WASTE CARICA PAPAYA OIL SEED EXTRACTION: A POTENTIAL FEED STOCK FOR BIODIESEL PRODUCTION TO ACHIEVE NET ZERO

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Abstract: The world is experiencing devastating environmental crisis due to the continuous burning of fossil fuel mostly in the form of petroleum fuels and coal. It was shown by BP statistical review of world energy 2021, that the world -wide primary energy utilization increased by 1.9% from 2009 to 2019, with industries accounting for more than 50% and transportation sector 20%. To achieve net-zero CO_2 emissions, countries such as the UK, China, US, Brazil, and others have agreed to increase the use of biomass feedstock base for biofuels production [1].

For this present research, biodiesel production is considered because it is a strong candidate for replacing coal and petroleum fuels with growing interest because of its benefits including air quality enhancement, non-toxicity, biodegradability, lubricity, and miscibility with petroleum-based diesel. However, challenges associated with conventional biodiesel synthesis are its quality and high price. Between 80 and 85% of the total production cost of this product is related to its feedstock, and a cautious selection of appropriate feedstock may help reduce production costs [2].

An inexpensive source of triglycerides could make biodiesel synthesis environmentally and economically appealing. Waste *Carica papaya* oil seed (WCPOS) and other oil seeds, are gaining recognition due to their high oleic fatty acid content. WCPOS contains 60-75% of oleic fatty acid which makes it apt as a raw material for biodiesel synthesis. *Papaya* is globally available and is extensively cultivated in the tropical regions of the world such India, Bangladesh, Malaysia, Australia, Indonesia, Philippines, Sri Lanka, Africa, and parts of tropical America. During its processing, large number of seeds are produced and discarded into the environment triggering organic pollution [3]. Notwithstanding its high availability, WCPOS has not been utilized for production of biodiesel, thus this current research was aimed at achieving the purpose for biodiesel synthesis from WCPOS to Waste *Carica Papaya* Oil Seed Biodiesel (WCPOSB) using a base heterogenous catalyst from Fermented Calcined Kola Nut Pod Husk (FCKNPH). However, several plant oils have been investigated for biodiesel production, these include vegetable oils feed stocks such moringa oil, waste cooking oil, soybean oil, Jatropha oil and so on. The Fatty Acid Methyl Esters (FAME) produced from such oils range from 94 – 99% [2].

Extraction is the first step towards separation of oil from WCPOS. This present research tested the efficiency of solvent - aided extraction by way of Soxhlet extraction and was proven to be one of the most cost effective and successful methods for oil extraction from plant seeds for biodiesel synthesis and other applications [3]. Various extraction process variables such as solid sample weight, solvent volume, and extraction time on oil yield, and its effects have been studied in this work using JMP factorial randomized experimental design. The oil extraction steps were done, and the oil yield was computed using the equation: Oil yield (%) = extracted oil weight/powder weight x 100. (1) [3].

The results obtained shows that the experimental oil yield ranges between 9 – 30%(v/v). The physicochemical and fuel properties analysis of the extracted WCPOS was carried out following the AOAC 2009 methods and the characteristics of the WCPOS obtained. Some of the results are: Physical state of oil – yellowish in color; moisture content – 0.0012%; density – 0.857g/cm^3; kinematic viscosity – 0.854711mm^{2}s^{-1}; % FFA (oleic acid) -0.2869; saponification value – 0.56555mgKOH/g oil; higher heating value – 47.85MJ/kg; diesel index 154.69. The obtained properties above are in line with EN14214, ASTM D2015, and ASTM D6751 biofuel standards.

It is therefore concluded that WCPOS is promising biomass feedstock for biodiesel production, to replace Petro-diesel and achieve net-zero.

References

1.BP Statistical Review of World Energy 2021 (Accessed on 13th August 2021) at :/www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2021-full-report.pdf

2.Eriola, B., Okeleye, A. A., Ishola, N. B., Osunleke, A. S., & Ojumu, T. V. (2019). Development of a Novel Mesoporous Biocatalyst Derived from Kola Nut Pod Husk for Conversion of *Kariya* Seed Oil to Methyl Esters: A Case of Synthesis, Modeling and Optimization Studies. *Catalysis Letters, 149*(7), 1772-1787. doi: http://dx.doi.org/10.1007/s10562-019-02788-6

3.Jeeva Senrayan & Sivakumar Venkatachalam (2018) Solvent-assisted extraction of oil from papaya (CaricapapayaL.) seeds: evaluation of its physiochemical properties and fatty-acid composition, Separation Science and Technology, 53:17, 2852-2859, DOI: 10.1080/01496395.2018.1480632

4. Muthusamy Balajii, Subramaniapillai Niju. (2019) A novel biobased heterogeneous catalyst derived from Musa acuminata peduncle for biodiesel production – Process optimization using central composite design, Energy Conversion and Management 189,118-131, https://doi.org/10.1016/j.enconman.2019.03.085.