CHAPTER IV

RESULT AND DISCUSSION

4.1 Overview of FGD Finding

The Focus Group Discussion (FGD) was conducted on 6th September 2025 at Likoopi, Bandungan for its Java Green Latte product. This FGD involved 10 participants from diverse backgrounds, including one Likoopi's owner, one Likoopi's manager, five food technology students, one agribusiness student, one psychology student, and one clinical psychologist. This multidisciplinary composition was intentional to produce different disciplinary perspectives but still related with the objective of this FGD, finding the key attributes of Java Green Latte. All participants were also selected on the basis that they were already familiar with *Moringa oleifera* leaves and had prior experience consuming moringa-based products, ensuring that the attributes generated during the discussion were grounded in genuine sensory knowledge of the ingredient rather than solely derived from first impressions during the testing session.

First, in the introduction session of FGD, moderator explained the objective of the discussion session, her roles, participant role to the participants. She mentioned that this FGD session will be recorded and general rules about the discussion. The rule was that only one individual should speak at a time and there are no wrong answers. In this session, participants were also introducing themselves especially the owner of Likoopi. He explains the history and values of Likoopi also the product, Java Green Latte itself. Second, in rapport session, the moderator

started to bring light topic to the discussion: the trend about sustainable lifestyle. Like Likoopi's value explanation from the owner, other participants also agree with this lifestyle and mention about Z generation that they said more aware now days. After, moderator was entering the topic about the product and asked participants individually to evaluate Java Green Latte after consuming its sample and documenting their sensory observations through online formulir before engaging in open discussion about the key attributes of that product. There were 30 attributes mentioned by all the participants that will be shown in Table 1.

Table 1. Java Green Latte Attributes from FGD Session

Sensory Category	Attributes Mentioned	Description
Appearance	Light green	The color of the drink appears bright and vivid green, reflecting the natural color from moringa (kelor) leaves
	Pale green	The green color that appears faint or washed out, indicating a lower concentration of moringa (kelor) leaves pigment
	Soft green	A gentle, muted green tone perceived as visually mild and natural
	Sage green	A grayish green hue reminiscent of sage herb, suggesting a mature or earthy visual tone
	Color uniformity	The green color is evenly distributed throughout the drink without separation or inconsistency
	Foamy	A layer of foam is visible on the surface of the drink, typically from blending
	Slushie-like	The drink has a semi frozen, textured appearance due to blended ice particles
Aroma	Milky	A dominant dairy-like scent reminiscent of fresh milk
	Creamy	A rich, smooth aroma associated with cream or fat content

	Dairy	A general scent characteristic of milk-based products
	Earthy	A mild, soil-like or natural scent derived from moringa leaf compounds
	Leafy	A leafy scent characteristic of dried moringa (kelor) leaves
	Herbs	A subtle herbal scent characteristic of dried plant-based ingredients
Taste	Sweet	A pleasant, sweet taste from sugar in the product
	Earthy	A mild, natural taste reminiscent of soil or unprocessed plant material
	Leafy	A leafy or herb taste from moringa (kelor) leaves
	Milky	A creamy, dairy-forward taste that dominates the flavor profile
	Slightly bland	A mild or understated flavor with low intensity overall
	Savory	A subtle umami-like taste, slightly salty
	Peppery	A mild spicy sensation in the throat, attributed to bioactive compounds in moringa (kelor) leaves
Texture/Mouthfeel	Smooth	A smooth mouth feel inside the mouth from all the ingredients except ice cubes
	Light	Non-heavy sensation in the mouth, lacking viscosity
	Thin	Low viscosity perceived as watery insufficiently thick
	Foamy	An airy, bubbly mouthfeel from blended ingredients
	Grainy	A slightly rough or gritty sensation caused by undissolved moringa (kelor) leaves particles
Aftertaste	Astringency	A drying, puckering sensation in the mouth after swallowing, associated with unripe fruit flavor
	Bitter	A mild bitter sensation lingering after consumption
	Creamy aftertaste	A smooth, fatty sensation that remains in the mouth after swallowing
	Sour	A slight acidic taste perceived

Source: Primary Data, 2025

Initial responses highlighted a few ranges of sensory impressions. The aroma was consistently described as milky and creamy with subtle earthy or herbal notes. Most participants found sweetness to be appropriate, though some expected a stronger leafy or matcha-like character. Texture observations frequently mentioned a slight grainy from kelor leaves. Astringency in the throat was also noted by several participants. Third, participants entered in depth session where they present their own opinion one by one and discuss it together which attributes that effect the liking score of the product and suitable for Just About Right (JAR) sensory test method the most. From this discussion, it becomes clear that the attributes most central to the identity of the product itself and most likely to influence consumer liking were those tied to its moringa (kelor) based product. Likoopi also clarified during the session that the product is positioned as a local version of matcha latte product, and that the leafy taste, mild bitterness, and astringency are intentional characteristics that of the product. Dominant milk flavor attribute was identified as aspects the product aims to balance rather than eliminate. Fourth, closure session identified the final key attributes of Java Green Latte that will be assessed in JAR sensory testing as a parameter.

Based on the attributes listing and discussion, six key attributes were agreed: green color, leafy aroma, leafy taste, smoothness, sweetness, and astringency. These six attributes were considered the most relevant and distinguishing characteristic of Java Green Latte and were subsequently used as the basis for sensory testing as a JAR scale parameter. From the JAR-OAL sensory testing, we can know whether any of six key sensory attributes required optimization, as tested

through penalty analysis. The result of this research support H_0, finding no statistically significant penalty among six evaluated key attributes.

4.2 JAR-OAL Sensory Testing Panelist Characteristic

JAR (Just-About-Right) dan OAL (Over-All-Liking) sensory testing was conducted on September until November 2025 at Likoopi, a coffee shop in Bandungan, Semarang.

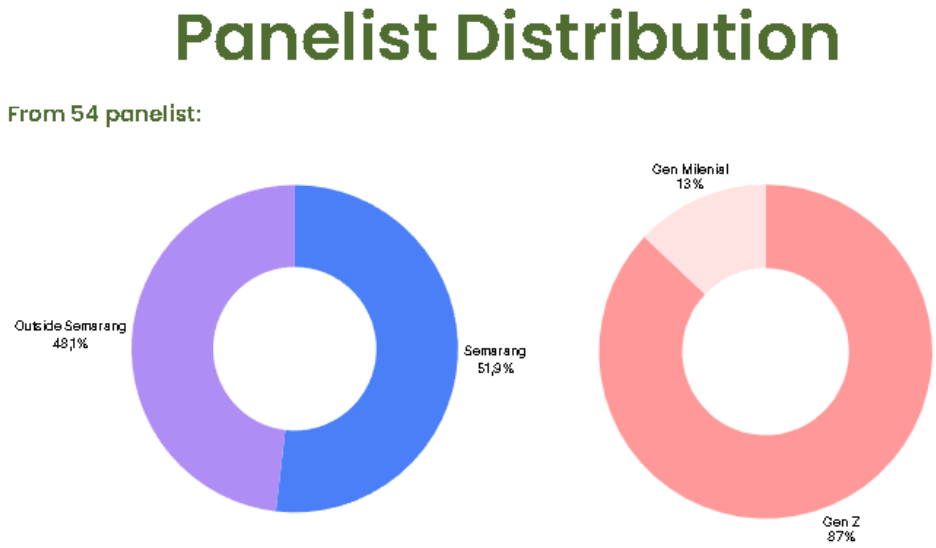

Figure 3. Panelist distribution (Primary Data, 2026)

The sensory testing involved 54 panelists, all existing consumers of Java Green Latte. Nearly half came from outside Semarang (48.1%), suggesting that consumer exposure to the product extends beyond its primary location. The majority were Gen Z (14–29 years old, 87%), reflecting Likoopi's actual consumer demographic. These characteristics are relevant as consumer age, geographical background, and lifestyle may influence sensory evaluation outcomes (Siegrist and Hartmann, 2020).

The dominance of Gen Z respondents is consistent with younger consumers' growing role as the primary segment in the café and specialty beverage industry. Gen Z tends to value product uniqueness, experiential consumption, and social media appeal (Djafarova and Bowes, 2021), and shows greater openness to novel functional ingredients (Siegrist and Hartmann, 2020; Onwezen et al., 2021). Increasing health consciousness among Gen Z consumers in Indonesia has also been shown to influence purchase intention toward functional beverages (Fathin et al., 2024), which may have increased Java Green Latte's attractiveness given moringa's recognized nutritional properties.

The balanced domicile distribution is likely attributed to Likoopi's location in Bandungan, a popular tourism destination that naturally attracts visitors from various regions (UN Tourist, 2023; Sthapit et al., 2019). Tourists frequently seek food products incorporating local ingredients and representing destination identity, a profile that Java Green Latte fits through its use of locally sourced moringa leaves (Sthapit et al., 2019).

Figure 4. Likoopi Ambience (Primary Data, 2025)

The uneven respondent distribution across the data collection period, with 75.9% participating in the final weeks, is common in commercial setting sensory studies where participation depends on actual customer traffic rather than controlled recruitment (Ares and Varela, 2018). Contributing factors include tourism-related visitor fluctuations (UN Tourism, 2023), word-of-mouth communication (Liu et al., 2022), and social media influence on cafe visitation among Gen Z consumers (Djafarova and Bowes, 2021).

4.3 OAL Result

The Over-All-Liking (OAL) score serves a hedonic measure reflecting the degree of consumer pleasure or acceptance toward the product as a whole. In this study, a 5-point hedonic scale was used, where 1 indicates dislike, 2 indicates slightly dislike, 3 is neutral, 4 indicates slightly dislike, and 5 indicates like. This method is the standard procedure to measure consumer preference and product

quality stability over time (Lawless and Heyman, 2018). The complete results of acceptance test are presented in the table below.

Table 2. Distribution of Panelists in OAL Result Value by Week

Week	Period (2025)	Panelist (n)	Score Distribution (Score Scale)					Average Score	Category	STD
			1	2	3	4	5			
1	14-20/09	2	0	0	0	0	2	5.00	Like	0.00
2	21-27/09	2	0	0	0	1	1	4.50	Slightly like	0.71
3	28/09-04/10	0						-	-	-
4	05-11/10	4	0	0	1	0	3	4.50	Slightly like	1.00
5	12-18/10	5	0	0	1	3	1	4.00	Slightly like	0.71
6	19-25/10	0						-	-	-
7	26/10-01/11	0						-	-	-
8	02-08/11	41	0	1	3	21	16	4.27	Slightly like	0.71
Total	8 weeks (3 months)	54			-			4.33	Slightly like	0.72

Source: Primary Data, 2025

Overall calculation showed that 53.70% of panelists gave score 5 (like), 38.89% gave score 4 (slightly like), 5.56% gave score 3 (neutral), and only 1.85% gave score 2 (slightly dislike). No panelist gave score 1 (dislike). The total average score obtained was 4.334 ± 0.727. it falls in the upper range of the scale, which is categorized as slightly like. From week 1 to week, the product acceptance result was consistently good and remained in the positive category range. Although the average score decreased slightly from 5.00 in the first week to 4.20 in the final week, this change was very small and still within the acceptable quality level. There

may be several factors influencing this consistent result, such as fixed formulation, good processing method, and proper storage that maintained sensory properties over time. This is likely caused by strict quality control during production, so the product characteristics did not change significantly. This proves that the product was stable and generally well accepted by consumers from beginning to end of the study period (Rosa and Masala, 2023).

In week 1, all 2 panelists gave a perfect score of 5.00, which belongs to the like category. This shows the producthad very good quality at the beginning, with optimal formulation, color, aroma, and taste. It is assumed that the product was made with fresh raw materials and followed strict standard operating procedures, so the sensory properties were good. One possible reason for this perfect score is that the product was newly produced and had not been stored for a long time, so no quality degradation occurred yet. Newly produced products usually have stable and consistent quality, as reported by Murkolis et al. (2021). In week 2, the average score was 4.50, which is categorized as slightly like. Scores ranged from 4 to 5. The slight decrease compared to week 1 was not caused by lower quality, but because each person has different taste preferences and sensitivity. There may be several factors influencing this difference, such as personal habit or familiarity with herbal taste. This is likely caused by natural variation in human perception, which is common even when the product tested is exactly the same. This variation in assessment is normal and commonly happens in sensory testing (Kremer et al., 2018).

Week 3 had no data recorded. This was due to there were no costumer in

Likoopi whose purchasing Java Green Latte product. In week 4, the average score was 4.50, still categorized as slightly like. Most panelists gave score 5, while one respondent gave score 3 (neutral). Most of them choosing in 5 out of 5 maybe happened because some people are more sensitive to the herbal taste or natural color from moringa (kelor) leaves. There may be several factors influencing this reaction, such as individual threshold or past experience with similar products. This is likely caused by the presence of natural compounds in plant based materials that are perceived differently by each person. This response is common in plant based products, where natural compounds can create unique characteristics (Domenech et al., 2020).

In week 5, the average score decreased slightly to 4.00, which is the lowest limit of slightly like category. This variation appeared because more panelists were involved compared to previous weeks. There is a possibility that caused this difference, maybe it was caused by small natural changes in raw material (kelor), strorage time, or sensory fatigue. It is assumed that small changes in weather or harvest time of leaves may also affect the taste and color. Similar results were also explained by Drake (2018), who stated that these factors often caused small score changes even when production standards are kept the same. Week 6 and 7 had no data recorded. Same with the data from week 3, It was assumed that this was due to limited consumer Likoopi that orders Java Green Latte. This may happen too because the research periode coincided with holidays or other activities. This situation is acceptable in field research and is often found in long term sensory studies (Stone and Sidel, 2020).

Week 8 was the most important periode, involving 41 panelists or 75.9% of total respondents. The average score was 4.20, categorized as slightly like. Score 4 was the most common (51.2%), while only few gave lower scores. Low standard deviation value (0.71) means most panelists had the same opinion about the product quality. There may be several factors influencing this result, such as clear sensory attributes and stable quality. This is likely caused by the large number of respondents, which made the assessment more balanced and representative. Lower score (2 or 3) were normal because no single product can satisty everyone, especially when tested by general consumers with different background (Guinard et al., 2026). The average score slowly decreased from 5.00 to 4.20 not because the quality dropped, but because of the significant fluctuation of panelist.

In conclusion of this sub chapter, during 8 weeks of study, the product showed good acceptance and remained consistent from week 1 to week 8, staying in the positive category range of slightly like to like. A total of 98.15% of panelists gave score ≥ 3, and 88.89% gave score ≥4. Uneven data and small score changes were likely caused by respondent availability, natural preference differences, different raw quality, not because by poor quality. It is assumed that all these factors are natural and acceptable in sensory research. This is likely caused by normal variation in research and human assessment, which does not reduce the validity of the result. The product kept stable quality and high consumer liking. This agress with other studies that herbal products are well accepted when formulation and processing are well controlled (Trigo et al., 2023).

4.4 JAR Result and Consumer Perception of Sensory Attributes

The JAR result shows a high proportion of JAR (Just About Right) responses for all the attributes tested (Figure 4). This result indicates that consumers perceive that attribute to be at an optimal intensity level in current formulation. The JAR distribution results for each of the six attributes are discussed below. “Less” category on the chart was considered as “less” and “slightly less option” on the JAR sensory test scale. “Too much” category on the chart was considered as “too much” and “slightly too much” on the JAR sensory test scale.

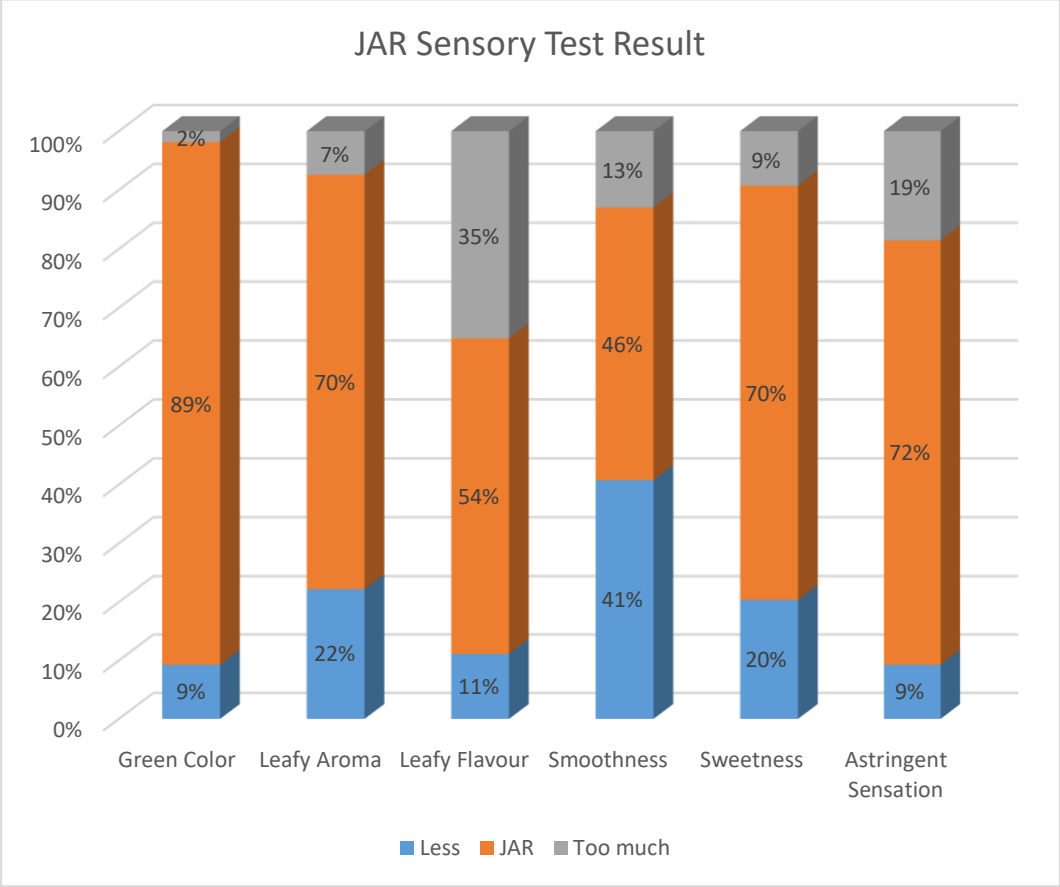

Figure 5. Percentages for the JAR Level (Primary Data, 2026)

4.4.1 Green Color

Green color is a visually prominent characteristic of Java Green Latte, derived from the natural chlorophyll content of moringa *(*kelor) leaves. The JAR results showed that 88.89% of panelist (n=48) rated the green color as "Just About Right," with only 9.26% (n=5) rated it as "less green" and 1.85% (n=1) as "too green." This distribution is among the most favorable of all attributes evaluated, demonstrating near-unanimous consumer alignment with the current color intensity. Color is often the first sensory cue used by consumers to form expectations about products quality, flavor, and naturalness. Therefore, the green color may have helped communicate

the plant based and functional characteristic of the product (Rodriguesetal, 2023). The high JAR percentage for green color aligns with the product's position as a locally based product that has potential same as matcha latte, where a visible green hue is associated with natural, plant-based ingredients and perceived quality (Fiszman and Tarrega, 2018). Costumers, particularly younger consumers, may already be familiar with green colored drinks, reducing the possibility of visual rejection and increasing acceptance of the product appearance (Wang et al., 2024). The kelor's green color may also carry positive association with health and environmental sustainability like core value of Likoopi branding that potentially enhancing its acceptability. The low "too green" proportion (1.85%) further suggests that the current formulation does not produce an excessively intense color that might be perceived as artificial or unpleasant by consumers and it is linear with the penalty analysis result (p = 1.000) in table 2 that confirmed no significant negative impact on OAL (Over-All-Liking).

4.4.2 Leafy Aroma

Leafy aroma is a leafy scent characteristic of dried moringa (kelor) leaves in Java Green Latte product. Leafy aroma received a JAR rating from 70.37% of respondents (n=38), with 22,22% (n=12) perceiving it as "less leafy aroma" and 7.41% (n=4) as "too leafy aroma." The moderately elevated "less" proportion is noteworthy, as it suggest that almost a fifth of panelists would prefer a stronger leafy aroma. However, as will be discussed in section 4.5, this did not translate into a statistically significant penalty. The penalty analysis result (p = 0.788) confirmed

no significant negative impact of non-JAR category on OAL (Over-All-Liking). This finding indicates the most respondents considered the leafy aroma appropriate for the product. Java Green Latte is formulated using moringa (kelor) leaves powder. A certain level of leafy aroma is expected and may contribute to the product authenticity. Previous studies have reported that consumers generally expect herbal and plant based beverages to possess characteristic vegetal aromas that reflect their natural ingredients (Rodrigues et al., 2023).

The perception of leafy or grassy aromas in plant-based beverages is strongly influenced by the presence of volatile green-note compounds such as hexanal and (E)-2-hexanal, which originate from the oxidation of polyunsaturated fatty acids in leaf tissue (Meyerhof et al., 2021). In kelor leaves, these compounds contribute to the characteristic herbaceous scent. The fact that 70.37% of the consumers found this aroma to be at an appropriate intensity suggests successful calibration of the moringa content in the current formulation. The 22.22% “less leafy aroma” response may reflect individual variation in aroma sensitivity and prior familiarity with moringa products rather than a formulation deficiency. The relatively higher percentage of respondents selecting “less” compared with “too much” may suggest that some consumers preferred a stronger moringa (kelor) aroma. This finding could indicate that the current formulation successfully reduced excessive herbal notes that often decrease acceptance in plant based beverages while still maintaining a recognizable moringa (kelor) identity.

4.4.3 Leafy Taste

Leafy taste is a leafy or herb taste from moringa (kelor) leaves in Java Green Latte product. Leafy taste showed 53.70% of panelists (n=29) selecting “Just About Right,” 11,11% (n=6) finding it “less leafy taste,” and 35.19% (n=19) perceiving it as “too leafy taste.” These attributes had the lowest JAR percentage across the six attributes, and the “too leafy taste” category was the most populated non-JAR category in the study. This big proportion of “too leafy taste” warrants careful interpretation. Kelor leaves produce the leafy taste to Java Green Latte product. It contain glucosinolates, polyphenols, and other bioactive compounds that contribute to a bitter or astringent sensation, which may be unfamiliar and undesirable to consumers who are not accustomed to herbal beverage products (Fahey, 2018). Although these characteristics contribute to product identity, excessive intensity may reduce consumer liking, particularly among consumers who are unfamiliar with moringa based product (Rodrigues et al., 2023). Despite this distribution skewing toward excess intensity, the penalty analysis (see section 4.5) did not yield statistical significance (p=0.122), meaning the impact of OAL (Over All Liking) was not large enough to warrant formulation change. Nonetheless, this attribute presents the most potential area for monitoring in future product iterations due to the relatively high proportion of respondents selecting “too much”. It indicates that some consumers perceived the leafy flavour as stronger than expected. This finding may also reflect the balance between preserving the unique characteristics of moringa and maintaining overall beverage acceptability.

4.4.4 Smoothness

Smoothness is a smooth mouth feel inside the mouth from all the ingredients except ice cubes in Java Green Latte product. Smoothness revealed a bimodal-learning distribution. 46.30% (n=25) rated it as JAR, while a substantial 40,47% (n=22) perceived the product as “less smooth” and 12.96% (n=7) as “too smooth.” The high proportion of “less smooth” responses indicates that a significant segment of consumers preferred smoother mouthfeel than what the current formulation provided. Possibly because latte beverages are commonly associated with creamy and smooth mouthfeel characteristic. Therefore, consumers may have compared Java Green Latte products when evaluating texture. Plant based beverages often have lower smoothness compared with conventional milk based beverages because of the presence of natural solids that affect mouthfeel. Smoothness in plant-based milk beverages are primarily governed by particle size distribution, fat content, and the degree of homogenization (McClements et al., 2019). Kelor leaves powder, when suspended in liquid, may contribute micro particle roughness that some consumers detect as a slightly gritty or less-smooth texture. The 40.74% “less smooth” response is the highest non-JAR response in this research. Previous studies have shown that texture plays an important role in determining consumer acceptance of functional beverages and plant based drinks (Kowalska et al., 2024). Nevertheless, the penalty analysis result was non-significant (p=0.321), indicating that this perception did not substantially reduce overall liking scores among those respondents as sensory test panelists.

4.4.5 Sweetness

Sweetness is a pleasant, sweet taste from sugar in the Java Green Latte product. Sweetness was well-calibrated with 70.37% of panelist (n=38) rating it as "Just About Right," 20.37% (n = 11) finding it "less sweet," and 9.26% (n =5) as "too sweet." The majority JAR response, combined with a relatively small "too sweet" proportion, indicates that the current sugar level in Java Green Latte is in the right level for the consumer segment tested. Sweetness can mask bitter or astringent notes (Ervina et al., 2023) also enhance the acceptability (Monteiro et al., 2017). The higher percentage of respondents selecting "less" compared with "too much" may indicate that some consumers preferred a sweater product. However, maintaining moderate sweetness may be beneficial because excessive sweetness could mask the natural characteristics of moringa and reduce the finctional beverage image of the product. Current consumer trends also indicate increasing preference for beverages with balanced sweetness levels rather than excessively sweet formulations (Fathin et al., 2024). Nevertheless, the non-significant penalty result ($p = 0.500$) confirms that this minority preference (20.37% of "less sweet) did not meaningfully reduce liking scores, and the sugar level represents an appropriate balance for most respondents.

4.4.6 Astringency Sensation

Astringency sensation is a drying, puckering sensation in the mouth after swallowing, associated with unripe fruit flavor in Java Green Latte product. Astringency sensation received a JAR rating from 72.22% of respondents (n = 39),

with 9.26% (n = 5) perceiving it as “less” and 18.52% (n = 10) as “too strong.” The proportion of astringency similar to leafy taste, reflects the inherent sensory profile of moringa based beverages. Astringency in plant based beverages is primally associated with polyphenolic and flavonoid compounds cause a drying, puckering sensation in the mouth (Arote et al., 2024). Since moringa (kelor) leaves contain phenolic compounds and antioxidants, the presence of a certain degree of astringency is expected in the product (Rodrigues et al., 2023). The 72.22% JAR response suggests that most consumers accepted this level as appropriate, likely because they expected or appreciated a degree of astringency as indicative of a natural taste from moringa leaves products without causing substantial sensory discomfort. The penalty analysis result ($p = 0.408$) confirmed no significant negative impact on OAL (Over-All-Liking). However, the proportion of respondents selecting “too much” was higher than for sweetness and aroma attributes. This result suggests that some consumers were sensitive to the drying or puckering sensation associated with astringency. Similar finding have been reported in studies of functional and plant based beverages, where excessive astringency is often identified as one of the main factors limiting consumer acceptance (Kowalska et al., 2024).

4.4.7 Discussion of Sensory Attributes with Lower JAR Agreement

Although all evaluated attributes showed acceptable JAR percentages, leafy taste and smoothness exhibited the lowest JAR agreement among the six sensory attributes evaluated. Leafy taste obtained 54% JAR responses, while smoothness

showed the lowest JAR percentage at 46%. These results suggest that consumers demonstrated greater variation in their perception of these attributes compared with green color, sweetness, leafy aroma, and astringent sensation. One possible explanation is that both attributes are closely related to the incorporation of moringa leaves as the main ingredient of Java Green Latte. Moringa leaves naturally contain chlorophyll, phenolic compounds, flavonoids, and other bioactive substances that contribute to characteristic herbal, grassy, and leafy taste notes (Rodrigues et al., 2023). While these sensory characteristics help establish product identity and authenticity, excessive intensity may not align with the preferences of all consumers, particularly those who less familiar with moringa based beverages.

The relatively high proportion of respondents who selected “too much” for leafy taste may indicate that some consumers perceived the herbal taste intensity to be stronger than expected. This finding may be explained by consumer familiarity. Research has shown that consumers generally exhibit greater acceptance toward flavours that are familiar, whereas unfamiliar flavour profiles often generate more diverse sensory responses (Siegrist and Hartmann, 2020). Compared with ingredients such as coffee, chocolate, or matcha, moringa (kelor) remains a relatively uncommon ingredient in commercial beverage products. Smoothness demonstrated an even lower JAR percentage, with 41% of respondents perceiving the product as less smooth than desired. One possible explanation is maybe some respondents may have perceived the beverages texture as slightly less smooth than their expectations of a typical latte product. Interestingly, leafy taste and smoothness may not be completely independent sensory attributes. The presence of

moringa (kelor) particles may simultaneously contribute to stronger leafy taste perception and reduced smoothness. In other words, the same formulation factor may influence both flavour intensity and mouthfeel. This relationship may explain why these two attributes showed the lowest JAR agreement compared with other evaluated sensory characteristics.

Therefore, leafy taste and smoothness should not be interpreted as product weakness. Instead, they may represent sensory attributes that warrant continued monitoring in future product development efforts. Potential optimization strategies could include improving particle size reduction, filtration efficiency, or homogenization processes to enhance smoothness while maintaining the characteristic moringa flavour that contributes to the unique identity of Java Green Latte. Braver option, reducing the amounts of kelor powder may will increase the JAR result in both leafy taste and smoothness.

4.5 Penalty Analysis Result and Hypothesis Testing

Penalty analysis is statistical method that links JAR scale data with Over-All-Liking (OAL) scores to identify which sensory attributes have a meaningful negative impact on consumer acceptance (Xiong et al., 2020). The underlying principle involves comparing the mean OAL score of respondents who selected a non JAR category, either “too little” or “too much” against the mean OAL of those who selected “just about right” for the same attribute. The difference between these two means is referred to as the mean drop, which represents the penalty associated with that non JAR perception. A positive mean drop indicates that non JAR

respondents liked the product less than JAR respondents, while a negative mean drop indicates the opposite (Gacula et al., 2009 as cited in Meyners and Castura, 2021).

The statistical significance of each penalty is determined through an independent samples t-test, which evaluates whether the difference in mean OAL between the JAR and non JAR groups is statistically meaningful at a 95% confidence level ($p<0.05$)(Varela and Ares, 2014). This test assumes that the two groups (JAR respondents and non JAR respondents) are independent of each other, and compares their OAL score distributions to determine whether the observed mean drop is unlikely to have occurred by chance. Only non JAR categories with more than 20% of total respondents are included in the significance testing, as subgroups below this threshold are considered too small to yield reliable statistical estimates. This 20% threshold is a widely applied convention in penalty analysis to prevent statistical noise from underpowered subgroups from generating misleading conclusions about reformulation priorities (Meyners and Castura, 2021). Attributes with a statistically significant penalty (p-value < 0.05) are flagged as candidates for reformulation. Table 2 presents the complete penalty analysis result for all six attributes of Java Green Latte product.

Table 2. Penalty Analysis Result for Java Green Latte Sensory Attributes

Attributes	Level	Frequency (n)	% of Respondents	Mean OAL	Mean Drop	p-value	Significant
Green Color	Less	5	9.26%	4.200	0.133		
	JAR	48	88.89%	4.333			
	Too Green	1	1.85%	5.000	-0.667	1.000	No
Leafy Aroma	Less	12	22.22%	4.417	-0.101		
	JAR	38	70.37%	4.316			
	Too Much	4	7.41%	4.250	0.066	0.788	No
Leafy Taste	Less	6	11.11%	4.500	-0.052		
	JAR	29	53.70%	4.448			
	Too Much	19	35.19%	4.105	0.343	0.122	No
Smoothness	Less	22	40.74%	4.227	0.213		
	JAR	25	46.30%	4.440			
	Too Smooth	7	12.96%	4.286	0.154	0.321	No
Sweetness	Less	11	20.37%	4.455	-0.165		
	JAR	38	70.37%	4.289			
	Too Sweet	5	9.26%	4.400	-0.111	0.500	No
Astringency	Less	5	9.26%	4.600	-0.215		
	JAR	39	72.22%	4.385			
	Too Strong	10	18.52%	4.000	0.385	0.408	No

Significant penalty p-value less than 0.05 (n = 54)
Source: Primary Data, 2025

The mean OAL score for the JAR group across attributes ranged from 4.289 (Sweetness – JAR) to 4.448 (Leafy Taste – JAR), reflecting consistently high overall liking among consumers who perceived each attribute to be at the right intensity. None of the six attributes produced a statistically significant penalty (all p-value less than 0.05), confirming the null hypothesis.

Interestingly, leafy taste and smoothness exhibits the lowest JAR agreement among all evaluated sensory attributes and also generated the most notable positive mean drop values. Nevertheless, both attributes failed to reach statistical

significance. This result suggests that lower sensory agreement does not necessarily translate into reduced product acceptance and highlights the importance of evaluating sensory attributes not only through perception but also through their impact on liking.

4.5.1 Interpretation of Mean Drop Value

Figure 6 presents the penalty plot, a scatter chart of mean drop values (y-axis) against the percentage of non-JAR respondents (x-axis) for both “Too litthe or Less” (blue markers) and “Too much” (red markers) directions. The vertical dashed line at 20% of respondents in a non-JAR category are considered to have practically relevant level of consumer disagreement.

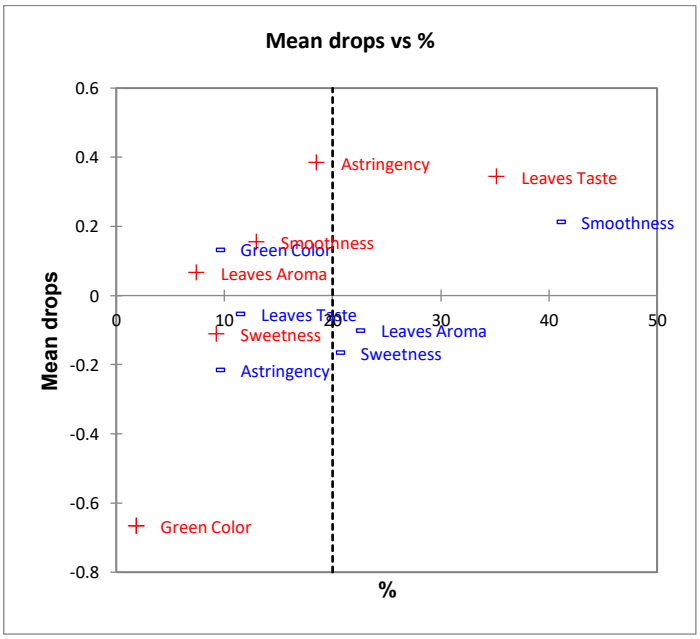

Figure 6. Mean Drop Graph (Primary Data, 2026)

Examining the plot quadrant reveals the following pattern. In the upper-right quadrant (high%, high mean drop) means zone of greatest reformulation concern,

two attributes appear: Leafy taste (too much," ~35%, mean drop ~0.34) and smoothness ("too little," ~41%, mean drop ~0.21). Leafy taste generated the highest practically relevant positive mean drop in the "too much" direction. This result indicates that respondents who perceived the leafy taste as excessively strong tended to report lower OAL score than respondents who perceived the flavor as just about right. However, the reduction remained relatively small, as the average OAL score of this non-JAR group was still 4.105 out of 5.000. Therefore, although excessive leafy taste reduced liking to some extend, it did not result in consumer rejection.

Smoothness produced the second most notable positive mean drop (0.213) in the "less smooth" direction. Similar to leafy taste, respondents who perceived the beverage as less smooth than desired still reported a relatively high average OAL score of 4.227. This finding suggests that the observed deviation affected preference intensity but did not substantially alter overall acceptance. These attributes, leafy taste and smoothness have both a substantial proportion of non-JAR respondents and a positive penalty on overall liking, making them the most notable observation in this study, even though neither crosses the statistical significance threshold. Their position in this quadrant signals that they are worth monitoring in future evaluations.

For other attributes, astringency ("too much," ~19%, mean drop ~0.39) sits just below the 20% threshold on the x-axis but has the highest mean drop among all "too much" responses which is consistent with the known negative hedonic impact of excessive astringency in beverages (Lima & Bolini, 2020), This condition

placing astingency near the upper boundary of the left zone. This indicates that while only a small percentage of consumers perceived excessive astringency, those who did showed a significantly sharper decline in OAL.

In contrast, several attributes are positioned near the center of the chart or within the ‘safe’ zone, suggesting that these factors do not cause significant concern for consumers. Green Color (“too little,” ~9%, mean drop ~0.13) and leafy aroma (“too little” and “too much”) both appear in the low % or near zero mean drop region, confirming their strong formulation alignment. The “less green” group in green color attribute showed a mean drop of 0.133, while the “too green” respondent (n =1) showed a mean drop of -0.667. Meaning this single respondent gave a higher OAL score than the JAR group. Due to the extreme minority size (1.85%), this finding has no practical or statistical significance. Leafy aroma attribute is quite similar. The “less leafy” aroma group produced a negative mean drop of -0.101, suggesting those who perceived less aroma still liked the product comparably to the JAR group. In sweetness attribute, the negative mean drop (“too little “ and “too much”) indicates that the small minority of respondents who perceived these attributes as non-JAR actually gave comparable or slightly higher OAL scores than the JAR group. These findings indicate that deviations from the ideal intensity of these attributes had little influence on OAL and suggest that the current formulation successfully achieved an acceptable sensory balance for these characteristics.

4.5.2 Implications of Lower JAR Agreement on Consumer Acceptance

The combination of relatively low JAR agreement and non significant penalties observed for leafy taste and smoothness attributes represents one of the most important findings of this study. At first glance, the lower JAR percentages might suggest that these attributes require optimization. However, the penalty analysis result indicate that consumers continued to report high liking score despite perceiving these attributes as non JAR. The possible explanation is that the observed mean drop value remained relatively small. It is relates to the magnitude of the observed mean drops. Although leafy taste generated the largest practically relevant penalty, the reduction in liking was less than one point on the five point OAL scale. Which means that these decreases were relatively small compared with the full OAL scale range of five points. For example, respondents who perceived leafy taste as “too much” still reported an average OAL score of 4.105, while respondents who perceived smoothness as “less smooth” reported an average OAL score of 4.227. Both values remained within the positive liking range. These findings suggest that respondents generally continued to like the product despite perceiving these attributes as non JAR. Consequently, the observed disagreement appears to reflect differences in preference intensity rather than actual product rejection. Previous studies have reported that consumers may identify sensory attributes as non ideal while still maintaining a positive overall evaluation of the product (Meyners and Castura, 2021).

An important distinction in sensory science is the difference between preference deviation and product rejection. JAR analysis measures whether an

attribute is perceived at its ideal intensity, whereas penalty analysis evaluates whether deviations from the ideal level actually reduce liking. In the present study, a substantial proportion of respondents perceived leafy taste and smoothness as non JAR. However, the consistently high OAL scores indicate that these deciations did not reach a level that triggered rejection. Instead, consumers appeared to recognize that the attributes differed from their personal ideal while still considering the overall product acceptable. This finding demonstrates that not all sensory deviations have practical consequences dor consumer acceptance. Some deviations may simply represent individual preference differences rather than formulation deficiencies (Ares and Varela, 2018).

Another possible explanation is that Java Green Latte possesses a relatively broad sensory acceptance window. The concept of an acceptance window refers to the range of sensory intensities that consumers consider acceptable before liking declines substantially. Products with broader acceptance windows are generally more tolerant of sensory variation because consumers remain satisfied despite moderate differences in attribute intensity (Giacalone et al., 2019). The present findings suggest that consumers remained satistied with Java Green Latte even when certain sensory attributes deviated from the ideal intensity. Therefore, the product appears to possess a relatively robust sensory profile that can accommodate differences in consumer perception. From a product development perspective, this characteristic is advantageous because it indicates greater formulation flexibility and lower risk of consumer dissatisfaction resulting from minor production variability.

Consumer acceptance may also have been influenced by compensatory affects among sensory attributes. OAL is rarely determined by a single sensory characteristic but instead reflects the combined influence of multiple sensory experiences (Lawless and Heymann, 2028). Consequently, less favorable evaluations of leafy taste or smoothness may have been compensated by positive perceptions of green color, sweetness, aroma, and the unique identity of the product. This compensatory mechanism may explain why OAL remained stable despite disagreement regarding certain attributes. In addition, consumers may have interpreted some non JAR perceptions as natural consequences of the product concept rather than indicators of poor quality. Java Green Latte is marketed as a moringa based functional beverage, and consumers may therefore expect certain sensory characteristics that differ from conventional latte products. Previous studies have shown that consumers are generally more tolerant of unusual sensory characteristics when these characteristics are perceived as authentic and consistent with the product identity (Siegrist and Hartmann, 2020). As a result, stronger leafy taste or reduced smoothness may have been viewd as acceptable characteristics rather than formulation defects.

Consumer familiarity may represent another contributing factor. The sensory testing involved actual consumers of Java Green Latte, including both repeat consumers and newly consumers who voluntarily participated in the study. Familiarity has consistently been associated with greater acceptance of foods and beverages because repeated exposure increase tolerance toward sensory characteristics that may initially appear unusual (Siegrist and Hartmann, 2020).

Since the sensory evaluation involved actual consumers of Java Green Latte, familiarity with the product may have developed expectations regarding its sensory profile. Consequently, minor deviations from the ideal intensity may have been perceived as acceptable variations rather than quality defects. This phenomenon is commonly described as learned acceptance, where consumer liking increases through repeated exposure and experience.

Finnaly, statistical power should also be considered when interpreting the results. Several non JAR categories contained relatively small numbers of respondents. For example, only one respondent selected “too green,” while four respondents selected “too much leafy aroma.” Small subgroup sizes increase variability and reduce the ability of statistical tests to detect significant differences even when true differences may exist (Meyners and Castura, 2021). Therefore, the absence of statistical significance should not automatically be interpreted as evidence that no sensory effect exists. Rather, it indicates that the available data did not provide sufficient evidence to conclude that the observed penalties differed significantly from random variation. Nevertheless, because OAL remained consistently high across both JAR and non JAR groups, the practical importance of any potential undetected effects is likely limited.

4.5.3 Acceptance of the Null Hypothesis

Based on penalty analysis results, the null hypothesis (H_0), which stated that no sensory attribute of Java Green Latte product requires optimization, was accepted. None of the evaluated attributes generated statistically penalties on OAL,

indicating that deviations from the ideal sensory intensity were not sufficiently severe to reduce consumer acceptance. An important implication on this finding is that sensory agreement and consumer acceptance should not be interpreted as equivalent concepts. While JAR analysis identified leafy taste and smoothness as the attributes with the greatest consumer disagreement, penalty analysis demonstrated that these deviations did not significantly affect liking. This result confirms that lower JAR agreement alone is insufficient justification for product reformulation. The high OAL score observed across both JAR and non JAR groups further support the conclusion that the current formulation is well accepted by consumers. Therefore, future product development efforts should be viewed as opportunities for incremental refinement rather than corrective reformulation. Based on the present findings, Java Green Latte can be considered sensory acceptable and aligned with consumer expectations.

4.5.4 Physicochemical Test Standardization

Physicochemical testing was conducted to establish objective, measurable production standards corresponding to the consumer-preferred sensory levels identified through JAR testing. Four parameters were measured with five repetitions each: color (L*, a*, b*), pH, Total Dissolved Solids (TDS), and viscosity, each directly relevant to the six key sensory attributes identified in the FGD.

The colorimetric measurement yielded mean values of L* = 53.94 ± 0.28, a* = −13.49 ± 0.35, and b* = 13.13 ± 0.59. The negative a* value confirms the

presence of a green hue, while the positive b* value reflects a slightly yellowish-green tone consistent with moringa leaf powder dissolved in a milk-based medium (Martins et al., 2017). This green color is primarily derived from chlorophyll content in *Moringa oleifera* leaves, and the high JAR percentage for green color (88.89%) suggests that the current chlorophyll concentration aligns well with consumer expectations, establishing these colorimetric values as the target standard for green color quality control.

The mean pH was 6.59 ± 0.05, indicating a slightly acidic to near-neutral product characteristic of milk-based beverages, where milk proteins naturally moderate acidity through their buffering capacity (Smithers, 2019). This pH range is relevant to both the astringency and leafy taste attributes. Astringency in moringa-based products is primarily attributed to polyphenolic compounds and tannins that interact with salivary proteins (Soares et al., 2017), and at near-neutral pH their activity may be partially moderated, which may explain the 72.22% JAR response for astringency. Similarly, pH influences the solubility and release of flavor compounds from moringa leaf particles, affecting leafy taste intensity during consumption (Teixeira et al., 2017).

The mean TDS was 20.76 ± 0.55 °Brix, primarily reflecting the combined contribution of added sugar, milk solids, and moringa powder. This value corresponds to the sweetness level that received a 70.37% JAR response, confirming its alignment with consumer sweetness preference. Beyond hedonic pleasure, the current sugar content also functionally masks the mild bitterness and astringency contributed by moringa's polyphenolic compounds, contributing to a

more balanced overall flavor profile (Hopfer et al., 2017). The mean viscosity was 26.16 ± 0.89 seconds, reflecting the flow characteristics of the product influenced by milk fat, protein concentration, and suspended moringa leaf particles from the blending process (McClements et al., 2019). The smoothness attribute received the lowest JAR percentage (46.30%), with 40.74% of panelists finding the product less smooth than desired, which may be attributed to residual moringa micro-particles contributing to a slightly grainy mouthfeel. Future formulation improvements targeting smoothness could explore adjustments to blending duration or moringa powder particle size through finer grinding. Leafy aroma is primarily governed by volatile organic compounds in moringa leaves that were beyond the scope of this study's measurements (Teixeira et al., 2017).

Collectively, the physicochemical values L* 53.94 ± 0.28, a* −13.49 ± 0.35, b* 13.13 ± 0.59, pH 6.59 ± 0.05, TDS 20.76 ± 0.55 °Brix, and viscosity 26.16 ± 0.89 seconds, establish an objective production standard for Java Green Latte corresponding to the consumer-validated sensory profile. By monitoring these parameters during production, Likoopi can ensure consistent sensory quality across batches without requiring periodic sensory evaluation for every production cycle.

4.6 Implication for Likoopi's Product Strategy

The finding that no attributes require optimization caries direct strategic value for Likoopi. First, it provides empirical confirmation that the current Java Green Latte formulation aligns with consumer preferences, reducing uncertainty in production decisions and building confidence in maintaining the existing recipe.

From the physiochemistry test, it can be standardized that the standard formulation of Java Green Latte should be with (L* 53.94 ± 0.28, a* −13.49 ± 0.35, b* 13.13 ± 0.59, pH 6.59 ± 0.05, TDS 20.76 ± 0.55 °Brix, and viscosity 26.16 ± 0.89 seconds). Second, the high mean OAL score of 4.334 suggests that Java Green Latte has strong potential as a signature product that can be promoted with consumer preference data as supporting evidence. However, leafy taste and smoothness showed that these attributes should be monitored in future evaluation even though not reaching statistical significance yet, particularly if the product is introduced to a broader or less familiar consumer market.

From sustainability and local sourcing Likoopi's values, the acceptance of the moringa leafy taste and astringency by most respondents is particularly encouraging. It suggests that consumers who engage with Java Green Latte are receptive to the sensory profile of moringa leaves as a base ingredient, supporting the brand's mission of promoting locally sourced, environmentally sustainable ingredients. This consumer alignment with the product's ingredient philosophy represents a valuable brand product coherence that should be communicated in marketing and product story telling. Like Java Green Latte itself, it represents the Java's latte style with kelor leaves. Finally, the use of this JAR and OAL sensory evaluation methodology in Java Green Latte shows that Likoopi now has an internal capability that can be applied to other products. The protocol developed in this study including the FGD design, sensory instrument construction, panelist recruitment criteria, penalty analysis procedure can be adapted for evaluating new product launches until existing products.

4.7 Limitations of the Study

Several limitations should be acknowledged when interpreting the findings of this study. First, the penalty analysis results for several non-JAR subgroups should be interpreted with caution due to small subgroup sizes. For example, only one respondent rated the green color as "too green," and only five respondents rated astringency as "less strong." When a subgroup contains very few respondents, the mean drop value becomes unstable. A single respondent with an unusually high or low OAL score can disproportionately influence the group average and make the result unreliable. A larger sample size would be needed to produce more statistically robust penalty estimates for these categories.

Second, this study evaluated only a single formulation of Java Green Latte without a comparative reference or benchmark product. When consumers evaluate a single product with no sensory contrast, they tend to anchor their responses toward neutral or moderate ratings, a phenomenon known as central tendency bias, resulting in compressed response variance across the rating scale (Meyners and Castura, 2021). This single-product design may have systematically reduced the likelihood of detecting statistically significant penalties, as narrower variance in OAL scores between JAR and non-JAR subgroups makes it more difficult for the t-test to reach significance. Had a benchmark product such as a commercial matcha latte been included, panelists would have had a comparative reference point that could have produced more discriminating responses, particularly for attributes such as leafy taste and smoothness which showed the highest non-JAR proportions in this study. Future research should therefore consider incorporating at least one

reference product to enhance the sensitivity and discriminating power of the penalty analysis (Varela and Ares, 2022).

Third, the prior familiarity of panelists with moringa (*Moringa oleifera*) leaves was not assessed or controlled in this study, which may have introduced response bias in two opposing directions. Panelists who had little or no prior experience with moringa may have perceived its characteristic sensory properties including leafy taste, mild bitterness, peppery sensation, and astringency as unfamiliar or disturbing, potentially resulting in lower OAL scores driven by novelty aversion rather than genuine formulation inadequacy (Siegrist and Hartmann, 2020). Conversely, panelists already familiar with moringa may have perceived these same characteristics as authentic and unique, positively influencing their OAL scores (Onwezen et al., 2021). Future studies should therefore screen panelists based on their prior familiarity with moringa leaves to obtain more accurate and nuanced sensory evaluation results.

Fourth, this study did not explicitly evaluate the potential presence of petrichor in the product's aroma profile. Petrichor is an earthy, soil-like aroma produced by geosmin compounds from soil bacteria (*Streptomyces* spp.) that may be present in moringa leaf powder due to its agricultural origin and minimal processing approach. For consumers unfamiliar with moringa, this aroma characteristic may be perceived as unpleasant or off-putting, representing a latent weakness that could reduce product acceptance in a broader market. Future product development should therefore consider processing methods that can reduce or mask geosmin-associated aroma, such as controlled drying temperature optimization,

blanching prior to drying, or ingredient-based aroma masking, to improve the aroma profile of Java Green Latte and broaden its consumer appeal (Teixeira et al., 2017).

CHAPTER V

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

Based on the results of this study, it can be concluded that the current formulation of Java Green Latte is well-accepted by its consumers. Six key sensory attributes identified through FGD, green color, leafy aroma, leafy taste, smoothness, sweetness, and astringency were evaluated using JAR-OAL sensory testing with penalty analysis. The overall liking score reflected a positive consumer impression, and penalty analysis confirmed that none of the attributes required optimization, therefore the null hypothesis is accepted. This study also successfully established a replicable JAR-OAL methodology that can be applied to Likoopi's future product development.

5.2 Recommendations

For Likoopi, the current formulation of Java Green Latte product is recommended to be maintained. Leafy taste and smoothness of Java Green Latte product should be monitored in future evaluation due to their relatively high non-JAR proportions. For future research, sensory testing should be conducted with more specific criteria of panelist with a benchmark sample and larger sample size to improve the reliability of penalty analysis results. The methodology from this study can also be extended to other products in Likoopi’s portfolio.

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