Journal Name: Environmental Research **IF: 8.2**

Title: Life-cycle and techno-economic analyses of agro-waste-derived biodegradable plastics enhanced via AI-based parametric optimization

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Abstract: Growing concerns over climate change and the environmental impact of the overuse of petrochemical-based plastics have prompted the adoption of eco-friendly alternatives. Here, a starch-based biodegradable plastic sheet was synthesized from underexploited agricultural waste (sago and jackfruit starches) and plasticized with glycerol and sorbitol using acetic acid as a moderate cross-linking agent. Operating parameters for high output were adjusted using a response surface approach and an artificial neural network model, exhibiting high prediction accuracies (R^2 = 0.980 and 0.991, respectively). The optimal combination included 5 g sago starch, 5 g jackfruit starch, 1.25 g glycerol, 1.25 g sorbitol, and 0.75 mL acetic acid to achieve 1.659 ± 0.03 MPa tensile strength, an elongation at break of 63.18%, and 104.26 MPa Young's modulus. Extensive solvent-resistance tests confirmed the film's strength, and 80% of the film degraded after 10 days of burial in soil. Life-cycle assessment showed that producing 1 tonne of starch-based biodegradable film resulted in a climate change impact of 1220 kg CO_2eq, mainly caused by the use of additives and the high energy demand during various unit operations. Techno-economic evaluations predicted a minimum selling price of USD 1.67/kg, confirming cost-competitiveness with conventional fossil-based polymers and substantially lower costs than polylactic acid and polyhydroxyalkanoate alternatives. Life-cycle and techno-economic analyses suggest that starch-based bioplastics made from agro-waste have a positive environmental impact and show potential for scalable production, supporting their application in packaging and other low-load uses.

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Journal Name: Biomass and Bioenergy **IF: 5.8**

Title: Superheated non-catalytic transesterification of binary mixture of Madhuca indica and waste cooking oil towards biodiesel synthesis

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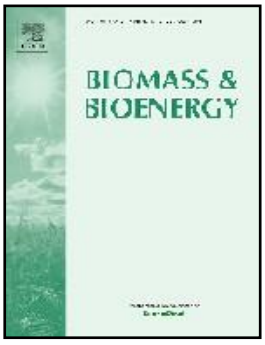
Abstract: Catalysed biodiesel synthesis requires an extended duration and produces large amounts of wastewater while incurring significant catalyst costs. In contrast, the uncatalysed conversion of suitable feedstock using superheated alcohols can provide sufficient energy, which means activation energy no longer affects reactivity. This eliminates catalyst requirement in addition to drastically reducing reaction time, as well as simplifying product separation and recovery of alcohols or by-products. The current study reports on uncatalysed alcoholysis of a binary blend made from mahua oil (MI) and waste cooking oil (WCO) to synthesize biodiesel using superheated blends of methanol and 2-propanol. Batch experiments identified ranges for six parameters suitable for soft-computational optimization and these parameters were then optimized via central composite design (CCD). A biodiesel yield of 98.9 % (predicted yield of 99.03 %) could be attained by reacting 600 g of WCO-MI oil blend in a 3:1 ratio using methanol and 2-propanol in a 6:5 ratio after preheating the alcohol mixture to 135 °C. The reaction proceeded optimally at 250 °C, taking 8 min retention time to be completed. Experimental results were analysed for reliability using ANOVA study, and data validation was carried out using artificial neural network (ANN). From ANOVA studies, it is seen that retention time has the most prominent impact on the process with a contribution factor of 48.82 %, while methanol to 2-propanol ratio has the lowest contribution factor of 0.25 %. The ANN model established adopting a 6-10-1 algorithm showed an R^2 value of 0.987, thereby reaching great accuracy which confirms its competence for reliable predictions.



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