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Purification of Cooking Oil Waste Using Coconut Shell-Derived Activated Carbon: Reduction in Free Fatty Acids and Quality Enhancement

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INTRODUCTION & AIM

Waste cooking oil (WCO), produced in large quantities from households, restaurants, and food industries, poses severe environmental and health risks when improperly disposed. Repeated heating leads to oil degradation through oxidation, hydrolysis, and polymerization, causing increases in free fatty acids (FFAs), viscosity, and off-odors. Developing low-cost sustainable purification methods are essential to improve oil quality for safe reuse and circular economy applications.

METHOD

This study aims to evaluate coconut shell–derived activated carbon as an efficient adsorbent for reducing free fatty acids and improving key physicochemical properties of WCO. Coconut shells were carbonized at 450 °C for three hours under limited oxygen to produce charcoal, which was then chemically activated with KOH, washed to neutral pH, dried, and ground to ≤250 µm. Purification experiments were conducted by treating 450 mL of WCO with 2.5% (w/w) activated carbon and stirring at 600 rpm for 30, 60, and 90 minutes. Afterwards, the oil was filtered using Whatman No.1 filter paper. The treated samples were analyzed for FFA content, pH, calorific value, viscosity, and density to assess the purification efficiency.

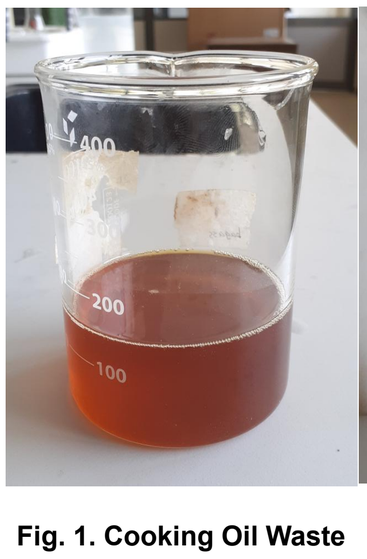


Fig. 1. Cooking Oil Waste

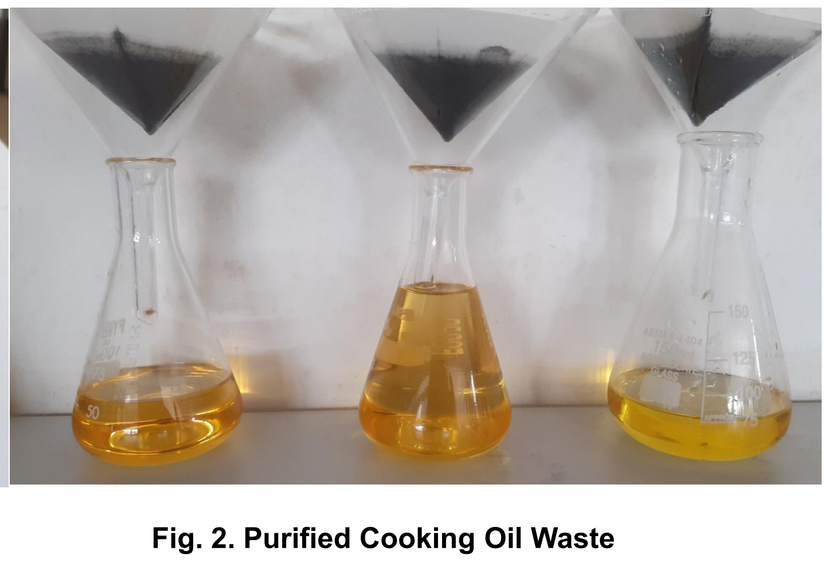
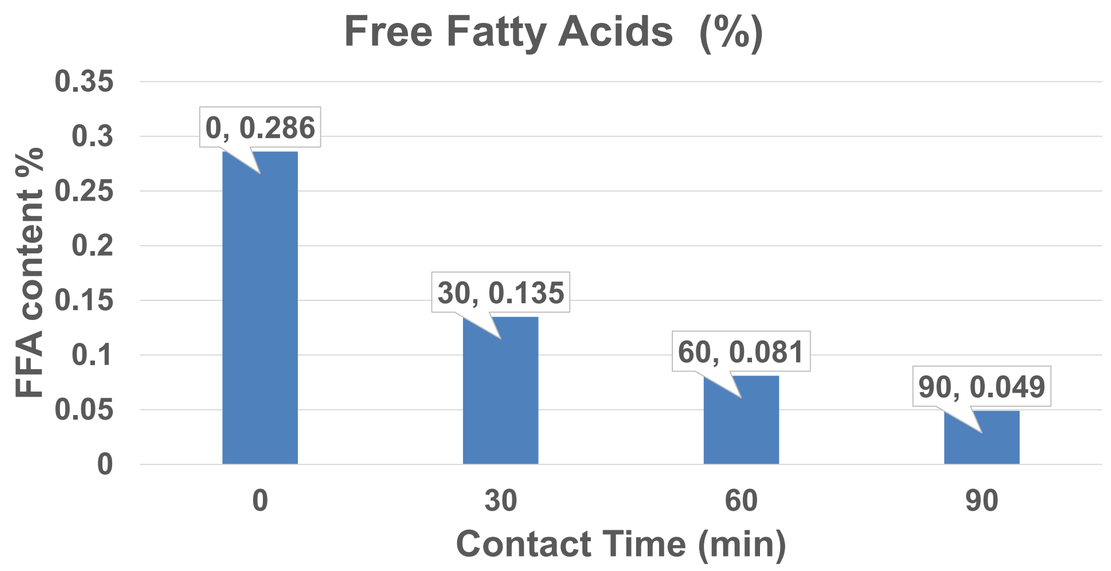
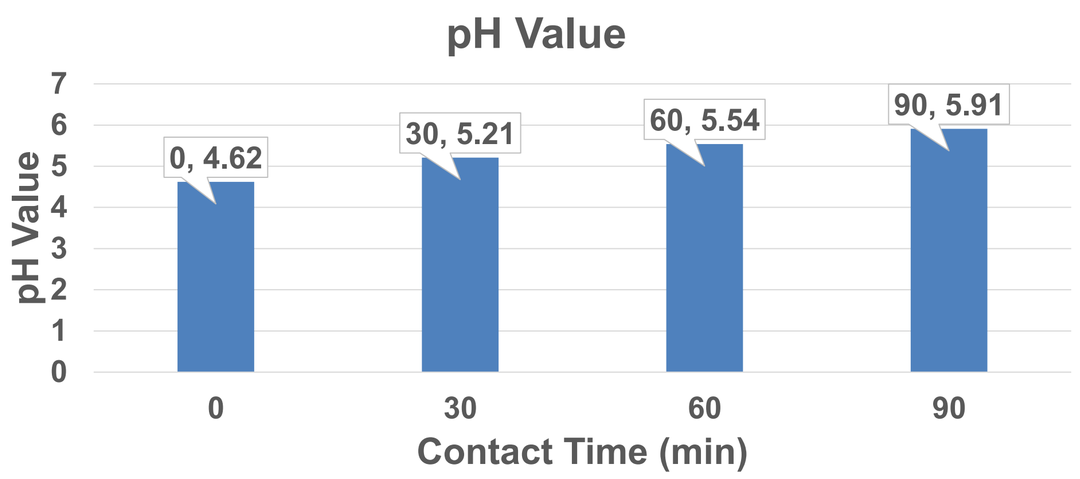


Fig. 2. Purified Cooking Oil Waste

RESULTS & DISCUSSION

The activated carbon showed strong adsorption capability, significantly improving the quality of waste cooking oil. FFA content decreased from 0.286% to 0.049%, achieving an 82.9% reduction with increasing contact time. The pH increased from 4.62 to 5.91, indicating the removal of acidic oxidation by-products. The calorific value also increased slightly from 8981 to 9019 Cal/g, reflecting a reduction in polar and degraded compounds. Overall, the treatment enhanced the oil's suitability for further processing and industrial use.





CONCLUSION

Coconut shell–derived activated carbon effectively purifies waste cooking oil by reducing acidity, improving pH, and enhancing fuel-related properties. The treated oil becomes suitable for biodiesel production and various non-food industrial applications. This low-cost, sustainable purification method provides a practical pathway for converting waste oil into valuable resources, supporting circular economy principles.

REFERENCES

Khuzaimah, S., & Eralita, N. (2020). Utilization of Adsorbent Carbon Coconut Shell for Purification of Used Cooking Oil. 03(02), 88–95.