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**HETEROGENEOUS BIOCATALYSTS FOR PRODUCTION OF BIODIESEL
FROM WASTE VEGETABLE OIL AND EFFECT OF CRUDE GLYCEROL
ON COMBUSTION PROPERTIES OF BRIQUETTES**

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ABSTRACT

The conversion of spent vegetable oils into biodiesel using biocatalysts provides both environment friendly and also innovative ways to manage wastes that would otherwise end in the environment. This study explored the use of FTIR-ATR as a quick analytical tool for characterizing heterogeneous biocatalysts for biodiesel production and crude glycerol generated during the transesterification reaction was evaluated for its effect on the combustion of charcoal dust briquettes. Heterogeneous biocatalysts were synthesized from mixtures of wood saw dust, sucrose and chicken egg shells and their catalytic activity compared to that of known standard catalysts such as sodium hydroxide, potassium hydroxide and sulphuric acid. Characterization of biocatalysts using FTIR-ATR revealed that egg shells calcinated at 1000° C had more basic properties and better catalytic activity than shells calcinated at lower temperatures. The FTIR scans of sulphonated sucrose showed clear evidence of the presence of active acidic groups (-SO₃H) than sulphonated saw dust. Therefore, a two-step transesterification reaction involving sulphonated sucrose (1% load) and 5% calcinated egg shell achieved a significantly higher yield of biodiesel (P<0.05) of 94.4% than 85.6% for the single step reaction, under similar reaction conditions. Overall, homogenous catalysts had a better performance than the heterogeneous biocatalysts in single step and two-step transesterification as well as esterification reactions by producing higher biodiesel yields in less reaction time. The biodiesel quality produced from the optimized two-step transesterification using biocatalysts complied with majority of known standard biodiesel qualities and was also comparable to regular diesel fuel. When crude glycerol from both single and two step reactions was added to charcoal dust briquettes to determine whether it improves their combustion properties, briquettes enriched with 5% glycerol had the highest calorific value of 23.3 MJ/Kg. Thermogravimetric analysis (TGA) of the 5% glycerol enriched briquette further confirmed better combustion properties than other briquettes. Such briquettes with improved combustion properties could be adopted to meet domestic and

industrial energy needs. The study further observed that very high level glycerol enrichment of briquettes (10 – 20%) reduced the calorific value and produced other undesirable combustion characteristics such as high volatile matter percentage and decrease in fixed carbon content. This study has therefore demonstrated the under-explored potential in harnessing environmental wastes to produce green energies sustainably.