

Comparative Analysis of Hot and Cold Saponification Processes in Eco-Friendly Soap Production Using Used Cooking Oil

Nur Firzanah Mansor, Siti Raihan Zakaria*

Structured Abstract

Background: The improper disposal of used cooking oil (UCO) has emerged as a major environmental issue in Malaysia, contributing to clogged drainage systems, soil contamination, and the overburdening of wastewater treatment plants. As a sustainable waste management solution, this study explores the conversion of UCO into eco-friendly soap via saponification. Specifically, it compares the Cold Saponification Process (CSP) and Hot Saponification Process (HSP) in terms of physicochemical quality and cleaning efficiency.

Methods: Soap samples were formulated using UCO and varying concentrations of sodium hydroxide (NaOH) (10%, 15%, 20%, and 30%) via CSP and HSP. CSP samples were cured at room temperature for 2 and 4 days, while HSP samples were heated between 68–75°C. All soaps were evaluated for physicochemical parameters including total fatty matter (TFM), moisture content, pH, and foam height. Cleaning performance was tested against standard household stains (soy sauce, grease, and lipstick), rated on a 1–5 scale.

Results: CSP soaps generally demonstrated higher TFM and lower pH and moisture content than their HSP counterparts. The most effective formulation was the CSP soap prepared with 15% NaOH and cured for 4 days, yielding a TFM of 72.2%, pH of 10.8, moisture content of 24.2%, and superior stain removal efficiency. Among all stains, lipstick was the most difficult to remove, yet CSP exhibited better overall performance. Foam height across all samples ranged from 1.3 to 22 cm, within acceptable limits.

Conclusion: This study confirms that CSP, particularly at 15% NaOH with a 4-day curing period, produces soap with superior physicochemical and cleaning properties. Utilizing UCO for soap production offers an environmentally responsible and practical approach to waste reduction. Further studies should include pH optimization, fragrance incorporation, packaging development, and user acceptance testing.

Keywords: Used cooking oil, eco-friendly soap, cold process soap, hot process soap, saponification

*Correspondence: sitiraihan@uitm.edu.my

School of Chemistry & Environment, Faculty of Applied Sciences, Universiti Teknologi MARA, Shah Alam, Malaysia