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REVISITING THE JATROPHA CURCAS L. AS A POTENTIAL RESOURCE OF DYES, MEDICINE, BIODIESEL, BIO -PESTICIDE AND INDUSTRIAL SURFACTANT.

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Abstract:- The plant Jatropha Curvus L. has gained much importance in recent days for the potential biodiesel source but the cost of the biodiesel is not comparable to that of mineral diesel. Therefore the farmers are reluctant to shift towards the farming of Jatropha Curvus L. The present work demonstrates the possibility of multiple product range from the plant and the possibility of processing at farm level. The use of eggshell catalyst for biodiesel production, single pot dying method, and low cost extraction of bio pesticides may open the avenue for farm level production unit making the cultivation of Jatropha Curvus L. profitable. The present work deals with the extraction of dye and production of biodiesel from Jatropha Curvus L. in an eco-friendly way using eggshell based heterogeneous catalyst.

Keywords:natural dye, Jatropha Curvus L., biodiesel.

INTRODUCTION

The plant Jatropha Curvus L. is of Euphorbiaceae family recently attracted an attention of scientists and technologists for the production of methyl ester of jatropha oil. But it is long known to tribes as a medicine, fertilizer and oil yielding plant. The white light produced from jatropha oil lamp resulted in the name Ratanjyot or chandrajyot. In recent days the increasing fuel crisis led the people think about the alternate source of automobile fuel. The Transesterification of fatty acid to form the methyl ester which resembles with mineral diesel in properties opened the door for discovery of low cost vegetable oils to produce the biodiesel. The Jatropha Curvus L. contains 38% oil and the plant grows at all altitudes and in adverse climatic conditions even in low quality land. The boost for the plantation of Jatropha Curvus L. from government and NGO levels increased the plantation but no assured yield of seeds and low price made the farmers disappointed. The Jatropha Curvus L. is not merely oil yielding plant but it has many applications in the fields of medicine, fertilizer, dye extraction and soap industries. Jatropha Curvus L. oil cake contains more percentage of N,P,K than any other compost or manure. The alkaloid Jatrophine makes the source anti cancer. The plant juice is analgesic and antihelmintic. The bark produce blue dye while brown is produced from leaves. The production of dye and biodiesel as farm based activities will be profitable to the farmers there fore here is an effort to make the technology of dye extraction and production of biodiesel economic, eco-friendly and appropriate.

The production of biodiesel:

1.1selection of catalyst: the use of metallic sodium or sodium hydroxide is common as catalyst in the production biodiesel but they are costly, corrosive and highly polluting. We used the calcinated egg shell as heterogeneous catalyst which is very low cost and can be prepared in lime kiln. Raw egg shells were collected from college students kitchen. The egg shells were washed with lot of hot water to remove the organic matter on shells. Then it was dried in hot air oven at 105 $^{\circ}$C for 12 hrs. Then it was ground in an agate mortar in powder form. Thereafter, powder was calcined in open furnace at 900 ^{0}c for 2 hrs. As the seeds often possess hard outer shells which bear no oil, it was considered appropriate to first dehusk the hard and woody seeds before carrying out the estimation of oil content.

Then seeds were dried at 105^{0}C for 30min in oven. Jatropha oil was extracted by mechanical press technique to avoid the use of costly solvents. Chemicals such as sulphuric acid, methyl alcohol, orthro- phosphoric acid, sodium sulphate were purchased from Merck ltd. Mumbai, Maharashtra.

CHARACTERIZATION-

Differential thermal analysis, X- ray diffraction (XRD), Surface Electron Microscopy (SEM), Fourier transform infrared (FTIR) spectroscopy experiments were conducted to study the characteristics of calcined egg shells. These entire tests were performed at IIT, BHU, Varanasi, India. The fatty acid profile of jatropha was performed on gas chromatogram mass spectra at CFT,Pune, Maharastra.

EXPERIMANTAL PROCEDURE-

The Transesterification reactions were performed in batch reactor having three necked round bottom flask of two liter capacity. The middle neck was used to insert a mechanical stirrer, left side neck was used to insert condenser and other neck was used to insert thermometer for temperature measurement. A total of 1000ml oil was dehydrated in oven at 105°C for 2 hr. & it was used for each experiment. Acid esterification was performed with 1.7% (v/v) sulphuric acid as a acid catalyst with 8:1 molar ratio (methyl alcohol to oil) to reduce acid value of feedstock oil for 1.3hr. The speed of mechanical stirrer was kept constant at 600 rpm to overcome mass transfer limitation. When acid esterication completed, reaction mixture was settled for 4hr. in the same reaction, water was formed which was dehydrated for 2hr. then the esterified jatropha oil was proceeded for Tranesterification reaction. Here calcined egg shell powder i.e. CaO is used as a base heterogeneous catalyst. The reaction conditions taken were as 8:1 (alcohol: oil) molar ratio with 2.5wt % of CaO catalyst at 65±0.5 °C for 2.5 hr of reaction time. Then after Transesterification completion, byproduct glycerol was separated manually. The important factors those affect on yield and conversion were studied separately. The extracted jatropha oil was filtered then it was proceeded to perform important physico-chemical properties as well as to analyze available fatty acids by Gas chromatography mass spectra of respected oil. The peaks were identified using standards of fatty acids and the identified fatty acids were listed in Table 1

The jatropha oil contains both saturated and unsaturated fatty acids. Amongest these, Oleic acid (37.279%) found highest, Lonoleic acid (35.00%) were in next quantity then Palmitic acid (14.240%), and Stearic acid (6.585%) were found. This stearic acid is responsible for high cloud point of biodiesel.

Table 1- Fatty acid composition of Jatropha oil.

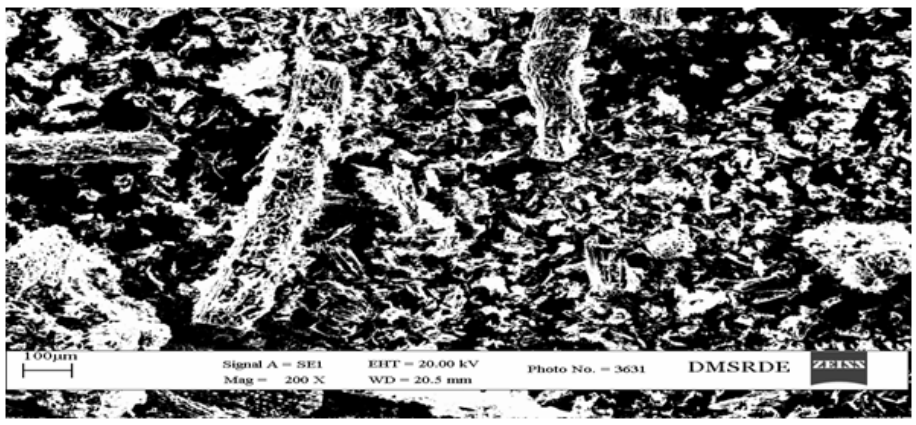
Sr.	Fatty acid name	Formula	Composition(%)
1	Caprylic Acid	C8:0	0.036
2	Myristic Acid	C14:0	0.066
3	Pentadecanoic acid	C15:0	0.009
4	Palmitic acid	C16:0	14.240
5	Heptadecanoic acid	C17:0	0.085
6	Stearic acid	C18:0	6.585
7	Palmitoleic Acid	C16:1	0.796
8	Cis-10 Heptodeconic Acid	C17:1	0.038
9	Oleic acid	C18:1	37.279
10	Cis-11 Eicosenoic acid	C20:1	0.230
11	Linoleic Acid	C18:2n6c	35.00
12	Alpha-Linolenic acid	C18:3n3	0.086
13	Gamma- Linolenic acid	C18:3n6	0.238
14	Eicosadienoic Acid	C20:2	
15	Cis- 11,14,17Eicosatrienoc acid	C20:3n3	0.086
16	Arachidonic Acid	C20:4n6	0.153
17	Cis-13'16 Docosadienoic acid	C22:2	0.202

Table 2- Physico- chemical properties of Jatropha oil.

Sr.no	Parameter	Jatropha Curcas Oil
1	Density (gm/cc),30^0c	0.94
2	Kinematic viscosity (mm^2/s), 30^0c	55
3	Flash Point (^{0}c)	265
4	Fire Point (^{0}c)	277
5	Cloud Point (^{0}c)	-5
6	Pour Point (^{0}c)	-1
7	Cloud Filter Plugging Point (^{0}c)	5
8	Saponification Value	187
9	Acid value(mg KOH/g)	17.88
10	Cetane value	51
11	Calorific value Kcal/Kg	8908
12	Sulphur (%) by Wt	0.0.13
13	Oxygen (%w.w)	11.06
14	Carbon (%,w/w)	76.11
15	Hydrogen (% w/w)	10.52
16	Ash Content (% w/w)	0.03±0.0

SEM Analysis –

SEM analysis revealed irregular and heterogeneous shaped particles. Particles of various shape are present in the SEM analysis. There are rod shaped particle 100 µm in breadth to several hundered micrometer in length. In addition to this irrengular shaped particles of ranging from 20 µm in diameter to few hundered diameter are present.



Transesterification reaction-

The Transesterification reaction has been carried out with calcined egg shell as a catalyst with jatropha oil feedstock.. The parameters that affected the trans-esterification reaction are molar ratio of alcohol to oil, catalyst concentration, temperature of reaction, time of reaction, stirring speed. All these parameters were studied separately for yield optimization.

The high yield and conversion of jatropha oil to biodiesel were achieved by optimizing the parameters such as molar ratio (alcohol to oil), catalyst concentration, and time of reaction, stirring speed and temperature. The parameters optimized during acid esterification were molar ratio of 8:1 (methanol to oil) with 1.7% (v/v) H_2SO_4 at 60± 0.5 ^{o}C for 1.3hr. The same parameters were optimized for Tranesterification with calcined eggshell as a catalyst. The optimized values obtained were molar ratio of 8:1 (methanol to oil) with 2.5wt% of catalyst (calcined eggshell) at 60± 0.5 ^{o}C for 2.5hr. Which given a high yield 90.04% of biodiesel. The biodiesel synthesized from jatropha biodiesel fulfilled minimum ASTM6751 specifications. The calorific value of optimized jatropha biodiesel was 37.5 MJ/Kg and that of diesel fuel is 42.5MJ.Kg. The flash point and fire point of jatropha biodiesel were determined as 167 ^{o}C and 176 ^{o}C which are higher than diesel fuel. That's why biodiesel is considered as a safe fuel for storage and transportation.

The comparison of jatropha bio diesel with mineral diesel

Parameters	ASTM- 6751 test method [20]	Jatropha methyl ester
Acid value (mg KOH/g)	D664-07	1.78
Density (gm/cc)	D1448-1972	0.872
Kinematic viscosity (Cst at 40 ^{O}C)	D664-06	4.9
Cloud point	D2500	4
Pour point	D2500	-1
Flash point (^{O}C)	D93	167
Fire point (^{O}C)	D93	176
Cetane number	D613	51
Calorific value	D6751	37.5
Carbon (%)	By elemental analysis	75.08
Oxygen (%)	By elemental analysis	11.68
Hydrogen (%)	By elemental analysis	12.78
Nitrogen (%)	By elemental analysis	0.09

The extraction of dye from Jatropha Curvus L:

The leaves and stem of Jatropha Curvus L were boiled for 3-4 hours and solution was filtered from muslin cloth and the filtrate was concentrated into syrup by evaporation. It is further dried in sunlight or in oven. The dark brown lump was formed which then dissolved in cold water. The bleached cloth was soaked in the brown solution containing 10% dye extract to the weight of the cloth. The bath is heated up to 70^{0}C and the process was continued for one hour. The colour is fast and non bleeding but still it can be mordented in dilute acid or alkali solution for getting different shades of brown. The fastness properties of the dye were tested with different mordents like Alum, Potassium dichromate, ferric chloride, sodium sulphate and copper sulphate. The dye showed very excellent rub fastness and good light and washing fastness. The dye was found to be cheaper and superior to synthetic dyes.

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