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Sensory evaluation of cold coffee drink with addition of canistel (*Pouteria Campechiana*) fruit powder

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ABSTRACT

The strong sensory of canistel powder (*Pouteria campechiana*) could be combined with other strong sensory like coffee. This combination made a unique innovative product and has benefit for body. The objective of this research was to evaluate the sensory of cold canistel coffee using Rate-All-That-Apply method. There were five comparison of overripe canistel powder and granule instant coffee, namely 50:50; 60:40; 70:30; 80:20; 90:10, then mixed with plain base of 25:75. The product analysis using Focus Group Discussion by selected panelists. Friedman and Nemenyi tests, Principal Component Analysis, and Preferences Mapping from XLSTAT 2019 were used for data analysis. The results showed that the most preferred by panelists was the cold canistel coffee of 70:30. It has dominant sensory of caramelly aroma and taste, green aroma, creamy taste and sweet taste. Overall, the consumers have high preference to the sensory attribute of caramelly aroma, caramelly taste and creamy taste.

Key words: Canistel fruit; fruit coffee drink; preference mapping; sensory profiling.

1 INTRODUCTION

Canistel fruit is a fruit rich in carotenoids, which range from 1.9-23.5 mg/g dry weight (Lanerolle et al., 2008; Costa et al., 2010). Canistel fruit is also a source of phenolic compounds and flavonoids (Kong et al., 2013). According to Mehraj et al. (2015), in addition to flavonoids, canistel fruit also contains alkaloids, tannins, steroids, and terpenoids. Research on fully ripe canistel fruit into flour and starch have been carried out by Paragados (2014) and Pertiwi Nurhalimah and Aminullah (2020), as well as Pertiwi et al. (2022). The application of full ripe canistel fruit flour has been carried out for the manufacture of non-gluten products, namely cookies (Paragados, 2014), biscuits (Sutrisno; Arief; Oktapiani, 2018), steamed brownies (Pertiwi et al., 2018), polvoron (Padilla et al., 2015), and wet noodles (Aminullah et al., 2020). Morton (2013) reported that the shelf life of fruit from picking to unfit for consumption was about ten days. According to Hossain, Karim, and Juthee (2020), chlorophyll degradation; carotenoid biosynthesis; starch hydrolysis into sugar; sugar respiration into carbon dioxide, water, and energy; protopectin hydrolysis into pectinic acid; and aromatic compound biosynthesis occur during the ripening process.

According to Rajkumar et al. (2007) and Morgan et al. (1961), foodstuffs containing high sugar such as fruits can be used with drying techniques with the foam-mat drying method. Wilson et al. (2012), Kandasamy and Varadharaju (2014), Prakotmak, Soponronnarit, and Prachayawarakorn (2010), and Pertiwi et al. (2020) reported the processing of high sugar fruits, namely mango, papaya, banana, and overripe canistel fruits into powder using foam-mat drying, respectively. Overripe canistel powder using this method has a dominant canistel taste, so appropriate treatment is needed based on the characteristics of this fruit. One of them is to combine canistel fruit powder with ingredients that have a solid taste to minimize the typical strong taste of canistel, such as coffee. Caffeine and other compounds such as amino acids and sugars are responsible for the aroma of coffee. Compounds that produce astringent or sour taste, such as tannins and acetic acid, will be lost, and some will react with amino acids to form melanoidin compounds that give brown color (Echavarrıa; Pagan; Ibarz, 2012). According to De Vivo et al. (2022) and Yu et al. (2021), the volatile compounds in coffee were aldehydes, alcohols, esters, ketones, furans, phenols, pyrroles, pyridines, pyrazines, and sulfur compounds. The more components of volatile compounds that dissolve in water during the brewing process, the sharper the resulting fragrance (Bhumiratana; Adhikari; Chambers, 2011). In addition, there are several studies on fruit coffee drinks such as blackcurrant and apple coffee drinks (Kārkliņa and Kampuse, 2021) and other fruits. This canistel fruit powder addition to coffee makes a unique, new sensory, and innovative product that benefits the body. Pertiwi, Aminullah, and Suprayatmi (2019) reported that overripe canistel powder had a sugar content of 29.04% and beta-carotene of 0.63 ppm.

Coffee is the most widely consumed beverage in the world. Coffee is also an essential dietary factor because it is one of the most widely consumed non-alcoholic beverages today (Miranda et al., 2017). Data from the Ministry of

Industry shows that Indonesia is the fourth largest coffee-producing country globally, with an average production of 639 thousand tons per year, or about 8% of world coffee production (Khakim, 2015). In addition, according to Wijaya (2021), coffee consumption in Indonesia is ranked number 1 in Southeast Asia, reaching 294,000 tons in 2019, an increase of 13.9% compared to the previous year. Coffee can be enjoyed by various age groups, with the most drinkers in the age range between 25 - 39 years. In 2020/2021, Indonesia has consumed coffee about 5 million bags of 60 kg, which is the second largest after Brazil for exporting countries (International Coffee Organization, 2021). In this study, a powder drink formulated from instant coffee granules and canistel powder will be carried out at various percentages, producing new sensory profiles.

This study aims to study the sensory profile of a mixed instant coffee granule and canistel powder drink using the RATA (Rate-All-That-Apply) method. The RATA method is a consumer-based product description method. This method can quickly collect information about the sensory profile of a food product based on consumer perceptions through the perceived intensity of each attribute (Ares et al., 2014).

2 MATERIAL AND METHODS

In this research, the preparation of overripe canistel powder (Padalarang, West Java, Indonesia) referred to Pertiwi et al. (2020b). In the manufacture of canistel powder, water (A, 50%) in the manufacture of fruit puree, egg albumin (B, 16.88%) as foaming material, and maltodextrin (C, 8.12%) as a stabilizer and filler. The total of A+B+C = 75% of the formulation, while the remaining 25% was the overripe canistel fruit. The resulting powder was mixed with instant coffee granules (*Nescafe*, robusta coffee) in various ratios (canistel powder:coffee granule), namely 50:50, 60:40, 70:30, 80:20, and 90:10. These proportions were based on using as much canistel powder as possible in this coffee drink formula. The resulting canistel coffee was then mixed with the plain base during serving with a ratio of canistel coffee and plain base of 25:75. The plain base was made by mixing 56.7% sugar, 30% creamer (*MaxCreamer*; composition: corn extract, vegetable oil, caseinate, dipotassium phosphate stabilizer, monoglyceride emulsifier, sodium aluminosilicate (anti-caking agent), and food coloring (anato CI 75120)), and 13.3% full cream milk powder (*Indomilk*; composition: full cream milk powder, inulin, vitamin premix, synthetic flavours, choline, natural flavours, vitamin E, vitamin C, DHA, (from fish oil contains tocopherol antioxidants), sodium ascorbate, ascorbil palmitate). Next, 20 g of a mixture of canistel coffee and the plain base was brewed using 100 mL of hot water at 80 °C. After that, the resulting infusion was put into a cooler to a temperature of 20 °C, and the sensory profile was evaluated using RATA (Rate-All-That-Apply) method.

2.1 Determination of sensory attributes

The attributes determination used in the questionnaire list of the RATA method can be obtained by Focus Group Discussion (FGD) (Dooley et al., 2010). The FGDs in this research were conducted by seven trained panelists calibrated every six months, accompanied by a moderator. These seven trained panelists work at PT. Food and Beverages (Ltd.) engaged in the beverage sector including coffee drinks. FGD was a process of verifying the sensory attributes used in the RATA test. They performed organoleptic testing twice, and all the results were collected, then the obtained results were discussed again to determine the most likely attribute.

2.2 Data retrieval

Sensory attributes generated through FGDs were assessed for their sensory by general panelists. The desired panelists in this research refer to the target consumers of coffee drinks, aged 17-40 years and of all genders. At this stage, a questionnaire will be given to explore these criteria. This questionnaire will be distributed online using a google form to obtain 50 panelists.

Sensory testing using the RATA and hedonic methods was carried out by panelists who met the criteria. The test sample was prepared by dissolving 20 g of canistel coffee in 30 mL of 80 °C hot water and added normal water and then stored in a refrigerator until a temperature of 20 °C was obtained. The test was started by neutralizing the sense of taste using mineral water, then tasting the test samples provided. This treatment was repeated for each different test sample. An evaluation of the hedonic rating was carried out with six scales, namely 1 (dislike very much), 2 (dislike moderately), 3 (dislike slightly), 4 (like slightly), 5 (like moderately), 6 (like very much). Then the RATA test was carried out with five scales, namely 1 (very weak), 2 (somewhat weak), 3 (moderate), 4 (somewhat strong), and 5 (very strong). Panelists were asked to provide a checklist in the attribute intensity column, which was considered to describe the test sample; the attribute column can be left blank and has a value of 0.

2.3 Data Analysis

The data analysis that will be carried out in this research were Friedman's test, PCA (Principal Component Analysis), and Preference Mapping using XLSTAT 2021 software. Friedman's test analysis was carried out to identify significant differences between samples for each sensory attribute (Ares et al., 2014). If the p-value was less than 5%, then Nemenyi's post hoc test was carried out. The output of PCA analysis was a biplot graph that describes the sensory profile of the cold canistel coffee drink.

Preference data was processed using Preference Mapping; this analysis was obtained based on the results of PCA analysis and the value given by the panelists; this analysis produces a contour plot image in 2-dimensional form.

3 RESULTS

3.1 Attribute profile of cold canistel coffee drinks

From the sample of cold canistel coffee drinks discussed in the FGD with seven trained panelists, 14 sensory attributes were obtained. Furthermore, an elaboration is made for the description of each attribute which can be seen in Table 1.

3.2 Panelist profile

Panelist profiling is conducted to obtain panelists who meet the Hedonic test and RATA criteria. In addition, the desired panelists in this study are those who like coffee drinks. The results of the panelist's first stage selection found that out of the initial 66 people, 50 (75.8%) stated that they had consumed coffee drinks, and the rest (24.2%) had never consumed coffee. Based on these results, as many as 50 people who had consumed coffee became panelists in this study. These panelists are general (untrained) and semi-trained panelists of PT Food and Beverage Bogor, with 50 panelists. According to Moskowitz (1997), at least 40-50 panelists were required to reduce bias in the obtained data in the sensory test. Panelist profiles obtained in this study can be seen in Figure 1.

Table 1: Sensory profile description of cold canistel coffee drink.

No.	Sensory attribute	Description
1.	Brown Color	Brown test sample
2.	Eggy Aroma	Fishy smell like raw egg
3.	Green Aroma	Bad smells like cut greenery, leaves, vegetables or grass
4.	Sweet Potato-Like Aroma	Smells like sweet potato
5.	Roasted Aroma	The distinctive aroma of roasted coffee beans
6.	Caramelly Aroma	Distinctive aroma of sugar that is cooked and becomes caramel
7.	Sweet Potato-Like Taste	Taste like sweet potato
8.	Burn Taste	Taste like burnt or over-roasted coffee
9.	Creamy Taste	Taste like milk and butter
10.	Bitter Taste	Bitter taste of coffee
11.	Caramelly Taste	The distinctive taste of sugar that is cooked and becomes caramel
12.	Acidic Taste	A distinctive sour taste is in coffee
13.	Sweet Taste	Sugar sweet taste
14.	Astringent Aftertaste	Bitter aftertaste

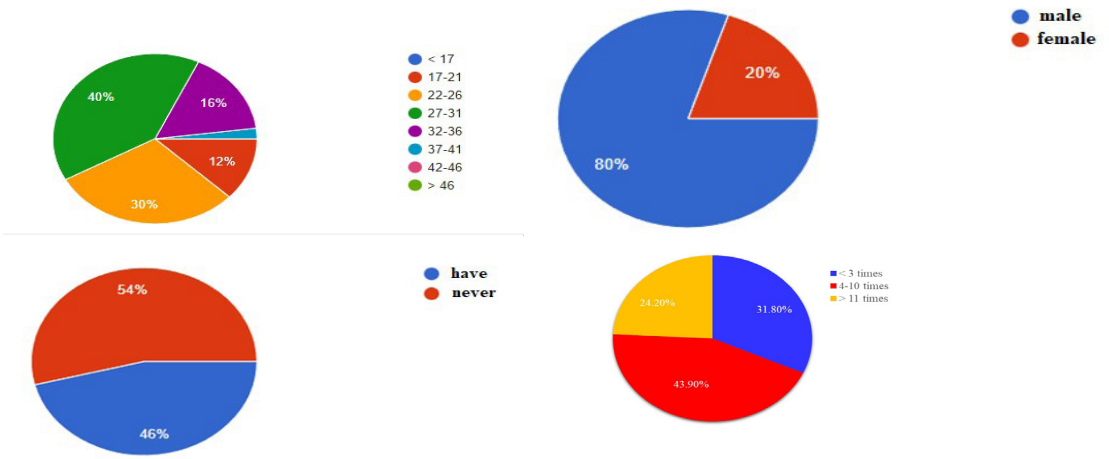

Figure 1: Panelist profiles based on (a) age, (b) gender, (c) consumption experience of canistel fruit, and (d) consumption frequency of coffee drinks (in a month).

3.3 Sensory profile of cold canistel coffee drink

All sensory attributes of each treatment are evaluated by Friedman's test at a significance level of 5%. The statistical results can be seen in Table 2.

Table 2: Friedman's test of cold canistel coffee drink.

No	Sensory profile	p-value
1	Brown Color	0.000
2	Eggy Aroma	0.000
3	Green Aroma	0.003
4	Sweet Potato-Like Aroma	0.000
5	Roasted Aroma	0.000
6	Caramelly Aroma	0.267
7	Sweet Potato-Like Taste	0.000
8	Burn Taste	0.000
9	Creamy Taste	0.000
10	Bitter Taste	0.000
11	Caramelly Taste	0.282
12	Acidic Taste	0.000
13	Sweet Taste	0.000
14	Astringent Aftertaste	0.000

These differences are then analyzed further by the Nemenyi's post hoc test, as shown in Table 3.

Then the PCA (Principal Component Analysis) test is carried out. According to Adawiyah, Tjiptoputri, and Lince (2020), PCA in the study of sensory attributes shows differences in perceptions and interactions between attributes. This can be seen from several factors: the attribute and product points' position in the quadrant, the vector angle proximity between the attribute and the product, and the distance between the attribute/product point and the centre axis of the graph. The biplot graph of PCA can be seen in Figure 2.

After PCA analysis, Preference mapping (PREFMAP) analysis is performed on cold canistel coffee drinks. PREFMAP is the result of analysis in a contour plot consisting of several colors to describe the percentage of panelists to the average preference value on a product. The contour plot (preference map) is divided into five color areas; the red area gives an interpretation of the preference value above the average as much as 80%-100%, the yellow area as much as 60%-80%, the green area as much as 40%-60%, the light blue area of 30% -40% and dark blue area of 0% -20%. The results of the preference mapping analysis can be seen in Figure 3.

Table 3: Nemenyi's post hoc test results of cold canistel coffee drink.

Attribute	Product				
	A1	A2	A3	A4	A5
Brown Color	4.48a	3.96b	3.24c	2,24d	2.00d
Eggy Aroma	0.46a	0.78a	1.02a,b	1.70b	1.76b
Green Aroma	0.86a	1.02a,b	1.30a,b	1.40a,b	1.50b
Sweet Potato-Like Aroma	1.00a	1.26a	1.58a,b	2.04b,c	2.68c
Roasted Aroma	3.62a	2.96a,b	2.78b	2.40b,c	1.84c
Caramelly Aroma	2.50a	2.36a	2.74a	2.62a	2.50a
Sweet Potato-Like Taste	1.10a	1.24a,b	1.90b,c	2.64c,d	3.06d
Burn Taste	2.92a	2.48a	2.02a,b	1.58b	1.36b
Creamy Taste	1.90a	2.14a,b	2.86b,c	2.96c	3.16c
Bitter Taste	3.46a	3.02a	2.08b	1.38b,c	0.94c
Caramelly Taste	2.36a	2.30a	2.72a	2.66a	2.68a
Acidic Taste	2.56a	1.78a,b	1.52b,c	0.96c,d	0.74d
Sweet Taste	2.64a	2.84a,b	3.46b,c	3.62c	3.96c
Astringent Aftertaste	2.96a	2.30a,b	1.76b,c	1.06c	0.90c

Note: A1= canistel powder and instant coffee granules of 50:50.
A2= canistel powder and instant coffee granules of 60:40.
A3= canistel powder and instant coffee granules of 70:30.
A4= canistel powder and instant coffee granules of 80:20.
A5= canistel powder and instant coffee granules of 90:10.

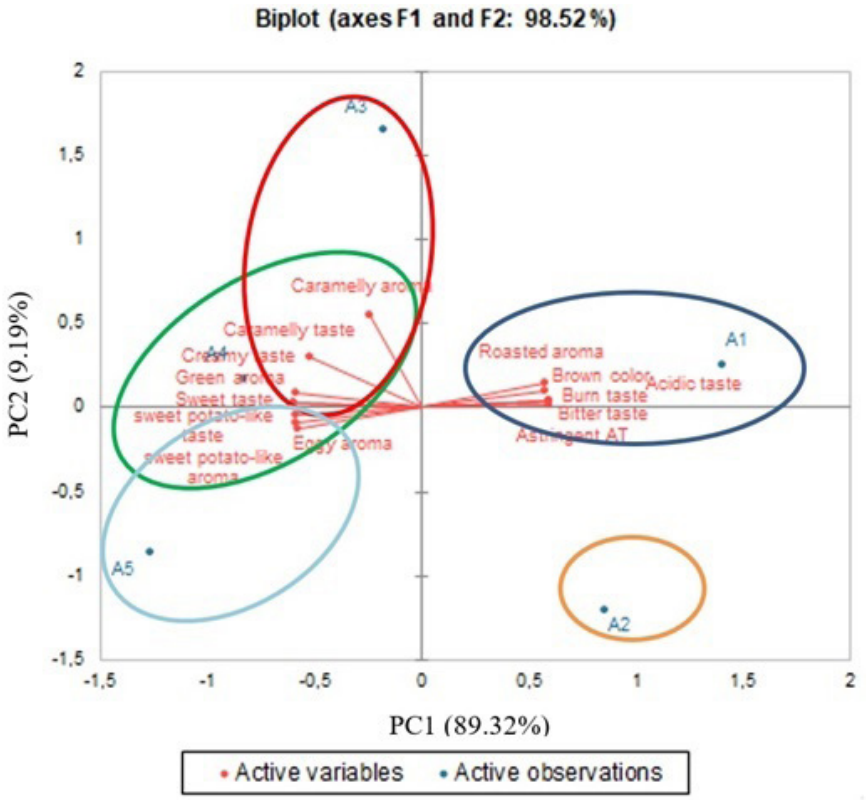

Figure 2: Representation of the sensory profile of cold canistel coffee drink.

Note: A1= canistel powder and instant coffee granules of 50:50.
A2= canistel powder and instant coffee granules of 60:40.
A3= canistel powder and instant coffee granules of 70:30.
A4= canistel powder and instant coffee granules of 80:20.
A5= canistel powder and instant coffee granules of 90:10.

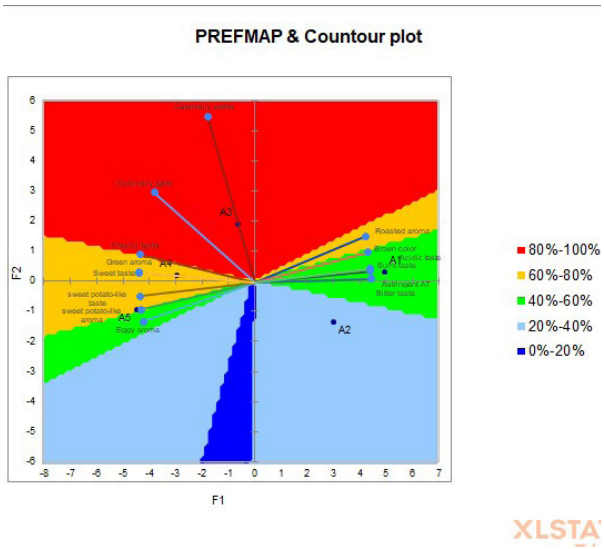

Figure 3: PREFMAP graph and countour plot of cold canistel coffee drink.

Note: A1= canistel powder and instant coffee granules of 50:50.
A2= canistel powder and instant coffee granules of 60:40.
A3= canistel powder and instant coffee granules of 70:30.
A4= canistel powder and instant coffee granules of 80:20.
A5= canistel powder and instant coffee granules of 90:10.

4 DISCUSSION

4.1 Attribute profile of cold canistel coffee drinks

The sensory attributes that appear in Table 1 are obtained from the sensory attributes of the constituent raw materials, namely overripe canistel powder, instant coffee, full cream, non-dairy creamer, and sugar. Eggy aroma, sweet potato-like aroma, and taste are obtained from the sensory attributes of the overripe canistel powder. According to Geel, Kinnear, and Kock (2005), roasted aroma and acidic taste are characteristic sensory attributes of instant coffee. The attribute of creamy taste is obtained from the taste of powdered milk, according to Drake et al. (2007). The bitter taste attribute obtained in cold canistel coffee products can be sourced from instant coffee (Geel; Kinnear; Kock, 2005), powdered milk (Drake et al., 2007), and non-dairy creamer (Brown et al., 2010). Caramelly aroma and taste and sweet tastes are characteristic sensory attributes of the granulated sugar and the sugar contained in other constituents. This sweet taste is also contributed quite much by overripe canistel powder, where overripe fruits, including canistel fruit, have a high sugar content (Hossain; Karim; Juthee, 2020; Pertiwi et al., 2020). While after taste astringent, according to Geel, Kinnear, and Kock (2005) and Drake et al. (2007), can be caused by instant coffee and powdered milk.

4.2 Panelist profile

Figure 1 shows that the dominant panelists obtained for sensory testing are male. This data also happened in the research of Nurazizah, Nur'utami, and Aminullah (2021) and Utama et al. (2021), who reported that male panelists dominated the panelists in sensory profiling. Demura et al. (2013) also reported that men consume more coffee than women. In addition, Figure 1 also shows that the panelists are dominated by the age range of 22-31 years, as much as 70%. However, some studies, such as Rehm et al. (2020) and Utama et al. (2021), explained that coffee connoisseurs were in the age range of 51 - 70 years and 40 - 50 years; however, Asioli et al. (2014) reported that cold coffee drinks, especially lattes, were preferred by young coffee drinkers. Figure 1 also shows that 54% of the panelists involved in this study have never consumed canistel fruit. According to Puspita et al. (2018), canistel fruit was one of the rare fruit plants in Indonesia. It was rarely found because these fruit plants in Indonesia were not cultivated but only for house garden plants. On Java Island, canistel trees and fruit traders are only found in West Java and its surroundings. The low production of this fruit causes many people to be not familiar with the characteristics of the fruit, which has good nutritional content and benefits for health.

4.3 Sensory profile of cold canistel coffee drink

Table 2 shows that the sensory attributes of caramelly aroma and taste are not significantly different between each treatment. Meanwhile, brown color, eggy aroma, green aroma, sweet potato-like aroma, roasted aroma, sweet potato-like taste, burnt taste, creamy taste, bitter taste, acidic taste, sweet taste, and astringent aftertaste are significantly different between each treatment. The caramelly aroma and taste are not significantly different between cold canistel coffee drinks.

Table 3 shows that eggy, green, sweet potato-like aromas and taste, creamy taste, and sweet taste tend to increase in intensity with more canistel powder added. This increase is because overripe canistel powder has several characteristics, such as having a sweet potato-like taste and aroma with a slightly strong odour and a sweet taste (Pertiwi et al., 2020; Puspita et al., 2018). The starch hydrolysis into sugar causes this dominant sweet taste during the fruit ripening (Hossain; Karim; Juthee, 2020). In addition, Table 3 shows that the decrease in overripe canistel powder or the increase in instant coffee in the cold canistel coffee drink formula tends to increase the roasted aroma, burnt taste, bitter taste, acidic taste, astringent aftertaste and brown colour in the drink. Geel, Kinnear, and Kock (2005) reported that coffee has a roasted aroma, acidic taste, bitter taste, and astringent aftertaste. Šeremet et al. (2022) reported that robusta brews were more astringent and bitter than Arabica. The bitter taste in coffee comes from caffeine by 30% and other compounds such as 2,5-diketopiperazines, caffeoyl quinides, feruloyl quinides, 4-vinylcatechol, methylated benzenes, mozambioside, dan 4-CQA, 5-CQA, and 2-O-β-D-glucopyranosyl-atractyligenin (Ginz; Engelhardt, 2000; Frank; Zehentbauer; Hofmann, 2006; Frank et al., 2007; Kreppenhofer; Frank; Hofmann, 2011; Lang et al., 2015; Gao; Tello; Peterson, 2022). While the astringency found in cold canistel coffee drinks comes from the chlorogenic acid content in coffee (Buffo; Cardelli-Freire, 2004).

Figure 2 shows that there are five clusters, where the determination of this cluster is based on the attribute and the sample position in the quadrant. Another consideration is based on the angle between one attribute and other attributes. Where the angle is less than 90° has a positive correlation so that these attributes are in the same cluster. Figure 2 shows that cold canistel coffee drinks with a 50:50 ratio of canistel powder and instant coffee have a dominant profile of roasted aroma, brown color, acidic taste, burnt taste, bitter taste, and astringent aftertaste which are in quadrant I. These attributes are dominant in instant coffee (Geel; Kinnear; Kock, 2005). In addition, these sensory attributes have a positive correlation which can be seen from the angle created between these attributes of less than 90°. Gower, Lubbe, and Le Roux (2011) explained that a slight angle (less than 90°) indicates the variables are positively correlated. Meanwhile, cold canistel coffee drink with a ratio of 60:40, which is in quadrant IV, does not seem to have a dominant profile. Canistel coffee drinks with a ratio of 70:30 and 80:20 tend to have a dominant caramel aroma and taste. Canistel coffee with a ratio of 70:30

has a slightly creamy, green aroma and sweet taste. In contrast, canistel coffee of 80:20 is stronger on these attributes, plus a sweet potato-like taste and aroma and an eggy aroma. These attributes of caramel and sweetness in a higher proportion of canistel powder relate to the sugar content in the canistel powder used, which has a sugar content of 29.04% (Pertiwi; Aminullah; Suprayatmi, 2019).

Attributes in canistel coffee of 70:30 and 80:20 have a negative correlation with attributes in canistel coffee of 50:50, which means the increasing presence of attributes in canistel coffee of 70:30 and 80:20 indicates a decrease in the presence of attributes in canistel coffee of 50:50. Cold canistel coffee with a ratio of 90:10, which is in quadrant III, tends to have a dominant profile of sweet potato-like taste and aroma and eggy aroma, a distinctive sensory attribute in overripe canistel fruit (Pertiwi et al., 2020; Puspita et al., 2018). This attribute is positively correlated with the attribute of cold canistel coffee of 70:30 and 80:20 and negatively correlated with the attribute of canistel coffee of 50:50.

Figure 3 shows the trend of the panelists' preference, namely cold canistel coffee drinks with 70:30 treatment, which is in the red area in quadrant II. This analysis shows that this canistel coffee drink gets 80%-100% likes above the average. Cold canistel coffee drink with 80:20 treatment is in the yellow color region in quadrant II, with a preference above the average of 60% -80% of the panelists. Cold canistel coffee drink with 50:50 and 90:10 treatment is in the green color region, which has a preference above the average 40%-60% of panelists, while cold drink canistel coffee with 60:40 treatment is in the light blue color region, which has a preference above the average of 20%-40% of panelists and is in quadrant IV. This condition indicates that the panelists liked the cold canistel coffee drink with a dominant caramelly aroma and taste, and creamy taste. And also with additional attributes such as green aroma, sweet taste, roasted aroma, sweet potato-like taste, and aroma. In addition, the panelists do not have specific unwanted attributes seen from the absence of attributes located in the light blue and blue color regions.

5 CONCLUSIONS

Based on Focus Group Discussion, a cold canistel coffee drink had a sensory profile of brown color, eggy aroma, green aroma, sweet potato-like aroma, roasted aroma, caramelly aroma, sweet potato-like taste, burnt taste, creamy taste, bitter taste, caramelly taste, acidic taste, sweet taste, and astringent aftertaste. The more addition of overripe canistel powder in the cold coffee drink formula, the higher the intensity of the eggy, green, sweet potato-like aromas and taste, creamy taste, and sweet taste attributes in a cold coffee drink. The best treatment for a cold canistel coffee drink that panelists preferred was a mixture of canistel powder and instant coffee granules with a ratio of 70:30. It had a dominant profile of caramelly aroma, green aroma, caramelly taste, creamy taste, and sweet taste. Moreover, the sensory attributes of caramelly aroma, caramelly taste, and creamy taste were highly favored by panelists in the product.

6 AUTHORS' CONTRIBUTIONS

SRRP wrote the manuscript and performed the experiment, **NN** supervised the experiment and co-work the manuscript, and **FLR** review and approved the final version of the work, **AA** conducted all statistical analyses.

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