IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Analysis of Heavy Metals and Physico-Chemical Properties of Jatropha Curcas Seed Oil from Arid Zone of Rajasthan

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ABSTRACT:

Jatropha curcas is a dry season safe bush having a place with the Euphorbiaceae family. *Jatropha curcas* is likewise alluded to as phyric nut, cleansing nut, pinoncillo, dark regurgitation nut and habb-el-meluk. In this work the physicochemical qualities including unsaturated fats and substantial metals examination of seed oil of *Jatropha curcas*. These seeds are acceptable wellspring of vitality, proteins, fats and minerals, for example sodium, calcium, zinc, iron, magnesium, aluminum, phosphorous and potassium.

In present work we studied fatty acid composition in seed oil of *Jatropha curcas* from arid region of western Rajasthan. The *Jatropha curcas* seed oil was extracted by soxhelt using petroleum ether (60-80°C). It was observed that *Jatropha curcas* seed oil contain about 34% oil. The fatty acid composition of the oil sample was analyzed by gas chromatography coupled with mass spectrometer. Heavy metals analysis the seed oil of Jatropha curcas by Atomic Emission Spectroscopy (AES). The Heavy metals found in seed oil in following order : Mg(153.60) > Fe(109.80) > K(82.40) > Zn(64.30) > Na(54.10) > Al(15.90) > P(5.10) > Ca(1.89) > Pb(0.10) > Cd(0.04) mg/L respectively. The total amount of saturated, unsaturated fatty acids was found 21% and 79% respectively. The major fatty acid present was oleic acid (43.10%) also named as Omega-9 fatty acid followed by Linoleic acid (34.25%) also named as Omega-6 fatty acid, linolenic acid (0.55%) and palmitic acid (13..65%), stearic acid (6.43%), and myristic acid (0.41%) were present in very low amounts.

Keywords: *Jatropha curcas*, Fatty acids, Omega-9, Omega-6, Linolenic acid, Palmitic acid.

1. INTRODUCTION

Jatropha curcas is a species of flowering plant in the spurge family, Euphorbiaceae, it is most widely specie across different regions all over the world due to its strength [1] that is native to the American tropics, most likely Mexico and Central America [2]. *Jatropha curcas* is a medium, delicate lush, deciduous multipurpose tree of 4-7 meter in stature and develops in tropical and sub-tropical atmospheres over the creating scene. Plant shows fiery development in early periods. *Jatropha curcas* is a morphologically various variety that contains 470 species (Paramathma et al., 2004). Common names in English include physic nut, Barbados nut, poison nut, bubble bush or purging nut [3]. The specific epithet, "curcas", was first used by Portuguese doctor Garcia de Orta more than 400 years ago [4].

Plant *Jatropha curcas* was named first by Carlvon Linnaeus. The term got from Greek word "Jatros" which means a "Specialist", Trophe signifying "Sustenance". Linneus understood the capability of this plant for therapeutic purposes. *Jatropha curcas* is a multipurpose plant with numerous traits and extensive potential. It is a tropical plant that can be developed in low to high precipitation regions and can be utilized to recover land, as a support as well as a business crop. Subsequently, developing it could give business, improve the earth and upgrade the nature of country life. *Jatropha curcas* is a semi-evergreen bush or little tree, arriving at a tallness of 6 m (20 ft) or more. It is impervious to a high level of aridity, permitting it to develop in deserts [5][6]. The foundation, the board and efficiency of *Jatropha* under different climatic conditions are not completely archived. This is talked about and the holes in the information clarified, particularly its compost prerequisites. The plant produces numerous helpful items, particularly the seed, from which oil can be removed; this oil has comparable properties to palm oil. The expenses and returns of developing the plant and delivering the plant oil are talked about and arranged. Since it tends to be utilized instead of lamp oil and diesel and as a substitute for fuel wood, it has been elevated to make country regions independent in fills for cooking, lighting and rationale power. This system is inspected and found not practical. Oil for cleanser making is the most gainful use. It is presumed that all business sectors for Jatropha items ought to be explored. On the off chance that the maximum capacity of the plant is to be acknowledged, substantially more research is required into the developing and the executives of *Jatropha curcas* and more data is required on the genuine and potential markets for every one of its items.
It contains phorbol esters, which are considered toxic [7]. curcas additionally contains mixes, for example, trypsin inhibitors, phytate, saponins and a sort of lectin [8][9] known as curcin [10].

The oil from the example was separated by utilizing soxhlet apparatus. The readied test is placed in to soxhlet apparatus. The readied test is placed in to soxhlet apparatus puts over warming mantle. The oil was extricated from test with the assistance of petroleum either followed by constant refining for 4 hours. The oil was recouped by complete refining of a large portion of the dissolvable on a warming mantle. The oil is then moved to estimating chamber. The estimating chamber is then positioned over water shower for complete dissipation of dissolvable for around 2-3 hrs. The seeds contain 27–40% oil (normal: 34.4%) [11][12]. It can be handled to deliver an excellent biodiesel fuel, usable in a standard diesel motor. Eatable (non-harmful) provenances can be utilized for creature feed and food [13].

2. *MATERIALS AND METHODS*

2.1 SAMPLING: Jatropha curcas seeds were collected from arid region of Rajasthan, India. The damaged seeds were discarded and good seeds were selected that means in seeds in good condition were cleaned, de-shelled and dried at high temperature of 100- 105°C for 35 min. Seeds were grounded using grinder prior to extraction.

2.2 OIL EXTRACTION: Extraction of oil from seeds was done by solvent extraction method. Oil was extracted with petroleum ether (60-80°C) in a Soxhlet apparatus for 5-6 hrs [14]. The obtained oil was stored in cool place (refrigerator) until further investigation [15]. The analytical values of seed and seed oil were determined according to the standard American Oil Chemist Society (AOCS) methods [16]. Methyl esters of oil were prepared using direct analytical TLC test [17], 2,4DNP TLC test [18], Halphen test [19], picric acid TLC test [20], and alkaline picrate test [21] were also performed for indication of any unusual fatty acid.

2.3 REAGENTS: All reagents were at the analytical level of the reagent. Double deionized water was mainly used for all dilutions. HNO_3, H_2SO_4, H_2O_2, HF, $HClO_4$ and HCl were of superior quality. All plastic and glassware were cleaned by applying fertilizer to HNO_3 and washed with saturated water prior to use. Standard operating solutions of the heavy metals used were prepared by mixing a stock solution of 1000 µg/L (Pb, Cd, Zn, Fe, and Ni).

2.4 PREPARATION OF STANDARD FOR METAL: In spectrophotometric measurements we are concerned with solution having very small concentration of the metal to be determined. It follows that the standard solution which will be required for analysis must also contain very small concentration of the relevant metal. Standards are prepared by dissolving 1gm of metal cadmium, nickel, iron lead and zinc dissolve in minimum quantity of aquaregia (1:3) HCl and HNO_3, made up to 1 litre in volumetric flask by adding deionized water. This is a stock solution which contains about 1000µg/L of required metal and then the working standard solution is prepared by suitable dilution of stock solution.

2.5 PERCENTAGE YIELD: 100 gm of the grounded seeds were taken and were set in the Soxhlet mechanical assembly and the oil was extricated utilizing oil ether as dissolvable. The get together was made to run for 8 hours. Anhydrous Sodium Sulfate was added to expel any hint of dampness from the separated arrangement. The oil was isolated from the dissolvable utilizing refining get together.
The percentage of oil content can be calculated as below

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

After the oil had been acquired and its level of oil content is determined the equivalent is exposed to physiological test, for example, acid value test, iodine value test and saponification value test, chemical analysis of seed oil.

2.6 SPECIFIC GRAVITY: Thickness bottle was utilized in deciding the particular gravity of the oil. A perfect and dry stoppered jug of 25 mL limit was gauged (W_0) and afterward loaded up with the oil stoppered and rechecked to give (W_1). The oil was subbed with refined water in the wake of washing and drying the jug and weighed to give (W_2). The articulation for explicit gravity (Sp.gr) is:

$$\text{Sp. gr.} = \frac{W_1 - W_2}{W_2 - W_0}$$

Where, W_0 = weight of dry empty density bottle; W_1 = weight of density bottle + oil; W_2 = weight of density bottle + distilled water [22-23].

2.7 ACID VALUE: 2 g of pure oil (250 ml) is weighed accurately using a conical transfer method Flask. Neutral ethanol (20 ml) was added by pipette and heated in a steam bath 3 minutes. The flask was then cooled and the subjects were diluted with 0.1N alcohol potassium Phenolphthalein hydroxide is used as an indicator for the solution. It has also driven space titration for years Aspect.

2.8 IODINE VALUE: The oil (0.2 g) is accurately weighed using a transfer method to a 250 ml iodine flask and dissolved in chloroform (20 ml). Wij's reagent (20 ml) was added by pipette. The flask Holds for 1 hour and put in the dark with intermittent trepidation. Then 15% potassium iodide solution (10 ml) and 50 ml of distilled water were added to the flask and the mixture was stirred. Free iodine was titrated with 0.1 N sodium thiosulfate solution and fresh flour solution Indicator. It has also driven space titration for years. [24]

2.9 SAPONIFICATION VALUE: 2 ml of oil using the transfer method is exactly 250 ml flask below and freshly prepared 0.5N alcohol potassium hydroxide solution (25 ml). The sample and mixture through the pipette is refluxed to the water bath using an air conditioner an one hour. Then the flask is cooled and the condenser tip is washed with a little distilled water. Subjects were titrated with 0.5 N hydrochloric acid solution using phenolphthalein as indicated.

3. RESULTS AND DISCUSSION

3.1 HEAVY METALS ANALYSIS: In plant samples Magnesium (Mg), Iron (Fe), Pottasium (K), Zinc (Zn), Sodium (Na), Aluminium (Al), Phosphorus (P),Calcium (Ca), Lead (Pb), Cadmium (Cd) were analyzed using microwave plasma atomic emission spectroscopy (MP-AES) equipped with nitrogen as the source gas for the plasma. In Jatropha curcus seeds oil Lead and Cadmium minerals is very low but Magnesium, Iron and Zinc minerals are very high are presented in table 1. Nitrogen fire was utilized for assurance of metal substance. It is utilized for synchronous multi-analyte assurance of major and minor components. MP-AES utilizes microwave vitality to deliver a plasma release utilizing nitrogen provided from a gas chamber or extricated from encompassing air, which dispenses with the requirement for sourcing gas.

Table 1: Heavy metals content of J. curcas seeds oil

S.No.	Analyte	Sample concentration unit (mg/L) of *Jatropha curcas* seeds oil
1	Mg	153.60
2	Fe	109.80
3	K	82.40
4	Zn	64.30
5	Na	54.10
6	Al	15.90
7	P	5.12
8	Ca	1.89
9	Pb	0.10
10	Cd	0.04

3.2 DETERMINATION OF PHYSICAL PARAMETERS:

Table 2: Physico-Chemical Parameters Value

S.No.	Characteristics	Value
1	Lipid Content	34.87
2	Iodine Value (Mg/G)	96.45
3	Moisture Content (%)	6.25
4	Acid Value (Mg/G)	3.5
5	Free Fatty Acid	0.4
6	Peroxide Value (Meq/Kg)	1.89
7	Saponification Value (Mg/g)	193.65
8	Unsaponifiable Matter(%)	1.1
9	Viscosity (centipoise)	42.88
10	Refractive Index	1.47
11	Appearance	Similar to castor oil
12	Odour	Similar to castor oil

The physical properties of the liquids depend on their chemical composition, pressure and temperature. An unknown oil physical parameter can be measured and compared with the literature and standard values, the oil can then be identified.

The oil yield is 34.2% and different chemical properties like as acid value, saponification value, iodine value, protein content give structural stability. The oil contents and physiochemical properties of oil *Jatropha curcas* seed from arid zone are presented in table 2. Fatty acids are the primary component of oil and fats.

3.3 DETERMINATION OF FATTY ACID COMPOSITION

The non-saturated fatty acids were oleic acid (43.10%), Linoleic acid (34.25%) linolenic acid (0.55%) present. The saturated fatty acids were identified as palmitic acid (13.65%), stearic acid (6.43%) and myristic acid (0.41). The fatty acid composition indicates the presence of higher amount of unsaturated fatty acids (79.50%) compared to saturated fatty acids (21.49%) are presented in table 3.

Table 3: Fatty acid composition of the oil from seed of *J. curcas*

S. No.	Fatty acid %	Composition
1	Oleic acid C 18:1	43.10
2	Linoleic acid C 18:2	34.25
3	Linolenic acid C 18:3	0.55
4	Palmitoleic acid C 16:1	1.60
5	Myristic acid C 14:0	0.41
6	Palmitic acid C 16:0	13.65
7	Stearic acid C 18:0	6.43

4. CONCLUSION AND APPLICATION

Based on the results of this study the conclusion can be made that seeds of the Jatropha oil obtained from the arid zone of Rajasthan contains high percentage of unsaturated fatty acid which is 79.50%. *Jatropha curcas* seeds are good source of magnesium, iron, zinc, calcium, phosphorus and sodium. Calcium, magnesium and phosphorous provide structure for our bones. Sodium and potassium help in the maintenance of normal blood pressure. Heavy metal analysis shows that these metals are within the limit. The analysis of seeds for the nutritional composition has shown that they are good source of energy, protein, fat and carbohydrates. The seeds provide opportunities to develop as medicines, value added products and dietary supplements.

Jatropha seed oil is good source of essential Omega-9(oleic acid C18:1) fatty acid. It is very important fatty acid because it increases HDL("good") cholesterol and decreases LDL("bad") cholesterol, they help reduce plaque build-up in the arteries, so it is prevent heart diseases. Jatropha seed oil is also good source of essential Omega-6 (linoleic acid C18:2) fatty acid. Linoleic acid is the most important PUFA in human diet, as it is also prevents heart and vascular diseases. It seed oil is good for human health. The high acid values of the crude vegetable oils lead to difficulties in the biodiesel preparation, occurs the formations of soaps and stable emulsions. Linoleic acid also used in paints-varnishes.

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