International Journal of Advanced Technology in Engineering and Science
Vol. No.3, Special Issue No. 01, November 2015
www.ijates.com
ijates
ISSN 2348 - 7550

PRODUCTION OF BIO-DIESEL FROM SILURIFORMES FISH OIL BY TRANS-ESTERIFICATION

R. Balasubramanian[1], P. Sivakumar[2], A. Sircar[3], Shivam Pandey[4]

[1,3,4]School of Petroleum Technology, Pandit Deendayal Petroleum University, Gujarat, (India)

[2]RVS College of Engineering and Technology, Coimbatore, Tamil Nadu, (India)

ABSTRACT

In the 21st century, a large volume of fish wastes is produced on a daily basis. In the Indian sub-continent, Gujarati too is not behind in it. This abundant waste fish source left out after processing of the fish products could serve as a commercial feedstock for bio energy generation. In the present study oil extracted from discarded fish parts were used for high quality biodiesel production.Siluriformes oil was transesterified using methanol and base catalyst NaOH. The optimum yield of biodiesel was produced 98.3%.Characterisation of biodiesel was done on GC, FT-NMR.

***Keywords*: Biodiesel; Siluriformesoil; Characterization; Transesterification**

I. INTRODUCTION

Break through caused by energy is ameliorating human developments. More than 80% of the world's energy requirements are met largely by fossil fuels, coal, crude oil, and natural gas. Although such fuel sources are limited, together with the increasing crave that future demands won't be sustained by completely leaning on these conventional sources. In the above mentioned context Bio-Diesel/Bio-fuel, act as a pre-eminent alternative.Bio-fuels advert to liquid or gaseous fuels used by the transport sector that are predominantly produced from biomass. The well-known aspect that a large percentage of energy consumption is for transport needs, it is of utmost importance and need that more sustainable alternative fuel options be explored. Huge contentment has been shown by biodiesel as a biofuel. Numerous methods are initiated for generating bio-diesel using various feedstock, now it is seen the ways to progress it further. Technically, it refers to a vegetable oil- or animal fat-based diesel fuel which comprises of long-chain alkyl esters and is typically made by reacting lipid/fatty acids with an alcohol chemically in presence of a catalyst.

The importance of fish as food has been understood by human being since ancient times. At present it has become an export-oriented industry contributing to the national economy. Fishing industry not only provides proteinaceous food for millions of people, but also employs millions of people throughout the world. In India with its tropical and subtropical climate, the problem of decomposition process become more severe as heat and moisture promote decomposition. It has been observed that depending upon the processing technology, the type of fish processed and seasons, the pollution load varies. Using the leftover of processing wastes for biodiesel generation can help in both the ways, reusing the waste generated and production of transportation fuel.

Renewable sources from both vegetable [1] and animal fat [2] origin can be used as raw materials for biodiesel production.The test performance of the biodiesel obtained from waste anchovy fish in neat form and blended

at various ratios with petroleum based diesel (25:75, 50:50, 75:25)[3]. Neat biodiesel from the fish oil and those blended with diesel at various proportions showed reduced engine torque by 4.14 %, reduced engine power by 5.16 % and increased specific fuel consumption by 4.96 %. On the advantageous side, the average reductions in exhaust emissions were significant (4.576, 21.3, 33.42 % reduction in CO_2, CO and hydrocarbons, respectively when compared to mineral diesel). Moreover, the anchovy fish oil contained significant amount of saturated fatty acids (37.93 %) that led to improvement in cetane number and resulted in lowered NO_x emission as well. It is also argued that biodiesel produced from fish oil had a higher heating value compared to than those of animal fat or vegetable oil.

The present work was set to establish a transesterification process for high quality biodiesel production from siluriformes fish oil. Further characterisation was done by using Fourier Transform-Nuclear Magnetic Resonance (FT-NMR), GC to investigate the quality of the fuel generated.

II. MATERIALS& METHODS

2.1Sample Collection

About 2 kg of fish sample (Siluriformes) that does not meet sales requirement was collected from local fish market in Gujarat, India. The catfishes group is an incredibly diverse group of mainly freshwater fish. There are 2400 species in 33 families; only 2 of those families contain species that may be found in salt water. Catfishes are recognizable by their smooth, almost scale-less skin, and the sets of barbells (or whiskers) on their faces. Siluriformes contains a good amount of fat in every part of body.

The coast line of Gujarat (1600 Km approx. 24 % of India) is the largest in India. Gujarat's contribution of fish production was around 8 Lakhs tons, which is approx.10.05%, of the total national production. Thus, there is ample opportunity for fish meal processing units, as value added processing of fish in Gujarat. As per industry norms about 15 to 20 % of fish catch can be converted into meal and as per this estimated potential in Gujarat is between 96000 to 127000 tons per annum and the same data also shows that there is around 35-45% fish waste is also generated, which gives a good scope for future for feedstock for bio-diesel production. Fishes like Siluriformes, Catlacatla, Labeorohita, Cirhhinusmrigala, are found in large number when compared to other fishes.

2.2Lipid Extraction

Aggregate lipid from the fish material was extracted following the method [4]. As the very first step, fish material was dried and it was ground with mortar and pestle. Then, chloroform and methanol in the ratio of (2:1) was added to about 800g of minced fish. It was then left untouched for 2 hours. Then later it was filtered through a Whatman filter paper no. 41 and the filtrate was collected in beaker. The residue was re-extracted in the same solvent and filtered. To the filtrate, $1/5^{th}$ volume of0.7 % saline was added and mixture was transferred to a separating funnel and left undisturbed for12 hrs. The layer at the bottom was cautiously taken out from the separating funnel and kept for drying.

2.3Evaporation

Then later on the mixture was evaporated in vacuum to release the undesirablechloroform and methanol using rotary vacuum evaporator. The beaker was weighed before andafter total evaporation and the difference

indicated the weight of lipid present in the fish material.

2.4 Catalyst Preparation and Production of Biodiesel

For the reaction of transesterification [5], 2 g of NaOH was mixed with 100mL of methanol and stirred properly. The mixture of catalyst and methanol was poured into extracted oil in a conical flask. The conical flask containing solution was stirred for 3hrs by magnetic stirrer at 250 rpm. After stirring, the solution was kept for 16 hrs to allow the mixture to separate out and settle down clearly in to two layers. Biodiesel was washed with 5% water until it became clean.

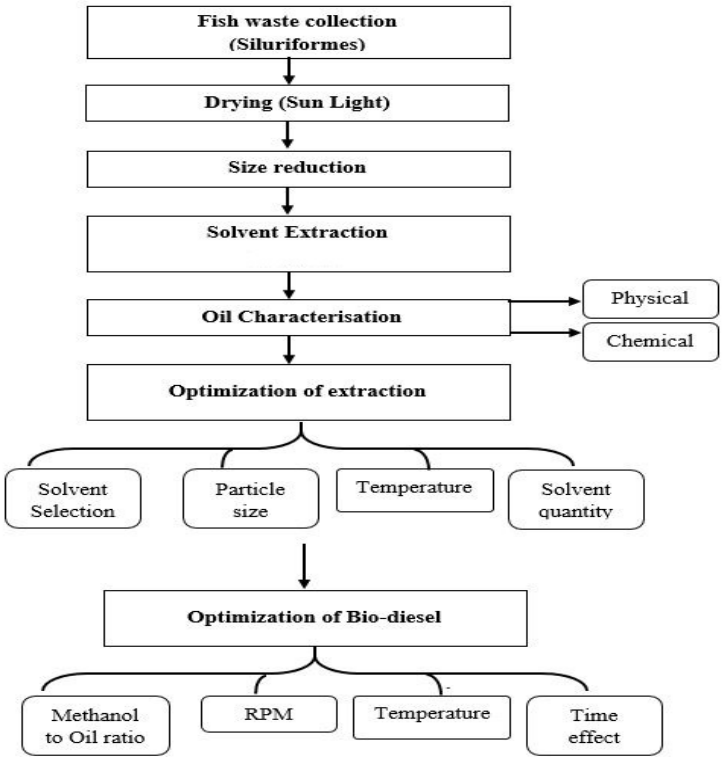

Fig.1. Process Flow chart

To 200mL of biodiesel obtained, 800mL ofpetroleum diesel fuel was added to produce Biodiesel blend (B-20). Then, it was investigated for finding out some important parameters such as [6] Density, Water content, Kinematic Viscosity, Flash point, Cloud point, Acidity, Copper strip Corrosion test, Ash, Carbon residue, Sulphur content, Calculated Cetane Index (CCI) and Final Boiling point (Table 2).

III. RESULTS AND DISCUSIONS

3.1 Fatty Acid Profile of Fish Oil

The fatty acid composition of siluriformes fish oil was analyzed according to AOCS Ce 1b-89. It shown in Table.1 that fish oil was composed 40.34 wt% Oleic acid (C18:1), 28.13 wt% Palmitic acid (C16:0) and 12.02 wt% Linoleic acid (C18:2).

Table 1. Fatty acid Composition of Fish Oil:

Fatty acid	Lipid Number	Siluriformes Fish oil
Myristic acid	C14:0	3.71
Palmitic acid	C16:0	28.13
Palmitoleic acid	C16:1	5.72
Stearic acid	C18:0	8.37
Oleic acid	C18:1	40.34
Linoleic acid	C18:2	12.02
Eicosenoic acid	C20:1	0.66
Eicosapentaenoic acid	C20:5	0.51
Arachidonic acid	C20:4	0.31
Erucic acid	C22:1	0.13
Total unsaturated		59.69
Total saturated		40.21

The content of polyunsaturated fatty acids with more than three doubles,including C20:1, C20:4, C20:5, and C22:1, amounts to 60wt%. The saturatedfattyacids,includes C14:0, C16:0, and C18:0, amounts to 40wt. %. Biodiesel usually shows similar fatty acid profile of its rawmaterial.

Table 2. Properties of Biodiesel

Tests	Test Method	Results Obtained
Density @ 15.5°C in gm/cc	IS 1448, P: 16	0.8291
Water content(%vol.)	IS 1448,P:40	0.031%
KinematicViscosity @40°C incSt	IS 1448,P:25	4.33
FlashPoint byPensky Marten's Method(°C)	IS 1448,P:20	115
Acidity, mgofKOH/gm	IS 1448,P:2	0.25
Copperstrip Corrosiontest @80°Cfor3hrs	IS1448,P:15	1A
Ash(%mass)	IS 1448,P:4	Nil
Conradsoncarbon Residue(%mass)	IS 1448,P:122	0.001%
Sulphurcontent(%mass)	IS:1448,P:33	<0.01%
CalculatedCetaneindex (CCI)	IS 1448,P:9	58
FinalBoilingPoint(°C)	IS 1448,P:18	356

3.2 Water Content

Biodiesel easily contaminated by presence of water and it will easily create corrosion problem to engine or easily react with glyceride to produce soap formation. Water act as a media for bacterial growth, leading to filter blockage. Due to these negative effects, ATM D 6751 set the maximum allowable content of 0.05% for water in biodiesel. Water and sediment test showed 0.031% water in biodiesel produced from siluriformes fish oil.

3.3 Boiling Point Test

The distillation apparatus (Fig 2.) used to test strongly correlates with the boiling point of a liquid fuel and thus can significantly affect the combustion characteristics of diesel engines.The ignition delay of fuel will be shortened at a higher distillation temperature, thus decreasing the probability of occurrence of knocking in diesel engines. Fish oil biodiesel showed in specific distillation temperature of 356°C, through very close to the limit of 360°C.

Fig. 2. Boiling Point Test

IV. CONCLUSION

As increasing amount of solid waste has become a second generation energy sources. These wastes could be convertedinto second generation fuel like high quality biofuel. The present study shows that biodiesel produced from siluriformes fish oil and the properties were tested as per ASTM specifications (D7467-10).

REFERENCES

[1] Reaney, M.J.T., Hertz, P.B., McCalley, W.W. 2005. Vegetable oils as biodiesel, In: Bailey's Industrial Oil and Fat Products (6th ed.), Shahidi, F., pp. 223-257, John Wiley & Sons, ISBN 978-04-716784-9-6,

Hoboken, USA.

[2] Lee, K.T., Foglia, T.A., Chang, K.S. 2002. Production of alkyl ester as biodiesel from fractionated lard and restaurant grease. Journal of the American Oil Chemists Society. 70(2), pp. 191-195.

[3] Behcet, R., 2011. Performance and emission study of waste anchovy fish biodiesel in a diesel engine. Fuel Process Technol. 92 (6), pp.1187-1194.

[4] Floch, J., Lees, M., Solane-Stanley, G.H. 1957. A simple method for the isolation and purification of total lipids from animal tissues. J.Biol.chem. 226,pp. 497-506.

[5] Rai, A.K., Swapna, H.C., Bhaskar, N., Halami, P.M., Sachindra, N.M., 2010. Effect of fermentation ensilaging on recovery of oil from fresh water fish viscera. Enzyme and Microbial Technology 46, pp. 9-13.

[6] Mohideen Abdul Khader, M.G., Abhishek, G., Priya, G., Magesh Peter, D., 2012. Biodiesel fule (B-10) production using waste fishes (Sardinella Fimbriata). Asian Journal of Microbiology Biotechnology & Environmental Sciences. 1, pp. 111-115.