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Analysis of oils extracted from vegetable seeds for their suitability as biofuels

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ABSTRACT

During recent years high activities can be observed in the field of alternative fuels, due to supply of petroleum fuels strongly depends on a small number of oil exporting countries. Biodiesel and alcohol are being considered to be supplementary fuels to the petroleum fuels in India. These biofuels are being looked to provide employment generation to rural people through plantation of vegetable oils. In this context, in the present study it is decided to determine the fuel property of dried seeds of selected plants; these seeds are otherwise thrown away in the garbage in the normal Indian household. Investigations were made into some basic properties of five different types of seeds obtained from different plants. Oil content of these seeds was determined to check their suitability for commercial extraction. Information on the physical properties (yield, density, viscosity, saponification number, iodine number, acid value, free fatty acid content) of the seeds was recorded. Among the tested seeds, cucumber seed was shown very good properties than other seeds.

Key words: Biodiesel, Seeds of vegetables, Oil analysis.

INTRODUCTION

The demand for diesel and gasoline is increased drastically. It has been estimated that the demand for diesel will be increasing day by day. During recent years high activities can be observed in the field of alternative fuels, due to supply of petroleum fuels strongly depends on a small number of oil exporting countries. Hence, government of India has taken necessary steps to fulfill future diesel and gasoline demand and to meet the stringent emission norms. Biodiesel and alcohol are being considered to be supplementary fuels to the petroleum fuels in India. These biofuels are being looked to provide employment generation to rural people through plantation of vegetable oils [1]. Considerable research has been done on vegetable oils as diesel fuel. Feedstock commonly used includes: palm oil, sunflower oil, coconut oil, rapeseed oil and tung oil [2]. Animal fats, although mentioned frequently, have not been studied to the same extent as vegetable oils. Some methods applicable to vegetable oils are not applicable to animal fats because of natural property differences. Oils from algae, bacteria and fungi also have been investigated [3]. Microalgae have been examined as a source of methyl ester diesel fuel [4]. Terpenes and latexes also were studied as diesel fuels [5].

Biodiesel has become more attractive recently because of its environmental benefits and the fact that is made from renewable resources [6]. Moreover, they have practically no sulfur content, offer no storage difficulty, and they have good lubrication properties [7]. Biodiesel almost completely eliminates lifecycle of carbon dioxide emissions. When compared with petro-diesel it reduces about half of the emission of particulate matter, unburned hydrocarbons, and carbon monoxide; most part of the polycyclic aromatic hydrocarbons and entire sulphates on an average [8]. Lower

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emission of sulphur dioxide, soot, carbon monoxide, hydrocarbons, polyaromatic hydrocarbons, and aromatics are noted. NO_x emissions from biodiesel are reported to range between plus or minus 10% as compared with petrodiesel depending on engine combustion characteristics [9]. Biodiesel can be mixed with petroleum-based diesel in any proportion [10]. Biodiesel blends can be used in most compression-ignition (diesel) engines with little or no modifications. Consequently, biofuel production can provide self employment opportunities [11]. In this context, in the present study it is decided to determine the fuel property of dried seeds of selected plants.

MATERIALS AND METHODS

In the present study, the following five different seeds were investigated for their potentiality to produce oil. a. Cucumber b. Ash gourd c. Pumpkin d. Papaya e. May flower

The seeds were dried and powdered. The oil from the powdered seeds was extracted by dichloromethane by using Soxhlet apparatus. After extraction, the excess solvent was evaporated and the oil thus obtained was checked for its different properties by the reported procedure [12].

A. Yield

The yield of the oil was determined by using the formula given below. % Yield = Amount of oil extracted $\times 100$ / Total weight of seeds

B. Determination of Density and Kinematic Viscosity

i. Density Measurement by Specific Gravity Bottle

Empty weight of dry specific gravity bottle was noted (m_0) . The specific gravity bottle was then filled with sample and weight was noted (m_s) . The same specific gravity bottle was dried and filled with water; weight was noted down (m_w) . The specific gravity was measured using following relation:

 $S_G = (m_S - m_W)/(m_W - m_0)$

The density of samples was calculated by multiplying S_G with density of water.

C. Kinematic Viscosity by Ostwald Viscometer

Ostwald viscometer is generally used for measuring viscosity of fluid in the range of 1-10 cSt. Ostwald viscometer consists of a bulb and a capillary filled with fluid. The time taken by the fluid to run through the capillary is measured. The time taken by water to flow through same capillary is also measured. The kinematic viscosity of fluid is given as:

 $\upsilon = \upsilon W {\times} (\theta {/} | \theta_W) {\times} \rho {/} | \rho_W$

Where v and v_W are kinematic viscosities of sample and water at given temperature, θ and θ_W are time taken by sample and water to flow through the capillary and ρ and ρ_W are the densities of sample and water at given temperature.

D. Determination of Saponification Number

The saponification value (S.V.) is the number of mg of potassium hydroxide required to saponify 1g of fat which is determined by IUPAC method¹². Weighed about 2 g samples to an accuracy of 0.005g into round bottom flask. Added 25 mL of ethanolic KOH solution and boiled. After 60 minutes of heating, to hot solution added 0.5 mL of phenolphthalein and titrated with hydrochloric acid solution until the color of indicator changes. Carried out a blank test without the sample.

Saponification value: S.V. = $56.1 \times N \times (V_B - V_S)/m$

Where N is standard normality of hydrochloric acid solution, V_B is titre value for blank, V_S is titre value for sample and m is mass of sample.

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E. Determination of Iodine Number

Iodine value (I.V.) of a fat is the number of grams of halogen absorbed by 100g of the fat, and expressed as weight of iodine. Iodine value is determined by IUPAC procedure using Wijs method¹². Weighed about 0.4g of sample to an accuracy of 0.001g into an iodine flask. Added 15 mL of CCl_4 to dissolve fat. Added exactly 25 mL of Wijs reagent, stoppered the flask, shaken gently and placed in dark for 30 min. Added 20 mL of potassium iodide solution and 150mL of water. Titrated with sodium thiosulfate solution using starch solution as indicator, continuing the titration until the blue color just disappears after vigorous shaking. Carried out a blank test simultaneously without the sample.

Indine value is given by: I.V. = $12.69 \times N \times (V_B - V_S)/m$

Where N is standard normality of sodium thiosulfate solution, V_B is titre value for blank, V_S is titre value for sample and m is mass of sample.

F.Determination of FFA and Acid Value

Free fatty acid content and acid value of oil and biodiesel were determined as per the IUPAC standard which is described as follows¹². Weighed about 1 g of sample to an accuracy of 0.001 in to a conical flask. Dissolved it in about 50 mL of the solvent. Added 0.3 mL of phenolphthalein indicator. Titrated with the solution of potassium hydroxide to the end point of the indicator (pink color must persist or atleast 10s)

The acid value is given as: A.V. = $56.1 \times N \times V/m$ (mgKOH/g)

Where V is titre value (mL), N is standardized normality of KOH solution; m is mass of sample (g)

Free fatty acid is given as: %FFA = $28.2 \times N \times V/m$

Where V is titre value (mL), N is standardized normality of KOH solution; m is mass of sample (g).

RESULTS AND DISCUSSION

A. Yeild:

The yield of the oil extracted from different seeds is found to be in the range 9-27%. Among the tested seeds the yield of cucumber and pumpkin has the highest values. The values are listed in the Table 1 (Fig. 1).

B. Determination of Density and Kinematic Viscosity

i. Density Measurement by Specific Gravity Bottle

The density of tested seed oils showed varying values. The Ash gourd seed oil is much denser than other oils where as cucumber seed oil has the lightest weight compare to other oils. The results are listed in the Table 1 (Fig. 2).

ii. Kinematic Viscosity by Ostwald Viscometer

Among the tested seed oils pumpkin is more viscous than other oils. But the cucumber seed oil showed very low viscosity compared with others (Table 1, Fig. 3).

C. Determination of Saponification Number

The saponification number of different tested oils is listed in Table 1 (Fig. 4). Cucumber showed very low saponification number where as Ash gourd showed very high saponification number compare to other tested seed oils.

D. Determination of Iodine Number

The iodine number of Pumpkin seed oil is found to be high among the tested oils. The Ash gourd seed oil showed very low iodine number compare to other oils. The results are presented in the Table 1 (Fig. 5).

E. Determination of FFA and Acid Value

The FFA and acid value of cucumber seed oil showed very high values compare to other tested oils. The values are listed in Table 1 (Fig. 6 & 7).

SEEDS	Yield (%)	Density (g/cc)	Viscosity (Centipoise)	Saponification number	Iodine number	Acid Value	% Free Fatty Acid
Cucumber	27	0.9872	8.024	56.10	29.51	48.807	24.53
Ash gourd	15	1.6466	37.913	299.29	6.13	8.976	4.51
Pumpkin	25	1.5794	28.594	70.12	52.34	5.049	2.53
Mayflower	9	1.4261	28.472	154.27	45.80	11.22	5.64
Pappaya	22	1.6235	36.148	120.61	31.41	12.342	6.204

Table 1: Physicochemical parameters of oils extracted from vegetable seeds



Fig. 1: Percentage oil yield



Fig. 2: Density of oil



Fig. 3: Viscosity of oil



Fig. 4: Saponification number of oil



Fig. 5: Iodine Number



Fig. 6: Acid value



Fig. 7: Percentage free fatty acid

CONCLUSION

Investigations were made into some basic properties of five different types of seeds obtained from different plants for their suitability as biofuels. Oil content of these seeds was determined to check their suitability for commercial extraction. Information on the physical properties (yield, density, viscosity, saponification number, iodine number, acid value, free fatty acid content) of the seeds were recorded. Among the five types of seeds, cucumber seed was shown very good properties than other seeds.

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REFERENCES

[1] K. N. Nadar, R. P. Reddy and E. R. Anjuri, *Thermal Science*, 2008, 12, 151.

[2] M. A. Haque, M. P. Islam, M. D. Hussain and F. Khan, CIGR Ejourna , 2009, 2009, 2.

[3] F. Xiaohu, Optimization of biodiesel production from crude cottonseed Oil and waste vegetable oil: conventional and ultrasonic Irradiation methods, A Thesis Presented to the Graduate School of Clemson University.

[4] A.V. Krishna Reddy M. Shiva Shankar, K. Apparao, International Journal of Engineering and Technology, 2010, 2 (5), 305.

[5] M. Pugazhvadivu1 and G. Sankaranarayanan, Indian Journal of Science and Technology, 2010, 3, 787.

[6] E. Saucedo, *Ingeniera Quimica*, **2001**, 20, 19.

[7] A.K. Mishra, N. Singh and V.P. Sharma, Indian J Malariol, 1995, 3, 99.

[8] W. Du, Y. Xu, D. Liu and J. Zeng. Journal of molecular catalysis B: enzymatic. 2004, 30, 125.

[9] J. Tickell, From the fryer to the fuel tank. Green Teach Publishing, Florida, USA. (1999).

[10] M.I. Khan, A.B. Chhetri, and M.R. Islam, Energy sources, 2000, 69, 21.

[11] A. A.V. Anuoluwa, O.D. Enock, S. A. Michael, O.O. Fatai, A. A. Kehinde, Int. J. Sci. & Eng. Res. 2013, 4, 654.

[12] Paquot, C. Paquot, Standard Methods for the Analysis of Oils, Fats and derivatives (sixth ed.) Springer (1979).