BIOMASS AND BIOENERGY 35 (2011) 1797–1803

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High quality biodiesel from yellow oleander (*Thevetia peruviana*) seed oil

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ARTICLE INFO

Article history:
Received 5 October 2010
Received in revised form
31 December 2010
Accepted 5 January 2011

Keywords:
Biodiesel
Thevetia peruviana
Musa balbisiana
Yellow oleander
Banana plant

ABSTRACT

Yellow oleander (*Thevetia peruviana* Schum.) seed oil has been investigated to produce biodiesel. Transesterification of the oil to biodiesel was carried out in methanol by batch reaction using a heterogeneous catalyst derived from the trunk of *Musa balbisiana* Colla (one variety of banana plant). 96 wt.% of the oil is converted to biodiesel at 32 °C in 3 h. The wt.% composition of the biodiesel is methyl oleate 43.72, methyl palmitate 23.28, methyl linoleate 19.85, methyl stearate 10.71 and methyl arachidate 2.41. Fuel properties conform to standards set for ASTM D6751, EN 14214, BS II and BS III, and in certain aspects better. The biodiesel is free from sulfur and has exhibited a high cetane number of 61.5.

1. Introduction

Biodiesel, as a substitute for petrodiesel, is receiving worldwide attention because of its renewability, biodegradability, nontoxicity and carbon neutrality [1–4]. Depleting petroleum reserves and ever-increasing demand for petrodiesel in the transport sector are two major concerns for both developed and developing countries and these have compelled the researchers to look for a viable alternative to the conventional transport fuel, petrodiesel.

Both the feedstock and technology know-how for the production of biodiesel are available but prohibitive cost associated with currently used feedstocks in developed countries is a deterrent factor in many developing and underdeveloped countries in switching over from petrodiesel to biodiesel mode. High cost of edible vegetable oils such as rapeseed oil and soybean oil, although used in several developed countries, is a major challenge for economic viability of biodiesel industries and can hardly be afforded by poor and underdeveloped countries. It is therefore inevitable to look for non-edible but economically viable feedstocks as alternatives to edible vegetable oils. Several such feedstocks such as karanja (*Pongamia glabra*) [5,6], field pennycress (*Thlaspi arvense* L.) [1], rubber (*Hevea brasiliensis*) [7], *Jatropha curcas* [8,9], microalgae (*Chlorella vulgaris*) [10], terminalia (*Terminalia belerica* Robx.) [11], mahua (*Madhuca indica*) [12,13], etc. are already under consideration by the world community. In this context, *Thevetia peruviana* Schum. (Fig. 1) seed oil could be an excellent feedstock for biodiesel industries and deserves attention. We are reporting here the extractability of *T. peruviana* seed oil and its convertability to biodiesel with excellent combustion parameters.

T. peruviana Schum., more commonly known as yellow oleander or milk bush, is a small, permanent and evergreen plant mainly grown as an ornamental plant. The plant belongs to the *Apocynaceae* family and is widespread in American, Asian and African continents. Hated by herbivorous animals, the plant produces seeds rich in oil (60–65%) [14–16], and can be grown on roadsides and road-dividers in expressways for

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0961-9534/$ – see front matter
doi:10.1016/j.biombioe.2011.01.007

Fig. 1 – Yellow Oleander plant (*Thevetia peruviana* Schum).

beautification, environmental protection and at the same time for the production of biodiesel. The plants can be grown on lands otherwise unsuitable for conventional agricultural purpose, and can be harvested for years together.

Another significant aspect of this report is to introduce a novel catalyst derived from the trunk of *Musa balbisiana* Colla (one variety of banana plant, Fig. 2) [17], into biodiesel industry. The catalyst is heterogeneous, and therefore can be easily separated from the product. The catalyst is easily prepared from the waste of post-harvest banana plants.

2. Materials and methods

2.1. Materials

The yellow oleander fruits (Fig. 3) were collected from plants grown in Gauhati University Campus, Guwahati, Assam, India and from plants grown on dividers of National High Way No. 37 near Gauhati University Campus. Mature fruits were collected two times a year (summer and winter seasons), pulps removed, seeds dried in sunlight, deshelled and the kernel crushed using a grinder prior to oil extraction. *M. balbisiana* plant (Fig. 2) was collected from a nearby village of Gauhati University for the preparation of the catalyst. Solvents and other chemicals used were of analytical grade, and they were procured from commercial sources and used as such without further treatment.

2.2. Instruments used

^{1}H and ^{13}C NMR spectra were recorded in $CDCl_3$ at 300 and 75 MHz, respectively using Bruker Avance III 300 MHz/54 mm

Fig. 2 – (left) *Musa balbisiana* plant with saplings. (right) close-up view of a *M. balbisiana* plant with fruits.