Lit Review

**Optimization of biodiesel production from waste cooking oil using eggshell catalyst**

1. The optimization of biodiesel production from waste cooking oil using chicken eggshells as a catalyst has been explored in various studies, with the current study indicating that calcined chicken eggshells (CES) significantly enhance biodiesel yield, achieving a yield of 45.52% at a methanol to oil molar ratio of 20:1 and a catalyst dosage of 45.47 g/L (5 wt%).

2. This finding aligns with previous research by Niju et al. [15], which also reported optimal biodiesel production at a similar catalyst dosage, emphasizing the effectiveness of CES in biodiesel synthesis.

3. Gupta and Rathod [12] noted that increasing the methanol to oil molar ratio positively affects biodiesel yield, with their study achieving yields between 85% and 99% at ratios up to 14:1, indicating the importance of optimizing this parameter.

4. Consistent with this, Issariyakul and Dalai [13] found that different types of oils yield varying optimal conditions, with waste cooking oil producing 94% biodiesel at a 7:1 ratio, further supporting the need for tailored approaches based on feedstock.

5. The current study's results suggest that while the yield of 45.52% is lower than some previous studies, it may be attributed to fluctuations in reaction temperature during the experiment, which can affect the efficiency of the transesterification process.

6. The authors emphasize the importance of maintaining consistent reaction conditions to optimize biodiesel production, highlighting that variations can lead to suboptimal yields.

7. In conclusion, the literature indicates that the use of calcined chicken eggshells as a catalyst is a promising approach for biodiesel production from waste cooking oil, with optimal conditions being crucial for maximizing yield.

8. Further research could explore the effects of different catalyst preparation methods and reaction conditions to enhance biodiesel production efficiency, suggesting a pathway for future investigations in this area.

**Recycling waste cooking oil into soap: Knowledge transfer through  
community service learning**

- The community engagement program aimed to teach participants how to make soap from waste cooking oil (WCO) and improve their understanding of recycling practices, achieving a 100% understanding post-training .

- Participants reported significant improvements in various skills after the program, including soap-making skills (90% good/very good), interaction with facilitators (93.3% good/very good), and understanding of recycling practices (100% good/very good) .

- The program included hands-on demonstrations, PowerPoint presentations, and distribution of brochures, which facilitated active learning and participant engagement .

- The effectiveness of the soap produced was evaluated based on its ability to remove different types of stains, with formulations using 10% and 25% NaOH showing varying effectiveness .

- Feedback collected from participants indicated a high level of satisfaction with the program organization and the delivery of knowledge by the speakers, scoring an average of 86.87% .

- The study highlighted the importance of community involvement in enhancing knowledge about recycling and the potential for economic benefits through the commercialization of recycled soap .

- The program's success was measured through follow-up questionnaires, where participants demonstrated their ability to apply the knowledge gained in their homes.

**The Quality of Transparent Soap with Addition of Moringa Leaf Extract**

- The study investigates the effect of Moringa leaf extract on the quality of transparent soap, focusing on foam ability, pH, and microbial contamination .

- The independent variables include the addition of Moringa leaf extract at concentrations of 0.1%, 0.15%, and 0.2%, while the dependent variables are the quality aspects of the soap .

- A true experimental design was employed, with a control group of transparent soap without Moringa extract and experimental groups with varying concentrations .

- Statistical analysis was conducted using single ANOVA, followed by Duncan's test if significant effects were found .

- Results indicated a significant effect of Moringa leaf extract on foam ability and pH, but not on microbial contamination .

- The addition of Moringa leaf extract improved foam ability, with the highest foam ability observed at 0.1% concentration .

- The pH of the soap decreased with increasing concentrations of Moringa leaf extract, with the average pH values being 10.3, 9.8, and 9.2 for 0.1%, 0.15%, and 0.2% respectively .

- Microbial contamination levels remained below the maximum limit set by SNI, indicating that Moringa extract has antimicrobial properties .

- The study concludes that Moringa leaf extract is a feasible additive for enhancing the quality of transparent soap .

**The Abrasive and Remineralising Efficacy of Coturnix  
Eggshell**

- The study aimed to determine the abrasive and remineralising efficacy of quail eggshell incorporated into a new experimental toothpaste .

- An in vitro, longitudinal, comparative, experimental design was used, with a sample size of 16 for each group evaluated .

- The quail paste showed a mean surface microroughness of 1.16 mm, significantly lower than unpolished PMMA, which had a mean of 4.60 mm .

- The surface microhardness of bovine enamel exposed to quail paste was the highest at 272.32 kg/mm², compared to 192.43 kg/mm² for the universal polishing paste .

- Statistical analyses indicated significant differences in both abrasive efficiency and remineralising effects among the tested toothpastes (P < .001) .

- The study concluded that quail eggshell toothpaste is effective in reducing surface microroughness and enhancing enamel microhardness .

**Characterization of Waste Cooking Oil Purified by Crushed  
and Sliced Zingiber Officinale (Ginger)**

- Waste cooking oil (WCO) is a significant environmental concern due to improper disposal methods, leading to water and soil pollution .

- The management of WCO involves specific challenges due to its physical properties, such as solidifying at low temperatures .

- Two main treatment methods for WCO are chemical treatments (esterification, transesterification, saponification) and physical treatments (distillation, extraction, filtration) .

- Ginger (Zingiber Officinale) has been recognized for its potential benefits, including antioxidant and anticancer properties , .

- A study found that ginger significantly reduces polycyclic aromatic hydrocarbons (PAHs) in WCO, attributed to its antioxidant capacity .

- The current research investigates the effect of ginger's surface area (crushed vs. sliced) on WCO treatment efficiency .

- The methodology involved mixing WCO with either crushed or sliced ginger, heating the mixture, and then analyzing the purified WCO using FTIR and SEM .

- SEM analysis showed that the structure of ginger changed after WCO treatment, indicating its ability to trap oil within its pores .

- FTIR results indicated that crushed ginger had a more significant effect on WCO purification compared to sliced ginger, with notable differences in functional groups .

- The highest percentage difference in functional groups was observed in WCO purified with sliced ginger (3.33% for (CH2)n of alkane) and with crushed ginger (2.22% for O-CH2 stretching band) .

**Environmental impact of increased soap consumption during COVID-19 pandemic: Biodegradable soap production and sustainable packaging**

- The COVID-19 pandemic has led to a significant increase in soap consumption, which poses environmental challenges due to increased packaging waste and detergent wastewater .

- Handwashing with soap is a primary recommendation to prevent the transmission of COVID-19, reducing virus spread by 45–55% .

- The chemical ingredients in soaps, primarily derived from petrochemicals, are released into the sewage system and eventually into the environment, necessitating eco-friendly alternatives .

- High concentrations of detergents in freshwater bodies can create foam, reducing oxygen penetration and harming aquatic organisms .

- The discharge of detergents can lead to eutrophication, threatening marine life, particularly corals and seaweed .

- Natural compounds, such as vegetable oils and plant extracts, are biodegradable and have antimicrobial properties, making them suitable alternatives to traditional soaps .

- Sustainable strategies like reduce, reuse, recycle, and redesigning packaging can help mitigate the environmental impact of soap consumption .

**Preparation And Characterization Of Eggshell  
Powder For Bio Application**

- The study focuses on the preparation and characterization of eggshell powder for bio applications, highlighting its potential as a low-cost and abundant material .

- Eggshells, which consist of about 91% calcium carbonate (CaCO3), are often discarded, with significant waste reported, such as 190,000 tons in India .

- The eggshell powder was treated with 7% NaOH and 1% stearic acid, followed by sonication, to enhance its properties .

- Fourier Transform Infrared (FTIR) analysis revealed characteristic peaks associated with carbonates, indicating the presence of CaCO3 in the eggshell powder .

- X-Ray Diffraction (XRD) studies confirmed the presence of calcium carbonate, with the main peak appearing at 2θ = 29.5 .

- Particle size analysis showed that the average grain size of the eggshell powder was around 63µm, with variations depending on the treatment method .

- The particle size distribution for treated eggshell powders indicated that the sizes were comparable to commercial calcium carbonates, suggesting their potential as bio-fillers .

**FORMULATION OF MORINGA SOAP AS AN ANTIOXIDANT TO  
PROTECT FREE RADICALS ON THE SKIN**

- The study focused on formulating Moringa soap as an antioxidant to protect the skin from free radicals, utilizing ethanol extract from Moringa leaves .

- Five different formulations of the soap were created, varying the concentration of Moringa extract from 0g to 4g .

- The extraction method used was soxhletation with 96% ethanol, yielding a percentage of 16.81% w/w ± 0.52 .

- Physical tests conducted on the soap included organoleptic properties, pH, water content, free alkali content, and ethanol insoluble materials , .

- The pH of the soap formulations ranged from 8.43 to 8.72, which is slightly alkaline and suitable for preventing bacterial growth .

- The water content of the Moringa soap was found to be between 15.69% and 17.20%, which is within the acceptable range according to Indonesian National Standards (INS) .

- The free alkali content was measured, with Formula II meeting the INS requirement of a maximum of 0.1% .

- Antioxidant activity was assessed using the DPPH reduction method, revealing that the IC50 values for the formulations ranged from 181.27 to 208.16, indicating weak antioxidant activity .

- The study concluded that while the Moringa soap formulations met several physical quality standards, their antioxidant activity was relatively low , .

**The Performance of Eggshell as Filler in Concrete Mixtures**

- The paper titled "The Performance of Eggshell as Filler in Concrete Mixtures" was presented at the 2014 International Conference on Industrial Engineering and Operations Management in Bali, Indonesia .

- The author, Doh Shu Ing, has over 9 years of experience in civil engineering, focusing on project management and material development .

- High egg consumption in Southeast Asian countries has led to significant amounts of eggshell waste, which is often disposed of in landfills .

- The study explores the potential of using eggshells as a concrete filler, with a maximum incorporation of 20% .

- Various tests were conducted to evaluate the performance of the concrete mixture, including slump, compressive strength, flexural, water absorption, and water penetration tests .

- The research highlights the limited use of food waste like eggshells in Malaysia compared to European countries .

- The study focuses on the production of antimicrobial soaps using Moringa oleifera oil and castor oil, highlighting the eco-friendliness of the organic soap process .

**Production of Antimicrobial Soap from A Blend of Moringa Oleifera Oil and Castor Oil**

- Eleven soap samples were prepared with varying ratios of Moringa oleifera oil to castor oil, specifically in ratios of 100:0, 90:10, 80:20, down to 0:100 .

- The hardness of the soap samples was measured using a needle penetration method, with results indicating varying hardness levels across the samples .

- The pH of the soap samples was determined to ensure they fell within the recommended range for skin application, with all samples showing a pH above 9.00 .

- Antimicrobial activity was assessed using the agar-well diffusion method against pathogens such as Staphylococcus aureus, Candida albicans, and Escherichia coli .

- The minimum inhibitory concentration (MIC) for S. aureus and C. albicans was found to be as low as 50 mg/ml, indicating high efficacy, while E. coli showed a higher MIC of 100 mg/ml .

- The study concluded that the formulated soaps have therapeutic potential for treating skin infections caused by the tested microorganisms .

**Recent advances in the conversion of waste cooking oil into value-added  
products: A review**

1. Waste cooking oil (WCO) is a significant environmental pollutant, especially in countries like China and India, where it is largely generated and improperly disposed of, leading to sewer blockages and water pollution .

2. The most common application of WCO is in biodiesel production, which has been widely adopted due to its similar properties to vegetable oils , .

3. WCO can also be valorized into various value-added products, including lubricants, plasticizers, and biopolymers, which can help reduce reliance on fossil resources , .

4. The transesterification process is the primary method for converting WCO into biodiesel, achieving high yields of up to 99.2% .

5. Recent studies have shown that WCO can be modified to produce eco-friendly plasticizers that can replace toxic dioctyl phthalate (DOP) in PVC formulations, improving mechanical and thermal properties , .

6. WCO has been successfully utilized as a rejuvenator for aged asphalt, enhancing its properties and making it comparable to virgin asphalt , .

7. The use of WCO in concrete production has shown promising results, improving compressive strength and reducing shrinkage deformation , .

8. Challenges in utilizing WCO include its variable quality, which can affect the performance of the final products, and the need for effective collection and management systems , .

9. The valorization of WCO not only contributes to waste reduction but also promotes a circular economy by transforming waste into valuable resources , .

**Recovery, Purification, Analysis and Chemical Modification of a Waste  
Cooking Oil**

- The study focuses on the recovery, purification, analysis, and chemical modification of waste cooking oil (WCO) to create valuable biochemicals .

- An original harvesting protocol was developed to collect WCO, ensuring a consistent chemical composition with a high percentage of mono and polyunsaturated fatty acids .

- The epoxidation process of WCO was performed using a mixture of hydrogen peroxide and formic acid, achieving over 95% conversion of starting materials within 6 hours, as confirmed by 1H-NMR analysis and .

- The physical properties of the synthesized derivatives, such as pour points and kinematic viscosities, were evaluated and compared to commercially available plasticizers, showing favorable results and .

- The oxidative stability of the WCO derivatives was assessed using pressure differential scanning calorimetry (PDSC), indicating significant improvements in stability after epoxidation and .

- The study highlights the potential of using WCO as a secondary raw material for producing biolubricants and bioplasticizers, contributing to a more sustainable circular economy and .

**Soap production: A green prospective**

- The soap formulations were tested to determine the most efficient and pleasant option for daily use, with various formulations yielding different results in terms of appearance and consistency .

- Formulation 10 was highlighted for its quality, shorter maturation time, and overall consumer acceptance, with 82.5% of participants expressing a desire to continue using it .

- The study emphasized the importance of recycling waste materials, such as used cooking oil and almond shells, to promote environmental awareness and support local economies .

- The production of soap from waste materials not only addresses waste management issues but also contributes to public health and ecological education .

- Cost analysis indicated that producing a batch of 65 soaps using formulation 10 costs approximately 5.60€, making each soap about 0.09€ .

**Utilization of eggshell waste as low-cost solid base catalyst for biodiesel production from used cooking oil**

- The study focuses on the utilization of eggshell waste as a low-cost solid base catalyst for biodiesel production from used cooking oil (UCO) .

- Key parameters affecting the transesterification process include free fatty acid (FFA) content and moisture content, with a maximum allowable water content of 0.5% to achieve a 90% yield of biodiesel , .

- The UCO used in the study had an initial FFA content of 4.4946%, which was reduced to 0.2079% through an adsorption process using 7% coconut coir powder , .

- The transesterification process was conducted at a temperature of 65ºC with a molar ratio of treated UCO to methanol of 1:15 .

- The amount of ES-CaO catalyst was varied between 3% to 7% (wt.% to UCO), with the optimum yield of biodiesel found at 6% catalyst loading , .

- The study indicates that the presence of the catalyst significantly influences the reaction rate, with no biodiesel produced in the absence of a catalyst .

- The research highlights the potential of using agricultural waste, such as eggshells, to reduce biodiesel production costs and environmental pollution , .