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PHYSICOCHEMICAL CHARACTERIZATION OF SEED OIL OF *JATROPHA CURCAS* L.COLLECTED FROM DEHRADUN (UTTARAKHAND) INDIA

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ABSTRACT: To study oil contents and fatty acid composition among the samples of *Jatropha curcas L*. seeds were collected from Dehradun, Uttarakhand. Soxhlet extraction method and gas chromatography (GC) were employed to determine the oil contents of Jatropha seeds and the fatty acid composition of Jatropha oil. The seed oil contents (dry basis) was *46.27%* .Physicochemical properties shows acid value (36.46), iodine value (106.00 mg/g) and saponification value (194.70 mg/g.The evaluation of fatty acid composition using gas chromatography (GC) revealed that, oleic (44.93%), linoleic acid (33.40 %), Palmitic acid (15.39%) and Stearic acid (6.26%).

Keywords: Jatropha curcas; oil characterisation; physiochemical properties.

INTRODUCTION

Jatropha curcas is a shrub belonging to the Euphorbiaceae family. It is cultivated in central and South America, South East Asia, India and Africa (1). *J. curcas* can grow well under such adverse climate because of its low moisture demands, fertility requirements and tolerance to high temperatures (2).Jatropha is a drought-resistant perennial crop able to grow in a wide range of soils [3]. It is a quick growing crop and can produce seeds for up to 50 years [4]. The jatropha nuts/ seeds become capable of having their oil extracted after 2-5 years of plantation depending on the soil quality and rainfall. The annual yield of jatropha nuts/seeds is in the range from 0.5 to 12 tons. The cultivation of jatropha is successful in the tropics with annual rainfall of 2503,000 mm [3]. Jatropha can also grow at low and high altitude areas that have an average annual temperature above 20 0C and can tolerate slight frost. The marginal soil qualities with a low nutrient content [5] are sufficient for growing jatropha plants. The cultivation of jatropha may be advantageous to farmers due to the fact of soil erosion prevention, its ability to act as living fence and reclamation of waste land. [5]. Jatropha is a multipurpose plant with many attributes and considerable potential. The various parts of jatropha plant have many useful applications [6]. The oil extracted from the seed can be utilised as a biodiesel feed stock and in soap production. During the World War II [7], the jatropha seed oil was used as a diesel substitute. The leaves are used in traditional medicine against coughs or as an antiseptic [8]. The tree itself can be used as fire wood and as a hedge plant for protection. The latex produced from the branches can act as a haemostatic agent. The oil cake, a by product remaining after the extraction of oil can be used as an organic fertilizer. Jatropha oil is non-edible due to the presence of anti-nutritional factors such as phorbol esters [9].

The utilisation of edible food crops (com, soya, etc.) for the production of biofuels are expected to create a short supply of food for human consumption. The utilisation of non-edible and renewable crops such as jatropha is expected to minimize this problem. In addition to this, the increased environmental concern and the anticipated diminution of petroleum reserves are the main reasons for the exploration of alternative non-edible crops for biodiesel production [10].

MATERIALS AND METHODS

Collection of plant materials

J. curcas seeds were collected from the different areas of Dehradun. The ripe seeds were collected and the damaged seeds were discarded. The seeds were cleaned, de-shelled and air dried in the shade for few days. The seeds were ground to powder using a grinder prior to oil extraction.

Extraction of material

100 gm of the grounded seeds were taken and were placed in the Soxhlet apparatus and the oil was extracted using petroleum ether as solvent. The assembly was made to run for 8 hours. Anhydrous Sodium Sulphate was added to remove any trace of moisture from the extracted solution. The oil was separated from the solvent using distillation assembly.

The percentage of oil content can be calculated as below

$$\% \text{ of oil} = \frac{\text{Wt of oil obtained in gm}}{\text{Wt of seed taken in gm}} \times 100$$

After the oil had been obtained and its percentage of oil content is calculated the same is subjected to physiological test such as acid value test, iodine value test and saponifiacation value test Chemical Analysis of Seed Oil.

Acid Value

Two gram of the pure oil was weighed accurately by transfer method into a 250 mL conical flask. Neutral ethanol (20 mL) was added by means of a pipette and the flask heated on a steam bath for 3-min. Then the flask was cooled and the contents titrated with 0.1N alcoholic potassium hydroxide solution using phenolphthalein as an indicator. A blank titration was also conducted side by side.

Iodine Value

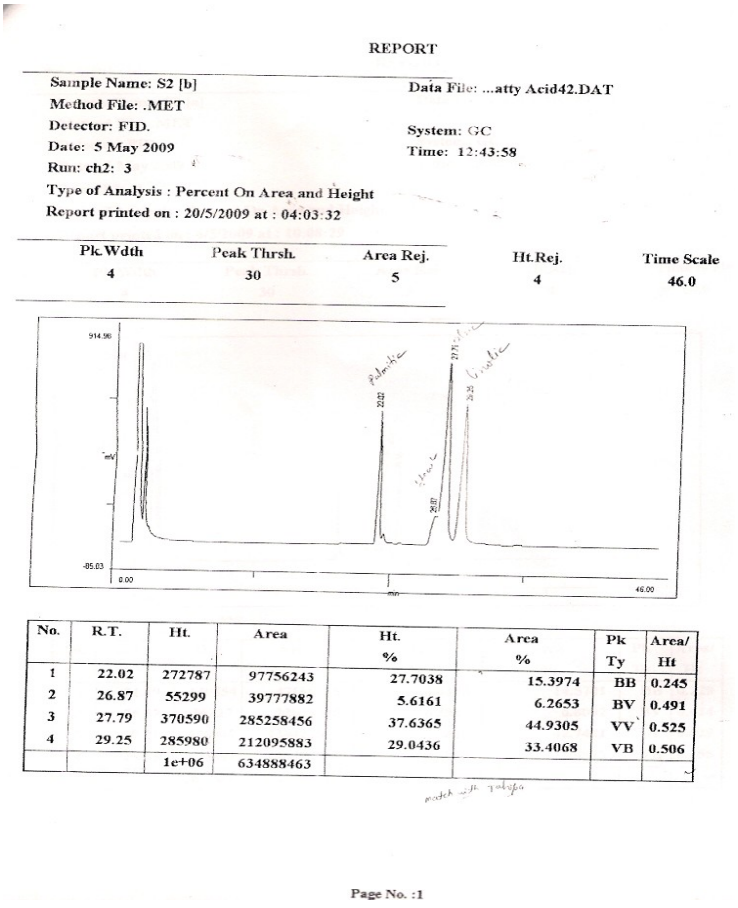
Oil (0.2 g) was weighed accurately by transfer method into a 250 mL iodine flask and dissolved in chloroform (20 mL). Wij's reagent (20 mL) was added by means of a pipette. The flask was stoppered and kept in darkness for one hr. with intermittent shaking. Then 15% of potassium iodide solution (10 mL) and 50 mL of distilled water were added to the flask and mixture was shaken well. The liberated iodine was titrated with 0.1 N sodium thiosulphate solution using fresh starch solution as indicator. A blank titration was also conducted side by side.

Saponification value

Two gram of oil was weighed accurately by transfer method into a 250 mL round bottom flask. Freshly prepared 0.5 N alcoholic potassium hydroxide solution (25 mL) was added to the sample by means of pipette and the mixture gently refluxed on a water bath using an air-condenser for one hr. Then the flask was cooled, the condenser tip washed with little distilled water and the contents were titrated with 0.5 N hydrochloric acid solution using phenolphthalein as indicator. A blank titration was carried out simultaneously.

GC condition for analysis of fatty acid profile

Fatty acid composition of the seed oil was determined using a NUCON series 5700 gas chromatograph equipped with the flame ionization detector and a stainless steel packed column 10 % DEGS having internal diameter 2mm and length 2.0cm . About 0.1 ml of oil was converted to the methyl ester by using the boron trifluoride and extracted in 1 ml hexane before being injected into the gc . The detector temperature was programmed for 200°C with a flow rate of 25ml/min. The injector temperature was set at 200°c .Column temerature was programmed from 70°c to 200°c with the increasing rate of temperature 6°c/min. Nitrogen was used as the carrier gas. Hydrogen 40ml/min. and Air 60ml/min were used for flame burnt.



REPORT

Sample Name: S2 [b]
Method File: .MET
Detector: FID.
Date: 5 May 2009
Run: ch2: 3
Type of Analysis : Percent On Area and Height
Report printed on : 20/5/2009 at : 04:03:32

Data File: ...atty Acid42.DAT
System: GC
Time: 12:43:58

Pk.Wdth	Peak Thrsh.	Area Rej.	Ht.Rej.	Time Scale
4	30	5	4	46.0

No.	R.T.	Ht.	Area	Ht. %	Area %	Pk Ty	Area/ Ht
1	22.02	272787	97756243	27.7038	15.3974	BB	0.245
2	26.87	55299	39777882	5.6161	6.2653	BV	0.491
3	27.79	370590	285258456	37.6365	44.9305	VV	0.525
4	29.25	285980	212095883	29.0436	33.4068	VB	0.506
		1e+06	634888463				

Page No. :1

Figure 1 . GC of seed oil

The peaks were identified by measuring the Retetion time of the samples and comparing the same standards analysed under the same conditions.

RESULTS AND DISCUSSION

Light brownish colour *Jatropha curcas* seed was evaluated for physical properties. Physical properties of seeds are given in Table 1. Chemicals are contained either in pulp or kernel that directly affected by the physical parameters. The average weight and volume of seed directly relate to the hardness of seeds that directly affects process of analysis. Physical properties of one seed to another seed could distinct the product quality of *J. curcas* seed and its chemical. The Jatropha seed contains *46.27*% oil. It has been reported that the toxicity and the disagreeable odor of seed is due to protein. The 4.56 %w/w total ash content of seeds indicates presence of abrasive solids, soluble metallic soaps, and silica residue in the seed.

The property of different fats and oils depends upon characterization of the degree of unsaturation or saturation with respect to hydrogen. Hence different oils are less or more saturated according as they contain greater or lesser proportion of the saturation in fatty acids. Therefore, it is important for researcher to know degree of unsaturation present in sample. The various number of test parameters like: iodine value (IV), saponification value (SV), and acid number (AN) had been estimated.

Results are presented in Table 2. The iodine value is a measure of the average amount of unsaturation of fats and oils and is expressed in terms of the number of centigrams of iodine absorbed per gram of sample (11). The oil shows a high iodine value due to its high content of unsaturated fatty acids (Table 3). The iodine value has found applications to various chemical and physical properties of fats and oils, having physiological applications, and serving as a quality control method for hydrogenation, these applications include use in standards for biodiesel and in assessing oxidative stability. *Jatropha* collected from rural area of Dehradun has nearer iodine value 104.46 then that reported 105.20 in Nigerian and 135.85 in Malaysian (12).

The saponification value (SV) is expressed as the number of milligrams of potassium hydroxide (KOH) required to saponify 1 g of sample. The saponification value of *J. curcas* seed oil was (175.12 mg/g)

Table1. Characterisation of *Jatropha curcas* Seed

Sr. No.	Analytical parameter	Values
1	Weight of 1000 seeds	540.51 g
2	Volume of 1000 seeds	730.00 mL
3	Oil content (% v/w)	46.31
4	Moisture and volatilities (%w/w)	05.80
5	Ash content (% w/w)	4.56
6	Colour	Light brownish
7	Odour	Disagreeable
8	Taste	Bitter
9	Protein % w/w (on dry basis)	22.50

Table2. Physicochemical characterisation of *Jatropha curcas* seed oil

Sr. No.	Physicochemical parameters	*Values for oil*
1	Specific gravity	0.913 at 28°C
2	Refractive index	1.496 at 28°C
3	Acid number (mg KOHm/g	36.461
4	Iodine value (mg/g)	104.46
5	Saponification value (mg/g)	175.12
6	Unsaponifiable matter (%)	1.02

Table 3. Fatty acid composition Of Jatropha seed oil by (Gas Chromatography)

Composition	%
Palmitic acid (C16:0) %	15.3974
Stearic acid (C18:0) %	6.2653
Oleic acid (C18:1) %	44.9305
Linoleic acid (C18:2) %	33.4068
Unsaturated Fatty Acid %	75.64
Saturated Fatty Acid %	24.36

The fatty acid composition of *J. curcas* oil was analysed by gas chromatography (Figure 1). Table 3 shows major long chain fatty acids present in the *J. curcas* oil which are palmitic acid (16.69%), stearic acid (7.67%), oleic acid (40.39%) linoleic acid (33.09%) and Linolenic acid (0.28%). *J. curcas* oil contains high percentage of unsaturated fatty acid which is about 75.64%.

CONCLUSION

Based on the physicochemical evaluation of the jatropha oil obtained from the seeds of Dehradun contains high percentage of unsaturated fatty acid which is about 75.64%. The jatropha oil can be classified as an unsaturated oil due to the presence of sufficient amounts of oleic and linoleic acids. Hence the *J. curcas* oil has a great potential for various application such as surface coating and low pour point biodiesel. Therefore, it is amiable to have more research on *J. curcas* seed oil in the future to explore its potentials for future industrial oilseeds crop.

REFERENCES

1. Gübitz, G.M., Mittlebach, M. & Trabi, M. 1999. Exploitation of the tropical oil seed plant *Jatropha curcas*. L. *International of Biosource Technology* 58: 77-82.
2. Kaushik, N., Kumar, K., Kumar, S., Kaushik, N. & Roy, S. 2007. Genetic variability and divergence studies in seed traits and oil content of Jatropha (*Jatropha curcas* L.) accessions. *Biomass and Bioenergy* 31: 497-502.
3. Foldi N, Goidl G, Sanchez M, Mittlebach M (1996) Jatropha curcas L.: as a source for the production of biofuel in Nicaragua. Bioresource Tech 58:77-82
4. Achten WMJ, Verchot L, Franken YJ, Mathijs E (2008) Jatropha biodiesel production and use. Biomass Bioener 32:1063-1084
5. Openshaw K (2000) A review of Jatropha curcas: an oil plant of unfulfilled promise. Biomass Bioenergy 19:1-15
6. Satheesh Kumar MN, Yaakob Z, Abdullah RS (2009) Applications of Jatropha oil seed crop. Ree Pat Mat Sci 2:131-139
7. Takeda Y (1982) Development STudy ai J atropa curcas oil as a substitute for diesel engine oil in Thailand, Interim Report of the Ministry of Agriculture, Thailand
8. Gubiz GM, Mittelbac M, Trabi M (1999) Exploitation of the tropical oil seed plant Jatropha curcas L. Biores Tech 67:73-82
9. Gubiz GM, Mittelbac M, Trabi M (1997) Biofuels and industrial products from Jatropha curcas. In: Symposium "Jatropha 97", Managua, Nicaragua
10. Charlene A, Markolwsi W, Kichere A, Saling P (2004) Using eco-efficiency analysis to assess renewable-resource-based technologies. Environ Prog 23:329-333
11. Gerhard Knothe. 2002. Structure indices in FA chemistry. How relevant is the iodine value? *J. Am. Oil Chem. Soc*. 79(9): 847-854.
12. Salimon Jumat & Abdullah Rozaini. 2008. Physicochemical properties of Malaysian *Jatropha curcas* seed oil. *Sains Malaysiana*. 37(4): 379-382.