Production and Characterization of Biodiesel from Tamarind Seed Oil

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Abstract: Biodiesel production from food graded oils is not economical due to high prices. Almost 80-85% cost of biodiesel is due to feedstocks. And currently used non-edible, waste oils are not capable of large scale biodiesel production. Therefore, search for other non-edible oil bearing feedstocks is need to be continued. The present investigation is an attempt to use non-edible tamarind seed oil as an inexpensive, sustainable and potential feedstock for biodiesel synthesis. Tamarind seed oil was converted to biodiesel by acid (HCl), base (KOH) and enzyme (immobilized lipase) catalysed transesterification. Tamarind seed biodiesel was found to have low iodine value (26-32) and high cetane number (65-68). Pour point values of biodiesel were ranged from -0.3 to -4.2. The components of produced biodiesel were evaluated by gas chromatographic-mass spectroscopic analysis.

***Keywords*:** tamarind, transesterication, biodiesel, catalysis, pour point .

INTRODUCTION

At present, global warming, scarcity of fossil fuels, ever increasing population, increasing costs of petro-fuels and climate change are the major issues driving the researcher's interests in developing alternative, sustainable and renewable biofuels [1, 2]. *Tamarindus indica* L. commonly known as Tamarind tree (a member of Leguminosae family) is one of the fruit species, mainly growing in Asian countries.

MATERIALS AND METHODS

Tamarind seed oil was subjected to acid, base and enzyme catalyzed transesterifications, for the production of biodiesel. Base catalyzed transesterification was carried out using pellets of potassium hydroxide (KOH) at concentration levels of 0.2%, 0.4%, 0.6%, 0.8% and 1% (w/w oil). The varied concentrations of catalyst were mixed with tamarind seed oil (5g) and methanol (2g). Mixture of oil, catalyst and methanol was mixed on a magnetic stirrer at 60°C for 90-minutes. In acid catalyzed transesterification, hydrochloric acid (HCl) at 20%, 40%, 60%, 80% and 100% (w/w oil), was mixed with oil, dissolved in methanol and stirred on magnetic stirrer for 4-hrs at 60 °C. Molar ratio of oil to methanol was 6:1. In case of enzyme catalyzed reactions, lipase immobilized on calcium alginate beads at concentration levels of 1%, 2%, 3%, 4% and 5% (w/w oil), was mixed with methanol and oil, under constant refluxing at 40 °C for 24-hrs. Molar ratio of methanol to oil was 5:1. After the reaction completion, the mixture was placed overnight for the separation of diesel from glycerol. Warm distilled water was used for the removal of excess methanol, unreacted catalyst and soap. Washed product was distilled for the removal of moisture. Final good quality biodiesel was subjected for chemical analysis. Fuel composition was tested by GC-MS analysis (ASTM, 2003) [3]. The density (g/ml) was determined by measuring the mass of 1ml of each sample [4].

RESULTS AND DISCUSSION

In case of acid catalysed reactions, five concentrations of HCl were used to optimize the yield of biodiesel. Biodiesel yield increased on increasing catalyst concentration. Optimum yield (97%) was obtained at HCl 40% (w/w). While, biodiesel yield was decreased by further increase in catalyst concentration, because of decomposition of fatty acids at higher acid concentration. Minimum yield (89%) was observed at HCl 100% (w/w). Same trend was recorded earlier during the production of biodiesel from rubber seed oil [5]. While in case of base catalysed biodiesel production, the maximum yield (86%) was achieved at KOH 0.6% (w/w). Biodiesel yield was reduced at higher concentrations due to gel and soap formations. Minimum yield (77%) was obtained at KOH 1% (w/w). Similar trend was recorded in another study, during production of biodiesel from waste soybean oil [6]. Five concentrations of immobilized lipase were used for synthesis of tamarind seed biodiesel. Optimum biodiesel yield (89%) was dependent on the available active site at lipase 3%.

GC-MS analysis was performed to quantify the esters present in tamarind seed biodiesel. Palmitic acid, stearic acid and linoleic acid were major fatty acids found in tamarind seed biodiesel, while, caprylic acid, myristic acid, capric acid, behenic acid, gondoic acid, tricosylic acid and arachidic acid were present in trace amount.

CONCLUSIONS

Fuel properties of Tamarind (*Tamarindus indica* L.) seed oil biodiesel, were comparable and in some cases superior to conventional biofuels. Presence of low molecular weight fatty acids in Tamarind seed oil, make it a perfect feedstock for biodiesel production. Furthermore, tamarind seed biodiesel had shown higher cetane number when compared to other biodiesel feedstocks. Lower cloud and pour points of tamarind seed biodiesel, make it suitable to be used as a substitute of conventional fuels in colder regions of world.

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