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Physicochemical and Sensory Analysis of Cocoa-Coffee Blend Drink Using the Check-All-That-Apply (CATA)

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Abstract— Chocolate drinks are widely consumed due to their rich flavor and polyphenol content. Previous research has highlighted the flavor richness and high polyphenol content of Arabica coffee. This study aims to examine the effects of adding Arabica coffee on the physical characteristics and sensory profiles of chocolate drinks. The composition of the chocolate drinks used in this study includes fermented cocoa powder, Java Preanger Arabica coffee powder, Cascara Arabica, and stevia sweetener. Physicochemical analysis methods encompass color testing, pH measurement, and total soluble solids (TSS) determination. The five tested formulations resulted in a slightly dark yellowish-red color, with pH values ranging from 5.82 ± 0.10 to 6.22 ± 0.08, and TSS content ranging from 5.17 ± 0.76 to 5.90 ± 0.46. In addition to physicochemical analysis, sensory analysis was conducted using the Check-All-That-Apply (CATA) method facilitated by XLSTAT. Although no formulations matched the ideal product, the most preferred formulation consisted of 80% cocoa and 20% coffee, attributed to its sweet flavor. With lower percentages of coffee addition, attributes such as chocolate flavor, sweetness, caramel flavor, and milk flavor became more prominent in the chocolate drinks.

Keywords*— *Arabica coffee, cascara,* chocolate drinks, *check-all-that-apply (CATA), physicochemical profiles, stevia.

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INTRODUCTION

Several chocolate drink products available in the market commonly contain additional ingredients such as milk and cane sugar (sucrose), resulting in a chocolate drink that is highly favored by consumers. Based on previous studies (Dogan et al., 2016; Wijanarti et al., 2020), the addition of milk and sugar (sucrose) concentration has shown a positive correlation with consumer acceptance. However, higher concentrations of added milk in chocolate drinks lead to lower extraction efficiency of phenolic compounds (Belščak-Cvitanović et al., 2010). Moreover, the excessive consumption of sucrose as a sweetener needs to be limited due to its association with various diseases, including diabetes (Prinz, 2019). Stevia, with zero calories, has been considered a healthier alternative sweetener compared to sucrose, which contains 4 kcal/g (Ashwell, 2015). Therefore, stevia can be used as an alternative sweetener in chocolate drinks to create a healthier chocolate drink. In addition to its positive health impacts, using stevia as an alternative sweetener in chocolate drinks produces a balanced sensory profile compared to other alternative sweeteners (Belščak-Cvitanović et al., 2010).

Based on the research conducted by Muktiningrum et al. (2022), chocolate drinks with high polyphenol content have a dominant bitter taste and low sweetness intensity. Therefore, other flavor-rich ingredients need to be added to enhance the taste of healthy chocolate drinks, such as Java Preanger Arabica Coffee. According to ig.dgip.go.id, Java Preanger Arabica Coffee has a distinctive sensory profile with a clean sweet taste, balanced acidity, and a strong aroma with rich nuances of flowery, floral, herbal, fruity, spicy, and very sweet notes. In addition to their taste properties, coffee and cascara are rich in functional compounds such as caffeic acid, chlorogenic acid, coumaric acid, ferulic acid, sinapic acid, hydroxycinnamic acid, and melanoidins, which play an important role as antioxidants (Esquivel & Jiménez, 2012).

Currently, there are various consumer-based sensory analysis methods, one of which is the Check-All-That-Apply (CATA) method. CATA is a multiple-choice question where respondents are presented with a list of words or phrases and asked to try the product, then answer the CATA question by selecting all the terms they find appropriate, marking each sample, without a limit on the number of attributes that can be chosen. This method is used as it allows for rapid collection of consumer perception information regarding the sensory characteristics of a food product (Ares & Jaeger, 2015).

This research aims to determine the physicochemical characteristics and sensory profiles of cocoa-based drinks with varying additions of Java Preanger arabica coffee and cascara. The study is conducted as part of chocolate drink product development. The substitution of coffee and cascara in this chocolate drink is expected not only to add functional value beneficial to consumer health but also to enrich the flavor of the resulting chocolate drink, making it appealing to consumers. Cascara and stevia are used in this study as additional ingredients in the chocolate drink formulation, with fixed percentages added to all formulations.

MATERIALS AND METHODS

A. Ingredients

The ingredients used in this study include 100% fermented cocoa powder brand "Oh Java," Single Origin Java Preanger Specialty Grade Arabica coffee (ID G 000000022), Arabica cascara (ID G 000000022) brand "Netisane," stevia sweetener brand "Tropicana Slim" (composition: sorbitol, erythritol, steviol glycoside, stabilizer). The Java Preanger Arabica coffee used is medium-roasted with a medium grind size. The Arabica cascara brand "Netisane" is the organic single-origin coffee cherry husk from Gunung Puntang Farm, processed using the continuous fermentation honey process method.

B. Preparation of Chocolate Drink

The Arabica coffee and cascara are directly weighed using a drip bag container, while the cocoa powder and stevia sweetener are weighed using a glass container. After weighing, the Arabica coffee and cascara in the drip bag are suspended over a glass containing the cocoa powder and stevia sweetener. Then, brewing is carried out for the Arabica coffee and cascara using water at a temperature of 90±3°C. While waiting for the brewing process to complete, the mixing process is also conducted to dissolve the cocoa powder and stevia sweetener. After the brewing process is finished, stirring is performed again until all the components are thoroughly mixed.

Table 1. Chocolate Drink Formulation

Ingredients	F1	F2	F3	F4	F5
Fermented Cocoa Powder (g)	3.7	4.2	4.5	4.9	5.3
Arabica Coffee (g)	2.9	2.4	2.1	1.7	1.3
Cascara Arabica (g)	1	1	1	1	1
Stevia Sweetener (g)	2.6	2.6	2.6	2.6	2.6
Water (mL)	90	90	90	90	90

F1 (931) = 56% : 44% (Cocoa : Coffee)
F2 (243) = 64% : 36% (Cocoa : Coffee)
F3 (751) = 68% : 32% (Cocoa : Coffee)
F4 (482) = 74% : 26% (Cocoa : Coffee)
F5 (369) = 80% : 20% (Cocoa : Coffee)

C. Color Analysis

The color analysis of the samples was measured using a chromameter at room temperature. Each formulation was identified for differences in color using the L*, a*, b* values. L* represents brightness, a* represents redness, and b* represents yellowness (Dogan et al., 2013).

D. pH Analysis

pH plays a crucial role in the Maillard reaction that occurs during the cocoa bean roasting process. An increase in the pH of chocolate paste can trigger the formation of characteristic chocolate aroma compounds that contribute to the flavor of chocolate. Higher acidity levels have the potential to produce products with more complex aromas compared to those with low acidity levels (Anoraga et al., 2018).

pH measurement (acidity level) was performed using a pH meter calibrated with pH 4 and 7 buffer solutions. After calibration, the electrode was rinsed with distilled water and dried with a tissue. pH measurement was conducted on each 20 mL of each formulation. The electrode was immersed in each formulation and left for a few moments. The electrode was rinsed with distilled water and dried with a tissue after measuring the pH of each formulation (Ismawati, 2016). pH measurement was repeated three times.

E. Total Soluble Solids Analysis

Total soluble solids (TSS) are typically dominated by sugars. Other minor components include organic acids, amino acids, water-soluble proteins, and other substances. Therefore, TSS is a good indicator of sweetness (Bexiga et al., 2017).

Before measuring the Brix degree of each formulation, calibration was performed on the refractometer using distilled water. The sample measurement was conducted by placing 2-3 drops of each formulation on the prism glass, and then the analysis was performed to observe the Brix value displayed on the instrument.

F. Check-All-That-Apply (CATA) Analysis

The sensory profile analysis of the chocolate drink was conducted using the CATA method involving 30 consumer panelists. The panelists consisted of university students and employees aged 19-28 years, with an equal number of females and males. The selection criteria for panelists were based on their experience as chocolate drink consumers. Additionally, the panelists were healthy individuals with no issues related to their sense of smell, taste, or allergies to the tested ingredients.

The initial step of the testing involved providing the panelists with an explanation of the attribute definitions in the scoresheet. In this session, a discussion was conducted to define the attributes accurately and ensure that they were easily understood by all panelists. During this training session, the panelists were also asked to smell and taste the product to familiarize themselves with its characteristics. Subsequently, the testing proceeded with the panelists being asked to evaluate all the samples. The samples provided consisted of five different formulations, each identified with a three-digit code.

The testing was conducted by providing a scoresheet to the panelists. The scoresheet consisted of 39 attribute terms that could be selected, along with their respective definitions, and a hedonic test using a 1-9 scale (ranging from extremely dislike to extremely like). The panelists were asked to evaluate the sensory attributes of each formulation by placing a check mark in the provided column next to the listed attributes (Ares & Jaeger, 2015).

Table 2. Attribute Terms Assessed for CATA Assessment

Attribute	Sensory Group	Description
Undissolved particles	*Appearance*	Solid particles that are visible and dispersed in the drink.
Brown color	*Appearance*	A chocolate-colored drink.
Molasses	*Aroma*	A strong aroma of sweetness from sugar.
Floral	*Aroma*	A refreshing aroma of flowers.
Citrus	*Aroma*	Aroma associated with citrus fruits such as lemon or orange.
Green/grassy	*Aroma*	A scent of dried and fresh grass.
Milky	*Flavor*	Fresh milk or UHT milk.
Chocolate	*Flavor*	Cocoa powder or chocolate bars (including dark chocolate or milk chocolate).
Nutty	*Flavor*	Nutty flavor; sweet, fatty, creamy, earthy.
Mokka	*Flavor*	Aroma or taste associated with whipping cream and coffee extract.
Buttery	*Flavor*	Has a buttery aroma and flavor with its delicious, mouth-melting, slightly gritty and sweet characteristics.
Fruity	*Flavor*	A sweet, floral, aromatic blend reminiscent of various ripe fruits.
Fermented	*Flavor*	Delicious flavor related to the presence of very little alcohol, such as in dried fruits on bread (raisins), fermented rice, durian, or yogurt.
Caramel	*Flavor, aftertaste*	Flavor of heating sugar to golden brown, resulting in a distinctive flavor of slight caramelization and sweetness.
Sour/tamarind	*Flavor, aftertaste*	Sour flavor.
Bitter	*Flavor, aftertaste*	Has a sharp and pungent taste or smell, not sweet, reminiscent of caffeine.
Sweet	*Flavor, aftertaste*	Sweet basic taste like sugar (sucrose, glucose, or fructose).
Roasted	*Flavor, aftertaste*	Flavor resembling roasted or toasted seeds, bread, or nuts.
Earthy	*Flavor, aftertaste*	Taste reminiscent of fresh, damp soil.
Ashy	*Flavor, aftertaste*	Perception of the aroma and taste of burnt wood, with a lingering wood sensation in the mouth cavity.
Burnt	*Flavor, aftertaste*	Perception associated with burnt wood, resulting in an unpleasant, sharp, lingering aroma or taste.
Spices	*Flavor, aftertaste*	A sharp sensation in the mouth, slightly spicy, smoky, oily, woody, refreshing, or a burning sensation in the mouth.
Astringent	*Taste, aftertaste*	A sharp sensation in the mouth, taste that causes the mouth to pucker, numbs the tongue, constricts the throat, and gives a dry mouth sensation.
Pungent	*Taste*	A pungent and sharp sensation in the mouth, similar to consuming garlic.
Savory	*Aftertaste*	Rich in flavor, enjoyable.
Creamy	*Mouthfeel*	A sensation of a thick, homogeneous product that coats the mouth, resulting in a creamy/fatty sensation in the mouth; a smooth and melting sensation in the mouth.
Sandiness	*Mouthfeel*	A sensation of grittiness or the presence of coarse particles like sand in the mouth.
Dense	*Mouthfeel*	The drink has a thick body, a heavy sensation, or feels thick in the mouth, requiring more time to be swallowed completely.

Watery	*Mouthfeel*	The drink has a thin consistency, similar to drinking mineral water, easy to swallow.

G. Data Analysis

The check-list data on the scoresheet was processed in binary form (0 = attribute not detected; 1 = attribute detected). Additionally, the panelists rated their liking level for each formulation (Ares & Jaeger, 2015). After obtaining the sensory analysis data using the CATA method, the sensory data was further processed using XLSTAT 2022 software. The sensory data analysis from the CATA method included Cochran's Q test, multiple pairwise comparisons, correspondence analysis, principle coordinate analysis, and penalty analysis (Adawiyah et al., 2019).

RESULTS AND DISCUSSIONS

Physicochemical Profile of Chocolate Drink

Based on the measurements conducted on the five formulations of chocolate drink, the L* values ranged from 34.20±0.10 to 53.07±0.31. The a* values for all formulations showed a positive (+a*) result, ranging from 12.27±2.20 to 56.97±0.15. Similarly, the b* values for all formulations indicated a positive (+b*) outcome, ranging from 14.53±0.75 to 35.10±0.35. Consequently, it can be concluded that all tested chocolate drink formulations exhibited a slightly dark reddish-yellow color, as depicted in Figure 1. These color characteristics align with a previous study conducted by Mazo Rivas et al. (2018), which indicated that chocolate drinks tend to have a slightly dark color.

Total soluble solids (TSS) in drinks are typically dominated by sugars, while other soluble components in small amounts include organic acids, amino acids, soluble proteins, and other substances. Therefore, TSS is a reliable parameter for evaluating sweetness (Aribah et.al., 2020; Bexiga et al., 2017). TSS measurements for the five formulations yielded values (refer to Table 3) ranging from 5.17±0.76 to 5.90±0.46. The obtained TSS values among the formulations did not show significant differences since this study employed stevia as a sweetener instead of sucrose (Ashwell, 2015).

Additionally, the pH measurements for the five formulations ranged from 5.82±0.10 to 6.22±0.08. Significant differences ($\alpha \leq 0.05$) were observed between formulation 931 and formulations 751, 482, and 369, with formulation 931 having the highest proportion of coffee composition among the formulations. This finding aligns with a study conducted by Mazo Rivas et al. (2018), which reported that the pH of chocolate drinks ranged from 6.19 to 6.73. Conversely, research by Bicho et al. (2011) indicated that the pH of coffee drinks ranged from 4.98 to 5.39. Hence, an increase in the coffee composition in chocolate drinks results in a decrease in the pH level.

Table 3. Physicochemicals Analysis of Chocolate Drink

Parameter	Color			pH	TSS (°Brix)
	L*	a*	b*		
931	53.07±0.31[c]	12.27±2.20[a]	35.10±0.35[bc]	5.82±0.10[a]	5.17±0.76
243	53.83±1.60[c]	28.80±4.85[c]	33.97±0.97[b]	6.03±0.20[ab]	5.33±0.61
751	51.87±0.90[c]	28.70±0.34[c]	35.33±0.45[c]	6.08±0.12[b]	5.50±0.60
482	43.87±1.80[b]	22.90±3.03[b]	36.63±0.45[d]	6.18±0.10[b]	5.70±0.44
369	34.20±0.10[a]	56.97±0.15[d]	14.53±0.75[a]	6.22±0.08[b]	5.90±0.46

Chocolate Drink Sensory Profile

Sensory profiling of the chocolate drinks was analyzed using the CATA method, involving Cochran's Q test with multiple pairwise comparisons, Correspondence analysis, Principle coordinate analysis, and Penalty analysis (Adawiyah et al., 2019). The ability of consumers to detect differences in attributes among the tested formulations was evaluated using the Q Cochran test, with significance represented by significant or non-significant outcomes (Ares & Jaeger, 2015). Based on the results of the Q Cochran test with multiple pairwise comparisons presented in Table 4, it was found that each formulation exhibited several different sensory attributes at a significance level of 5%, including chocolate flavor, mokka flavor, caramel flavor, sweet flavor, and roasted flavor. This analysis indicates that all tested formulations have distinct sensory characteristics (DePaula et al., 2022; Jaywant et al., 2022; Joel et al., 2013; Muktiningrum et al., 2022; Oliviera et al., 2015; Peixoto et al., 2016; Safrijal et al., 2021; Seninde & Chambers, 2020; Sunarharum et al., 2014; Tournier et al., 2007).

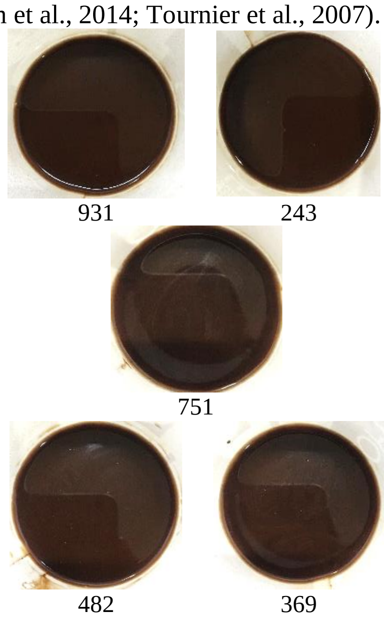

Figure 1. Chocolate Drink Color

The chocolate notes in the drinks are derived from compounds such as 2-Methylbutanal and 3-methylbutanal (Aprotosoaie et al., 2016). Additionally, pyrazine compounds play a role in the formation of basic chocolate notes, including 2,3,5,6-tetramethylpyrazine (TMP) and 2,3,5-trimethylpyrazine (TrMP) (Castro-Alayo et al., 2019). During the roasting process of cocoa and coffee beans, various complex chemical reactions occur, including caramelization reactions involving the sugars present in the beans. These reactions result in the formation of numerous caramel compounds such as 2-phenyl-2-butenal, 5-methyl-2-furfural, and 2-3-dimethylpyrazine, which contribute to the caramel aroma and sweet perception, forming the perception of caramel and sweetness. Additionally, the roasted flavor arises from the reaction between chlorogenic acid and quinic acid, leading to the production of lactones and volatile phenols with basic tastes of bitterness, acidity, and sweetness. Volatile furans also contribute to the sweet roasted aroma. The attribute of sandiness or mouthfeel, characterized by a gritty sensation, is a result of the processing method used, where cocoa powder is directly brewed without filtration. This attribute can be perceived by some panelists (Belščak-Cvitanović et al., 2010)

Correspondence analysis (CA) is commonly used in testing with the CATA method as it allows for the visualization of attribute data for each sample and the ideal product (preference mapping) in a biplot (two-dimensional) form (Addinsoft, 2022; Alexi, 2018; Meyners & Castura, 2014). Figure 2 shows the relationship between the tested attributes in each sample and the ideal product. Based on the analysis results, none of the chocolate drink formulations is located in the same quadrant as the ideal product. Therefore, none of the formulations have the same attributes as the ideal product. Based on the analysis, it can be observed that the ideal chocolate drink has sensory profiles of caramel (aftertaste) and sandiness (mouthfeel). Another analysis performed is principal coordinate analysis (PCoA), which is used to examine the correlation between the tested attributes and the panelists' preference for the products (Adawiyah et al., 2019). Similar to CA, the results of PCoA are displayed in a biplot (two-dimensional) form.

Based on the results presented in Figure 3, it is found that the attribute of sweet flavor significantly influences the panelists' preference. Chocolate drink formulations evaluated by consumers with a sandiness mouthfeel attribute tend to be less preferred. This can be observed in Figure 3, where the sandiness mouthfeel attribute is located in Quadrant I, opposite to the sweet flavor attribute in Quadrant III (the attribute that influences panelists' preference). This is consistent with previous research conducted by de Melo et al. (2009) and Oliveira et al. (2015) on low-calorie chocolate drinks, which found that the attribute contributing to the liked products is sweet flavor. On the other hand, the attribute of sandiness mouthfeel tends to negatively impact the panelists' liking of the product. Penalty analysis is used to determine the value of preference loss due to deviations in sensory profiles between the samples and the ideal product according to the panelists' perception (Ares & Jaeger, 2015). Preference can increase due to the presence of positive attributes or the absence of negative attributes. Conversely, preference can decrease due to the presence of negative attributes or the absence of positive attributes (Meyners & Castura, 2014). Based on the penalty analysis results using XLSTAT 2022 software, sensory attributes are categorized into five categories: must-have, nice to have, does not influence, does not harm, and must not have. An attribute is classified as "must-have" when it is desired to be present in the ideal product but is not found in the tested products.

The "must-have" attribute appears when the preference for selecting the attribute in the tested product (1,1) is significantly higher than selecting the attribute in the ideal product but not in the tested product (1,0). The "must-not-have" attribute appears when the preference for selecting no attribute in both the ideal product and the tested product (0,0) is significantly higher than selecting the attribute in the tested product (0,1). The "nice to have" attribute appears when the preference for selecting the attribute in the tested product (0,1) is significantly greater than selecting the attribute in both the ideal product and not in the tested product (0,0) ((0,1)>(0,0)). The "does not harm" attribute appears when the preference for selecting the product (0,1) is comparable to not selecting the attribute in both the ideal product and the tested product (0,0). The "does not influence" attribute appears when the preference for selecting the attribute in both the ideal product and the tested product (1,1) is comparable to the preference for selecting the attribute in the ideal product (1,0) (Addinsoft, 2022; Meyners et al., 2013).

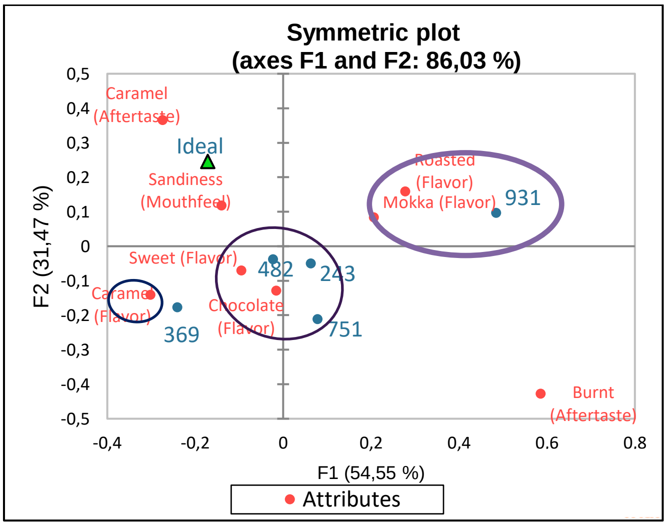

Figure 2. Symmetric Plot Representation of Sample Sensory Profiles

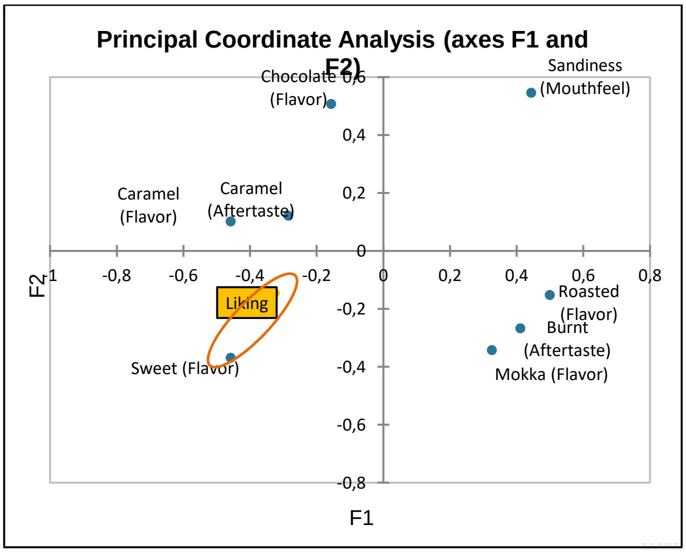

Figure 3. Map of Correlation of Sensory Attributes of Chocolate Drinks with Enjoyment

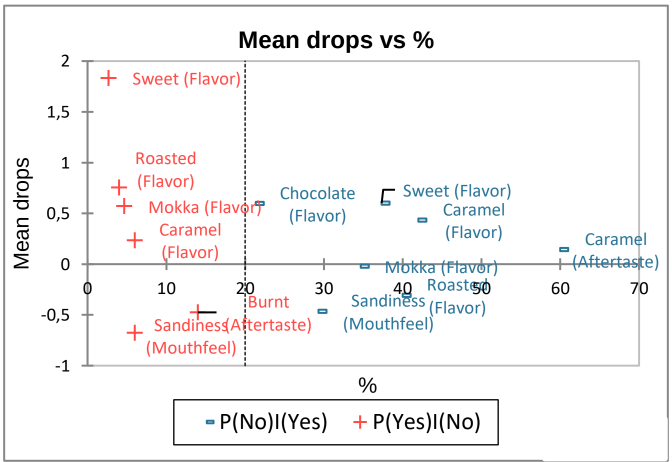

Figure 4. Map of Mean Drops Vs% Must Have, Nice to Have, and Must not Have attributes

Table 4. Cochran's Q Test Results with Multiple Pairwise Comparisons of Chocolate Drink Formulations

Attributes	243	369	482	751	931
Undissolved particles (Appearance)	0.500 (a)	0.433 (a)	0.400 (a)	0.400 (a)	0.533 (a)
Brown color (Appearance)	1 (a)	0.967 (a)	1 (a)	0.967 (a)	0.967 (a)
Molasses (Aroma)	0.300 (a)	0.433 (a)	0.433 (a)	0.300 (a)	0.367 (a)
Floral (Aroma)	0.067 (a)	0.067 (a)	0.067 (a)	0.067 (a)	0.067 (a)
Citrus (Aroma)	0.067 (a)	0.033 (a)	0.133 (a)	0.067 (a)	0.067 (a)
Green/grassy (Aroma)	0.033 (a)	0.033 (a)	0.033 (a)	0 (a)	0.067 (a)
Milky (Flavor)	0.300 (a)	0.533 (a)	0.367 (a)	0.433 (a)	0.333 (a)
Chocolate (Flavor)	0.800 (ab)	0.900 (b)	0.833 (ab)	0.833 (ab)	0.567 (a)
Nutty (Flavor)	0.400 (a)	0.567 (a)	0.567 (a)	0.667 (a)	0.567 (a)
Mokka (Flavor)	0.667 (ab)	0.433 (a)	0.633 (ab)	0.500 (ab)	0.767 (b)
Buttery (Flavor)	0.133 (a)	0.167 (a)	0.200 (a)	0.100 (a)	0.067 (a)
Fruity (Flavor)	0.133 (a)	0.033 (a)	0.033 (a)	0.033 (a)	0.100 (a)
Caramel (Flavor)	0.400 (ab)	0.800 (c)	0.500 (abc)	0.533 (bc)	0.133 (a)
Fermented (Flavor)	0.033 (a)	0.067 (a)	0.033 (a)	0 (a)	0.067 (a)
Sour/tamarind (Flavor)	0.033 (a)	0.100 (a)	0 (a)	0.067 (a)	0.133 (a)
Bitter (Flavor)	0.467 (a)	0.567 (a)	0.400 (a)	0.533 (a)	0.633 (a)
Sweet (Flavor)	0.567 (ab)	0.767 (b)	0.600 (ab)	0.600 (ab)	0.400 (a)
Roasted (Flavor)	0.367 (a)	0.333 (a)	0.433 (a)	0.467 (ab)	0.767 (b)
Earthy (Flavor)	0.200 (a)	0.233 (a)	0.200 (a)	0.233 (a)	0.200 (a)
Ashy (Flavor)	0.167 (a)	0.100 (a)	0.233 (a)	0.200 (a)	0.133 (a)
Burnt (Flavor)	0.233 (a)	0.167 (a)	0.167 (a)	0.167 (a)	0.200 (a)
Spices (Flavor)	0.033 (a)	0 (a)	0.100 (a)	0.033 (a)	0.033 (a)
Astringent (Taste)	0.333 (a)	0.167 (a)	0.167 (a)	0.200 (a)	0.267 (a)
Pungent (Taste)	0.067 (a)	0.067 (a)	0.100 (a)	0.067 (a)	0.133 (a)
Caramel (Aftertaste)	0.300 (a)	0.200 (a)	0.233 (a)	0.167 (a)	0.100 (a)
Sour/tamarind (Aftertaste)	0.033 (a)	0 (a)	0.033 (a)	0.067 (a)	0.133 (a)
Bitter (Aftertaste)	0.433 (a)	0.433 (a)	0.400 (a)	0.467 (a)	0.367 (a)
Sweet (Aftertaste)	0.400 (a)	0.267 (a)	0.333 (a)	0.233 (a)	0.300 (a)
Roasted (Aftertaste)	0.333 (a)	0.367 (a)	0.433 (a)	0.300 (a)	0.333 (a)
Earthy (Aftertaste)	0.167 (a)	0.167 (a)	0.200 (a)	0.167 (a)	0.167 (a)
Ashy (Aftertaste)	0.200 (a)	0.067 (a)	0.133 (a)	0.100 (a)	0.167 (a)
Burnt (Aftertaste)	0.200 (a)	0.067 (a)	0.067 (a)	0.200 (a)	0.167 (a)
Spices (Aftertaste)	0.033 (a)	0.033 (a)	0.033 (a)	0 (a)	0.033 (a)
Astringent (Aftertaste)	0.233 (a)	0.200 (a)	0.133 (a)	0.167 (a)	0.300 (a)
Savory (Aftertaste)	0.100 (a)	0.167 (a)	0.133 (a)	0.100 (a)	0.133 (a)
Creamy (Mouthfeel)	0.200 (a)	0.200 (a)	0.267 (a)	0.200 (a)	0.333 (a)
Sandiness (Mouthfeel)	0.267 (a)	0.300 (a)	0.167 (a)	0.100 (a)	0.167 (a)
Dense (Mouthfeel)	0.133 (a)	0.333 (a)	0.267 (a)	0.233 (a)	0.267 (a)
Watery (Mouthfeel)	0.467 (a)	0.400 (a)	0.333 (a)	0.400 (a)	0.367 (a)

Based on the analysis results in Table 5 and Figure 4, it can be seen that the "burnt" (aftertaste) and "sandiness" (mouthfeel) attributes have +P(Yes)|(No) values of less than 20% with negative mean drop differences (located to the left and below on the Y-axis) and no significant difference between the preference for selecting the product (0,1) and the attribute not selected in both the ideal product and the tested product (0,0), making these attributes "does not harm." Other attributes such as "chocolate flavor," "sweet flavor," "caramel flavor," and "caramel aftertaste" are attributes that have -P(No)|(Yes) values greater than 20% with positive mean drop differences (located to the right and above on the Y-axis), and the preference for selecting the attribute in the ideal product and the tested product (1,1) is significantly higher than not selecting the attribute in the tested product (1,0), making these attributes "must not have." This may be due to panelists' confusion in providing the ideal characteristics. Almost all panelists stated that they had never encountered a combination of chocolate drink with Arabica coffee before. Despite the introduction and familiarization of the products and terms before the testing, the panelists' preliminary judgment of the tested formulations was that they were drinks other than chocolate (panelists assumed that the tested products were coffee drinks). Therefore, the preliminary judgment by the panelists could have resulted in inaccuracies in the obtained results.

Table 5. Penalty Analysis Attributes

Attributes	Ideal	Produk		Keterangan
		0	1	
Chocolate (flavor)	0	0.0 (0%)	0.0 (0%)	*This attribute does not influence*
	1	4.8 (21%)	5.4 (79%)	
Mokka (Flavor)	0	4.0 (5%)	4.6 (5%)	*This attribute does not influence*
	1	5.4 (35%)	5.4 (55%)	
Caramel (Flavor)	0	5.9 (11%)	6.1 (6%)	*This attribute does not influence*
	1	5.0 (42%)	5.4 (41%)	
Sweet (Flavor)	0	4.2 (4%)	6.0 (3%)	*This attribute does not influence*
	1	5.0 (37%)	5.6 (56%)	
Roasted (Flavor)	0	4.6 (13%)	5.3 (4%)	*This attribute does not influence*
	1	5.6 (40%)	5.3 (43%)	
Caramel (Aftertaste)	0	5.0 (20%)	0.0 (0%)	*This attribute does not influence*
	1	5.4 (60%)	5.5 (20%)	
Burnt (Aftertaste)	0	5.4 (86%)	4.9 (14%)	*This attribute does not harm*
	1	0.0 (0%)	0.0 (0%)	
Sandiness (Mouthfeel)	0	5.6 (51%)	4.9 (6%)	*This attribute does not harm*
	1	5.2 (29%)	4.8 (14%)	

CONCLUSIONS

In the study, the five tested chocolate drink formulations had characteristics of dark chocolate color, pH ranging from 5.82±0.10 to 6.22±0.08, and total soluble solids (ºBrix) ranging from 5.17±0.76 to 5.90±0.46. With the addition of coffee composition, a decrease in pH and TSS values in the chocolate drink was observed. Additionally, the percentage of coffee composition added to the chocolate drink affected changes in several sensory attributes of the resulting drink. Increasing the percentage of coffee addition resulted in dominant attributes such as mocha flavor, roasted flavor, bitter flavor, and watery mouthfeel. Conversely, reducing the percentage of coffee addition resulted in dominant attributes such as chocolate flavor, sweet flavor, caramel flavor, and milky flavor becoming more pronounced. Formulation 369, with a cocoa-to-coffee ratio of 80% to 20%, was the most preferred formulation among the other four formulations due to its sweet flavor attribute.

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REFERENCES

Adawiyah, D. R., Azis, M. A., Ramadhani, A. S., & Chueamchaitrakun, P. (2019). Perbandingan Profil Sensori Teh Hijau Menggunakan Metode Analisis Deskripsi Kuantitatif dan CATA (Check-All-That-Apply). *Jurnal Teknologi Dan Industri Pangan*, *30*(2), 161–172. https://doi.org/10.6066/jtip.2019.30.2.161

Addinsoft. (2022). *CATA Check-All-That-Apply Analysis Tutorial in Excel*. Addinsoft. https://help.xlstat.com/6491-cata-check-all-apply-analysis-tutorial-excel

Alexi, N., Nanou, E., Lazo, O., Guerrero, L., Grigorakis, K., & Byrne, D. v. (2018). Check-All-That-Apply (CATA) with Semi-trained Assessors: Sensory Profiles Closer to Descriptive Analysis or Consumer Elicited Data? *Food Quality and Preference*, *64*, 11–20. https://doi.org/10.1016/j.foodqual.2017.10.009

Anoraga, S. B., Wijanarti, S., & Sabarisman, I. (2018). Pengaruh Suhu dan Waktu Pengepresan terhadap Mutu Organoleptik Bubuk Kakao sebagai Bahan Baku Minuman Coklat. *CEMARA*, *15*(2), 20–28.

Aprotosoaie, A. C., Luca, S. V., & Miron, A. (2016). Flavor Chemistry of Cocoa and Cocoa Products-An Overview. *Comprehensive Reviews in Food Science and Food Safety*, *15*(1), 73–91. https://doi.org/10.1111/1541-4337.12180

Ares, G., & Jaeger, S. R. (2015). Check-all-that-apply (CATA) Questions with Consumers in Practice: Experimental Considerations and Impact on Outcome. In *Rapid Sensory Profiling Techniques and Related Methods: Applications in New Product Development and Consumer Research* (pp. 227–245). Elsevier Inc. https://doi.org/10.1533/9781782422587.2.227

Aribah, S. al, Sanjaya, A. P., Muhammad, D. R. A., & Praseptiangga, D. (2020). Sensorial and Physical

Properties of Chocolate Beverage Prepared Using Low Fat Cocoa Powder. *AIP Conference Proceedings*, *2219*. https://doi.org/10.1063/5.0003435

Ashwell, M. (2015). Stevia, Nature's Zero-calorie Sustainable Sweetener: A New Player in The Fight Against Obesity. *Nutrition Today*, *50*(3), 129–134. https://doi.org/10.1097/NT.0000000000000094

Belščak-Cvitanović, A., Benković, M., Komes, D., Bauman, I., Horžić, D., Dujmić, F., & Matijašec, M. (2010). Physical Properties and Bioactive Constituents of Powdered Mixtures and Drinks Prepared with Cocoa and Various Sweeteners. *Journal of Agricultural and Food Chemistry*, *58*(12), 7187–7195. https://doi.org/10.1021/jf1005484

Bexiga, F., Rodrigues, D., Guerra, R., Brázio, A., Balegas, T., Cavaco, A. M., Antunes, M. D., & Valente de Oliveira, J. (2017). A TSS Classification Study of 'Rocha' Pear (Pyrus communis L.) Based on Non-Invasive Visible/near Infra-red Reflectance Spectra. *Postharvest Biology and Technology*, *132*, 23–30. https://doi.org/10.1016/j.postharvbio.2017.05.014

Bicho, N. C., Leitão, A. E., Ramalho, J. C., de Alvarenga, N. B., & Lidon, F. C. (2011). Identification of Nutritional Descriptors of Roasting Intensity in Beverages of Arabica and Robusta Coffee Beans. *International Journal of Food Sciences and Nutrition*, *62*(8), 865–871. https://doi.org/10.3109/09637486.2011.588594

Castro-Alayo, E. M., Idrogo-V Asquez, G., Ul Siche, R., & Cardenas-Toro, F. P. (2019). Formation of Aromatic Compounds Precursors during Fermentation of Criollo and Forastero Cocoa. *Heliyon*, *5*(1), 1157. https://doi.org/10.1016/j.heliyon.2019

DePaula, J., Cunha, S. C., Cruz, A., Sales, A. L., Revi, I., Fernandes, J., Ferreira, I. M. P. L. V. O., Miguel, M. A. L., & Farah, A. (2022). Volatile Fingerprinting and Sensory Profiles of Coffee Cascara Teas Produced in Latin American Countries. *Foods*, *11*(19), 3144. https://doi.org/10.3390/foods11193144

Dogan, M., Aslan, D., Aktar, T., & Goksel Sarac, M. (2016). A Methodology to Evaluate the Sensory Properties of Instant Hot Chocolate Beverage with Different Fat Contents: Multi-criteria Decision-making Techniques Approach. *European Food Research and Technology*, *242*(6), 953–966. https://doi.org/10.1007/s00217-015-2602-z

Dogan, M., Toker, O. S., Aktar, T., & Goksel, M. (2013). Optimization of Gum Combination in Prebiotic Instant Hot Chocolate Beverage Model System in Terms of Rheological Aspect: Mixture Design Approach. *Food and Bioprocess Technology*, *6*(3), 783–794. https://doi.org/10.1007/s11947-011-0736-y

Jaywant, S. A., Singh, H., & Arif, K. M. (2022). Sensors and Instruments for Brix Measurement: A Review. In *Sensors* (Vol. 22, Issue 6). MDPI. https://doi.org/10.3390/s22062290

Joel, N., Pius, B., Deborah, A., & Chris, U. (2013). *Production and Quality Evaluation of Cocoa Products (Plain Cocoa Powder and Chocolate)*. https://doi.org/10.5251/ajfn.2013.3.1.31.38

Mazo Rivas, J. C., Dietze, M., Zahn, S., Schneider, Y., & Rohm, H. (2018). Diversity of Sensory Profiles and Physicochemical Characteristics of Commercial Hot Chocolate Drinks from Cocoa Powders and Block Chocolates. *European Food Research and Technology*, *244*(8), 1407–1414. https://doi.org/10.1007/s00217-018-3054-z

Meyners, M., & Castura, J. C. (2014). Check-All-That-Apply Questions. In P. Varela & G. Ares (Eds.), *Novel Techniques in Sensory Characterization and Consumer Profiling* (1st ed., pp. 190–221). CRC Press. https://doi.org/10.1201/b16853-12

Muktiningrum, T. A., Fauza, G., Ariviani, S., Muhammad, D. R. A., & Affandi, D. R. (2022). Sensory Profile Analysis of Chocolate Drinks Using Quantitative Descriptive Analysis (QDA). In E. Yanase, I. Tewfik, & S. Radu (Eds.), *International Food Conferences (IFC 2021)* (Vol. 344, p. 04005). EDP Sciences. https://doi.org/10.1051/e3sconf/202234404005

Oliveira, D., Antúnez, L., Giménez, A., Castura, J. C., Deliza, R., & Ares, G. (2015). Sugar Reduction in Probiotic Chocolate-flavored Milk: Impact on Dynamic Sensory Profile and Liking. *Food Research International*, *75*, 148–156. https://doi.org/10.1016/j.foodres.2015.05.050

Peixoto, R. R. A., Devesa, V., Vélez, D., Cervera, M. L., & Cadore, S. (2016). Study of The Factors Influencing the Bioaccessibility of 10 Elements from Chocolate Drink Powder. *Journal of Food Composition and Analysis*, *48*, 41–47. https://doi.org/10.1016/j.jfca.2016.02.002

Safrijal, H., Widayat, H. P., & Jaya, R. (2021). Hedonic Attributes Evaluation of Mixed Arabica Coffee-Cocoa Beverages. *IOP Conference Series: Earth and Environmental Science*, *667*(1). https://doi.org/10.1088/1755-1315/667/1/012065

Seninde, D. R., & Chambers, E. (2020). Coffee Flavor: A Review. *Beverages*, *6*(3), 1–25. https://doi.org/10.3390/beverages6030044

Sunarharum, W. B., Williams, D. J., & Smyth, H. E. (2014). Complexity of Coffee Flavor: A Compositional and Sensory Perspective. *Food Research International*, *62*, 315–325. https://doi.org/10.1016/j.foodres.2014.02.030

Tournier, C., Sulmont-Rossé, C., & Guichard, E. (2007). Flavour Perception: Aroma, Taste and Texture Interactions. *Food Global Science Books*, *1*(2), 246–257. https://hal.inrae.fr/hal-02823959