OPTIMISATION OF BIODIESEL PRODUCTION FROM SANDBOX (*HURA CREPITANS*) SEED OIL

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ABSTRACT

Transesterification reaction is the most common method of biodiesel production from fats or vegetable oil. In this research, Sandbox (*Hura crepitans*) seed oil is used as feedstock extracted by solvent extraction using N-hexane as solvent. The study evaluates properties of the oil for it suitability in biodiesel production, biodiesel yields as it is affected by the reacting conditions such as methano-oil molar ratio, reaction temperature, catalyst concentration and reaction time, the reaction conditions are optimized using a two-step four factor factorial design. Results indicate that the feedstock is suitable for biodiesel production, catalyst concentration and reaction times interaction are the important factors that has greater effect on the yield of ethyl ester. The optimum yield condition for Sandbox (*Hura crepitans*) were 0.2wt/wt molar ratio, 30°C temperature, 0.4wt% catalyst concentration and 60 min reaction time yielding 93% ethyl ester (biodiesel), and all the measured properties of Sandbox (*Hura crepitans*) of biodiesel met with ASTM6751 standard exception of high polarization rate and slightly high viscosity that can be normalize by appropriate blending. The result showed that only molar ratio showed a negative effect on the reaction. Hence adhering to the standards for high quality biodiesel and economically cheap production process.

Keywords: *Biodiesel; Process Optimization; Renewable Energy; Sandbox*

1 INTRODUCTION

Hura crepitans seed which is highly rich in non-edible oil which falls into group of underutilized species of plants. *Hura crepitans* commonly known as sand box, possum wood, monkey no climb or dynamite tree is about 25m tall with very spiny trunk and branches and it is commonly planted as shade (Okolie *et al,* 2012), it has gained much attention as a feedstoch for biodiesel production (Srivastava et al., 2018).

In the world today, there is ever increasing demand for petroleum resource, although, high speculations concerning its dwindling supplies, unstable price, non-renewable nature and environmental problems has led to an extensive research on the seek for the alternative resource attributes of the petroleum as the most important source of energy (Nakpong and wootthikanokkhan, 2010).

There are four ways in which vegetable oils and fats can be converted into biodiesel namely; transesterification, blending, micro-emulsions and pyrolysis (Verma and Sharma, 2016; Silitonga et al., 2018). The most common method to produce biodiesel is transesterification of vegetable oils and animal fats in the presence of a catalyst such as acid, alkali or enzyme (Gashaw and Lakachew, 2014; Rodionova et al., 2017). This is due to complications faced in biodiesel production of the presence of Free Fatty Acids (FFAs) in non-edible oils. Adoption of homogeneous base catalyst, results in formation of soaps causing strenuous separation thus decreasing ester yield (Marchetti et al., 2007). Therefore, high FFA feedstock, acid catalyst is preferred to produce biodiesel, but it demands more reaction time and alcohol (Meher *et al.,* 2006). For oils or fats having high FFA acid esterification is advantageous, as acid catalyse the FFA esterification to produce fatty acid methyl ester (FAME). (Verma and Sharma, 2016)

Moreover, Type of alcohol, molar ratio and reaction time play significant role in biodiesel yield and its properties. literature are available on optimisation of process variables of biodiesel production from different oils using Response Surface Methodology (RSM) but little work is reported particularly on Sandbox seed oil and comparison of impact of different alcohols on biodiesel production to optimize the reaction parameters.

Saydut et al., (2016), used RSM to optimise biodiesel production from sunflower oil, Ethanol was used as alcohol for transesterification reaction and highest yield of 97.8% was obtained which was close to predicted yield of 99.2%. Galeano et al., (2017) produced biodiesel from palm oil on ethanolysis using 0.2–1 wt.% NaOH at temperature between 60 and 80 C and ethanol to oil molar ratio 6:1. Highest yield of 96% with 100% conversion of fatty acids into