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Variation in Oil content and Physico-chemical properties of Jatropha curcus Seed collected from different areas of Garwhal, Uttarakhand India

Archana Joshi[1,2], P.K. Singhal[1] and R.K. Bachheti[1,2]*

[1]Department of Applied Science, Graphic Era University, Dehradun (Uttarakhand) India.

[2]College of Natural and Computational Sciences, Haramaya University, Ethiopia.

***Corres. author: rkbachheti@gmail.com**
Phone: 00251-924216611

Abstract: To study the oil content variation and physico-chemical properties of *Jatropha curcus* seed were collected from various places of Garwhal region, Uttarakhand, India. The oil yield of the seeds range from 31.4 %-46.3%, which shows the variation in oil content. The maximum oil content was 46.3% found in seeds collected from Dehradun, while minimum was 31.4% in the seeds collected from Tehri Garwhal. The physico-chemical properties of the oil such as acid value, iodine value and saponification value are in the range of 2.97 - 22.72, 83.18 - 111.56 and 130 - 192.70, respectively. The gas chromatographic (GC) analysis showed amount of oleic acid rages from 44.93 % to 37.43%, linoleic acid from 33.40%, to40.19 % palmatic acid from 14.66 % to 16.46 % and stearic acid from 5.90 % to 7.10 %.
Key words: *Jatropha curcus*, variation in oil content, physico – chemical properties, fatty acid.

Introduction

Natural products obtained from plants are used to promote health and fight diseases and some of them are marketed as food or herbal medicines (1).Oils produced from plant sources have a rich history of use by local people as a source of food, energy, medicine , for cosmetic and can serve as a high-energy biofuel. It has been used in the production of lubricants, soaps and personal care products, as well as in the topical treatment of various conditions such as hair dandruff, muscle spasms, varicose veins and wounds (2 - 3). In recent years, demand for seed oils as ingredients for food, cosmetics and biofuel has greatly increased as industry seeks natural alternatives

Jatropha curcus is a small evergreen tree or softwood shrub 3–4m in height. The current distribution of the world shows that its introduction has been most successful in the drier regions of the tropics with annual rainfall of 300–1000mm (4-6). Seeds normally mature 2–4 months after fertilization. Jatropha can be grown on very poor soils like sandy, saline, stony or even in the crevices of rocks (7). It prefers alkaline soils. Jatropha can

even stand droughts to some extent. Jatropha seeds contain 35–40% oil of seed weight and 50–60% of the kernel (8 - 10).

The uses of various parts of Jatropa plant are well known. *J. curcas* whole plant is used for wounds; allergies; burns and cuts (11 - 12), Seed oil is used as Purgative (13), rheumatic pain; skin diseases; eczema. Fruits and seeds are used for abdominal complains; dysentery; urinary discharge; fistula; heart disease; antihelminthic (13), the Stem/bark is use against HIV; tumor while Sap/latex is used for toothache; stypic (7, 11). Extracts and pure compounds of *J.curcus* are reported for cytotoxicity, tumor-promoting, antimicrobial, antiprotozoal, anticoagulant, immunomodulating, anti-inflammatory, antioxidant, protoscolicidal, insecticidal, molluscicidal.(14).

Experimental

Collection of plant materials

The seeds of *J. curcas* were collected from different areas of Garhwal, Uttarakhand namely : Dehraun, Haridwar, Tehri, Chamoli, Pauri and Rudraprayag. The plant species were identified by Dr. Sumer Chand, Ex-scientist, Systematic Botany Division, Forest Research Institute (FRI) Dehradun, Uttarakhand, India in the year 2008 – 2009. The healthy 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 grinded to powder using a grinder prior to oil extraction.

Extraction of oil

The oil extractions from the seeds were carried out in a Soxhlet apparatus. 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 At the completion of extraction process the oil was recovered from the mixture by distillation and stored in a labeled sample bottle. This process was repeated for each sample.

The percentage of oil content is 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 was calculated the same is subjected to analyse the physio-chemical properties of oil.

Acid Value:

The acid value of the sample oil was determined by dissolving about 5.0-5.5g of the sample oil in a hot mixture of 25ml diethyl ether and 25ml 95 %v/v ethyl alcohol. The hot solution was neutralized with 0.1 M NaOH using phenolphthalein as indicator. The acid value was calculated according to recommendation of AOAC 1990 (15)

Iodine Value:

The iodine value was determined by the standard methods of AOAC 1984 (16). About 0.23-0.26g of each sample oil was weighed into a glass stoppered flask and dissolved in 10ml cyclohexane. 20ml of Wij's solution was added, the flask was stoppered and allowed to stand for 30 minutes in the dark at 25^{o} C after which 20ml of 10% KI solution was added. The mixture was titrated with 0.1M $Na_2S_2O_3$ using starch as an indicator. A blank was carried out and the iodine value was calculated.

Saponification Value:

For saponification value approximately 1g of each sample oil was weighed into a 250ml Quickfit conical flask and 25ml of ethanolic potassium hydroxide was added. The mixture was heated under reflux for 1 hour with

constant shaking to allow uniform temperature. Then the hot soap was titrated with 0.5M HCl using 1ml of phenolphthalein as an indicator. A blank was determined under the same condition and the saponification value of the oil was calculated as recommended by AOAC 1984(16).

Gas Chromatography 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 of25ml/min. The injector temperature was set at 200°C .Column temperature 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. The peaks were identified by measuring the Retention time of the samples and comparing the same standards analyzed under the same conditions.

Result and Discussion

Oil yield (%)

As regard to the oil percent, it varied from 31.4 to 46.3 % in the Garhwal region of Uttarakhand.The maximum oil yield (%) was estimated in Dehradun district (46.3 %) followed by Chamoli district (44.7 %), Rudraprayag district (42.1 %), Haridwar (38.3 %), Kotdwara (34.8 %) and least oil % was shown by Tehri district (31.4) as presented in Table.1.

Table 1. Oil yield (%) in the districts of Garhwal region

S.No	Places	Oil Yield (%)
1	Dehradun	46.3
2	Rudraprayag	42.1
3	Kotdwara	34.8
4	Haridwar	38.3
5	Chamoli	44.7
6	Tehri	31.4

Fatty Acid Composition:

Fatty acid composition was another important characteristics carried out in this study. The gas chromatographic (GC) analysis was used to determine the fatty acid composition.The fatty acid composition of seed oil is shown in (Table 2 and Figure 1). The properties of triglycerides and the biodiesel fuel are determined by the amounts of each fatty acid that are present in the molecules.

The major fatty acids in Jatropha seed oil of Garhwal were the Oleic, Linoleic, Palmitic and Stearic acid. Oleic acid showed the highest percentage of composition of 37.43 to 44.93% followed by linoleic acid with 33.40 to 40.19% (Table 2) Oleic acid is reported to be an effective percutaneous absorption enhancer. It markedly enhanced the penetration of tenoxicam, a non-steroidal anti-inflammatory drug (NSAID), by as much as 15% and is reported to increase diffusivity and partitioning as well as the fluidity and flux by interaction with subcutaneous lipids (17).

Unsaturated fatty acid, namely linoeic (C18:2) , linolenic (C18:3), arachidonic acids (C20:1) are termed essential fatty acids, as they are not produced in the human body and must be provided in the diet .Unsaturated fatty acids (polyunsaturated) help to reduce cholesterol formation or deposition and hence to decrease the risks of atherosclerosis and other heart disease (18 - 20).

Table 2 Fatty acid composition of seed oil

Fatty acid	Formula	Structure	Fraction (%)					
			Dehradun	Rudraprayag	Kotdwara,	Haridwar	Tehri	Chmoli
Palmitic acid	$C_{16}H_{32}O_2$	16:0	15.39	14.57	14.66	16.41	15.32	16.46
Stearic acid	$C_{18}H_{36}O_2$	18:0	6.26	6.82	7.10	6.39	6.24	5.90
Oleic acid	$C_{18}H_{34}O_2$	18:1	44.93	42.74	43.32	42.75	40.65	37.43
Linoleic acid	$C_{18}H_{32}O_2$	18:2	33.40	35.88	34.90	34.43	37.99	40.19

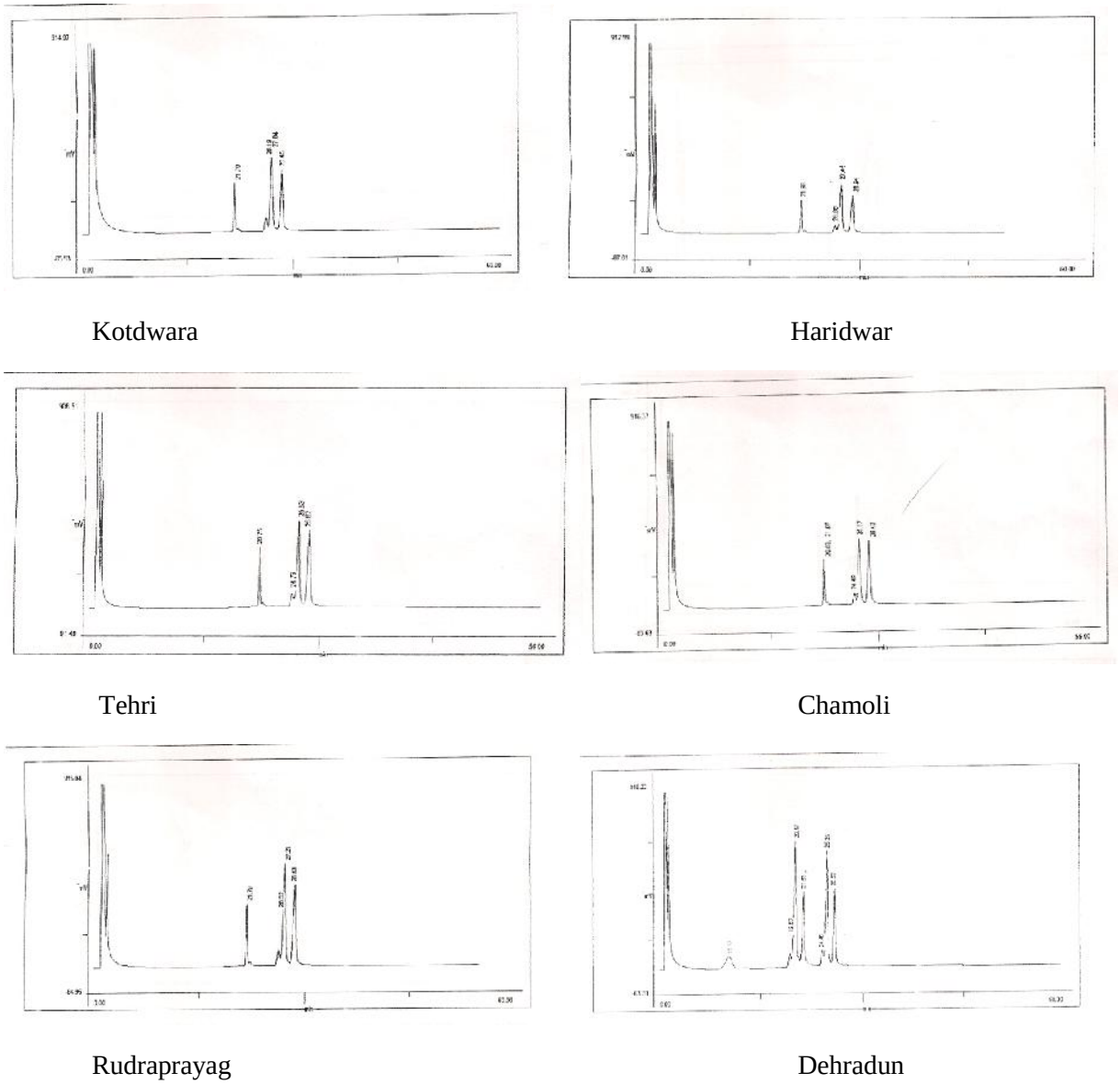

Figure 1.Gas chromatography of *Jatropha curcuas* seed oil from different region of Garhwal, Uttarakhand, India

Acid Value:

The acid value of the oils extracted from the seeds of Garhwal region as tabulated in Table 3, indicated that the value are in the range of 2.97- 22.72 mg KOH/g. Acid value is an indicator of edibility of oil and suitability for industrial use. Haridwar district of Garhwal area has the highest acid value of 22.72. . Most of *Jatropha curcus* seed oil has acid value less than 8 (except Haridwar) falls within the recommended codex of 0.6 and 10 for virgin and non -virgin edible oils and fats nearest to other conventional oils, which are already in use for edible and commercial industries(21).

Iodine Value

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. The iodine value which is useful in predicting the drying property of oils was found to be in the range 83.18- 111.56 in the oil of Garhwal region of Uttarakhand (Table.4). The highest iodine value was shown by the district Kotdwara (115.15) while Rudraprayag contains lowest degree of iodine (83.18). The Iodine value of Dehradun (104.46), Chamoli (104.14) kotdwara (115.15) are very closer to *mustard oil*(108), *cotton seed* oil (108) reported in Nutritive value of Indian food (22).

Saponification Value

The saponification value of the seed oil of different sites of Garhwal region are in the range of 130 - 192.70. The highest saponification value recorded for the seed oil is for Rudraprayag (192.70) while the lowest is in Tehri (130) as presented in table 5. Saponification value of *jatropha curcas* seed oil of Dehradun, Rudraprayag which suggests that the oils contain high molecular weight fatty acids and low level of impurities, so it can be used in soap making industry (18).

Table 3. Acid Value of the different sites of Garhwal Region

S.No	Different sites of Garhwal	Acid Value mgKOH/g
1	Dehradun	5.27
2	Rudraprayag	5.41
3.	Kotdwara	7.31
4.	Haridwar	22.72
5.	Tehri	2.97
6.	Chamoli	4.55

Table 4. Iodine Value of different sites of Garhwal Region

S.No	Different sites of Garhwal	Iodine Value
1	Dehradun	104.46
2	Rudraprayag	83.18
3.	Kotdwara	115.15
4.	Haridwar	93.34
5.	Tehri	86.58
6.	Chamoli	104.14

Table 5. Saponification Value different sites of Garhwal Region

S.No	Different sites of Garhwal	Saponification Value mg KOH/g
1	Dehradun	171.52
2	Rudraprayag	192.70
3.	kotdwara	133.24
4.	Haridwar	157.92
5.	Tehri	130.0
6.	Chamoli	159.04

Conclusion:

The study shows that the *J. curcas* seed has a good oil yield and its physico-chemical properties have a great potential for industrial use. As the *Jatropha curcas* has very good potential to be grown in Garwhal therefore it is recommended that it should be cultivated to uplift the economic condition of the rural people of this region. Therefore, it is amiable to have more research on *Jatropha curcas* seed oil in the future to explore its potentials for future industrial oilseeds crop.

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