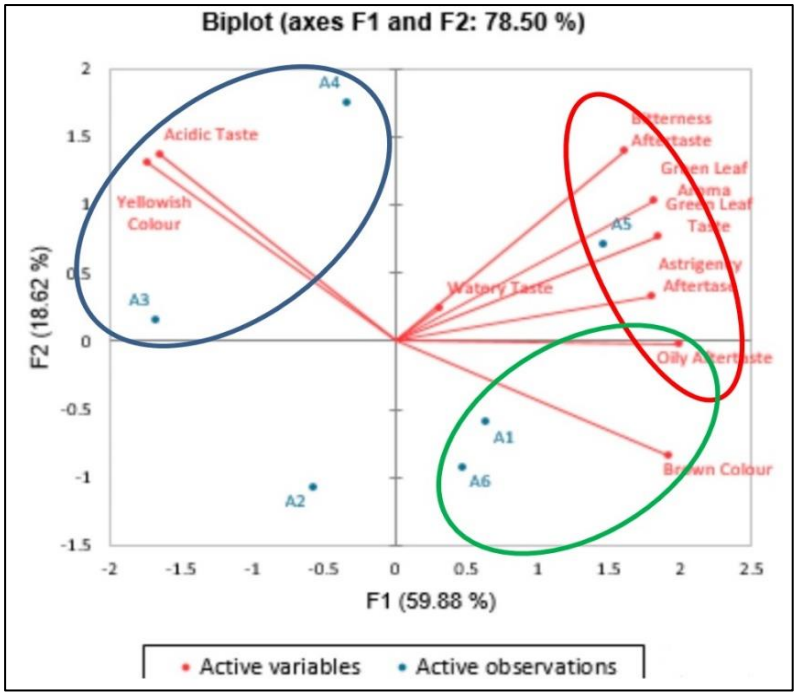

Figure 2: Principal component analysis of mango leaf tea.

A1-A6: soft infusion, hard infusion, ambient infusion, chilled green tea, green tea puree, and sun green tea, respectively.

The figure shows that green tea puree brewing has the most diverse sensory characteristics with bitterness aftertaste, leaves aroma, green taste, watery taste, astringency, and oily aftertaste dominating. Both ambient infusion and chilled green tea brewing techniques have dominant characteristics of an acidic taste with a yellowish color. Figure 2 also shows that tea using soft infusion and sun green tea brewing techniques have dominant sensory characteristics of brown color with an oily aftertaste, while the hard infusion brewing technique does not produce any such characteristics.

In addition, the point's location in the biplot graph also shows the influence on the relationship between attributes. (17) explained that sensory attributes showing angles less than 90° or closer to the axis have a positive correlation, while those greater than 90° have negative correlations. Figure 2 shows that the yellowish and brown sensory attributes have a negative correlation, while the yellowish color correlated positively with an acidic taste. This explains that the yellower the color of the brewed tea, the more acerbic the dominant taste. In comparison, brown tea positively correlates with the aftertaste attributes of oily, astringent, leafy taste, green leaf aroma, and bitter aftertaste. Furthermore, all of these attributes will be stronger or dominant, along with the dark color of the tea.

Consumer Preference Mapping of Mango-leaf Tea: Preference mapping analysis (Figure 3) seeks to develop a product by providing an assessment through a more specific hedonic test (5). The figure shows all panelists according average values of 20-40% to the soft infusion, chilled green tea, and green tea puree tea products, while

the hard infusion, ambient infusion, and sun green tea brewing techniques had average rates of 40-60%.

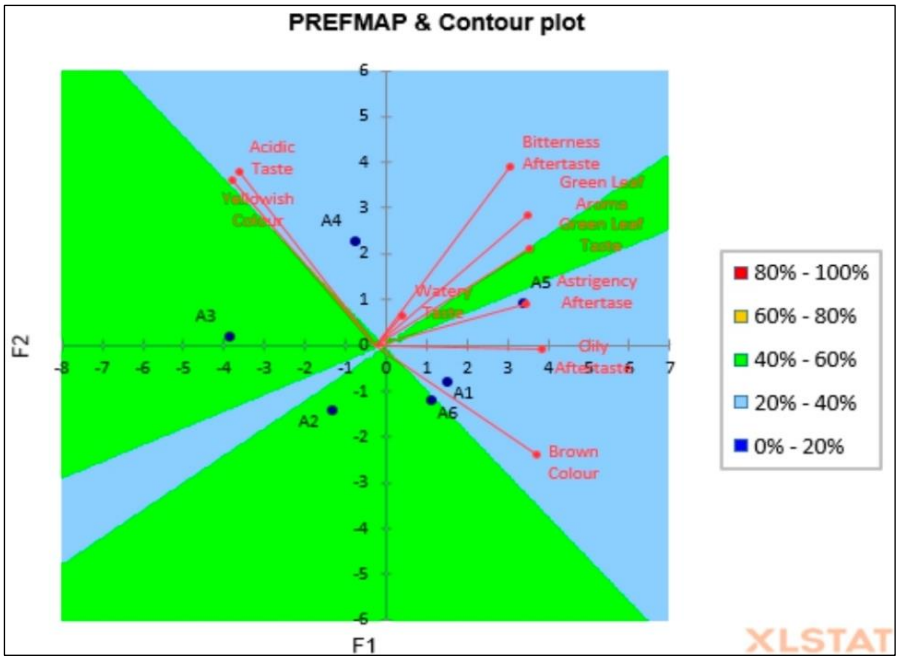

Figure 3: Preference mapping and contour plot of mango leaf tea.

A1-A6: soft infusion, hard infusion, ambient infusion, chilled green tea, green tea puree, and sun green tea, respectively.

Consumers generally need help accepting mango leaf herbal tea products, especially when brewed using soft infusion techniques, chilled green tea, and green tea puree. The relatively low level of consumer acceptance of mango leaf herbal tea in this study could be due to the larger number of young panelists who like cold and flavorful drinks. This result aligns with a research survey by (13) indicating that nearly 61% of Brazilians tend to consume sweet-infused tea. This finding was reinforced by (19), which stated that most herbal tea consumers in Bogor, Indonesia were aged 40-50 years.

Conclusions

Different brewing methods for mango leaf herbal tea significantly affected antioxidant activity values. The sun green tea brewing method had high antioxidant activity while green tea puree brewing was weak in that aspect. The FGD trained panelists noted 9 dominant sensory attributes, namely yellow color, brown color, green aroma, green taste, watery taste, acidic taste, astringency aftertaste, oily aftertaste, and bitterness aftertaste. The brewing technique affected the sensory characteristics in the resulting mango leaf herbal tea, especially on the attributes of yellow and brown colors, green aroma of leaves, green taste, acidic taste, oily aftertaste, and bitterness aftertaste. Mango leaf tea brewed using the green tea puree method had the most dominant attributes compared to the others, namely bitterness aftertaste, leaf aroma, green taste, watery taste, astringency, and oily aftertaste, although the panelists somewhat less accepted this tea than other with fewer dominant attributes.

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No Supplementary Materials.

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