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PHYSIOCHEMICAL PROPERTIES EVALUATION OF DELINOX REGIA SEED OIL FOR BIODIESEL PRODUCTION

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ABSTRACT

Environmental concern and limited resources of petroleum oil has increased the demand of biodiesel. One way of reducing the biodiesel production costs is to use the less expensive feedstock containing fatty acids such as inedible oils, animal fats, waste food oil and by products of the refining vegetables oils. Oil was extracted from delinox regia seeds. The solvent extraction using n-hexane gave 56.67%. The specific gravity, free fatty acids (% FFA), viscosity, carbon residue and moisture content were found to be 0.92, 12.8, 13.98, 0.62 and 0.3 respectively. By these results the delinox regia seed oil has great potential for biodiesel production.

Keywords: Delinox regia, Biodiesel, Physiochemical properties, Bio oil, Transesterification.

Introduction

Nowadays, energy sources are among the main issues in the world. The gradual depletion of energy sources has increased due to the increasing energy demand. Fossil fuels are among the energy sources that have a large share of demand, thus alternative fuels are sought-after for the gradual replacement of fossil fuels. Various fuel types such as hydrogen, biogas, and biodiesel, and their blends have been used in engines as alternative fuels to achieve better engine performance and lower fuel consumption (Murugesan *et al.*, 2009). Biodiesel is one of the various alternative fuels that is considered the most suitable fuel for combustion engines. There are numerous studies on using biodiesel as an alternative fuel, which revealed similarities in properties with diesel, for instance, calorific value, cetane number, liquid nature, readily availability, and renewability Panigrahi,(2018).

Delonix Regia plant is a species of flowering plant in the bean family *Fabaceae*, subfamily *Caesalpinioideae*. It has fern-like leaves and a flamboyant display of flowers. The tree grown is mainly for its shade and ornamental value. Long pods dangle from the trees, green and flaccid when young, firm and dark brown when mature. The pods contain non-edible seeds. It is found to be one of the most underutilized biomass products in Sub-Saharan Africa and is frequently referred to as a waste product (Yuh-Shan and Malarvizhi, 2009). The seed has a significant amount of oil that cannot be used for cooking hence the flamboyant seed oil can be viable for biofuel production (Adejumo *et al.*, 2019).

Diesel engine plays a significant role in transportation and power generation systems because of their higher efficiency, however, growing concerns about harmful emissions from the combustion of such fuels have motivated researchers to search for alternatives. Biodiesels can be used directly in diesel engines without modifications. More importantly, biodiesels can be blended with other fuels to improve the physicochemical properties of the fuel, enhance engine performance, and reduce exhaust emissions of diesel engines (Najafi *et al.*,2018).

To stem the tide of the growing anxiety over the future of the world's crude oil reserve, this paper intends to examine the technical potentials of biodiesel production using delinox regia seed oil to reduce the inordinate reliance on

petroleum products as fuel for automobile transport, and to mitigate the emission of greenhouse gas emission caused by the combustion of petroleum products.

Materials and methods

Seed Preparation and Oil Extraction

Dry pods of flamboyant was collected from different areas in Bauchi town. The pods were split open to obtain the seeds. The seeds were de-shelled and ground with a mechanical grinder A mass of $100g$ of flamboyant seed powder was placed in a thimble which was inserted in a sample chamber containing an evaporating and siphoning tube attached to the sample chamber. Beneath is a collecting flask($1dm^3$) containing 500mls of N-hexane. The heating mantle was switched on at 60°C. The N-hexane starts boiling and evaporates through the evaporating tube to the sample chamber. As it gets in contact with the condenser which contains cold water, the evaporated N-hexane solvent start dripping on the sample containing dry flamboyant seed powder thereby washing the sample and the distillate siphon back to the collecting flask

Physiochemical Properties

Determination of free fatty acid (FFA)

The method used for the determination is that British standard institute no 684. The oil (4g) was placed in a 250ml conical flask and warmed. Methanol(25ml) was added with thorough stirring followed by two drops of phenolphthalein indicator and a drop of 0.14M potassium hydroxide solution while shaking vigorously until a permanent light pink colour, which persisted for 1 minute was seen. The end point was recorded and used to calculate the FFA value as

%FFA (as oleic)= Titre x N x 28.2/Weight sample 3

Where N = molarities of base

Determination of acid value (A.V)

The method used for the determination is that British standard institute no 684. The oil (4g) was placed in a 250ml conical flask and warmed. Methanol(25ml) was added with thorough stirring followed by two drops of phenolphthalein indicator and a drop of 0.14M potassium hydroxide solution while shaking vigorously until a permanent light pink colour, which persisted for 1 minute was seen. The end point was recorded and used to calculate the A.V value as

Acid value=%FFA(as oleic) x 1.99 4

Determination of Saponification value

The method that was used for the determination of that saponification value is that of British standards institute 1995. Two grams of oil was placed in a 250ml conical flask and 25ml of 0.5M ethanol potassium hydroxide solution added. A reflux condenser was attached and the flask content refluxed for 30minutes on a water bath with continuous swirling until it simmered. The excess potassium hydroxide was titrated with 0.5M hydrochloric acid using phenolphthalein indicator while still hot. A blank determination was carried out under the same condition and the S,V calculated.

Saponification value S.V=$\frac{(B-R)x28.5}{weight\ of\ oil}$ 5

B= Blank titre value

R= Real titre value

Determination of Iodine value

One gram of oil was placed in a 250ml conical flask, 30ml of Hnaus solution was added to oil, the contents was mixed and placed in a drawer for exacltly 30minutes. Pottasium iodide solution(10mlof 15%) was added to the

flask washing down any iodide that may be found on the stopper. This was titrated against 0.14m $Na_2S_2O_3$ until the solution became light yellow. Starch indicator (1%,) 2ml was added and the titration continued until the blue color just disappeared. A blank determination was carried out the same conditions. The titre value was recorded and used to calculate the I.V

Iodine value= $\frac{(B-R)x malarity\ of\ \text{Na2S2O3 x 12.69}}{weight\ of\ oil}$

Results and Discussion of Results

Results

Percentage yield of oil $(\%\ yield) = \frac{weight\ of\ oil}{weight\ of\ sample}\ x\ \frac{100}{1}$

Table 1: Percentage yield of oil

S/N	Weight of ground seed used(g)	Weight of oil extracted (g)
1	100	62
2	100	58
3	100	56
Average	100	56.67

Percentage yield of oil $(\%\ yield)$ =56.67%

Table 2:Properties of delinox regia seed oil

Property	Value
pH	5.70
Specific Gravity	0.92
Iodine Value (mg/g)	48.20
Acid Value (mgKoH/g)	25.95
Free Fatty Acid	12.18
Saponification Value (Mg/100g)	198
Moisture Content (%)	0.30
Pour Point (°C)	15
Flash Point (°C)	210
Cloud Point	18
Viscosity (mm^2/s)	13.98
Carbon Residue	0.62

The oil content of delinox regia seeds in this study was 56.67% as shown in table 1. The physiochemical analysis was carried out based on astm standard. The high content of free fatty acid of 12.18 shows the feasibility of good tranesterication outcome. The carbon residue is 0.62, while the moisture content is only 0.3% as shown in table 2.

Conclusion

The oil content reveals good source of oil for biodiesel production. The physiochemical properties as shown in table 2 also reveals strong potentials for biodiesel production. It is a non edible seed oil and thus, would not lead to food crises. With an average yield of 56.67% per 100g of seed used shows its great potential for production of biodiesel

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