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Short Communication

Biomass potentials of *Lophira lanceolata* fruit as a renewable energy resource

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Oil was extracted from *Lophira lanceolata* seeds and some physicochemical properties were examined. The oil yield is promising. Methyl ester derivative which exhibited better fuel properties was produced from the oil. The refractive index, free fatty acid, kinematic viscosity, saponification and iodine values were determined and discussed in relationship to its applications. The energy density compared favourably with those of other seed oils and commercial grade diesel. The waste shells were also utilized for the production of biogas with potentials as energy resource that can be stored and used. The residue left behind possessed bio-fertilizer value showing the presence of N, P, K, Ca, Mg. Hence, *L. lanceolata* has potentials of a renewable energy resource.

Key words: *Lophira lanceolata*, methyl ester, refractive index, biogas, bio-fertilizer.

INTRODUCTION

Frequent scarcity of petroleum products in the country coupled with exhaustible petroleum reserve and fluctuation in their prizes have caused uncertainty in the future availability and supply of petroleum products as the major source of raw materials available for domestic and industrial uses. Thus, there has been a renewed interest in the search and development of renewable resources that would serve as viable alternative (Aigbodion et al., 2004). It is estimated that more than two-thirds of the households in the world live in developing countries and about three-quarters of these are in rural areas where biomass (wood and agricultural wastes) is the principal fuel and where both income and energy consumption are among the lowest in the world (Deckoning et al., 1985).

Fats and oils are being greatly favoured for use in surface coatings, soaps, cosmetics, pharmaceuticals, lubricants, surfactants and polymer processing. Their wide acceptance in these fields of application is attributed to their being renewable resources and biodegradable, hence environmentally friendly (Aigbodion et al., 2004). In Nigeria, fuel wood, petroleum gas, kerosene and electricity constitute important sources of energy (Itodo and Kucha, 1997). More than 70% of Nigerians are living in rural areas and do not have access to gas and electricity. Developing countries generally rely on wood, dung, agricultural, animal and human power to meet most of their basic needs (Barminas et al., 2001). There is the need to develop alternative source of energy with a particular focus on renewable sources of energy such as biogas technology, considering the availability of raw material and easy maintenance of the technology (Tambawal et al., 1997).

The use of lower-cost feed stock is of particular interest due to the abundance of potential feedstock (lignocellulosic biomass) e.g. waste paper, wood waste, pulp sludge and grass straw. The global energy crisis has generated interest in the use of agricultural waste as a substitute for fossil fuels, the production of biogas which is a biological process through which waste are converted to fuels, and as an efficient way of making clean environment (Abubakar, 1990).

In Nigeria, a promising wild plant which could be utilizeed as biomass is *Lophira lanceolata*. This plant grows in the moist savannah regions having grayish bark. It grows to about 12 m with twisted short branches and is traditionally employed for use in the treatment of skin diseases and cure for stomach ache. Its fruits develop between February and April in which tough reddish elongated seeds are found. Its protein and carbohydrate contents have been found to be 27 and 24.05%, respec-

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Table 1. Fuel properties of *Lophira lanceolata* oil.

Parameter	*Lophira lanceolata* oil		African oil bean[a]	Black beniseed[b]
	Raw oil	Methyl ester		
Refractive Index (at 30℃)	11.447	0.436	1.461	*
Free acid (as oleic acid) (%)	1.074	0.046	1.64	0.73
Kinematic viscosity (at 40℃) (mm^2/S)	10.63	2.44	*	33.2
Saponification value (mgKOH/g)	223.6	58.3	171.11	158.04
Iodine value (g I_2/100 g)	72.4	21.7	56.76	106.26
Biofuel potential (MJ/L)	38.78	45.32	40.85	34.90

Values are mean 3 determinations.
[a]Aigbodion et al. (2004).
[b]Fariku et al. (2007).

Table 2. Properties of digested slurry of *Lophira lanceolata* shells.

Parameter	Value
P (mg/kg)	1.879
K (mg/kg)	28.22
N (%)	0.095
Ca (%)	0.076
Mg (%)	0.035

tively (Eromosele and Eromosele, 1993).

In this study, the physicochemical properties and bio-fuel potentials of oil from the seeds of *L. lanceolata* as well as the utilization of its shell for the production of biogas and bio-fertilizer were investigated.

MATERIALS AND METHODS

The fruits of *L. lanceolata* were obtained from some trees located at Ganye, Adamawa state. This was dried on the sun for several days and partially crushed to obtain the seeds. The seeds were fried and grounded into a powder. Boiling water was added and stirred to form a paste. This is kept for two days after which the oil produced is decanted. The process is repeated several times until negligible oil is found floating. Some portion of the oil was transesterified using the method of Foidl et al. (1996). The refractive index, free fatty acid (as oleic acid), kinematic viscosity, saponification and iodine values where determined using standard methods. The fuel potential was obtained using the relationship of Batel et al. (1980):

$$Hu = 47645 - 4.187I - 38.31S \quad KJ/Kg$$

Where Hu is the gross calorific value, and I and S are the iodine and saponification values, respectively.

The shells were reduced to smaller particles for easy degrade-ation, using pestle and mortar and then mixed with water in the ratio of 1:2 to obtain a slurry which was in turn poured into an airtight digester and left for 3 days to ferment (Baki et al., 2004). The gas produced was collected through cylinder constructed mainly for biogas generation which could be stored. Anaerobic digestion continued for about 2 weeks and the gas production declined. The slurry left behind was tested for the presence of the nutritional composition nutrients N, P, K, Ca and Mg.

RESULTS AND DISCUSSION

The fuel properties of the raw oil and the methyl ester obtained through esterification is presented in Table 1. The refractive index of 11.447 and 0.436 for the raw oil and methyl ester, respectively, is comparable to those obtained for other conventional fuels. The free acid of 1.074 and 0.046 for the raw oil and the methyl derivative, respectively, suggests that the seeds could be edible. The kinematic viscosity of the methyl ester 0.436 mm^2/S is lower than 11.447mm^2/S for the oil obtained through traditional method and both compares to many exploited oils. The saponification values of 223.6 and 58.3 mgKOH/g for the raw oil and methyl ester, respectively, suggest their suitability for manufacture of soap. The iodine values 72.4 and 21.7 g I_2/100 g for the raw oil and methyl ester, respectively, suggests low unsaturated level. The fuel potential; 38.78 and 45.32 MJ/L for the raw oil and methyl ester, respectively, fall within acceptable range. The results in general show that the energy density of *L. lanceolata* oil compares favourably with those of other seed oils and commercial grade diesel.

The slurry from the shell of *L. lanceolata* had remarkable potentials as a source of energy as shown in Table 2. The gas collected into the biogas cylinder produced clean flame which was used to heat 100 cm^3 water to boiling point within 10 min. The hot weather in Yola contributed to the fast rate of fermentation. The average daily temperature for the retention time of 2 weeks was 33ºC. The gas collected into the biogas cylinder produced clean flame which was used to heat 100 cm^3 water to boiling point within 10 min. The digested slurry had good biofertilizer values which could be utilized for effective farming to boost agricultural production. The digested slurry was spread on one part of a large farm and decomposition took place within few days. The area became more fertile and also recorded better yield.

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