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The Effect of Herbal Tea Formulation Made of Mangosteen Pericarp (Garcinia mangostana), Cinnamon (Cinnamon verum), and Clove (Syzygium aromaticum) on Panelist Acceptance Level

Pengaruh Formulasi Teh Herbal Perikarp Manggis (Garcinia mangostana)*, Kayu Manis* (Cinnamon verum)*, dan Cengkeh* (Syzygium aromaticum) *terhadap Tingkat Penerimaan Konsumen*

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ABSTRACT

Background: Herbal tea Is one of the herbal drinks that has been widely consumed by Indonesian people and known as tea that have functional properties, one of them is source of antioxidants. Antioxidants can be obtained from a lot of sources, such as the mixture of mangosteen pericarp, cinnamon, and cloves. The use of cinnamon and clove expected to increase the consumers' preference towards this tea.
Objectives: This research aims at evaluating the acceptance level of several sensory parameters of tea made of mixture of mangosteen pericarp, cinnamon, and clove.
Methods: The experimental design used in this research was completely randomized design with three replications, resulting in 27 samples of herbal tea. Besides, the data obtained from panelists will be analyzed by using Analysis of Varian (ANOVA) and followed by Duncan's Multiple Range Test (DMRT) in SPSS 25.0 software.
Results: The results show that the addition of cinnamon and cloves showed a significant difference. The more addition of spices will lower the panelist score. It can be seen in the sample containing 24 grams of mangosteen pericarp, 3 grams of cinnamon (B4) which had the highest panelist score in color, taste, and bitterness aspects. While the lowest panelist score was obtained by a sample containing 12 grams of mangosteen pericarp, 3 grams of cinnamon and cloves (A1).
Conclusions: The more spices added, especially cloves will reduce the liking score. The result obtained by this research can be used for optimization of the best formula so maximum points can be known.

INTRODUCTION

Herbal tea is one of the most preferred drinks consumed recently, especially during the COVID-19 pandemic era. The increasing consumption of herbal tea, especially which generates health benefits, has been the main concern for many people. In the global market, herbal tea has been marketed in some regions, including Asia Pacific, Europe, North and South America, Middle East, and Africa. The forms of herbal tea marketed globally are grouped according to the source of raw materials, function, packaging type, product type, and its application. Based on data published in Data Bridge Market Research, the herbal tea market was accounted for USD 3,290.17 million in 2021 and is forecast to reach the value of USD 5,445.22 million by 2029. This value was analyzed based on pricing, production-consumption data, and consumer behavior[1].

Herbal tea refers to plant elements, including flowers, leaves, seeds, roots, or dried fruit which is not derived from the tea plant (Camellia sinensis)[2]. There are several steps in herbal tea production which involves harvesting, cleaning, drying, storage of herb in suitable material, grinding, and blending. The most common source of raw materials used for herbal tea production are linden (Tilia cordata), sage (Salvia officinalis), chamomile (Matricaria chamomilla), fennel (Foeniculum vulgare), senna (Cassia acutifolia), ginger (Zingiber officinale), and mate (Ilex paraguariensis). The herbal tea made of those plants have been widely consumed across the countries, due to its therapeutic effects on the human body[3].

Meanwhile, the use of mangosteen in herbal tea production has not been extensively carried out. Mangosteen is also potential for human health due to the

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presence of various pharmacological effects produced by its phytochemical contents[4]. The daily consumption of mangosteen-based drinks showed antioxidative and anti-inflammatory effects with no side effects observed on immune, hepatic, and renal functions. Besides, the mangosteen pericarp is potential as a source of herbal tea production[5]. The chemical composition of mangosteen pericarp consists of 61.83% of moisture, 3.29% of ash (dry basis), 1.23% of fat (dry basis), 21.04% of fiber (dry basis), 2.66% of proteins (dry basis), and 30.99% of carbohydrates (by different). Besides, the bioactive compounds present in mangosteen pericarp are xanthone (165.90 mg/100mL), anthocyanin (17.52 mg/g), and tannin (3.32%)[6]. These bio-active compounds also showed pharmacological effect including antioxidant, anticancer, antinociceptive, anti-inflammatory, anti-obesity, anti-hyperglycemic[7].

Therefore, these potencies can be used for producing herbal tea which is also required to comply with the consumers' expectation. The characteristics and the quality of herbal tea products, especially in terms of color, taste, and flavor, are mostly influenced by the presence of catechin[8]. Catechin is the most abundant polyphenol compound in tea and mostly found in the form of epigallocatechin gallate (EGCG), epicatechin gallate (ECG), epicatechin (EC), epigallocatechin (EGC), and catechin[9]. The sensory characteristics of herbal tea are also affected by the presence of other volatile compounds from other ingredients if the herbal tea is made of mixture of several raw materials, including cinnamon and clove. These two herbs also possess the antioxidant properties that would be beneficial for human body.

To our knowledge, the development of herbal tea products from the combination of mangosteen pericarp, cinnamon, and clove has been very limited. Therefore, the objective of this research is to evaluate the effect of formulation on acceptance sensory parameters of herbal tea made of the combination of powder mangosteen pericarp, cinnamon, and clove.

METHODS

Preparation of Mangosteen Pericarp, Cinnamon, and Clove Powder

The mangosteen was purchased from a local farmer in Jember District, East Java, while the cloves and cinnamon was purchased from a local seller in Tanjung Market, Jember, East Java. After that, all the stamen and leaves were removed from the pericarp. Then, the pericarp was separated from the mangosteen seed covered with aril, and it was sliced into small pieces (approximately 2 cm). Those pieces were dried under the sunlight until the moisture content below 10%. The dried mangosteen pericarp, cinnamon, and clove respectively was grinded and sieved within 20 mesh to produce uniform size of powder particle. The powdered mangosteen pericarp, cinnamon, and clove were weighed according to the formulation set in Table 1. Then, all the ingredients were placed into food processors to be mixed evenly. After that, each sample was stored in plastic packaging for further analysis.

a. Mangosteen Pericarp b. Dried Mangosteen Pericarp c. Sieved Dried Mangosteen

Figure 1. Preparation of Mangosteen Pericarp

Formulation of Herbal Tea

The mangosteen pericarp was weighed and divided into three groups (Table 1), namely A (12 grams), B (24 grams), and C (36 grams). Then, the cinnamon and clove were added according to the set formulation by initial pre-formulation. Therefore, there were 11 samples with 3 replications, resulting in 33 samples of herbal teas.

Table 1. Herbal Tea Formulation by Initial Pre-formulation

Sample code	Formulation		
	Mangosteen pericarp (gram)	Cinnamon (gram)	Clove (gram)
A1	12	3	3
A2	12	1.5	1.5
A3	12	3	0
B1	24	3	3
B2	24	1.5	1.5
B3	24	3	0
C1	36	3	3
C2	36	1.5	1.5
C3	36	3	0

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Organoleptic Test of Herbal Tea

As many of 70 respondents semi-trained, consisting of 35 males and 35 females, were subjected to hedonic tests. Each respondent was instructed to evaluate all the sensory characteristics, including flavor, taste, color, and bitterness of all formulations of herbal teas. The score range used was 1-5 (1: very not similar to tea; 2: not similar to tea ; 3: neutral; 4: similar to tea; 5: very similar to tea)

Data Analysis

All the data were collected and analyzed using Analysis of Varian (ANOVA) and followed by Duncan's Multiple Range Test (DMRT) in SPSS 25.0 software with 95% confidence interval. The meaning of significantly different was the value of p-value less than 0,05.

Ethical Clearance

All of the panelists have signed a letter of ethical clearance as an agreement to become the organoleptic test subject. Besides, the ingredients that have been used on the herbal tea sample did not contain any toxic and safe for human consumption.

RESULTS AND DISCUSSION

In this research, the herbal teas made of the mixture of mangosteen pericarp, cinnamon, and clove powder were evaluated in terms of panelist acceptance of sensory aspects, such as taste, flavor, color, and mouthfeel. For herbal tea products, flavor, taste, color, and bitterness are the most influencing factors perceived by consumers when consuming it. The determination of significantly different attributes from organoleptic test was made using Analysis of Varian (ANOVA) and followed by Duncan's Multiple Range Test (DMRT), which can be interpreted as the panelist can detect the difference in the intensity of sensory attribute of herbal tea made with mixture of pericarp mangosteen, cinnamon, and clove (Table 2).

Table 2. Duncan Test Result of The Effect of Different Formulation of Herbal Tea on Sensory Characteristics

Sample code	Average Score of Organoleptic Test*			
	Flavor	Taste	Color	Bitterness
A1	5.00^{f}	3.29^{a}	3.04^{a}	3.23^{ab}
A2	3.70^{e}	3.57^{ab}	3.96^{b}	3.26^{b}
A3	3.37^{cd}	3.50^{ab}	3.99^{bc}	3.24^{b}
B1	3.61^{de}	3.36^{a}	3.09^{a}	2.93^{a}
B2	3.14^{bc}	3.66^{b}	4.19^{bcd}	3.40^{bc}
B3	3.21^{bc}	3.36^{a}	4.21^{cde}	3.19^{ab}
C1	3.17^{bc}	3.74^{b}	4.41^{de}	3.46^{bcd}
C2	2.96^{ab}	3.76^{b}	4.44^{e}	3.40^{bc}
C3	2.81^{a}	4.03^{c}	4.89^{f}	3.63^{cd}

*The difference of the alphabets shows that there's a significant difference between the samples. Alphabet "a" shows the lowest liking score by panelist, while the alphabet "f" shows the highest liking score by panelist.

Flavor

The most favorable flavor of herbal tea was herbal tea A1 which consists of 12 grams of mangosteen pericarp, 3 grams of cinnamon, and 3 grams of clove, whilst the least favorable was herbal tea C3 which consists of 36 grams of mangosteen pericarp and 3 grams of cinnamon. Besides, in the herbal teas consisting of 12 grams of mangosteen pericarp (A samples), the higher amount of cinnamon and clove added significantly increase the pleasant flavor of the herbal teas, while it was not observed when the herbal teas consisting of 24 grams of mangosteen pericarp (B samples).

This is because the amount of mangosteen pericarp used in the formulation was only 12 grams (67%) and was obscured by the addition of a considerably large ratio of cloves (16.5%) and cinnamon (16.5%) compared to other treatments. The content of eugenol compounds present in cloves and cinnamon can mask the distinctive aroma of herbal teas. The same result has been found that stated with the addition of spices in the form of 11.38% cinnamon and 45% cardamom in 43.62% black tea also produced a strong aroma[10]. Besides, the result also stated that the more mangosteen pericarp was added will decrease the favorable of herbal tea, that is because based on literature stated that mangosteen has a distinctive flavor which produces sour flavor. Sourness has an important role in flavor attributes, the main organic acids regarding flavor notes for most fruits are citric acid, malic acid, tartaric acid, succinic acid and quinic acid[11,12]. The same result also has been found on the research by Andirini et al.[13] which obtained with the addition of cinnamon extract can improve the sting sour flavor profile of mangosteen pericarp.

Taste

According to Zhang et al.[14] stated that taste is one of the important factors in testing the quality of tea. The sweetness and umami of tea are generally the most acceptable flavors for consumers, while bitter and astringent flavors are not liked by consumers. Based on the results of this study, it can be seen that the most preferred herbal tea flavor is Sample C3, which is made from 36 grams of mangosteen pericarp and 3 grams of cinnamon. While the least preferred taste was Sample A1 which was made from 12 grams of mangosteen pericarp and 3 grams of cinnamon and 3 grams of cloves. In addition, in the herbal tea sample made from 36 grams of mangosteen pericarp (Sample C) it was found that the addition of too many cloves could give the panelists a taste that was not liked by the panelists. However, the addition of cinnamon has the opposite effect, which is to give the panelists a taste that is preferred. A significant difference was found in sample B, which can be seen in the herbal tea made from 24 grams of mangosteen

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pericarp and 3 grams of cinnamon (Sample of B3) which produced a taste favored by the panelists, while herbal tea made from 24 grams of mangosteen pericarp and 3 grams of cinnamon and 3 grams of cloves (Sample of B1) produced a taste that was not liked by the panelists.

This is because not everyone likes the taste of cloves which has a slight spiciness, mixing mangosteen and cinnamon will give the tea a sweet taste and the distinctive taste of mangosteen can still be felt. This is supported by the literature which states that cinnamon is warm, spicy, fragrant, and slightly sweet[15]. The sweet taste of cinnamon probably comes from the sugar content in it, so a tea formula made from 36 grams of mangosteen pericarp and 3 grams of cinnamon (Sample of C3) has a high value. The results of a similar study of lemongrass tea with the addition of cinnamon conducted by Arisanti et al.[15] based on the results of organoleptic tests on the taste of lemongrass tea with the addition of cinnamon showed that the panelists' acceptance of the taste parameters of lemongrass tea has been increased with the addition of cinnamon. It shows that the comparison between lemongrass with the 50% cinnamon addition has higher panelist' acceptance rather than the lemongrass tea with no addition of cinnamon and 25% cinnamon. The cinnamon can influenced the taste because cinnamon can produce a slightly spicy taste compared to the treatment without cinnamon. Regarding the addition of cloves, cloves can produce a bitter taste which is disliked by the panelist. Literature by Alfikri et al.[16] states that the combination of **β**-cis-caryophyllene and eugenol in cloves can produce a bitter taste and spicy aroma.

Color

In this research was found that the most preferred color is in the herbal tea which consists 36 gram of mangosteen pericarp with 3 gram of cinnamon (Sample of B3) and also in the herbal tea which consists of 24 gram of mangosteen pericarp with 3 grams of cinnamon (Sample of C3). Meanwhile, the least favorable color of herbal tea was found in the herbal tea which consists of 12 grams of mangosteen pericarp with 3 grams of cinnamon and 3 grams of cloves (Sample of A1). Besides, in herbal tea that consists of 36 grams of mangosteen pericarp (Sample C) was found that the more spices (cinnamon and cloves) have been added in the herbal tea formulation, so the higher brown color of the color tea produced, while it was not observed in the herbal tea which consists of 12 grams of mangosteen pericarp (Sample A). In comparison, the B Sample of herbal tea shows the significant difference. The herbal tea which consists of 24 grams of mangosteen pericarp with 3 grams of cinnamon (Sample of B3) produce the most preferred color, while the least preferred tea color was found in the herbal tea that consists of 24 grams mangosteen pericarp with 3 grams of cinnamon and 3 grams of cloves. In general, the color of tea depends on the ingredients used on the tea products. The most preferred water herbal tea color is brown-yellowish[17]. The lighter color of the brewing water, the more suitable tea to consumers' preference. The same result also has been found in the research by Wijana et al.[18] which stated the darker of the tea color will decrease the color score by the panelist.

This was because with the addition of spices, cinnamon and cloves in the herbal tea formulation makes the pigments that contained in the cinnamon and cloves reacted to each other which produced the darker color of the herbal tea. This result can be shown in the comparison between each sample, which the herbal tea samples that contained respectively 3 grams of both of spices (cinnamon and cloves) will result in a lower hedonic score compared to the herbal tea samples that contain less both of spices in one formulation. Similar result was also found on some research by (Yulianto et al., Ranggawati et al., Lutfiani et al.)[19,20,21] who observed that cinnamon contain anthocyanin pigment and cinnamaldehyde which can produce reddish color. So that the more cinnamon has been added in a functional drink will produce the darker color due of the solubility of cinnamaldehyde. The same way goes with the cloves, atsiri oil which contains cloves can produce brownish color due of 12% of calcium oxalate and 7% tannin in it[22]. In general, with the addition of spices have a possibility to produce the darker color of herbal tea. Besides, mangosteen pericarp also contributes in the herbal tea brownish color. Mangosteen pericarp contains anthocyanins pigments such as cyanidin3-sophoroside, and cyanidin-3-glucoside. These compounds can produce red, purple and blue pigments[23].

Bitterness

In general tea products can produce the bitter taste and astringency sensation due of the combination between the components like polyphenol, caffeine, and some amino acids. Based on literature by Ye et al.[24] stated that alkaloid, catechins, anthocyanin, phenolic acid, flavonol glycoside, and theaflavin is the components that contained in a brewed tea which these components can contribute in produce of the bitterness and astringent sensation. In this research was found that the most accepted bitter is in the herbal tea which consists of 24 grams of mangosteen pericarp and 3 grams of cinnamon (Sample of B3), while the least accepted bitter is in the herbal tea which consists 24 grams of mangosteen pericarp with 3 grams of cinnamon and 3 grams of cloves. Besides, in the herbal tea that consists 36 grams of mangosteen pericarp (Samples C) was found that with the addition of cloves can increase the bitterness level of herbal teas, while it was not observed in the herbal tea that consists 12 gram of mangosteen pericarp (Samples A). In comparison, the B samples of herbal tea show a significant difference. The herbal tea which consists 24 mangosteen pericarp and 3 gram of cinnamon (Samples of B3) produce the most accepted bitter sensation, while the herbal tea which consists of 24 mangosteen pericarps with 3 grams of cinnamon and 3 grams of cloves (Samples of B1) produce the least accepted bitter taste.

Based on the result that has been obtained shows that cloves have more components that can contribute in produce the bitterness sensation of the herbal tea than cinnamon. Similar results also have been found in the research conducted by Towaha[25] who stated that cloves have more eugenol components than cinnamon and nutmeg. Based on literature by Alfikri et al.[16] also added that the combination between **β**-cis-caryophyllene and

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eugenol produces the bitter taste and spicy aroma. Besides, cinnamon and cloves also has been known as one of spices that have high phenolic level[26,27]. The literature by Wirnawati et al.[28] also stated that cloves contained alkaloid. The research also obtained based on organoleptic test shows that with the addition of spices as flavoring agents in the corn tea can increase the bitterness of the corn tea. Other than that, based on research conducted by Fibrianto et al.[29] obtained that the brewing methods with hot water can increase the bitterness level of herbal tea. That is because the use of heat can cause oxidation, epimerization, and polymerization reactions.

CONCLUSIONS

Based on the result that has been obtained shows that in general the most likely sample by panelist is the herbal tea which consists of 24 grams of mangosteen pericarp, 3 grams of cinnamon, and 0 grams of cloves (Sample of B3). The sample of B3 has obtained the higher hedonic score in color, taste and bitterness aspects. Whereas, in the aroma aspects, the most preferred flavor was observed in the herbal tea which consists of 12 grams of mangosteen pericarp, 3 grams cinnamon, and 3 grams of cloves (Sample of A1). So, based on the data has obtained in this research shows that the addition of spices, cinnamon and cloves with the right amount will increase preference liking/acceptance by panelists. The less desirable spice in this research is cloves. The result obtained by this research can be used for optimization of the best formula so maximum points can be known.

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