PRELIMINARY STUDY ON FORMULATION AND BASIC EVALUATION OF COCONUT ENZYME - BASED DISHWASHING LIQUID

Nguyen Thi Kim Ngan [(1)], Nguyen Thi Huong Giang [(2)], Nguyen Thi Ngoc Trang [(3)], Le My Phuong [(4)], Bui Pham Phuong Thanh [(5)], Nguyen Thi Xuan Hanh [(6, *)]

(1) Institute of Green and Sustainable Technology, Thu Dau Mot University, email: 2228501010065@student.tdmu.edu.vn
(2) Institute of Green and Sustainable Technology, Thu Dau Mot University, email: 2228501010107@student.tdmu.edu.vn
(3) Institute of Green and Sustainable Technology, Thu Dau Mot University, email: 2228501010079@student.tdmu.edu.vn
(4) Institute of Green and Sustainable Technology, Thu Dau Mot University, email: 2228501010209@student.tdmu.edu.vn
(5) Institute of Green and Sustainable Technology, Thu Dau Mot University, email: thanhbpp@tdmu.edu.vn
(6) Institute of Green and Sustainable Technology, Thu Dau Mot University, email: hanhntx@tdmu.edu.vn
(*) Corresponding author

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Abstract

Currently, chemical dishwashing liquids are among the most commonly used cleaning products in households due to their convenience, rapid effectiveness, and low cost. Although chemical dishwashing liquids provide significant cleaning efficiency, they pose many potential risks to human health and the environment, particularly aquatic environments. This is because industrial dishwashing liquids are mostly formulated from water combined with various chemical components such as LAS, SLS, NaOH, SLES, $MgSO_4$, NH_4Cl, acids, alkalis, fragrances, formaldehyde, and the antibacterial agent triclosan (Adelliya, 2021). These substances can cause numerous health problems with frequent exposure, including the risk of irritant dermatitis. Moreover, if not thoroughly rinsed off, residues may remain on dishes and enter the body, leading to serious health impacts on users, especially pregnant homemakers. In addition, when discharged into the environment, industrial dishwashing liquids contribute to environmental pollution and harm aquatic organisms (Hong-Yan et al., 2009). Given these concerns, the replacement of industrial dishwashing liquids with environmentally friendly alternatives has become increasingly necessary.

The fermentation of coconut is a complex biological process in which microorganisms convert sugars in coconut water into products such as alcohols, organic acids, and flavor compounds. Coconut enzyme is fermented coconut water produced by a microbial system. Due to its organic acid content and synergistic

combination with natural ingredients—including coconut ash water (for odor removal), coconut essential oil extract (cocamidopropyl betaine source), coco glucoside (foaming agent), guar gum (thickener), baking soda ($NaHCO_3$), and table salt (NaCl)—the formulation offers effective cleaning, skin moisturization, and safety for children and individuals with sensitive skin.

Keywords: coconut enzymes; dishwashing liquids; environment; experiment; water pollution.

1. Introduction

Concepts such as coconut enzyme, eco-enzyme, and biological dishwashing liquid have been addressed in numerous previous studies conducted in Indonesia, Thailand, and Vietnam. Most of these studies have focused on investigating the characteristics of eco-enzymes derived from organic materials, their antimicrobial properties, or their potential applications in environmental treatment. Several studies have demonstrated the role of enzymes in the degradation of grease and organic substances; however, these investigations were primarily carried out in the context of wastewater treatment or industrial cleaning processes rather than the development of consumer dishwashing products. To date, scientific publications remain limited with respect to the formulation of dishwashing liquids based on coconut enzymes and the quantitative evaluation of their basic technical properties. Therefore, the present study was conducted to address this research gap by developing a coconut enzyme-based dishwashing liquid formulation and conducting a preliminary evaluation of its key technical characteristics relevant to practical application.

The creativity of this study lies in its application-oriented approach, in which coconut enzyme is systematically integrated into the formulation of a biological dishwashing liquid rather than being examined solely for its enzymatic or eco-enzyme properties. The study focuses on developing a suitable formulation by combining coconut enzyme with bio-based ingredients and evaluating basic technical parameters, including pH, viscosity, and grease removal efficiency, to reflect the product's practical usability. This approach enables the translation of enzyme-based research into a tangible consumer product, thereby bridging the gap between academic research and real-world application, and providing a foundation for the development of environmentally friendly dishwashing products. There have been several studies on extraction from biological raw materials, such as: Extraction of saponins from soap pod (bồ kết) peel and their application in herbal dishwashing liquid (Luu., 2020). Research on the production process of skin-conditioning hand wash from coconut oil (Nguyen., 2022). However, to date, there have been no studies related to the production of coconut enzyme–based dishwashing liquid. Based on this gap, this study focuses on developing a dishwashing liquid from coconut enzyme, consisting of the following components: fermented coconut water with vinegar (coconut enzyme), coconut ash water (for deodorization), coconut essential oil extract (cocamidopropyl), the foaming agent coco glucoside, the thickening agent guar gum, baking soda ($NaHCO_3$), sodium chloride (NaCl), and lemongrass essential oil. Therefore, this study focuses on investigating the structure, growth characteristics, and enzyme production of *Acetobacter aceti* during the bioconversion of ethanol into acetic acid. In addition, the paper highlights the applications of *Acetobacter aceti*, with particular emphasis on the role of its enzymes in scientific and industrial applications.

Coconut water consists of approximately 95% water, with small amounts of carbohydrates, proteins, lipids, vitamins, and minerals. It also contains trace levels of enzymes, which vary

depending on the maturity of the coconut. During coconut water processing and packaging, it is essential to control these enzymatic reactions to maintain clarity and ensure product quality over time. In general, enzyme content is assessed based on enzymatic activity. As coconuts mature, the activity of peroxidase (POD) and polyphenol oxidase (PPO) changes (Tran., 2022). Coconut enzyme refers to coconut water fermented by a microbial consortium. Owing to its organic acid characteristics, and when combined with traditional functional ingredients such as coconut ash water (for odor removal), coconut oil–derived surfactants (e.g., cocamidopropyl), the foaming agent coco glucoside, the thickening agent guar gum, baking soda ($NaHCO_3$), and sodium chloride (NaCl), the formulation exhibits effective cleaning performance while providing skin moisturizing properties. Thus, the combination of enzymes produced by acetic acid bacteria and coconut oil can result in an effective dishwashing product. Enzymes derived from vinegar fermentation facilitate the degradation of grease and organic residues adhering to dishware, while coconut oil enhances detergency and contributes to product stability. Coconut-derived enzymes promote the breakdown of organic substances, particularly lipids and proteins, enabling effective dish cleaning without damaging surface coatings. Simultaneously, coconut oil helps soften and protect the skin from the harsh effects of chemical detergents and provides antibacterial activity, thereby improving overall hygienic performance.

2. Material and methods

2.1. The method of data collection

A comprehensive review and collection of materials related to the research topic were conducted using various sources, including textbooks, scientific journals, and previously published studies available online, particularly articles addressing biological dishwashing liquid products. The review focused on production methods and processes, as well as the advantages and limitations of such products. One of the most significant advantages of developing biological dishwashing liquids is the reduction of the adverse environmental impacts associated with chemical detergents, especially on aquatic ecosystems, while simultaneously ensuring user safety and protecting human health.

2.2. An experimental method for the preparation of dishwashing liquid from coconut enzymes

Table 1. Statistics of raw materials

Number	Ingredient - Material	Quantity	Unit
1	Coconut: coconut water, coconut meat, coconut husk	5	Kilogram
2	Acetic acid bacteria	2	Kilogram
3	Pot	1	Piece
4	Container	2	Box
5	Medical gloves	1	Package
6	Face mask	1	Box
7	Spoon	3	Piece
8	Glass fermentation vessel	1	Bottle
9	Plastic dispensing bottle	5	Bottle
10	Filter tray	1	Piece
11	Plates and bowls	5	Piece
12	Dishwashing sponge	1	Piece
13	Guar gum powder	1	Kilogram
14	Baking Soda	1	Kilogram

Number	Ingredient - Material	Quantity	Unit
15	Coconut extract (Cocamidopropyl betaine)	1	Litre
16	Coco glucoside solution	1	Litre
17	Coconut ash	1/2	Kilogram
18	Lemongrass essential oil	1	Litre
19	Table salt	1/2	Kilogram
20	Butterfly pea flower	1/2	Kilogram

Source: Extracted from the Student Scientific Research Project, 2024 - 2025, entitled "Research on the Production of Dishwashing Liquid from Coconut Enzyme", conducted by the author group

To produce a complete dishwashing liquid derived from coconut enzymes, the following procedures must be carried out:

***Materials**:* To make a complete dishwashing liquid derived from coconut enzymes, the materials used are specifically listed as follows:

Coconut water and coconut meat were collected from local markets and used as raw materials for enzyme fermentation. Acetic acid bacteria were used as fermentation starters. Additional ingredients for dishwashing liquid formulation included coco glucoside, cocamidopropyl betaine, guar gum, baking soda ($NaHCO_3$), sodium chloride (NaCl), coconut ash water, lemongrass essential oil, and distilled water. A commercial chemical dishwashing liquid was selected as a control sample for comparative evaluation.

***Preparation of Coconut Enzyme**:* Fresh coconut water was mixed with coconut meat and brown sugar and transferred into a glass fermentation vessel. Acetic acid bacteria were added at a ratio of 1:10 (starter to coconut water, v/v). The mixture was sealed and fermented under anaerobic conditions at ambient temperature for approximately five months. After fermentation, the mixture was filtered to obtain the coconut enzyme solution, which was used for dishwashing liquid formulation.

***Formulation of Coconut Enzyme-Based Dishwashing Liquid*:** The dishwashing liquid was formulated by mixing coconut enzyme with bio-based ingredients, including coco glucoside, cocamidopropyl betaine, guar gum, baking soda, sodium chloride, coconut ash water, lemongrass essential oil, and distilled water. The formulation process was conducted under constant stirring to ensure homogeneity. The final product volume was adjusted to 1 L.

***Experimental Design and Replication*:** All experiments were conducted in triplicate to ensure reproducibility. A commercial chemical dishwashing liquid was used as a control sample to allow comparative evaluation of cleaning performance and basic physicochemical properties.

***User Survey*:** A preliminary user survey was conducted with 10 participants to collect feedback on cleaning performance, foaming ability, and skin comfort. Due to the limited number of participants, the survey results were considered exploratory and were used only to support qualitative discussion.

***Implementation process*:** The raw materials were purchased, prepared, and collected from local markets. Duration of the study: All three products were developed from November 2024 to April 2025 (excluding the time spent on procuring raw materials).

Group members proceed to make products according to the following process and materials:

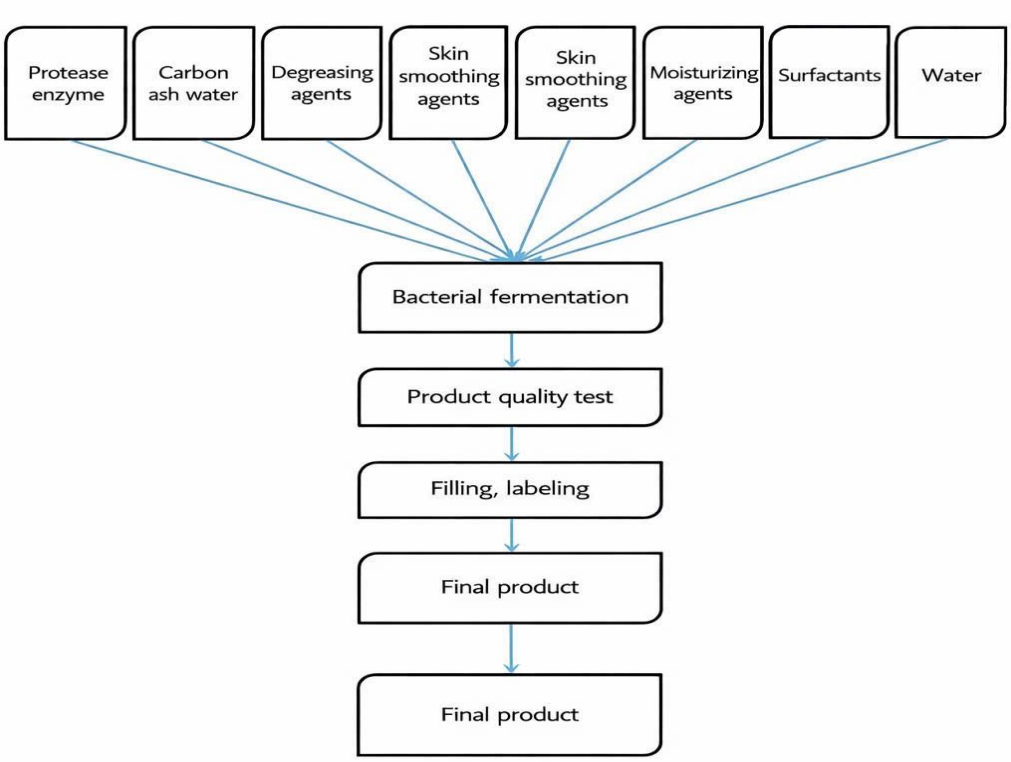


Figure 1. Procedure for Producing Dishwashing Liquid from Coconut Fermentation and Acetic Acid

Source: Author, 2025

To produce a biological dishwashing liquid from coconut enzymes, the following materials are required: coconut enzyme and biological by-products, including coconut ash water (for odor removal), coconut oil extract (cocamidopropyl), the foaming agent coco glucoside, the thickening agent guar gum powder, baking soda ($NaHCO_3$), table salt (NaCl), and lemongrass essential oil.

Bacteria*:* 6 steps

Step 1*: Collection of Raw Materials*

Students collect coconuts, acetic acid bacteria, raw materials, and other biological cleaning agents.

Step 2*: Fermentation to Produce Coconut Enzyme*

The collected ingredients are brought to a designated location. 2000 ml of coconut water is combined with the acetic acid bacteria and allowed to ferment to generate coconut enzyme.

Step 3*: Preparation of Ingredients and Foaming Agents*

Once the coconut enzyme extract is obtained, it is mixed with biological cleaning agents to enhance cleaning efficiency:

Natural foaming agents: Coco glucoside, baking soda.

Viscosity enhancer: Guar gum powder.

Fragrance: Lemongrass essential oil, coconut oil extract.

*Colorant***:** Butterfly pea flower.

*Preservative***:** Sodium chloride (NaCl)

Deodorizer: Coconut ash water

Step 4*: Mixing Coconut Enzyme with Cleaning Agents (Total 1000 ml)*

- Coconut enzyme: 500 ml.
- Coco glucoside: 70 ml
- Baking soda: 2 g + 20 ml distilled water → 20 ml
- Coconut ash water: 40 ml
- Coconut oil extract: 20 ml
- Guar gum (thickener): 4 g + 40 ml distilled water → 40 ml
- Lemongrass essential oil: 10 ml (for fragrance and antibacterial effect)
- Sodium chloride: 4 g + 40 ml distilled water (for preservation and stability)
- Distilled water: 240 ml
- Butterfly pea flower: 10 flowers (pre-soaked in warm water)
- Result: The total mixed solution yields 1000 ml (1 liter) of product.

Step 5*: Product Testing*

After 6 months (from November 2024 to April 2025), the product is tested for quality. The shelf life is determined to be 3 months.

Step 6*: Packaging*

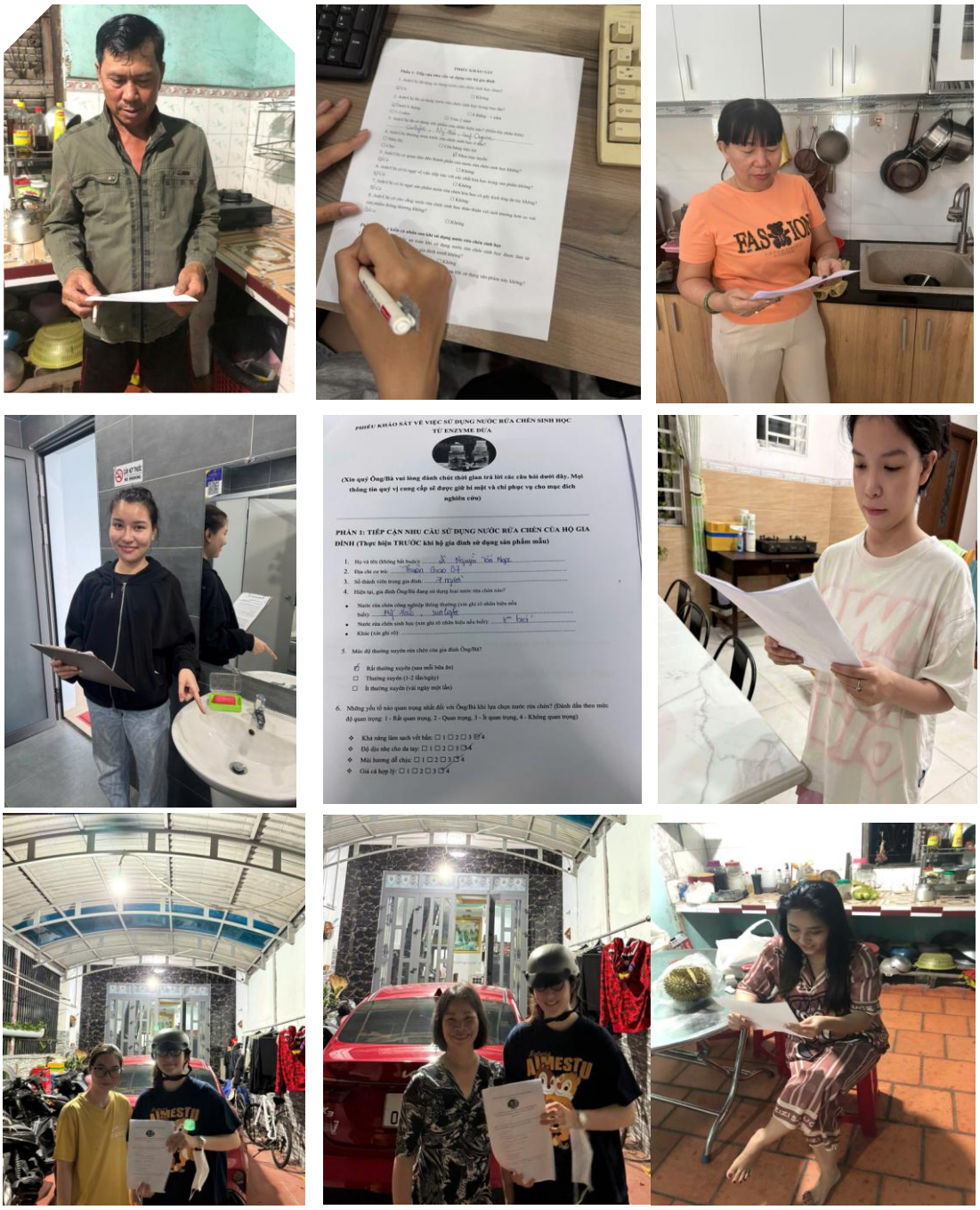
The final product is poured into dispensing bottles and labeled with the product logo.

Production of Coconut Enzyme: two liters of fresh coconut water are mixed with coconut meat and 200 g of brown sugar, then transferred into a 4-liter glass fermentation vessel. Acetic acid bacteria (vinegar starter) and 200 ml of starter water are added to the vessel (the typical ratio of acetic acid bacteria to coconut water is 1:10). The mixture is stirred thoroughly to ensure the bacteria are evenly distributed throughout the coconut water. The vessel is sealed and incubated under anaerobic conditions for 5 months. During fermentation, acetic acid bacteria convert sugars in the coconut water into acetic acid, the main component of vinegar, through a biochemical process. The anaerobic environment prevents contamination from other microorganisms, ensuring high-quality fermentation. Quality is monitored weekly through visual inspection. After 4 months of fermentation, the coconut mixture is filtered to separate the vinegar, yielding the final coconut enzyme product.

2.3. Method for Surveying User Opinions on the Quality Experience of Biological Dishwashing Liquid

The research team conducted a user survey at several households in Phu My Ward, Thu Dau Mot City, Binh Duong Province. A total of 10 survey questionnaires were planned to be distributed. The survey was designed to collect user opinions regarding the experience and quality of the biological dishwashing liquid. Based on this hypothetical data, the biological dishwashing liquid made from coconut enzyme demonstrates strengths such as

being gentle on the hands and environmentally friendly. However, the product requires improvements in cleaning efficiency for some users, foaming ability, and particularly fragrance, in order to better meet diverse market demands. Price and packaging are also factors that need consideration. The proportion of users who expressed definite willingness to continue using the product is still low, indicating that adjustments are necessary to enhance customer engagement and loyalty.



Source: Author, 2025

To evaluate the practical applicability of the developed product, the research team conducted a field survey involving ten representative households within the study area. The selected households participated in a trial use of the coconut enzyme–based dishwashing liquid formulated by the authors. The assessment was carried out through direct interviews combined with on-site observation of product usage under normal household conditions.

The survey focused on key performance indicators, including grease removal efficiency, foaming capacity, fragrance acceptability, skin compatibility, and overall user satisfaction. Participants were also encouraged to provide qualitative feedback regarding product performance and usability. The collected data were used to assess the feasibility of the formulation for domestic application and to identify aspects requiring further optimization.

3. Results and discussion

3.1.The final product is a bottle of dishwashing liquid made from coconut enzyme

Following the completion of the prototype formulation, the research team conducted a preliminary evaluation under household conditions. The product was tested on stainless steel sinks and commonly used kitchen utensils to observe its functional characteristics

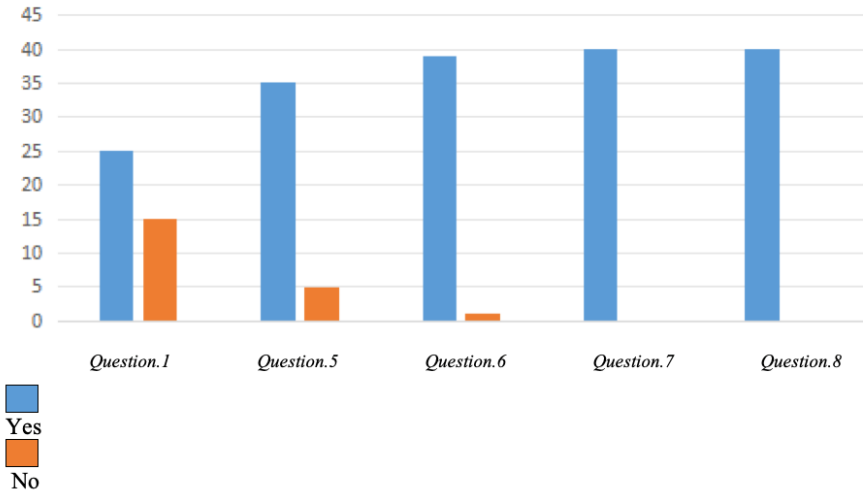


Figure 2. Understanding Household Usage Needs

Source: Author, 2025

Currently, data collected from 10 households show the following:

- *Industrial dishwashing liquid (Sunlight):* 5 households
- *Industrial dishwashing liquid (OMO):* 2 households
- *Biological dishwashing liquid (Soapberry*): 1 household
- *Others (homemade dishwashing liquid):* 2 households

Analysis**:** Among the 10 surveyed households, the majority (70%) are using conventional industrial dishwashing liquids, with the Sunlight brand dominating (50%). Only 10% of households use biological dishwashing liquid (Soapberry), while 20% tend to use homemade dishwashing solutions. This indicates that industrial dishwashing products

still dominate the market; however, there is a segment of consumers interested in natural or biological alternatives. The results indicated that the formulation was capable of producing foam during application and was able to remove visible grease under normal washing conditions. Users reported a generally acceptable sensory experience, including mild fragrance and a soft skin feel after rinsing. However, these observations were qualitative in nature and were not supported by standardized laboratory measurements or quantitative performance indicators. Therefore, the findings presented in this section should be interpreted as preliminary functional observations rather than definitive evidence of cleaning efficiency or product safety. Further controlled experimental studies are required to validate performance parameters and ensure reproducibility.

Figure 3. Cleaning Test on Stainless Steel Sink

Source: Author, 2025

Comment: The cleaning performance of the product was evaluated on a stainless steel sink to assess its foaming ability, grease removal efficiency, and effect on skin softness.

Figure 4. Final Product

Source: Author, 2025

3.2. Analysis of product application effectiveness:

The table below evaluates the use of coconut enzyme and chemical detergents, highlighting the advantages of coconut enzyme as follows:

Table 2. Comparison of the Properties of Coconut Enzyme and Chemical Detergents

No.	Product Attributes	Coconut Enzyme	Chemical Detergents
1	Origin and source	Derived from natural ingredients	Derived from chemical substances (Linear Alkylbenzene Sulfonate (LAS) and Sodium Lauryl Sulfate (SLS)
2	Chemical properties	Ranges from acidic to alkaline	Mainly acidic
3	Impact on the natural environment	Environmentally friendly	Harmful to the natural environment (soil, water, and groundwater pollution)
4	Product cost	Low cost (raw materials are easily available and abundant in nature)	High cost (due to the use of chemical ingredients)
5	Biodegradability	Easily biodegradable, causing minimal impact on the environment	Long decomposition time, potentially causing negative environmental impacts (LAS is difficult to fully biodegrade in aquatic environments and may persist, posing toxicity risks to aquatic organisms. SLS is more biodegradable, but at high concentrations it can cause skin and eye irritation)
6	Ecological impact (soil)	Mild and beneficial; components can support plant growth	Disrupts and inhibits soil ecosystems
7	Toxicity	Safe and non-toxic to human health (suitable for pregnant women and children)	Contains chemical components that may be harmful to humans through skin contact

Source: Author, 2025

Thus, the use of coconut enzyme as a cleaning product shows potential effectiveness when compared with conventional chemical-based cleaning solutions currently available on the market. However, the coconut enzyme formulation developed in this study is currently at the preliminary stage and primarily focuses on establishing the product formulation. This research represents an initial attempt to develop a prototype formulation. The product has not yet undergone comprehensive laboratory testing, standardized performance evaluation, toxicological assessment, or long-term stability analysis. Therefore, conclusions regarding safety, efficiency, and environmental impact cannot be definitively established at this stage. The observed cleaning performance was based on small-scale experimental applications and qualitative observations. As such, the findings should be considered exploratory and objective rather than confirmatory. Future research will focus on formulation optimization, long-term stability assessment, and comprehensive safety evaluations to support practical application and potential commercialization. This project

will involve further controlled laboratory experiments, quantitative analyses, and standardized testing procedures to confirm the product's efficacy, safety, and commercial viability.

4. Conclusion and recommendation

4.1. Conclusion

This study investigated the potential development of a dishwashing liquid formulated from coconut enzyme as a natural alternative to conventional chemical-based cleaning products. The preliminary experimental results suggest that coconut enzyme exhibits the ability to break down fats and oils, indicating its potential applicability in cleaning formulations.

The findings indicate that the coconut enzyme-based dishwashing liquid achieved observable cleaning performance under laboratory-scale testing conditions. In addition, the product formulation is derived from natural raw materials, which may contribute to reduced reliance on synthetic chemical components. However, since this study primarily focused on formulation development and initial performance assessment, comprehensive evaluations of product safety, long-term stability, biodegradability, and comparative efficiency have not yet been fully established. The results demonstrate promising potential for further development. Nevertheless, additional studies involving controlled experiments, quantitative performance analysis, toxicity assessment, shelf-life testing, and large-scale application trials are required to validate safety, effectiveness, and commercial feasibility. Overall, coconut enzyme shows potential as a sustainable raw material for environmentally oriented cleaning products. Future research should focus on optimizing formulation parameters, standardizing enzyme activity, and conducting systematic safety and performance evaluations to support practical application and commercialization.

4.2. Recommendation

Strengthening investment in research by government agencies, research institutions, and enterprises is essential to conduct more extensive studies on coconut enzymes, optimize production processes, and enhance the cleaning efficiency of products. Standardized production protocols should be developed to ensure that coconut enzyme-based dishwashing liquid meets quality and safety standards for consumers. Efforts should also be made to promote application and commercialization, including programs to introduce and market coconut enzyme-based dishwashing products to both consumers and businesses. Research and development of coconut enzyme-based dishwashing liquids with multiple functionalities and various formulations are needed to meet diverse consumer demands and provide better economic opportunities for coconut farmers. In addition, public awareness should be raised through education and outreach programs about the benefits of using environmentally friendly products, particularly coconut enzyme-based dishwashing liquids. Encouraging consumers to choose and use these eco-friendly products will contribute to environmental protection and public health.

References

Adelliya, N. (2021). Eco-enzyme based on household organic waste as multi-purpose liquid. AGRIWAR Journal, 1(1), 13–18.

Hong-Yan, Z., Kai-Bo, L., Deng, X., Jiang, H., & Zhang, F. (2009). Characterization of lipase immobilized on Mg–Al hydrotalcite for biodiesel. Process Biochemistry, 44(7), 791–798.

Luu, M. C. (2020). Application of lactic acid bacteria in the pilot production of biological cleaning agents from fermented tofu wastewater (Unpublished thesis). Institute of Biotechnology Research and Development, Can Tho University, Vietnam.

Nguyen, M. N. (2022). Study and evaluation of properties and cleaning applications of eco-enzymes derived from citrus fruit peels (Unpublished thesis). Hanoi Architectural University, Vietnam.

Tran, T. B. L. (2022). Study of lipase enzymes from Candida rugosa and porcine pancreas catalyzing the transesterification reaction of coconut oil (Unpublished thesis). Can Tho University, Vietnam.