APPLICATION OF JUST-ABOUT-RIGHT WITH OVER-ALL-LIKING SENSORY TESTING IN PENALTY ANALYSIS TO IDENTIFYING CONSUMER PREFERENCES FOR JAVA GREEN LATTE PRODUCT

BACHELOR THESIS

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UNIVERSITAS DIPONEGORO
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As One of the Requirements for Bachelor's Degree in Food Technology Study Program Faculty of Animal and Agricultural Sciences
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ORIGINALITY STATEMENT OF BACHELOR THESIS

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Hereby declare as follows:

1. The scientific work entitled: "**Application of Just-About-Right with Over-All-Liking Sensory Testing in Penalty Analysis to Identifying Consumer Preferences for Java Green Latte Product**" and the research related to this scientific work is the result of my own work.
2. Each core citation from other people in the form of publications in this scientific work has been recognized in accordance with standard procedures.
3. I also recognize that this scientific work has been done under supervision of **Dr. Rafli Zulfa Kamil, S.T.P.** and **Dr. Sri Mulyani, S.Pt., M.P.**

Should any form of academic misconduct be discovered in the future within this bachelor thesis, the author is willing to have the awarded bachelor's degree revoked in accordance with the regulations of the Bachelor Program in Food Technology, Faculty of Animal and Agricultural Science, Universitas Diponegoro

Semarang, Juni 2026
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ENDORSMENT LETTER

Title of Bachelor Thesis	:	APPLICATION OF JUST-ABOUT-RIGHT WITH OVER-ALL-LIKING SENSORY TESTING IN PENALTY ANALYSIS TO IDENTIFYING CONSUMER PREFERENCES FOR JAVA GREEN LATTE PRODUCT
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SUMMARY

KARTIKA RATIH NURDIYANA. 23020122130104. 2026. Application of Just-About-Right with Over-All-Liking Sensory Testing in Penalty Analysis to Identifying Consumer Preferences for Java Green Latte Product.
(Advisor: **RAFLI ZULFA KAMIL** and **SRI MULYANI**).

The food and beverage industry has seen growing interest in plant-based beverages utilizing local functional ingredients. Java Green Latte, produced by Likoopi in Bandungan, Semarang, is a milk-based drink using *Moringa oleifera* leaves as its highlight ingredient, positioning it as a local alternative to matcha latte. As a developing product, its consumer perception and sensory acceptance had not yet been systematically studied. This research was conducted from August 2025 to May 2026, with sensory testing at Likoopi and physicochemical testing at the RPHP and KGP Laboratory, Faculty of Animal and Agricultural Sciences, Universitas Diponegoro. The study applied JAR-OAL sensory testing combined with penalty analysis to identify consumer preferences based on key sensory attributes of the product.

The research was conducted through several stages: preparation and literature review, Focus Group Discussion (FGD) with 10 participants to identify six key sensory attributes, sensory testing using 5-point JAR and OAL scales with 54 panelists, and data analysis using penalty analysis. Since no attribute required optimization, the validation process was skipped. Physicochemical testing (color, pH, TDS, and viscosity) was then conducted with 5 repetitions each as a formulation standardization.

The penalty analysis results accepted H_0, indicating no attribute required optimization, as all p-values exceeded 0.05 (green color: 1.000; leafy aroma: 0.788; leafy taste: 0.214; smoothness: 0.321; sweetness: 0.500; astringency: 0.408). The mean OAL score was 4.334 out of 5.000. It is concluded that the current formulation of Java Green Latte is acceptable and matches consumer preferences.

PREFACE

All praise and gratitude for Allah S.W.T, for His endless mercy and blessings. Without His permission and help, the author cannot complete the bachelor thesis entitled "Application of Just-About-Right with Over-All-Liking Sensory Testing in Penalty Analysis to Identifying Consumer Preferences for Java Green Latte Product." This bachelor thesis is submitted as one of the requirements to obtain a bachelor's degree in Agricultural Technology, at the Food Technology Study Program, Department of Agriculture Science, Faculty of Animal and Agriculture Science, Universitas Diponegoro.

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This bachelor thesis still has some flaws and weaknesses. Because of that, the author is open to any suggestion that will lead to improvements. The author hopes that this bachelor thesis can be accepted and will have a meaningful impact on others, especially the readers.

Semarang, June 2026

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CHAPTER I

INTRODUCTION

1.1 Background

The health beverage industry has grown significantly due to rising consumer awareness of nutrition (Nair and Kumar, 2025; Pinthanon et al., 2025). Understanding consumer preferences has become crucial for product success and brand sustainability (Sikalidis et al., 2020). In this context, Likoopi, a local food and beverage business, has developed Java Green Latte, an innovative product combining local ingredients with modern consumer demands for unique, healthy, and sustainable beverages.

Java Green Latte is a dairy-based product using *Moringa oleifera* leaves powder as its highlight ingredient, giving it a green appearance, astringent aftertaste, creamy milk taste, and sweetness. “The name reflects three key aspects: *Java* represents the local identity of kelor leaves *(moringa oleifera)* native to Java, Indonesia; *Green* refers to the natural green color derived from moringa leaves; and *Latte* indicates the milk-based nature of the drink, reflecting Likoopi's intention to offer a local alternative to matcha latte given their similar sensory characteristics” (Morgan, personal communication, September 6, 2025). The product's uniqueness lies in its potential to position moringa as a local superfood ingredient (Divya et al., 2024) with comparable market potential to matcha from Japan (Shokery et al., 2017). Kelor leaves are rich in antioxidants, vitamins, minerals, and amino acids (Sachan et al., 2024), offering a compelling value proposition for health-conscious

consumers while supporting local agriculture and sustainability (Shokery et al., 2017).

Consumer preference identification in sensory science has become increasingly important in new product development (Tu et al., 2020), particularly in the food and beverage industry where taste, aroma, texture, and overall sensory experience determine product acceptance (Tarwendah, 2017). Previous studies on moringa-based beverages and dairy products have primarily relied on conventional hedonic scale testing to assess consumer acceptance (Rodrigues et al., 2023; Shaukat et al., 2025). While these methods indicate whether a product is liked or disliked overall, they do not identify which specific sensory attributes drive consumer acceptance or rejection, nor do they provide directional guidance for product optimization. Traditional product development approaches often rely on manufacturer preferences or limited consumer feedback, creating a gap between product characteristics and consumer expectations that can lead to product failure regardless of nutritional or sustainability credentials.

The combined use of Just-About-Right (JAR) and Over-All-Liking (OAL) scales has been previously applied in beverage studies, including flavored milk evaluation (Gere et al., 2017) and blended tea assessment (Kim et al., 2020) demonstrating its effectiveness in identifying attribute-specific consumer preferences beyond what hedonic testing alone can reveal. The JAR methodology identifies not only whether consumers like or dislike a product but also provides direction on how specific attributes should be modified to improve overall acceptance (de Almeida et al., 2017). Penalty analysis further quantifies the impact

of each attribute deviation from the ideal level on overall product liking, allowing developers to prioritize reformulation efforts and reduce guesswork in product development (Varela and Ares, 2022). This diagnostic capability is particularly important for Java Green Latte, given that moringa is a relatively unfamiliar ingredient to many consumers, understanding which specific sensory attributes are problematic is far more actionable than simply knowing whether the product is liked or disliked overall. Currently, Likoopi has not implemented this systematic approach, relying instead on internal taste panels or limited consumer feedback. This research therefore introduces JAR-OAL sensory testing with penalty analysis to identify consumer preferences for Java Green Latte, establishing a replicable methodology that can benefit not only this product but Likoopi's broader product development process while maintaining its commitment to local sourcing and sustainability.

1.2 Objective and Benefit

This research aims to identify consumer preferences for Java Green Latte as a Likoopi product using JAR-OAL sensory testing with penalty analysis to guide product optimization with determine key sensory attributes through FGD, evaluate current formulation perception through sensory testing, and establish replicable methodology for Likoopi's product development if there is any attributes of the product that needs to be optimized. The study benefits include providing Likoopi with actionable consumer insights for reformulation guidance and establishing standardized JAR-OAL methodology for replication.

CHAPTER II

LITERATURE REVIEW

2.1 Sensory Evaluation and Consumer Preference

Sensory evaluation is the systematic analysis of products using human senses (Khatwani, 2025). Sensory evaluation plays a vital role in understanding consumer perception and guiding product development in the food and beverage industry. It provides structured methods to measure how consumers perceive products through their senses like appearance, aroma, taste, texture, and aftertaste also how these perceptions influence their preferences and purchasing decisions (Khatwani, 2025). Sensory evaluation methods are generally divided into discrimination tests, descriptive tests and affective tests (Varela and Ares, 2022). Discrimination tests assess if there is a significant difference between products or not. Descriptive tests identify the nature of the sensory difference or the magnitude of the difference by measuring attribute intensity or describing the product characteristic. Affective tests involve consumers to assess hedonic responses or liking levels. Affective testing is particularly relevant for product optimization since it captures actual consumer preferences.

According to Tu et al. (2020), consumer-oriented sensory evaluation bridges the gap between technical product development and market expectations. It ensures that new formulations meet consumer demands rather than relying solely on internal judgments. Tarwendah (2017) also emphasizes that consumer acceptance depends

on the sensory experience more than nutritional or marketing aspects. Therefore, incorporating sensory evaluation into product development is essential to improve product acceptance and market success.

2.2 Just About Right (JAR) Scale

The Just-About-Right (JAR) scale is one of the affective tests with consumer-based diagnostic methods that evaluates whether the intensity of specific product attributes is appropriate according to consumer expectations. It combines both intensity assessment and liking judgment, offering actionable feedback for product reformulation (de Almeida et al., 2017). The JAR scale typically consists of five levels ranging from "too weak," "slightly too weak," "just about right," "slightly too strong," to "too strong." The midpoint represents the ideal intensity, while the other points indicate deviations that may reduce product acceptance. Unlike pure liking tests, JAR helps researchers determine why consumers like or dislike a product and provides direction for adjustment (Rothman and Parker, 2009 in de Almeida et al., 2017).

Applications of JAR testing have been successfully reported in a wide range of food and beverage studies, including coffee, tea, chocolate, and dairy products (Gere et al., 2017). For example, in the development of fruit filling (Agudelo et al., 2015), nutraceutical-rich juices (Lawless et al., 2015), and aleurone-rich pastas and breads (Bagdi et al., 2014). JAR scales are also widely used to develop dairy products, for example sweetener concentrations in vanilla yoghurts (Narayanan et al., 2014), chocolate dairy desserts (Morais et al., 2014), inulin fortified ovine milk

yoghurt (Balthazar et al., 2015), and coffee flavored milk (Li et al., 2015). Through JAR data, developers can identify which sensory attributes such as sweetness, bitterness, or color that require fine tuning to achieve better consumer satisfaction.

2.3 Over All liking (OAL) Scale

Consumers rely on sensory attributes to purchase products and make re-purchases on products that they like (Mandha et al., 2022). Overall Liking (OAL) is a fundamental measure in sensory and consumer research used to capture the overall hedonic impression of a product. It reflects how much consumers like or dislike a product as a whole, integrating all sensory perceptions, including appearance, aroma, taste, and texture into a single holistic judgment without focusing on any specific attribute (Lawless and Heymann, 2010). Typically, OAL is measured using a 5-point or 9-point hedonic scale ranging from "dislike extremely" to "like extremely" (Mandha et al., 2022). The simplicity and interpretability of OAL make it one of the most widely used tools for assessing consumer acceptance in both academic research and industry product development. Unlike descriptive sensory methods that require trained panelists, OAL testing is designed for untrained consumer panels, making it particularly suitable for capturing genuine market-representative hedonic responses (Varela and Ares, 2014). The score obtained from OAL testing reflects the consumer's spontaneous and subjective overall impression of the product, which is ultimately the most relevant indicator of commercial viability and potential for repeat purchase behavior (Ares and Varela, 2017).

While OAL captures the consumer's overall impression of a product, it does not provide information about which specific sensory attributes are driving that impression, whether positively or negatively. This is where the Just-About-Right (JAR) scale serves a complementary and diagnostic function. JAR scales ask consumers to evaluate each sensory attribute individually on a bipolar scale, indicating whether a particular attribute, such as sweetness, aroma intensity, or smoothness, is perceived as too little, just about right, or too much (Rothman and Parker, 2009). Unlike OAL, which measures hedonic outcome, JAR measures attribute intensity relative to the consumer's ideal level, providing directional information that OAL alone cannot offer (Meyners and Castura, 2021). In the context of sensory optimization, OAL serves as the dependent variable against which the appropriateness of each sensory attribute measured by JAR can be compared. When combined with JAR data through penalty analysis, OAL helps reveal how deviations in attribute intensity influence overall product liking, information that becomes critical for guiding targeted product reformulation (Sadek and Melyana, 2023). Together, OAL and JAR form an integrated sensory evaluation framework that enables researchers to not only confirm whether a product is accepted, but also to identify precisely which attributes require adjustment and in which direction, making the combination significantly more actionable than either method used in isolation (Varela and Ares, 2014; Gere et al., 2017).

2.4 Penalty Analysis

Penalty Analysis is a statistical approach that integrates JAR and OAL data to quantify how deviations from ideal attribute levels affect overall product liking (Sadek and Melyana, 2023). The core principle of penalty analysis involves comparing the mean Overall Liking (OAL) score of consumers who rated a specific attribute as non-JAR, either "too little" or "too much," against the mean OAL score of consumers who rated the same attribute as "Just About Right." The difference between these two means is referred to as the "mean drop," which represents the average decrease in OAL scores associated with a particular directional deviation from the ideal attribute intensity. A positive mean drop indicates that consumers who perceived the attribute as non-JAR liked the product less than those who found it JAR, representing a true penalty to overall liking. Conversely, a negative mean drop suggests that non-JAR respondents actually rated the product similarly or slightly higher than the JAR group, indicating negligible concern for that attribute (Meyners and Castura, 2021). To ensure statistical reliability, a conventional threshold of 20% is applied, only attributes where more than 20% of respondents select a non-JAR category are entered into significance testing, as smaller subgroups are considered insufficient to produce reliable penalty estimates. The statistical significance of each penalty is then determined through an independent samples t-test at a 95% confidence level ($p < 0.05$), confirming whether the observed mean drop is statistically meaningful rather than a product of sampling variation.

Penalty analysis was selected over other multivariate approaches such as Partial Least Squares (PLS) regression and Response Surface Methodology (RSM) for several reasons. While PLS regression requires larger sample sizes and more complex statistical modeling, and RSM necessitates multiple formulation variants as experimental treatments, penalty analysis is uniquely suited for single-product consumer studies where the goal is to identify attribute-level improvement priorities directly from consumer JAR responses without requiring reformulated samples (Varela and Ares, 2022). Its straightforward interpretation and direct linkage between JAR distributions and OAL scores also make it particularly accessible and replicable for small food businesses such as Likoopi (Meyners and Castura, 2021). Penalty analysis has been applied widely in beverage and food product optimization studies, providing a quantitative foundation for evidence-based product improvement decisions. By identifying not only which attributes deviate from consumer ideals but also quantifying the magnitude of their impact on overall liking, penalty analysis allows researchers to prioritize reformulation efforts toward attributes with the highest penalties (Varela and Ares, 2022). For instance, if sweetness shows a higher mean drop than color, it indicates that sweetness deviations have a greater negative impact on consumer acceptance and should be addressed first in product reformulation. This directional and quantitative nature of penalty analysis makes it significantly more actionable than general hedonic testing alone. Kim et al. (2020) demonstrated its utility in blended tea evaluation, where penalty analysis successfully identified specific attributes requiring adjustment even when overall liking scores appeared acceptable. Similarly, Gere et al. (2017)

applied the method to flavored milk beverages, showing that penalty analysis could reveal attribute-specific improvement priorities across different consumer segments. By identifying which attributes to modify and in which direction, whether to increase or decrease their intensity, penalty analysis minimizes trial-and-error in product development, reduces reformulation costs, and enhances decision-making accuracy (Varela and Ares, 2022). When used in combination with JAR and OAL data, penalty analysis forms a complete and replicable sensory evaluation framework that is particularly valuable for small and medium food businesses seeking to optimize products based on genuine consumer insight rather than internal assumptions.

2.5 Product Optimization in Beverage Industry

In the beverage industry, sensory based optimization has become an essential strategy to ensure that formulations align with consumer preferences. In this industry, consumer preference is primarily driven by sensory attributes such as taste, aroma, color, and mouthfeel. It makes systematic sensory evaluation essential in product development. Several sensory evaluation methods are commonly used in beverage optimization. Previous studies on moringa based beverages and dairy products have relied primarily in hedonic scales to assess consumer acceptance, but were unable to identify which attributes specifically required optimization (Rodringues et al., 2023; Shaukat et al., 2025). More diagnosic approaches include Quantitative Descriptive Analysis (QDA), which profiles attributes intensities using trained panels, and Check-All-That-Apply (CATA), which captures

consumer generated sensory descriptions (Kim et al., 2020). However, neither mothod directly quantifies the impact of individual attributes on over all liking.

The combination of JAR, OAL, and penalty analysis enables product developers to link consumer insight with scientific data, leading to targeted reformulations and improved market performance (Sadek and Melyana, 2023). This approach has been applied to blende teas (Kim et al., 2020), flavored milk beverages (Gere et al., 2017). And black coffee (Ristenpart et al., 2022), demonstrating its broad applicability across beverage categories. In practice, the JAR-OAL methodology begins with Focus Group Discussion (FGD) to identify consumer relevant sensory attributes. Yonathan et al. (2021) demonstrated that FGD effectively identified key sensory parameters for a new beverage product prior to quantitative sensory testing. After FGD, it can be followed with sensory testing using JAR and OAL scales, and also penalty analysis to determine which non JAR attributes agnificantly reduce over all liking (Rothman and Parker, 2009). This data driven approach reduces the uncertainty of product innovation by providing clear, measurable evidence of what drives consumer liking. It also aligns with sustainable production trends. By applying sensory optimization methods, companies can achieve both technical and emotional satisfaction among consumers, ensuring that products are not only functional but also enjoyable.

2.6 Java Green Latte Product

Java Green Latte is a product from Likoopi, an environmentally sustainable value-based cafe in Bandungan, Semarang District. The product uses local *Moringa*

oleifera leaves as its highlight ingredient, alongside milk, sugar, ice, and other complementary ingredients. The production process begins with harvesting fresh kelor leaves, which are then dried and ground into a fine powder. When a customer places an order, the barista blends all ingredients together until a smooth, homogeneous mixture is achieved, resulting in a cold beverage with a distinctive slushie-like texture that sets it apart from conventional latte beverages.

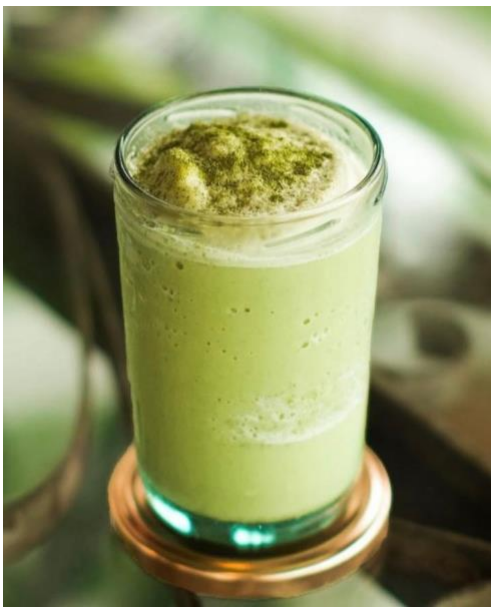

Figure 1. Java Green Latte Product (Primary Data, 2025)

In the context of Java Green Latte, *moringa oleifera* leaves serve as both a functional and sustainable local ingredient. Its local sourcing directly supports smallholder agriculture in Java, reinforcing the product's identity as a sustainable local innovation and contributing to the preservation of local agricultural ecosystems (Shokery et al., 2017). The integration of kelor leaves in sensory optimization research therefore contributes not only to product quality improvement but also to local economic and environmental sustainability, aligning with the growing global demand for products that are both health-promoting and

environmentally responsible (Divya et al., 2024). Likoopi's long-term vision is to establish kelor as a globally recognized flavor, comparable to the international prominence that matcha from Japan has achieved in the premium beverage market (Shokery et al., 2017). The detailed nutritional profile and functional properties of kelor leaves that underpin this potential are discussed further in the following sub-chapter.

2.7 *Moringa Oleifera* Leaves

The moringa tree is referred to by various regional names such as Benzolive, Drumstick Tree, Horseradish, Mulangay, Marango, Sajna, Kelor, Saijihan, and Mlonge (Fahey, 2005 in Peñalver et al., 2022). All parts of the plant including pods, seeds, leaves, and roots are consumed both fresh and cooked, as they constitute a nutritionally complete food with a pleasant flavor (Peñalver et al., 2022). *Moringa oleifera* is popularly referred to as the "Miracle Tree" and "Mother's Best Friend" due to its rich nutrient content (Sachan et al., 2024), and has been used to address several health conditions including kidney stones, anaemia, hypertension, stress, depression, diabetes, and various skin and joint-related ailments (Narina et al., 2019).

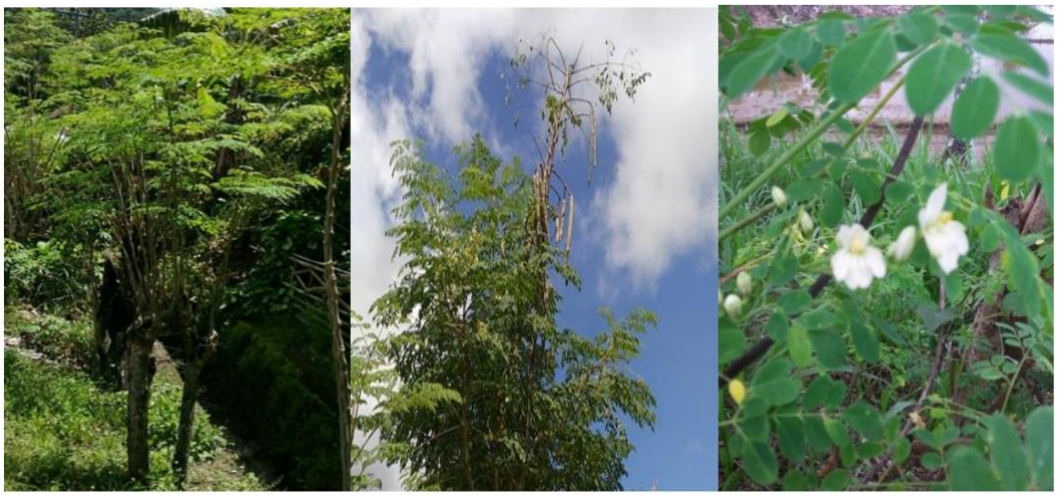

Figure 2. *Moringa Oleifera* (Isnan et al., 2017)

In recent years, moringa has gained significant traction in the global health and wellness market. The global moringa products market has been experiencing rapid growth, driven by increasing consumer demand for plant-based superfoods and functional ingredients (Rockström et al., 2020 in Peñalver et al., 2022). Moringa has been increasingly incorporated into a wide range of commercial products including teas, smoothies, energy drinks, supplements, and dairy-based beverages, particularly in health-conscious markets across Asia, Europe, and North America (Teixeira et al., 2014 in Peñalver et al., 2022). This growing global recognition positions moringa not merely as a traditional medicinal plant but as a commercially viable ingredient with significant potential in modern food and beverage innovation.

Moringa leaves-based beverages are increasingly recognized for their potential as a functional superfood ingredient. The leaves contain high levels of antioxidants, vitamins (A, C, and E), minerals (calcium, potassium, iron), and amino acids (Lalas and Tsaknis, 2019). Notably, fresh, cooked, or dried moringa

leaves stored in powder form for months without refrigeration do not lose their nutritional content, making them highly suitable for food and beverage processing (Sachan et al., 2024). The dried *Moringa oleifera* powder also has a milder flavor and less bitter taste compared to fresh leaves, which is advantageous for beverage formulation (Sachan et al., 2024). In comparison to common dietary products such as oranges, carrots, milk, bananas, yogurt, and spinach, moringa leaves have been found to contain higher proportions of vitamins A and C, calcium, potassium, iron, and protein (Anwar et al., 2007 in Sachan et al., 2024). The addition of moringa leaves to various food products such as bread, cookies, cereal porridge, cake, yogurt, and cheese has also been shown to enhance both sensory qualities and shelf life, thereby increasing consumer satisfaction (Moyo et al., 2010 in Sachan et al., 2024).

From a sensory perspective, moringa leaves possess a distinctive profile that distinguishes them from other plant-based ingredients while simultaneously sharing certain characteristics with green tea. The appearance of moringa leaf powder is characterized by a natural, vivid green color derived from its high chlorophyll content, which gives moringa-based products their visually appealing green hue (Martins et al., 2017). In terms of aroma, moringa leaves carry a mild, earthy, and slightly herbaceous scent with subtle green-note volatile compounds, which become more pronounced when the leaves are dried and powdered (Teixeira et al., 2017). The taste profile of moringa is complex, it presents a combination of mild bitterness, slight earthiness, and a characteristic peppery sensation that is felt particularly at the back of the throat, attributed to the presence of isothiocyanates

and glucosinolates in the leaves (Fahey, 2005 in Peñalver et al., 2022). A notable astringency is also present, resulting from the polyphenolic compounds and tannins that interact with salivary proteins upon consumption, producing a drying and slightly puckering sensation in the mouth (Soares et al., 2017).

In terms of texture, when processed into powder form and incorporated into beverages, moringa can contribute a slightly grainy mouthfeel if not adequately homogenized, due to residual leaf particles from the minimal processing approach (Teixeira et al., 2017). These sensory characteristics, green color, earthy and leafy aroma, mild bitterness, astringency, and characteristic peppery aftertaste, make moringa leaves notably similar to green tea and matcha in their sensory profile, making them particularly suitable as a base ingredient for latte-style beverages and positioning them as a promising local alternative to matcha (Shokery et al., 2017). Given these nutritional, functional, and sensory characteristics, kelor leaves present a strong scientific and commercial foundation for developing Java Green Latte as a locally sourced, health-oriented beverage that can compete with established green tea and matcha-based products in both domestic and global markets.

CHAPTER III

MATERIALS AND METHODS

This research took 10 months. In September – November 2025, the sensory data was being collected at Likoopi coffee shop, Bandungan, Semarang. In May 2026, the physiochemical data was being collected at the KGP and RPHP Food Technology Laboratory, Diponegoro University.

3.1 Research Materials

The material used in this research is questioner form (google form), Java Green Latte product, and palate cleanser (water) for the main data (sensory data). One portion Java Green Latte (250 ml) itself has a few ingredients: kelor leaves (1.5 gram); creamer (9 gram); vanilla syrup (10 ml); sweet condensed milk (20 ml); ultra high temperature milk (120 ml); vanilla ice cream (50 gram); ice cube (50 gram). All these ingredients will be blended together using blender until it mixes perfectly. This research also used colorimeter, pH meter digital, viscometer oswald, refractometer for physiochemical data (color, pH, viscosity, TDS) as a standardization of the Java Geen Latte optimal formulation based on the sensory data.

3.2 Research Methods

The research method used consists of preparation, Focus Group Discussion (FGD), sensory testing with JAR and OAL scale, data analysis with penalty analysis

and validation process if needed, physicochemical testing, discussion and conclusion. FGD was chosen over Check-All-That-Apply (CATA) because CATA can generate inconsistent and overly broad descriptors from panelists unfamiliar with the product or its ingredients, whereas FGD facilitates structured discussion among participants with relevant product and ingredient knowledge, producing more precise and representative sensory attributes particularly important given that moringa leaves require a degree of familiarity to accurately describe their sensory characteristics.

3.3 Experimental Design

This study was designed to consist of two main experimental stages. In the first stage, consumer untrained panelists evaluate Java Green Latte sample using JAR, and OAL scale in sensory testing with the list of attributes from FGD result. The results of this sensory test will be analyzed through penalty analysis to identify key sensory attributes that need to be optimized. If there are any attributes of the product that need to be optimized, there will be a second stage as a validation process. Reformulation and a second sensory test using JAR and OAL scale will be held to assess improvements in consumer acceptance in this second stage. But if there are no attributes of the product that need to be optimized, there will be no second stage. This experiment has a hypothesis:

H_0: There is no attribute in the Java Green Latte that needs to be optimized.

H_1: At least there is an attribute in Java Green Latte that needs to be optimized and has been proven from the validation process.

3.4 Research Procedure

This research must through a few steps: planning and early discussion, literature review, FGD, JAR and OAL sensory testing, data analysis, and validation process including the standardization with physiochemistry test.

3.4.1 Planning and Early Discussion

The research begins with comprehensive planning that includes early discussions with Likoopi as a stakeholder to understand the current Java Green Latte formulation, production processes, and existing consumer feedback. This phase involves defining research scopes and objectives, establishing timelines, identifying resource requirements, and obtaining approval from them.

3.4.2 Literature Review and Product Knowledge Development

A thorough literature review being conducted focusing on JAR-OAL methodology applications in milk-based products, common sensory test, and penalty analysis techniques, kelor (moringa) as functional ingredient, and the attributes of similar products since the author have not found the previous research that discussed milk with moringa oleifera drink sensory attributes.

3.4.3 Focus Group Discussion (FGD) for Sensory Attributes Identification

A Focus Group Discussion (FGD) was conducted with 10 participants who were familiar with the research objective and had previous experience consuming

moringa-based products. The purpose of the FGD was not to evaluate consumer acceptance, but to qualitatively identify the key sensory attributes of Java Green Latte that were most relevant to consumers. Unlike the subsequent JAR and OAL sensory evaluation, which required a larger sample to quantitatively assess consumer perception and preference, the FGD was designed to generate rich, in-depth discussions and reach consensus on the sensory characteristics to be included in the questionnaire. A group of 6–12 participants is commonly considered sufficient for obtaining diverse opinions while maintaining effective interaction and discussion in qualitative sensory research (Krueger and Casey, 2015). Therefore, ten participants were considered adequate to identify the principal sensory attributes that were subsequently evaluated in the consumer sensory test. The FGD was being divided into four stages: introduction, rapport, in depth and closure.

3.4.4 JAR-OAL Sensory Testing

The main sensory evaluation phase involves conducting JAR-OAL testing with 54 untrained panelists which is the comsumer of Java Green Latte using the attributes identified from FGD. The panelists were being asked to fulfill the online form of sensory test consisting of Just-About-Right (JAR) and Over-All-Liking (OAL) scale based questions regarding the java green latte product. The amounts of JAR questions were adjusted according to the key attributes identified through the FGD. For JAR question there will be 5 non binominal scales consisting of (less, slightly less, just about right, slightly too much, and too much). OAL question were asking the panelists from 1 to 5, how much do they like the product.

3.4.5 Data Analysis

Sensory data were analyzed using XLSTAT 2019 for Windows software. Penalty analysis was conducted using the JAR data analyzer feature in XLSTAT, which evaluates the overall penalty of each sensory attribute by aggregating non-JAR responses and comparing their mean OAL scores against the JAR group. Statisticak significance was determined using a two-tailed independent amples t-test at a 95% confidence level, where an attribute was considered to require optimization if $p<0.05$. A population size threshold of 20% was applied, meaning only attributes where the proportion of non JAR respondents exceeded 20% or the total panelist were entered into significance testing. Results are presented through OAL and JAR distribution graphs, a penalty analysis table, and a mean drop plot. the physiochemistry data will be held to complement the understanding of the relationship between products and consumer preferences as described by sensory data in the shape of standardization.

3.4.6 Validation Process (Product Reformulation and Second Sensory Test)

The validation process stated that the formulation of the product being tested in first stage sensory testing was optional based on the results of the penalty analysis. Product reformulation will not be carried out since there was no attribute in Java Green Latte that needs to be significantly optimized. Nevertheless, if a second stage had been conducted, the product, java green latte would have been reformulated and evaluated again through a sensory test using the same design as the first sensory testing to evaluate the effectiveness of the intervention.

3.4.7 Physicochemical Test for Standardization

Physicochemical testing was conducted as a standardization step following the sensory evaluation. Four physicochemical parameters were measured: color (L*, a*, b*) using a colorimeter, pH using a digital pH meter, Total Dissolved Solids (TDS) using a refractometer, and viscosity using an Ostwald viscometer, each with five repetitions. These measurements serve as objective, quantifiable production standards that correspond to the consumer-preferred sensory levels identified in the JAR testing, enabling Likoopi to maintain batch-to-batch consistency without relying solely on periodic sensory evaluation