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Formulation and Evaluation of a Guava (*Psidium guajava)* Leaf Extract-Based Dishwashing Liquid

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Abstract

Maintaining sanitary food-contact surfaces is vital for public health, yet many commercial detergents rely on synthetic chemicals that may cause skin irritation and leave unwanted residues. This study explores guava (*Psidium guajava*) leaf extract as a natural, bio-based alternative to traditional agents in a dishwashing liquid formulation. Using the natural compounds found in guava leaves, this formulation provides a bio-based alternative for dishwashing that ensures both high cleaning performance and ensuring the product is non-irritating and safe for frequent skin contact. Specifically, this study evaluates the guava leaf extract–based dishwashing liquid in terms of its aroma, texture, and color, along with a detailed assessment of its odor and overall user preference.

Additionally, the formulation was analyzed based on its post-wash skin feel to ensure that the natural extract effectively prevents dryness while maintaining strong cleaning performance. Selected respondents and experts were engaged to evaluate the product's physical attributes and performance. A developmental research design was employed in the formulation of the dishwashing liquid. Fresh guava leaves were collected, processed, and extracted using ethanol. The extract was combined with selected ingredients to produce the dishwashing liquid. Several formulations were prepared and subjected to sensory evaluation. Selected users served as respondents in assessing the product's aroma, texture, and color, while experts evaluated the formulation based on post-wash skin feel, odor quality, and overall preference. Data were gathered using structured questionnaires and evaluation forms and were analyzed using descriptive statistical tools such as weighted mean and rank.

The results revealed that users generally strongly agreed on the description of the product's aroma, texture, and color, indicating that the dishwashing liquid was pleasant, smooth, and visually appealing. Expert evaluators also provided positive assessments, particularly in terms of post-wash skin feel, confirming that the formulation was gentle and non-irritating. The product odor assessment and overall preference likewise received favorable ratings, suggesting that the product is suitable for daily household use.

However, experts recommended further improvements in fragrance and color intensity to enhance market appeal. The study confirms that guava leaf extract is effective in producing a safe and user-acceptable dishwashing liquid, and future research should focus on improving its fragrance, color, stability, and market potential.

Keywords: Dishwashing Liquid, Eco-friendly Cleaning Agent, Guava Leaf-Extract, Sensory Evaluation

1. Introduction

Research in Science, Technology, Engineering, and Mathematics (STEM) is increasingly recognized as a global priority. The widespread use of chemical-based cleaning products posed risks to both human health and the environment. Within the Philippine environment, many communities still depended on commercial dishwashing liquids that contained synthetic chemicals, which could harm aquatic ecosystems and pose potential health risks with prolonged use. Central Aurora, particularly Maria Aurora, encountered challenges because many households continued to use chemical-based dishwashing liquids, often unaware of their potential impact.

Similarly, students and staff at Maria Aurora National High School (MANHS) frequently used store-bought synthetic dishwashing liquids, often without knowing about their potential health risks and environmental damage. This practice ran counter to the growing global trend toward eco-friendly cleaning products, a market that had expanded significantly since 2018 due to increased consumer demand for non-toxic, biodegradable options. Research had consistently shown that natural alternatives, such as those made from guava leaf extracts, were highly effective. For example, studies by Biswas et al. (2018) and Gutierrez-Montiel et al. (2024) confirmed that guava leaves contained powerful phytochemicals like tannins and flavonoids that had strong antibacterial properties against a variety of bacteria, including drug-resistant strains. Additionally, recent research from Fajriyah et al. (2023) and Baluarte et al. (2024) successfully demonstrated that liquid soap formulations using these extracts were physically stable and highly effective against common pathogens like Staphylococcus aureus and Escherichia coli, making them a promising natural alternative to synthetic products. The present study was conducted to address the overreliance on synthetic dishwashing products at MANHS and to explore a viable, natural alternative. Additionally, this study also relied on literature-based efficacy of the guava leaf extract-based dishwashing liquid.

By formulating and evaluating biodegradable dishwashing liquid made from guava leaf extracts, the researchers aimed to provide a safer, more sustainable solution for the school community. This research sought to demonstrate that a natural, plant-based alternative could be just as effective as commercial synthetic products, offering a practical way to mitigate health and environmental concerns while aligning with the global movement toward eco-friendly consumer goods.

2. Literature Review

The literature strongly supports the efficacy of *Psidium guajava* (guava) leaf extracts, particularly against Gram-positive bacteria such as Staphylococcus aureus and Bacillus species. Studies show that methanol and ethanol extracts of guava leaves exhibit inhibitory effects against Gram-positive bacteria, while Gram-negative bacteria tend to be more resistant to these extracts. The antibacterial activity is largely attributed to the phytochemicals present in the leaves — notably flavonoids, tannins, terpenoids, glycosides, and saponins.

These compounds exert their effects through mechanisms such as disruption of bacterial cell membranes, inhibition of bacterial enzymes, and interference with metabolic processes like oxidative phosphorylation. Moreover, research highlights the guava leaf extract's potential to inhibit and disrupt biofilm formation, which is significant since biofilms contribute to persistent microbial contamination on surfaces. The antibacterial properties of guava leaf extracts have been confirmed by various extraction methods, with ethanol and methanol solvents showing superior efficacy in isolating the active antimicrobial compounds.

Additionally, aqueous extracts have demonstrated antimicrobial activity with potential for combating resistant strains of Gram-positive bacteria, emphasizing the therapeutic versatility of guava leaves. In summary, the scientific evidence validates the use of guava leaf extract as a natural antibacterial agent, supporting its application in formulations like dishwashing liquids designed to reduce microbial contamination on household items. The broad-spectrum antibacterial properties combined with biofilm

inhibition justify its role as the key active ingredient in such products, aligning with the goal of creating natural, effective antimicrobial cleaning solutions based on established phytochemical properties and documented efficacy of *Psidium guajava* leaf extracts

This section will establish the scientific foundation for the study by exploring existing literature on the antibacterial and phytochemical properties of *Psidium guajava* leaves. The antimicrobial efficacy of guava leaf extracts has been widely documented, with numerous studies confirming its broad-spectrum activity against a range of Gram-positive and Gram-negative bacteria (Metwaly et al., 2019; Almeida et al., 2020). The literature suggests that this activity is primarily attributed to the presence of key phytochemicals, such as flavonoids, tannins, and terpenoids. which work through various mechanisms, including the disruption of bacterial cell membranes and the inhibition of enzyme activity (Sharma et al., 2021).

Furthermore, recent research highlights the extract's potential to inhibit and disrupt the formation of biofilms, which are a major source of microbial contamination on household surfaces (Bhattacharyya et al., 2021). This review will synthesize these findings to validate the use of guava leaf extract as the primary antibacterial agent in the proposed dishwashing liquid formulation.

2.1. Formulation and Evaluation of Natural Liquid Detergents

The development of a natural dishwashing liquid involves a comprehensive understanding of the challenges associated with plant-based formulations. This review delves into the literature on selecting eco-friendly and biodegradable surfactants, which are crucial for the product's cleaning performance and environmental profile. Research shows that natural surfactants, often derived from renewable resources like plants and microorganisms, are a viable, less toxic alternative to petrochemical-based ones (Sallam et al., 2024). They possess comparable properties, including emulsifying and foaming capacity, while offering the added benefits of biodegradability and reduced environmental toxicity (Kanyama et al., 2025).

The review also examines the use of natural thickeners and stabilizing agents, such as xanthan gum and guar gum, which are essential for achieving the desired viscosity and preventing physical separation over time (Gómez et al., 2019; Lopez & Gonzalez, 2020). These agents ensure the product has a stable, gel-like consistency that consumers associate with quality and effectiveness.

A crucial aspect of formulation is addressing long-term stability and shelf-life, which necessitates a complete natural preservative system to inhibit microbial growth (Davies & Hughes, 2018). Studies highlight the use of plant extracts and organic acids as effective natural preservatives, aligning with consumer demand for "clean label" products (Zou et al., 2025).

2.2. Product Safety, Consumer Acceptance, and Marketability beyond its technical efficacy, a new household product's success hinges on its safety and market viability.

This section reviews the literature on the dermal safety and cytotoxicity of plant extracts to ensure the final product is safe for human use (Singh et al., 2021; Kim et al., 2022). Research confirms that many plant-derived materials are generally well-tolerated and less likely to cause irritation or allergic reactions compared to their synthetic counterparts (Akita et al., 2025). The review also explores consumer attitudes toward natural and eco-friendly cleaning products, focusing on the attributes that most influence purchasing decisions, such as efficacy, safety, and scent (Lim & Tan, 2021).

The strategic importance of sensory attributes is also considered, as the natural color and aroma of the guava extract can significantly enhance consumer appeal (Luo & Wang, 2019). Studies indicate that consumers are increasingly willing to pay a premium for products with sustainable attributes and transparent ingredient lists (Smith & Johnson, 2021; Zhang et al., 2025). The review further discusses the role of effective marketing

and packaging in communicating the product's unique selling points and addressing the "green gap"—the disconnect between consumers' stated intentions to buy green products and their actual purchase behavior (Duong, 2022).

2.3. Aroma of dishwashing liquid.

The final product's aroma must be pleasant and non-irritating, distinguishing it from conventional synthetic cleaners. Initially, the formulation may carry a mild, distinctively earthy or herbaceous scent naturally imparted by the guava leaf extract itself (Lee, 2024). To enhance consumer appeal, a natural essential oil (such as lemon, orange, or peppermint) may be incorporated to deliver a desirable, fresh scent profile (Chen & Wang, 2023) while complementing the product's natural origins. The goal is to ensure the product is free of harsh chemical odors and the essential oil concentration must be carefully controlled to be subtle and not overpowered (Rodriguez, 2022). Crucially, the scent must remain stable throughout the product's intended shelf life and not cause any sensory irritation upon use (Miller et al., 2024). The natural aroma should serve as a key marketing differentiator, emphasizing its plant-based composition (Almeida, 2023). Furthermore, the scent should not transfer to the washed dishes, ensuring a clean, neutral finish (Patel & Singh, 2024). Finally, the aroma may change slightly upon dilution with water, which needs to be monitored during use testing (Thompson, 2022).

2.4. Texture of dishwashing liquid.

The texture (viscosity) of the liquid is crucial, as consumers often associate a thicker, more viscous product with higher concentration and better cleaning power (Nantong Reform Petro-chemical Co., 2025). A gel-like consistency, achieved using natural thickeners like xanthan gum or guar gum, is ideal for both dispensing and perceived quality. The texture of the dishwashing liquid is critical for consumer acceptance and functional performance (Garcia, 2023). The product should be formulated to have a medium-to-high viscosity, allowing it to be easily dispensed and adhere effectively to the sponge or cleaning utensil (Jackson & Khan, 2024). This required thickness is typically achieved through the addition of natural thickeners (like xanthan gum or cellulose derivatives) which must be compatible with the guava extract and other components (Kim et al., 2023). The formulation needs to exhibit shear-thinning behavior, meaning it pours easily but holds its shape when resting (Evans, 2022). Furthermore, the texture must allow for the formation of a stable, rich leather upon agitation, as this foaming property is strongly correlated with perceived cleaning power by consumers (Zhou & Li, 2024). The liquid should feel smooth and non-sticky to the hands during washing (Williams, 2023), and the viscosity should remain stable across a range of storage temperatures (Ngo & Tran, 2024). Lastly, the texture must facilitate quick and complete rinsing from dishes without leaving a slimy feel (Martinez, 2022).

2.5. Color of dishwashing liquid.

The color of the dishwashing liquid, a distinct greenish-brown or amber hue from the guava extract, reinforces the product's "all-natural" narrative, eliminating the need for synthetic dyes and serving as a visual cue of authenticity (EPA, 2025). The color of the dishwashing liquid is a direct visual indicator of its natural composition (Silva, 2023). The final color will predominantly be influenced by the concentrated guava leaf extract, resulting in a hue that is typically a pale, translucent yellowish-green, light amber, or brownish tint (Akhtar, 2022). This color should be naturally derived and should not require any synthetic dyes, reinforcing the plant-based claim (Green Tech Institute, 2024). The formulation must undergo extensive color stability testing, demonstrating resistance to fading or darkening when exposed to typical storage conditions, especially light and heat (Ramirez et al., 2023). Any significant color change over time could indicate chemical degradation of the active components (Bauer & Schmidt, 2024). The color should be uniform and consistent across different production batches (Lopez, 2022). The desired aesthetic is a clear, natural appearance, rather than an opaque or artificially bright shade (Wong, 2023). Furthermore, the color should not stain surfaces or

cleaning cloths (Fujita, 2022). The transparency should allow consumers to easily see the volume remaining in the container (Singh, 2024).

2.6. Antibacterial properties of guava leaf extract dishwashing liquid.

Guava leaves contain powerful phytochemicals such as tannins, flavonoids, and triterpenoids which are the key to their antibacterial action. Recent studies have confirmed that guava extracts are highly effective against a broad spectrum of bacteria, including common Gram-positive bacteria like Staphylococcus aureus and Bacillus cereus, as well as some Gram-negative strains like Escherichia coli (Metwaly et al., 2019; Farag et al., 2024). The extracts work by damaging the bacterial cell walls and membranes, inhibiting their growth and multiplication. This positions guava as a promising natural alternative to synthetic antimicrobial agents, especially in the context of growing antibiotic resistance (Almeida et al., 2020).

2.7. Cleaning capabilities of dishwashing liquid.

Beyond its medicinal uses, guava is being increasingly researched for its cleaning and sanitization capabilities. The same compounds that provide antibacterial properties can be used to disinfect surfaces. For example, a simple guava leaf extract has shown effectiveness as a surface disinfectant and an ingredient in natural hand soaps (Bhattacharyya et al., 2021). Research also demonstrates its ability to act as a natural coagulant and remove contaminants like fecal coliforms from water, highlighting its potential as an inexpensive and eco-friendly solution for hygiene and sanitation (Kanyama et al., 2025). The core functional claim relies on the product's potent antibacterial properties derived from the guava leaf extract (Hernandez, 2023). The liquid must demonstrate potent inhibitory effects against a broad spectrum of common household bacteria, including key pathogens like *Staphylococcus aureus* and *Escherichia coli* (Dubois et al., 2024). Efficacy will be rigorously quantified using standard methods, such as measuring the zone of inhibition in an agar diffusion assay compared to a control (Global Microbiology Journal, 2023). The antibacterial activity must be retained even after the liquid.

2.8. Suggestions for improving guava leaf extract dishwashing liquid.

Guava leaf extract optimization, the primary focus must shift to maximizing the quality of the raw leaf material, enhancing extraction efficiency, and ensuring the final compounds are stable. This involves implementing precision agricultural management to encourage the biosynthesis of high-value secondary metabolites like flavonoids and tannins in the leaves, followed by adopting high-efficiency methods such as Ultrasound Assisted Extraction (UAE) to increase the yield and purity of the crude extract while minimizing thermal degradation. the final step involves post-extraction stabilization, typically through microencapsulation techniques using biopolymers to protect the sensitive bioactive compounds from environmental factors (light, heat, oxidation), thereby extending shelf life and improving the extract's suitability for commercial product formulation.

The incorporation of essential oils like carvacrol into these coatings has also been shown to provide an additional antimicrobial barrier, reducing post-harvest losses and making the fruit more marketable (Guo et al., 2024). For maximizing the bioactive compounds in guava leaf extracts, experts are exploring advanced extraction techniques beyond traditional methods. Recent literature highlights the superiority of ultrasound-assisted and microwave-assisted extraction methods, which are faster, more efficient, and can minimize the degradation of heat sensitive compounds (Hadidi et al., 2024). Furthermore, post-extraction techniques such as encapsulation and microemulsion are promising methods that can protect the delicate natural compounds from degradation, ensuring their stability and potency in the final product (Lee et al., 2025). These advanced

methods allow for the development of more effective and reliable natural preservatives and antiseptic products, thus maximizing the value of the raw material.

Antibacterial activity of Psidium guajava leaf extract. A highly relevant study by Manandhar, Luitel, & Dahal (2019) directly supports your product's efficacy by demonstrating the inhibitory activity of guava leaf extract against multidrug-resistant (MDR) Staphylococcus aureus. This finding is crucial because it elevates the value of your natural product beyond simple germ-killing, suggesting its potential effectiveness against difficult-to-treat, antibiotic-resistant strains. Furthermore, the work by Kim & Park (2021) explored the concept of synergy in antimicrobial formulations. Their research suggested that a combination of guava extracts with citrus extracts was more effective against a broader range of microbes. Since your formulation includes a natural fragrance like lemon or calamansi oil, this RRL provides a scientific rationale, indicating that the fragrance may act as an active ingredient that enhances the overall antibacterial performance rather than just serving a sensory role. To maximize the performance of your dishwashing liquid, it is essential to ensure that the extraction process yields the highest possible concentration of active compounds. The research by Vuong, Hirun, et al. (2021) on Psidium guajava is highly instrumental here, as it investigated how different extraction conditions such as time, temperature, and solvent concentration affect the yield of total phenolic compounds and the antioxidant activities in guava leaf extracts. Understanding these variables provides critical scientific guidance for optimizing your Process and Method to achieve maximum potency, thereby strengthening the quality of the raw material used in your product.

In addition, the practical aspects of creating a successful liquid cleaning product are supported by the work of Badon & Carandang (2023). They successfully formulated and tested a guava leaf extract-based hand wash soap, which showed significant antibacterial activity against Staphylococcus aureus. This study offers a direct, functional precedent for the development and evaluation of your own liquid detergent product, providing a valuable comparison model for your formulation, testing procedures (such as the Kirby-Bauer assay), and data interpretation. To reinforce the strong environmental and ethical foundation of your research, the literature by Garcia, Rodriguez, & Perez (2019) is highly relevant. Their study focused on documenting the environmental benefits of using biodegradable surfactants and plant-based extracts in cleaning products. This research directly supports your rationale by providing concrete evidence of the reduced environmental impact, especially concerning aquatic ecosystems, thereby underscoring the necessity and positive social contribution of your eco-friendly, guava-based dishwashing liquid.

For the antibacterial results to be scientifically robust and repeatable, the extract must be standardized. Kumar, Sharma, & Singh (2018) emphasized the importance of standardizing herbal extracts based on their phytochemical content and biological activity. This research underscores the need for precise analytical methods, beyond just concentration percentages, to ensure batch-to-batch consistency in the active components (e.g., flavonoids and tannins) of your guava extract. Furthermore, Patel, Jain, & Gupta (2019) investigated the effect of pH on the antimicrobial activity of various plant extracts. Since the pH of a liquid soap formulation significantly affects its stability, foaming, and skin compatibility, this provides essential technical knowledge for fine-tuning the final product to maximize both the extract's antibacterial performance and the product's overall quality.

The reviewed literature consistently demonstrates that *Psidium guajava* (guava) leaf extract possesses strong antibacterial activity, particularly against Gram-positive bacteria, due to its rich phytochemical content such as flavonoids, tannins, terpenoids, and saponins that disrupt bacterial cells and metabolic processes. Studies further indicate that ethanol, methanol, and even aqueous extracts effectively inhibit bacterial growth and biofilm formation, which are major contributors to surface contamination. These findings collectively support the formulation of a guava leaf extract-based dishwashing liquid, as the extract provides a natural,

effective, and sustainable antibacterial agent capable of reducing microbial contamination on household utensils.

3. Conceptual Framework

The study aimed to develop and evaluate a dishwashing liquid utilizing guava leaf extract. The Input section listed the required starting materials, including the Guava leaf extract, other standard dishwashing ingredients, necessary extraction and formulation. The Process and Method outlined the steps, which started with preparing the guava leaves and extracting their compounds, followed by the actual formulation of the dishwashing liquid. This formulated product was then rigorously evaluated for key performance indicators. Finally, the Output included the finished Guava leaf extract-based dishwashing liquid and evaluation data on performance and safety.

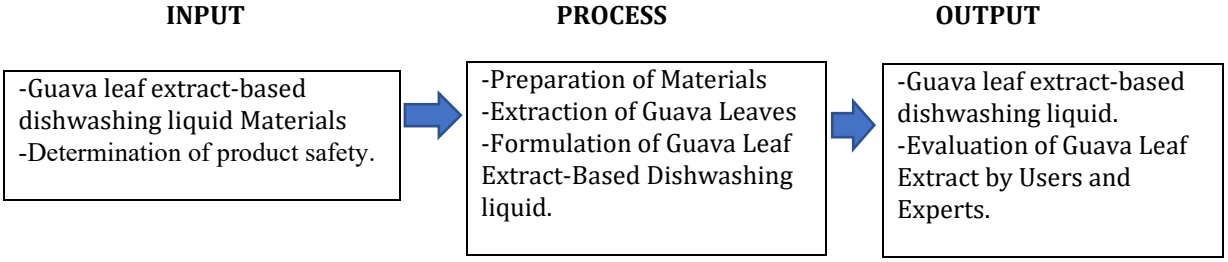


Figure 1. *Conceptual framework of the study.*

4. Statement of the Problem

This study formulated and evaluated a new, environmentally friendly dishwashing liquid based on guava leaf extract. The primary focus was to create a safe, effective, and sustainable plant-based alternative to synthetic cleaning products. Specifically, this study aimed to address the following research questions.

1. How may the guava leaf extract-based dishwashing liquid be described by users in terms of:
   1.1 aroma;
   1.2 texture; and
   1.3 color?
2. How may the Guava Leaf extract-based dishwashing liquid be evaluated by the experts in terms of:
   3.1 post-wash skin feel;
   3.2 product odor assessment; and
   3.3 overall preference?
3. what are the suggestions of the experts in improving the quality of guava leaf extract-based dishwashing liquid?

5. Methods and Procedures

This section presents research design, material and procedure, data collection, data analysis and ethical consideration.

4.1. Research Design

This study employed a developmental research design in formulating the guava (*Psidium guajava*) leaf extract-based dishwashing liquid. Developmental research design is characterized by an iterative process of

design, development, and evaluation (Richey & Klein, 2021).

To facilitate the data collection process, a survey design was integrated into the methodology. A survey design is a non-experimental, quantitative technique used to gather information from a specific group of people through standardized instruments (Ponto, 2015; Slater & Hasson, 2024). In this study, a structured survey questionnaire served as the primary tool to collect responses regarding the product's aroma, texture, and color (Ranganathan & Caduff, 2023). By utilizing this design, the researchers can transform individual perceptions into organized data, allowing for a comprehensive description of how the participants and experts perceive the guava-based formulation (Goodfellow, 2023).

5.1. Materials and Procedures

The materials that the researchers used included freshly harvested mature guava leaves, which they collected from healthy, pesticide-free trees to ensure the purity of the extract. Distilled water was used throughout the extraction and formulation to prevent contamination. Researchers used 95% ethanol as the solvent for the extraction process. Additional ingredients included a surfactant (sodium lauryl sulfate) for effective cleansing, Foam booster (CDEA), Degreaser (LABSA), Thickener (Industrial salt), Edta to soften build-up on dishes, a small amount of natural fragrance (such as lemon or calamansi oil) to improve the scent, and instead of glycerin, aloe vera for a moisturizing effect.

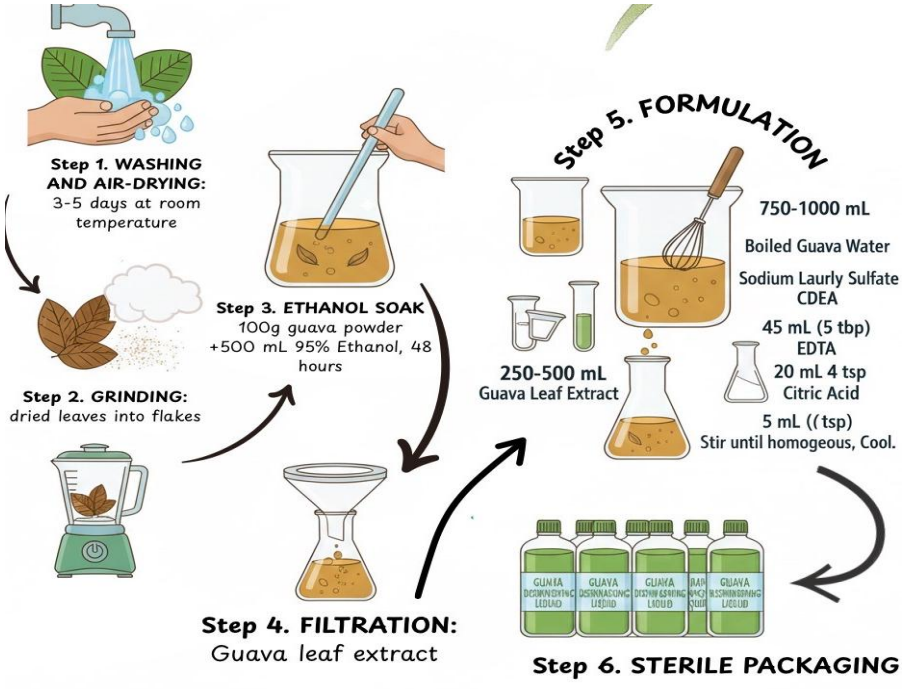


Figure 2. Materials and Procedures

The process began by thoroughly washing fresh guava leaves with running tap water. The cleaned leaves were then air-dried at room temperature for three to five days until they were completely dehydrated. After drying, the leaves were ground into a fine powder using a sterile blender. The researchers soaked approximately 100 grams of the powdered guava leaves in 500 mL of 95% ethanol for 48 hours, stirring

occasionally to enhance solvent penetration. After soaking, the mixture was filtered using filter paper to obtain the guava leaf extract.

To formulate the dishwashing liquid, 750 mL of boiled guava was prepared, and then 8 tablespoons/120 mL (measuring spoon) of sodium lauryl sulfate and 5 tablespoons/45 mL of CDEA were slowly added until fully dissolved. 4 teaspoons/20 mL (measuring spoon) of Edta was then added. Next, 250 mL (measuring cup) of the guava leaf extract and 1 teaspoon/5 mL (measuring spoon) of citric acid were added. The researchers continued stirring the mixture until it became homogenous, then allowed it to cool at room temperature before transferring it into sterile containers.

5.2. Sample and Sampling Methods

The samples of the study were strategically categorized into two distinct groups to ensure a balanced and credible evaluation of the product. The first group consisted of fifty (50) users from the Maria Aurora National High School community, including students and staff, who represent the daily consumers of dishwashing products. The second group was composed of ten (10) technical experts qualified to assess the product's professional standards, such as its aroma, texture and color. These samples provided the necessary data to describe the product's performance from both a consumer and a professional perspective.

The researchers utilized purposive sampling as the primary method for selecting the participants. Purposive sampling is a non-probability sampling technique where respondents are selected based on specific characteristics, criteria, or expertise that are relevant to the research objectives. This method was essential for the study because it ensured that the "users" selected were individuals who regularly handle household cleaning agents, and the "experts" were those with the professional background necessary to evaluate chemical formulation. Through this sampling technique, the researchers guaranteed that the feedback gathered was informed and reliable, focusing on the specific goals of describing the quality of the guava leaf extract-based dishwashing liquid. According to Creswell and Creswell (2018), it involves the intentional selection of participants who are best positioned to provide information that addresses the research objectives, such as choosing technical experts and regular household users for a specialized product evaluation.

5.3. Data Analysis

To answer the first statement of the problem, the guava leaf extract was described through sensory evaluation, in which selected evaluators assessed its aroma, texture, and color through direct observation. The aroma was examined using descriptive smelling, the texture was evaluated by observing and feeling the extract's consistency, and the color was determined through visual inspection using commonly used descriptive terms.

Table 1. *Response mode for evaluating the aroma of the guava leaf extract-based dishwashing liquid.*

Scale	Verbal Description	Verbal Interpretation
3.26 - 4.00	Strongly Agree	Extremely pleasant; strong, fresh natural guava scent with no chemical odor.
2.51 - 3.25	Agree	Pleasant and recognizable guava scent; minimal underlying chemical smell.
1.76 - 2.50	Slightly Agree	Faint or weak guava scent; slightly overpowered by base ingredients.
1.00 – 1.75	Disagree	Unpleasant or medicinal smell; no detectable guava aroma.

The scoring system is anchored by the highest range, 3.26 – 4.00 (Strongly Agree), which represents a "gold standard" formulation where the natural botanical essence of the guava leaf is dominant, masking the

synthetic scent of the surfactant base. Achieving a score in this range suggests that the extraction process successfully preserved the volatile aromatic compounds of the leaves.

As the mean score decreases into the Agree (2.51 – 3.25) and Slightly Agree (1.76 – 2.50) categories, the "sensory clarity" of the product diminishes. In these ranges, the guava scent becomes secondary or faint, indicating either a low concentration of the extract or a formulation where the chemical odors of the cleaning agents (such as SLS or SLES) are too pungent. Finally, the Disagree (1.00 – 1.75) range indicates a sensory failure, where the product lacks any characteristic guava aroma or, worse, has developed a medicinal or "off" smell, which often occurs if the organic plant matter begins to oxidize or degrade within the solution.

Table 2. *Response mode for evaluating the texture of the guava leaf extract-based dishwashing liquid.*

Scale	Verbal Description	Verbal Interpretation
3.26 - 4.00	Strongly Agree	Ideal thickness: very smooth, produces rich lather, and feels gentle on skin.
2.51 - 3.25	Agree	Good consistency; easy to pour and creates sufficient bubbles.
1.76 - 2.50	Slightly Agree	A bit too watery or overly "slimy"; inconsistent lathering.
1.00 – 1.75	Disagree	Very thin/watery or unpleasantly sticky; harsh on the skin.

The evaluation of the dishwashing liquid's texture is categorized into four distinct levels of quality based on tactile performance and user experience. At the highest tier (3.26 – 4.00), the product is interpreted as having an "ideal thickness," characterized by a smooth application, rich lathering capabilities, and a skin-friendly feel, which are the hallmarks of a high-quality surfactant blend. As the mean score moves into the 2.51 – 3.25 range, the texture is still considered favorable, possessing a "good consistency" that is practical for daily use and produces sufficient bubbles, even if it lacks the premium "richness" of the top tier.

Table 3. *Response mode for evaluating the color of the guava leaf extract-based dishwashing liquid.*

Scale	Verbal Description	Verbal Interpretation
3.26 - 4.00	Strongly Agree	Clear, consistent, and appealing natural hue; no sediment or separation.
2.51 - 3.25	Agree	Consistent color throughout; looks professional and stable.
1.76 - 2.50	Slightly Agree	Slightly cloudy or uneven color; minor visible particles.
1.00 – 1.75	Disagree	Unappealing or murky color; significant separation or sediment.

The evaluation of the color of the guava leaf extract-based dishwashing liquid is structured around a four-point mean distribution that correlates visual aesthetics with product stability. A mean score between 3.26 and 4.00 (Strongly Agree) signifies an ideal formulation where the liquid exhibits a clear, appealing natural hue and remains free of any sediment or phase separation. Scores falling within the 2.51 to 3.25 (Agree) range indicate a professionally stable product with consistent coloring, though perhaps lacking the "premium" clarity of the highest tier. Conversely, a score of 1.76 to 2.50 (Slightly Agree) points to minor technical flaws, such as cloudiness or the presence of suspended particles, which may suggest a need for better filtration. The lowest bracket, 1.00 to 1.75 (Disagree), represents a failure in visual quality, characterized by a murky appearance or significant separation, which typically indicates that the guava extract has not been properly emulsified or that the plant material is degrading.

To address the second problem, the experts evaluated the guava leaf extract-based dishwashing liquid in terms of post-wash skin feel, product odor and overall preference. Below shows the response for experts' evaluation.

Table 4. *Response mode for evaluating the post-wash feel of the guava leaf extract-based dishwashing liquid.*

Scale	Verbal Description	Verbal Interpretation
3.26 - 4.00	Strongly Agree	Hands feel exceptionally soft and hydrated; zero dryness or irritation.
2.51 - 3.25	Agree	Hands feel clean and normal; no noticeable tightness or itching.
1.76 - 2.50	Slightly Agree	Hands feel slightly dry or "stiff" after use; requires some rinsing.
1.00 – 1.75	Disagree	Hands feel very dry, itchy, or "slimy" (residue left on skin).

The evaluation of the post-wash feels for the guava leaf extract-based dishwashing liquid, as detailed in Table 4, serves as a primary measure of the product's dermatological impact and user comfort. A mean score within the 3.26 to 4.00 (Strongly Agree) range indicates a superior formulation that goes beyond mere cleaning to provide skin-conditioning benefits, leaving hands feeling exceptionally hydrated without irritation. Scores between 2.51 and 3.25 (Agree) reflect a standard, successful performance where the product effectively cleans while maintaining the skin's natural balance, resulting in a "normal" tactile sensation free of itching. In contrast, a result in the 1.76 to 2.50 (Slightly Agree) bracket suggests a slight imbalance in the surfactant-to-extract ratio, causing minor dryness or a "stiff" sensation that necessitates additional rinsing. Finally, a score of 1.00 to 1.75 (Disagree) indicates a significant failure in the formulation, where the product leaves the skin feeling unpleasantly dry, itchy, or coated in a slimy residue, suggesting that the concentration of guava extract or the base cleaning agents may be too harsh for regular use.

Table 5. *Response mode for evaluating the odor assessment of the guava leaf extract-based dishwashing liquid.*

Scale	Verbal Description	Verbal Interpretation
3.26 - 4.00	Strongly Agree	Leaves a fresh, clean scent on dishes with no greasy or "fishy" residue.
2.51 - 3.25	Agree	Dishes smell neutral and clean; any food odors are effectively neutralized.
1.76 - 2.50	Slightly Agree	Faint food odors remain, or the guava scent is too overwhelming on the plates.
1.00 – 1.75	Disagree	Unpleasant smell remains on dishes; failed to neutralize food odors.

The evaluation of the odor assessment for the guava leaf extract-based dishwashing liquid, as detailed in Table 5, measures the product's deodorizing efficacy through a four-point statistical distribution. A mean score between 3.26 and 4.00 (Strongly Agree) indicates a superior performance where the extract effectively eliminates organic odors, leaving the dishes with a fresh, clean scent and no oily or "fishy" lingering smells. In the 2.51 to 3.25 (Agree) range, the product is considered successful in neutralizing food odors, resulting in a neutral and acceptable cleanliness. Conversely, a score of 1.76 to 2.50 (Slightly Agree) suggests a lack of balance, where either faint food smells persist or the botanical guava scent remains too intensely on the dishware, which could interfere with food taste. The lowest tier, 1.00 to 1.75 (Disagree), identifies a failure in the formulation's functional purpose, as it fails to neutralize odors and leaves behind an unpleasant smell, indicating that the deodorizing properties of the guava extract were insufficient in the current concentration.

Table 6. *Response mode for evaluating the overall preference for the guava leaf extract-based dishwashing liquid.*

Scale	Verbal Description	Verbal Interpretation
3.26 - 4.00	Strongly Agree	Would switch to this product over commercial brands.
2.51 - 3.25	Agree	Would likely use this product as a regular alternative.
1.76 - 2.50	Slightly Agree	Might use this occasionally but prefers current brands.
1.00 – 1.75	Disagree	Would not use this product again or recommend it.

The evaluation of overall preference for the guava leaf extract-based dishwashing liquid, as detailed in Table 6, provides a comprehensive look at the product's market potential and user satisfaction through a weighted mean distribution. A score between 3.26 and 4.00 (Strongly Agree) represents the highest level of consumer acceptance, indicating that the natural formulation is so effective that users would prioritize it over established commercial brands. Mean scores within the 2.51 to 3.25 (Agree) range suggest a high degree of viability, with participants viewing the dishwashing liquid as a reliable and regular alternative to their current products. In contrast, a score from 1.76 to 2.50 (Slightly Agree) reflects a hesitant acceptance; while the product is functional, users still harbor a preference for commercial competitors, likely due to specific sensory or performance gaps. Finally, a mean of 1.00 to 1.75 (Disagree) indicates a lack of consumer confidence, where the product fails to meet basic expectations, resulting in a refusal to reuse or recommend the liquid.

For the third statement of the problem, expert suggestions for improving the quality of the guava-based dishwashing liquid were collected through expert interviews and evaluation forms. Professionals in relevant fields were asked to assess the product's formulation, cleaning performance, and their feedback was documented to identify areas for improvement.

5.4. Ethical Considerations

In conducting the study on the "Formulation and evaluation of a Guava (Psidium guajava) Leaf Extract-Based Dishwashing Liquid", the researchers ensured that ethical standards were carefully observed. The foremost concern of the study is the principle of safety and non-toxicity. The formulation was designed to be safe for human use while also promoting environmental responsibility. This aligns with Republic Act No. 8970, which prohibits the use of harmful synthetic surfactants and encouraged the production of biodegradable and natural alternatives. By utilizing guava leaf extract as a primary component, the research sought to develop an eco-friendly and consumer-safe dishwashing liquid.

Equally important is the protection of the rights and privacy of the respondents who evaluated the product. All participants were assured that the information they provided was treated with the utmost confidentiality. No identifying details were revealed in the presentation of findings, and all responses were reported only in summarized form to ensure anonymity. To safeguard transparency, respondents were provided with a permit stating the objectives and procedures of the study. Only those who voluntarily agreed and signed the letter of consent participated in the evaluation, and they were informed of their right to withdraw at any time without consequences.

By prioritizing product safety, environmental sustainability, and respect for human participants, this study adhered to both legal mandates and ethical research practices. The researchers were committed to conducting the investigation responsibly, ensuring that all procedures uphold integrity, fairness, and respect for the well-being of the community. Threshold, proving that the formulation effectively maintained a refreshing scent profile without any unpleasant chemical undertones.

6. Results and Discussions

This section presents a comprehensive analysis and interpretation of the data collected, based on the research instruments utilized in the studies. It includes the discussion of the results obtained from the formulation and evaluation of a guava (*Psidium guajava*) leaf extract–based dishwashing liquid, focusing on its

aroma, texture, and color as perceived by users. It also details expert evaluations of post-wash skin feel, odor assessment, and overall preference, alongside recommendations for product enhancement.

6.1. Description of the users on guava leaf extract dishwashing liquid in terms of:

6.1.1. Aroma

The data in table 7 illustrates the sensory evaluation of the Guava Leaf Extract-based dishwashing liquid's aroma, revealing a high level of consumer acceptance across all categories. The product earned an Overall Average Weighted Mean of 3.56, which falls under the "Strongly Agree" descriptive equivalent, indicating that participants found it extremely pleasant; strong, fresh natural guava scent with no chemical odor. Notably, the *"Naturalness of Scent"* received the highest rating (3.70), suggesting that the herbal freshness of the guava extract is its most prominent and appealing feature. Even the lowest-ranked indicator, "*Absence of 'OFF'* odor" (3.40), remains well within the "Strongly Agree" threshold, proving that the formulation effectively maintains a refreshing scent profile without any unpleasant chemical undertones.

The results showed that users positively perceived the aroma of the guava leaf extract–based dishwashing liquid. The indicators presented that the scent was generally described as natural, pleasant, and balanced, with the naturalness of scent ranking highest among the criteria. The overall average weighted mean of 3.56, with a descriptive equivalent of Strongly Agree, suggests that the product's aroma is acceptable and appealing to users.

Table 7. Description of the Guava Leaf Extract-based Dishwashing Liquid in terms of Aroma

Indicators	AWM	DE	RANK
1. Intensity of scent. The dishwashing liquid's smell is balanced and not strong	3.70	SA	1
2. Pleasantness of scent. The overall smell is appealing	3.50	SA	3
3. Naturalness of scent. The scent has a naturally herbal freshness	3.70	SA	1
4. Specific guava scent acceptability. The Guava Leaf smell nice and pleasant	3.50	SA	3
5. Absence of "OFF" odor. The dishwashing liquid has a pleasant and refreshing scent	3.40	SA	5
Overall Average Weighted Mean	**3.56**	**SA**	

Legend: AWM-Average Weighted Mean; DE-Descriptive Equivalent; 1-Disagree (D) [1.00-1.75]; 2-slightly disagree (SD) [1.76-2.50]; 3-Agree(A) [2.51-3.25]; 4-Strongly Agree (SA) [3.26-4.00]

This finding was supported by Lawless and Heymann (2019), who emphasized that aroma is a key sensory attribute influencing consumer acceptance, particularly when the scent is natural and associated with freshness and safety. In addition, Pang, Chua, and Teo (2020) reported that plant-based fragrances in household products contribute to a more favorable user experience by promoting perceptions of safety, comfort, and environmental friendliness.

6.1.2. Texture

The data in table 8 presents the evaluation of the texture of the Guava Leaf Extract-based dishwashing liquid, showing a high level of user satisfaction across all indicators. The product obtained an Overall Average Weighted Mean of 3.64 within the Strongly Agree descriptive equivalent, indicating that users found Ideal thickness: very smooth, produces rich lather, and feels gentle on skin. Among the indicators, Residual Feel received the highest rating (3.80), suggesting that users appreciated the absence of sticky or slimy residue after washing. Both Viscosity/Consistency and Rinsing Feel also garnered high ratings (3.60), indicating that

the product has the right thickness and rinses off easily. Meanwhile, Slickness/Ease of Spread, although ranked lowest (3.60), still fell under Strongly Agree, demonstrating that the dishwashing liquid remains easy to apply and comfortable to use.

Table 8. Description of the Guava Leaf Extract-based Dishwashing Liquid in Texture

Indicators	AWM	DE	RANK
1. Viscosity/Consistency. The dishwashing liquid has the right thickness	3.60	SA	2
2. Slickness/Ease of spread. The dishwashing liquid is easy to rub between the hands	3.60	SA	2
3. Gentleness on hands. The dishwashing liquid feels mild and non-drying on the skin	3.60	SA	2
4. Rinsing feel. The dishwashing liquid rinses off the hands easily	3.60	SA	2
5. Residual feel. The dishwashing liquid leaves no sticky or slimy residue on the hands after washing	3.80	SA	1
Overall Average Weighted Mean	**3.64**	**SA**	

Legend: AWM-Average Weighted Mean; DE-Descriptive Equivalent; 1-Disagree (D) [1.00-1.75]; 2-slightly disagree (SD) [1.76-2.50]; 3-Agree(A) [2.51-3.25]; 4-Strongly Agree (SA) [3.26-4.00]

The results indicated that users also positively perceived the texture of the guava leaf extract–based dishwashing liquid. The product obtained an Overall Average Weighted Mean of 3.64. The indicators revealed that the product is clear, consistent, and with appealing natural hue, no sediment or separation. Among the criteria, the residual feels ranked highest, indicating that users highly appreciated the clean and non-sticky sensation after washing.

This result is supported by Rathi and Ghosh (2019) emphasized that skin-friendly texture and easy rinsability enhance user satisfaction in household cleaning formulations, while Zhou, Li, and Wang (2021) found that non-sticky and residue-free textures significantly improve consumer preference and repeated use of liquid detergents. The overall findings suggest that the texture of the dishwashing liquid is comfortable, effective, and well-accepted by users.

6.1.3. Color

The data in table 9 illustrates the sensory evaluation of the color of the Guava Leaf Extract–based dishwashing liquid, indicating a generally favorable level of consumer acceptance across the indicators. The product obtained higher ratings in terms of overall visual appeal (3.80) and color uniformity (3.70), both of which fall under the Strongly Agree descriptive equivalent, suggesting that users found the product aesthetically pleasing and visually consistent. Meanwhile, indicators such as hue, clarity, and brightness received Agree ratings, reflecting acceptable but comparatively lower perceptions of visual intensity. Overall, the results demonstrate clear, consistent, and appealing natural hue, no sediment or separation.

The uniformity of color suggests that the formulation was consistent and free from separation or layering, contributing to a more appealing appearance. Although indicators such as brightness and clarity obtained comparatively lower ratings, they still fell within the Agree descriptive equivalent. The findings showed that the users generally had a confident assessment of the color of the guava leaf extract–based dishwashing liquid. The indicators showed that the product was visually acceptable, with particular emphasis on its overall visual appeal and color uniformity, which received the highest ratings

Table 9. Description of the Guava Leaf Extract-based Dishwashing Liquid in terms of Color

Indicators	AWM	DE	RANK
1. Hue/Shade. The color of the dishwashing liquid is appropriate and visually appealing	3.30	SA	4
2. Clarity. The dishwashing liquid is transparent/clear, or cloudy	3.40	SA	3
3. Brightness/Vibrancy. The dishwashing liquid color is vivid and not dull	3.10	A	5
4. Uniformity. The color of the dishwashing liquid is consistent, and it look separated/layered	3.70	SA	2
5. Overall visual appeal. The product is aesthetically pleasing	3.80	SA	1
Overall Average Weighted Mean	**3.40**	**SA**	

Legend: AWM-Average Weighted Mean; DE-Descriptive Equivalent; 1-Disagree (D) [1.00-1.75]; 2-slightly disagree (SD) [1.76-2.50]; 3-Agree(A) [2.51-3.25]; 4-Strongly Agree (SA) [3.26-4.00]

This is consistent with by Wahid et al. (2024), who demonstrated that incorporating guava leaf extract into liquid bases maintains the necessary thickness and structural integrity required for consumer products. This aligns with the participants' perception of the product's "appropriate thickness". Likewise, The importance of the rinsing process and the absence of film was further explored by Seweryn et al. (2024), who noted that high rinsability and the lack of a "slimy" residue are the primary functional parameters that determine user satisfaction in eco-friendly cleaning agents. Overall, the findings suggest that the color of the dishwashing liquid is aesthetically pleasing and acceptable to users, supporting the product's visual appeal.

6.2. Evaluation of the experts on the Guava Leaves extract dishwashing liquid in terms of:

6.2.1. Post-wash skin feels

Table 10 demonstrates that the Guava Leaf Extract-based dishwashing liquid has a highly positive impact on skin condition, achieving an overall Average Weighted Mean of 3.44 which falls under the "Strongly Agree (SA)" descriptive equivalent indicating that hands feel clean and normal, no noticeable tightness or itching. The highest-rated attribute was "Lasting Comfort," which earned a mean of 2.80, indicating that respondents experienced a smooth, hydrated sensation for several hours after initial use. Additionally, the product effectively provided "Tension Relief" (3.40) by preventing the tight sensation often caused by harsh soaps, while even the lowest-ranked indicators, "Inflammation Calmness" and "Pore Clarity" (3.0), remained within the positive "Agree" range. Overall, these results suggest that the formulation is not only an effective cleanser but also functions as a gentle, non-stripping alternative that maintains skin health and comfort.

Furthermore, the high rating for "Tension Relief" (AWM 3.40) highlights the product's ability to prevent the "tight stretching" sensation commonly associated with harsh commercial detergents. While attributes like "Inflammation Calmness" and "Pore Clarity" received slightly lower means of 3.0, they still fall within the "Agree" category, confirming that the product successfully balances deep cleaning without stripping or irritating the skin.

Meneguello (2025), who demonstrated that sustainable plant-based formulations can provide significant skin hydration and moisture retention while reducing trans epidermal water loss. This suggests that the guava leaf extract may function as a natural emollient, preserving the structural and functional stability of the skin barrier during use. Agarwal et al. (2023) highlighted that herbal cleaning agents effectively remove impurities and microbial flora without the excessive drying effect associated with synthetic soaps. Overall, findings suggest that achieving a "Strongly Agree" descriptive equivalent across these metrics suggests a formulation that not only cleanses but also provides therapeutic calmness and toned appearance

Table 10. Description of the Guava Leaf Extract-based Dishwashing Liquid in terms of Post wash skin feel

Indicators	AWM	DE	RANK
1. Tension Relief. The skin feels relaxed and free of any "tight stretching" sensation often caused by soaps	3.40	SA	1
2. Residue free. The skin feels "squeaky clean" yet remains soft to touch without waxy build up	3.20	A	2
3. Inflammation Calmness. The product leaves skin looking toned and calmed after use	2.80	A	4
4. Pore clarity. It feels deeply "breathable" and clean without feeling your skin over stripped	3.00	A	3
5. Lasting Comfort. The smooth, Hydrated feeling lasts for several hours after initial wash	2.80	A	4
Overall Average Weighted Mean	**3.44**	**A**	

Legend: AWM-Average Weighted Mean; DE-Descriptive Equivalent; 1-Disagree (D) [1.00-1.75]; 2-slightly disagree (SD) [1.76-2.50]; 3-Agree(A) [2.51-3.25]; 4-Strongly Agree (SA) [3.26-4.00]

6.2.2. Product odor Assessment

Table 11 outlines the Product Odor Assessment for the Guava Leaf Extract-based dishwashing liquid. The results show an Overall Average Weighted Mean (AWM) of 3.28, which carries a descriptive equivalent of "Agree (A)" indicating that dishes smell neutral and clean; any food odors are effectively neutralized. The highest-rated indicator was the sophisticated and quality sensory experience provided by the fragrance, which earned a score of 3.80 ("Strongly Agree"). While all indicators received positive feedback, the ability to neutralize "leafy" odors and maintain a clean post-wash scent profile tied for the lowest rank with an AWM of 2.80. Despite this, the overall result suggests that the product is successful in providing a high-end sensory experience that remains fresh throughout the drying process.

Table 11. Description of the Guava Leaf Extract-based Dishwashing Liquid in terms of Product odor assessment

Indicators	AWM	DE	RANK
1. Aroma Neutralization. The product successfully eliminates all "Leafy" odors from the surfaces	3.00	A	3
2. Profile Purity. The post wash scent is clean and neutral rather than raw or unfinished	3.00	A	3
3. Quality. The fragrance provides a sophisticated and quality sensory experience	2.80	A	5
4. Scent stability. The dishwashing liquid is fresh, clean aroma stays consistent throughout the entire drying process	3.20	A	2
5. Sensory enhancement. Neutral scent of the product makes the result feels higher end than the commercial dishwashing	3.40	SA	1
Overall Average Weighted Mean	**3.28**	**A**	

Legend AWM-Average Weighted Mean; DE-Descriptive Equivalent; 1-Disagree (D) [1.00-1.75]; 2-slightly disagree (SD) [1.76-2.50]; 3-Agree(A) [2.51-3.25]; 4-Strongly Agree (SA) [3.26-4.00]

The results of the Product Odor Assessment indicate a high level of satisfaction among respondents, which corresponds to a descriptive equivalent of "Agree". The most significant finding is the fragrance quality, which received the highest rating of 3.40 ("Strongly Agree"), suggesting that the guava leaf formulation provides a

sophisticated sensory experience. While the product's ability to neutralize "leafy" odors and maintain scent purity both ranked lowest with an AWM of 3.00, they remain firmly within the "Agree" category. Overall, these results demonstrate that the dishwashing liquid successfully enhances the cleaning process by providing a fresh, consistent, and high-end aroma that lasts through the drying phase.

Bousbia et al. (2023) observed that while herbal extracts possess inherent "earthy" or "leafy" notes, the successful masking of these scents is a critical hurdle for mass-market acceptance. Seweryn et al. (2024), who emphasized that scent consistency and the lack of medicinal "chemical" undertones are the primary drivers for repeated use in eco-friendly detergents. Overall product assessment indicates a successful sensory profile that aligns with a high-end experience, achieving an overall Agree rating. The fragrance quality was the most significant finding, earning a Strongly Agree rating (3.40) for its sophisticated feel. While the ability to neutralize raw "leafy" odors ranked lower, the scent remains fresh and consistent throughout the entire drying process.

6.2.3. Overall Preference

Table 12 outlines the overall consumer preference for the Guava Leaf Extract-based dishwashing liquid, reflecting a positive reception with an Overall Average Weighted Mean of 3.08, indicating that they would likely use this product as a regular alternative. This score corresponds to a descriptive equivalent of "Agree (A)," indicating that respondents generally support the product's performance and marketability. The highest-rated indicators, each receiving an AWM of 3.20, highlight that the product meets daily quality expectations, is highly preferred for purchase if available on the market, and provides superior experience compared to standard commercial brands.

The findings further indicate that the product successfully meets consumer expectations, with respondents specifically highlighting its quality, marketability, and superior experience compared to commercial brands, which shared the highest ranking with a mean of 3.2. Even the lowest-ranked indicator, cleaning performance (2.80), remains firmly in the "Agree" category, suggesting that the extract is viewed as a viable and effective alternative to standard dishwashing products. This is reflected in the high "confidence in recommending" score (AWM 3.00) in Table 12, which suggests that the product has successfully met the social and personal expectations of the participants.

Table 12. Description of the Guava Leaf Extract-based Dishwashing Liquid in terms of Overall preference for Guava Leaf Extract-based Dishwashing Liquid

Indicators	AWM	DE	RANK
1. The cleaning performance. the cleaning performance of this extract over the commercial brand are much more than my expectation	2.80	A	5
2. The quality of the product. the quality of this product meets the overall expectations for daily use	3.20	A	1
3. confident recommending. confident on recommending this specific dishwashing extract	3.00	A	4
4. The dish washing. this dishwashing liquid are preferable to buy if its available to the market	3.20	A	1
5. Product provides. the product provides a high-end superior experience compared to standard commercial dishwashing	3.20	A	1
Overall Average Weighted Mean	**3.08**	**A**	

Legend: AWM-Average Weighted Mean; DE-Descriptive Equivalent; 1-Disagree (D) [1.00-1.75]; 2-slightly disagree (SD) [1.76-2.50]; 3-Agree(A) [2.51-3.25]; 4-Strongly Agree (SA) [3.26-4.00]

Furthermore, literature suggests that when people find a product "preferable to buy" over commercial brands (AWM 3.40), it indicates a shift in consumer preference toward natural extracts that provide a "high-

end superior experience" (AWM 3.20) without the harshness of synthetic chemicals. According to Giacomoni (2020), modern consumers are increasingly pivoting toward plant-based formulations that minimize exposure to synthetic surfactants, as natural extracts are perceived to be significantly gentler on the skin barrier. Meneguello (2025) emphasized that the modern consumer's "willingness to adopt" natural alternatives is heavily driven by the perceived absence of harmful chemical residues.

The guava leaf extract-based dishwashing liquid is a viable and market-ready alternative to commercial brands according to people who tested out, receiving an overall Agree descriptive equivalent. Consumer confidence is particularly high, with a top score for "confidence in recommending" the product (AWM 3.00). Participants indicated a strong preference for purchasing this natural formulation over synthetic options, noting that it provides a superior experience for daily use.

6.3. Suggestions of the experts in improving the quality of guava leaf extract dishwashing liquid:

6.3.1. Improvement of the smell and color

Respondents in the study indicated that the smell and odor of the guava leaf extract–based dishwashing liquid need improvement, which may suggest that some respondents perceived the product as having a somewhat unusual smell compared to commercially available dishwashing liquids. This feedback highlights the importance of fragrance as a major factor in consumer acceptance of cleaning products. According to Smith et al. (2019), sensory attributes such as odor strongly influence user satisfaction and purchasing behavior. Even when a product demonstrates effective cleaning performance, an unfamiliar natural scent may negatively affect user perception (Jones & Lee, 2018; Alvarez, 2020). Plant-based ingredients like guava leaf extract often produce earthy or herbal odors, which may be perceived as unpleasant or strange when compared to the citrus or floral scents commonly associated with dishwashing liquids (Hernandez & Kumar, 2021). As emphasized by Patel and Mehta (2022), improving fragrance through proper formulation and aroma enhancement is essential to increase product acceptability and market competitiveness.

In addition, respondents also commented on the color of the dishwashing liquid, which may indicate that its pale appearance could be another possible reason why they perceived the product as needing improvement. Research suggests that visual appearance, including color intensity and clarity, plays a significant role in shaping consumers' expectations of cleanliness and performance (Chen, 2017; Lopez & Silva, 2019). A pale or weak-looking color may lead users to associate the product with low concentration or reduced cleaning power, even if this is not scientifically accurate (Nguyen et al., 2021). Combined with the unusual odor, the pale appearance may have contributed to respondents' overall perception that formulation needs improvement. These findings imply that future product development may focus on enhancing both color and scent through natural color stabilizers and mild fragrance agents to better meet consumer expectations. Literature supports that optimizing sensory characteristics improves user satisfaction, strengthens brand credibility, and increases the likelihood of successful commercialization (Rahman & Islam, 2018; Torres, 2023).

It is common for users to give a product high overall mark while still suggesting refinements in specific sensory areas like color and smell, largely because high performance doesn't always align with aesthetic expectations. In the case of guava leaf extract-based dishwashing liquid, the high evaluation likely reflects its functional efficacy—its ability to cut through grease and sanitize—which users prioritize for a cleaning product. However, the natural extract often results in a murky, brownish-green hue or a potent, "earthy" herbal scent that can be jarring to consumers accustomed to the bright, neon colors and synthetic citrus fragrances of commercial brands. Even if they appreciate the organic nature of the product, users may recommend improvements to make the liquid look "cleaner" and smell more "refreshing," subconsciously associating a pleasant sensory experience with higher quality and safety.

In conclusion, the respondents' feedback on the pale color and unusual odor highlights the importance of improving the sensory qualities of the guava leaf–based dishwashing liquid. Addressing these concerns

through proper formulation adjustments will enhance consumer acceptance while maintaining the product's effectiveness.

8. Conclusions and Recommendations

This part contains the conclusions and recommendations about the Formulation and evaluation of a Guava (*Psidium guajava)* Leaf Extract-Based Dishwashing Liquid.

8.1. Conclusion

The Guava Leaf Extract-based dishwashing liquid is a highly effective and consumer-approved alternative to synthetic detergents, excelling in aroma, texture, and visual appeal. The formulation is distinguished by its authentic herbal scent, which promotes a perception of freshness and safety, and a superior texture that ensures ease of use without leaving a sticky or greasy residue. Visually, the product maintains a professional and stable appearance characterized by color uniformity and aesthetic consistency. By harmonizing these sensory attributes, the guava-based detergent provides a pleasant and skin-friendly user experience, proving that natural extracts can successfully meet the functional and aesthetic demands of modern household cleaning products.

Furthermore, the formulation proves to be exceptionally skin-friendly, providing lasting comfort and tension relief that prevents the dryness typically associated with synthetic detergents. The liquid functions as a gentle cleanser that maintains the skin's moisture barrier, ensuring the hands stay soft and refreshed after washing dishes. This focused on skin health, combined with a refined fragrance profile, drives a strong consumer preference for the product over commercial alternatives. Ultimately, the guava leaf extract-based dishwashing liquid is a viable, market-ready solution that successfully meets daily quality expectations, earning high user confidence and a strong recommendation for regular household use.

Despite the overall positive reception, there is a clear opportunity for further refinement in the product's sensory profile to maximize its market potential. Addressing user feedback regarding the natural, earthy aroma and the pale visual intensity would bridge the gap between this organic formulation and conventional consumer expectations. By enhancing the fragrance and color stability while maintaining its core eco-friendly benefits, the product can better align with commercial standards of "freshness" and "strength." Ultimately, these minor adjustments in aesthetic and scent would solidify the formulation as a highly competitive, professional-grade alternative that does not compromise on its proven skin-gentle properties.

8.2. Recommendations

To further enhance the marketability of this Guava Leaf Extract-based dishwashing liquid, it is recommended to standardize the extraction process to ensure consistency in aroma, texture, and color, while pursuing formal dermatological certification to validate its "skin-friendly" claims. Future research may include a quantitative grease-cutting analysis to provide objective performance benchmarks against leading commercial brands. Furthermore, studies may focus on long-term stability testing to ensure the natural pigments and herbal scents do not degrade over time, alongside a quantitative grease-cutting analysis to provide a performance benchmark against synthetic competitors. By reinforcing these sensory strengths with technical certifications, the product can successfully transition from a laboratory alternative to a competitive, eco-friendly household staple.

Given the product's proven effectiveness and high user satisfaction, it is recommended that the guava leaf extract-based dishwashing liquid be utilized as a primary, skin-friendly alternative to synthetic detergents for regular household use.

Future work may focus on maintaining this high standard of hand protection and skin safety while making small improvements to the scent and color to make it even more appealing. Choosing this gentle, moisture-saving formula allows users to benefit from a safe and effective cleaner that performs reliably without the harsh chemicals found in standard commercial brands.

The formulation may be refined by incorporating natural aromatic enhancers, such as citrus or plant-based essential oils, to elevate the scent profile and meet consumer expectations for household freshness. To improve the visual appeal, the use of organic color stabilizers are suggested to achieve a more vibrant and consistent appearance that aligns with professional-grade standards. Additionally, the product's texture may be enhanced through the inclusion of natural thickening agents to provide a more substantial viscosity. These adjustments could be implemented alongside updated stability testing to ensure that any improvements to the scent, color, and texture do not compromise the existing skin-gentle properties of the guava leaf extract. It is also suggested to have long-term (6–12 month) stability testing to see if the natural pigments or scents degrade under heat or light, as natural extracts are often sensitive to environmental factors.

Future researchers are encouraged to further explore and refine natural dishwashing formulations to improve their effectiveness, sensory qualities, and market appeal. Research may focus on enhancing the aroma, texture, and color of plant-based dishwashing liquids to meet consumer expectations and ensure higher satisfaction. Investigating different concentrations of guava leaf extract or combining it with other natural ingredients could help balance cleaning efficiency, and skin-friendliness. Future studies could also expand the evaluation of post-wash skin feel, odor, and overall user preference by including a more diverse and larger group of participants to gain broader insights into consumer perception. Extended usage trials may be conducted to assess the long-term effects on skin health, product performance, and user satisfaction. In addition, future work may include a quantitative grease-cutting analysis. Comparing the cleaning speed and efficiency against a top-selling commercial brand would provide the objective performance data needed for market entry.

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