E-PROCEEDINGS

INTERNATIONAL TINKER INNOVATION & ENTREPRENEURSHIP CHALLENGE (i-TIEC 2025)

"Fostering a Culture of Innovation and Entrepreneurial Excellence"

23 January 2025
PTDI, UiTM Cawangan Johor
Kampus Pasir Gudang

ORGANIZED BY:

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A-ST029: GREEN SAPONIFICATION PROCESS: LIQUID SOAP FROM WASTE COOKING OIL AND PANDAN LEAVES

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ABSTRACT

Global waste is expected to grow significantly by 2050. One of the contributors comes from improper treatment of waste cooking oil (WCO) which eventually causes environmental pollution. Therefore, effective waste management strategies are essential to reduce this impact. This research finds an eco-friendly solution to overcome this issue through a green saponification process using waste-cooking oils (WCO) incorporated with pandan leaves for liquid soap production. The objective of our study is to produce liquid soaps from waste cooking oil incorporated with different masses of powdered pandan leaves (1.02 g, 2.55 g, 3.06 g, 5.10 g) and determine its physicochemical properties. Seven tests were conducted, namely pH, total alkali content, foam test and stability, moisture content and solubility to determine the ideal liquid soap formulation. This product provides innovative approaches where it converts cooking oil and plant (pandan leaves) into a valuable and marketable product, contributing to circular economy principles and the soap formulation itself uses minimal chemicals ingredients making it more skin-friendly to the consumers.

Keywords: Waste Cooking Oil, Pandan Leaves, Saponification, Liquid Soap, Eco-friendly

1. Product Description

This green technology focuses on repurposing waste cooking oil (WCO) into liquid soap through saponification process. It is an eco-friendly product embodying sustainability and innovation in personal care products. The incorporation of pandan leaves, known scientifically as *Pandanus amaryllifolius* commonly found in tropical regions of Southeast Asia, rich in antioxidants and valued for their potential health benefits. Traditionally, they have been used for their anti-microbial properties, as well as to soothe skin irritation, prevent bacterial growth and reduce inflammation which makes them a beneficial ingredient in natural soap. This innovative liquid soap formulation ensures a pH-balanced liquid soap product for daily use with improved foam stability, moisture content and stability. Hence, this liquid soap integrates functionality, affordability and environmental responsibility, catering to consumers seeking natural, effective and sustainable hygiene personal care product. **Figure 1** illustrates the overall flow of this green saponification process, starting from WCO and pandan leaves collection, saponified process and seven physicochemical tests were conducted to determine ideal liquid soap production from four different masses of powdered pandan leaves.

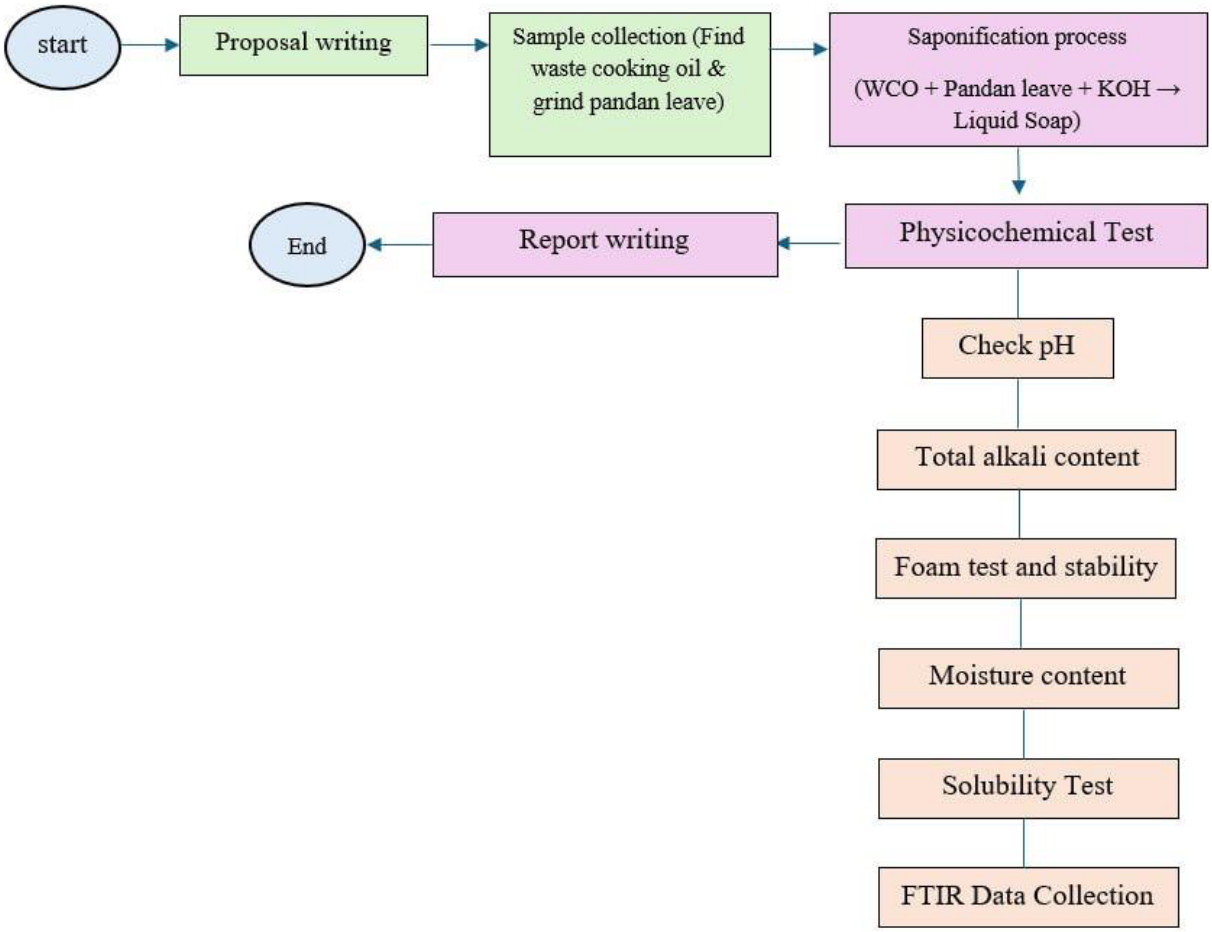

Figure 1. Method Flowchart

2. Methodology

This saponification process follows the method from Hamzah et al. (2023) with slight modifications. Waste cooking oil was heated to a controlled temperature (~75 ^{o}C) and slowly added the lye which is potassium hydroxide (KOH) solution. The mixture is stirred consistently to ensure complete saponification. Based on **Figure 2**, all samples showed strong carboxylate peaks (~1660 cm-1) where it indicates complete saponification process. To enhance the formulation, natural additives such as glycerin, propylene glycol, xanthan gum, and pandan leaves (1.20, 2.55, 3.06, 5.10 g) were added to improve skin hydration, consistency and microbial properties respectively. Once the soap reaches a homogeneous mixture, citric acid is added gradually to adjust the pH to a skin-friendly level. The soap is then left for a few days to allow complete saponification. Based on **Table 1**, sample S1 shows the ideal liquid soap formulation where it shows less than 1% total alkali content (0.465%), high foam stability (88%), and high solubility (80%) which indicates better dissolution in water.

Table 1. Physicochemical Test of Liquid Soap with different mass of pandan leaves powder.

Sample Pandan	*Foam Stability (%)*	*Foam Test (%)*	*Total Alkali Content (%)*	*pH*	*Moisture Content (%)*	*Solubility Test (%)*
S1 (1%)	88	75	0.465	7	20	80
S2 (2%)	93	50	0.775	7	60	33
S3 (3%)	84	25	1.705	7	62	45
S4 (5%)	91	15	2.015	7	42	41.5

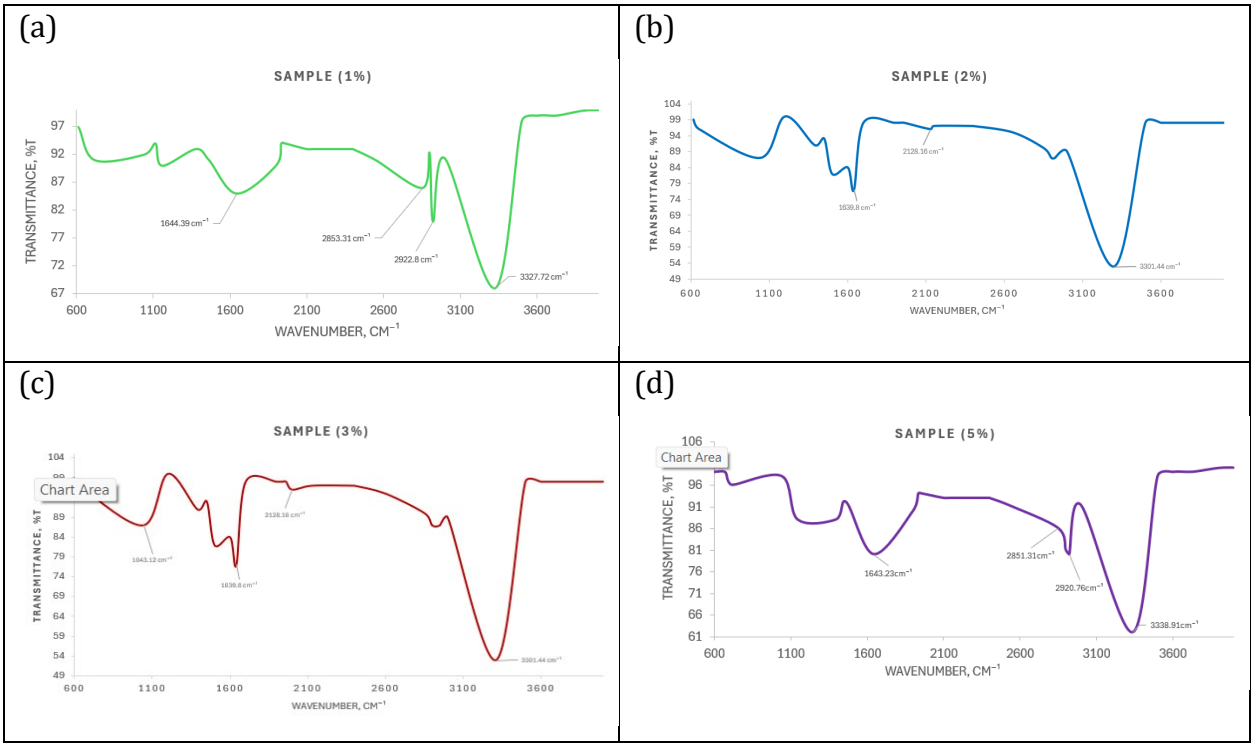

Figure 2. FTIR of liquid soap (a) 1% pandan leaves (b) 2% pandan leaves (c) 3% pandan leaves (d) 5% pandan leaves.

3. Novelty and uniqueness

The novelty of this project lies in its innovative use of waste cooking oil (WCO) as the primary oil for liquid soap production instead of using fresh palm oil or virgin coconut oil. Pandan leaves were powdered and infused in the liquid soap formulation. The aromatic compounds in pandan leaves enhance the soap fragrance. Unlike commercial liquid soaps that rely on synthetic additives, this formulation avoids using harmful chemicals like cocamide DEA, opting for natural stabilizers which is xanthan gum. The neutral pH 7 across all samples ensures skin-friendliness. This unique combination of sustainability and natural ingredients highlights the distinctiveness of the soap.

4. Benefit to mankind

The soap made from WCO and pandan leaves offers various benefits to mankind, primarily through its focus on sustainability and health. By repurposing waste cooking oil, it reduces environmental pollution and promotes waste management practices. The incorporation of pandan leaves enhances the soap with natural antioxidants which contribute to skin health. Its pH-balanced (pH 7) ensures skin-friendliness, making it suitable for all skin types. The soap's formulation aligns with eco-friendly principle, provides an alternative to commercial soap products. Lastly, this innovative product supports environmental conservation while encouraging awareness about sustainable practices, thus benefiting both individuals and communities globally.

5. Innovation and Entrepreneurial Impact

This innovative product holds significant potential commercialization within personal care products. The saponification process uses minimal energy (low heating ~75 ^{o}C) making it suitable for sustainable manufacturing. The formulation itself is simplified without any complex surfactants or chemical additives. In terms of entrepreneurial impacts, it empowers women entrepreneurs where this simple formulation can empower rural women to produce and sell the soap as a source of income. This innovative soap can easily scale from homemade scale to large batches for commercial sales. Apart from that, this innovation promotes partnership with environmental non-government association (NGO) to support sustainable practices.

6. Potential commercialization

The innovative it offers demand for green consumer products. By partnering with hotels, eco-resorts or spas to supply this eco-friendly soap as part of their amenities, leveraging its unique natural properties. Apart from that, complimentary products such as shampoo or bodywash can be created based on the same formulation principles. The highlighted lab-tested properties such as moisturizing effect, total alkali content and antioxidant properties enhance this product's credibility to marketing claims.

7. Acknowledgment

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8. Authors' Biography

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