

Physicochemical Characterization and Phytochemical Screening of *Jatropha Curcas* L. Seed Oil Cultivated in Tigray Ethiopia

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Abstract: To investigate the potential use of *Jatropha curcas* L. seed oil, dried *Jatropha curcas* L. seeds were crushed to release the kernels and oil was extracted using Soxhlet apparatus and the physicochemical characteristics of the oil determined using standard methods. The physico-chemical characteristics showed: oil yield 42.19%, specific gravity 0.93, saponification value 122.49mgKOH/g, iodine value 129.66gI₂/100g, acid value 1.38mgKOH/g, free fatty acid value 0.74mgKOH/g and peroxide value 1.55meq/Kg. The phytochemical screening of the oil showed the presence of saponins, alkaloids, steroids, terpenoids and cardiac glycosides, while tannins, flavonoids and phenols were absent. From the determined parameters, *Jatropha curcas* seed oil may be use as cooking oil and in cosmetics. In addition, the revealed phytochemical suggested that the seeds oil has pharmacological potentialities.

Keywords: *Jatropha Curcas* L., Seed Oil, Physico-Chemicals, Phytochemical

1. Introduction

Jatropha is a multipurpose genus rich in oil that can be used to manufacture fuel, candles, soap, cosmetic and drugs (4). The seed oils are potential renewable source for biodiesel production and the chemical industry. Currently, the most common feed stocks for biodiesel production are edible oils that according to many organizations are competing for resources with the food industry [9].

The genus *Jatropha* derived from Greekiatros (Doctor) and trophé (food) belongs to the Euphorbiaceae family characteristic for its toxicity. The genus consists of over 170 species including *Jatropha cinerea*, *J. curcas*, and *J. platyphylla* native of Mexico and Centroamerica. A variety non-toxic *J. curcas* has been found only in Mexico [8]. The roasted seeds of

J. curcas and *J. platyphylla* are consumed by the local population for the preparation of traditional dishes [13, 14]. Defatted kernel meal of *Jatropha* non-toxic species can also be used as animal feed because of its protein high content. *Jatropha curcas* L. is a well-established plant in many Asian, African and South American countries and has been touted in

support of agriculture, social and economic security for developing and transitional economic regions. It produces oil-rich seeds, is known to thrive on eroded lands, and to require only limited amounts of water, nutrients and capital inputs. The “added value” product that can be derived from *J. curcas* seed harvest residue is first grade, quality Organic Fertilizer. This has a direct substitution value upon the importation of inorganic nitrogen based fertilizers and this has great contribution for countries like Ethiopia as it is a major importer of fertilizer. This plant offers the option both to cultivate wastelands and to produce oil suitable for conversion to bio-diesel. More versatile than hydrogen and new propulsion systems such as fuel cell technology, bio-diesel can be used in today's vehicle fleets worldwide, offering a viable path to sustainable transportation, i.e., lower greenhouse gas emissions and hence mitigate global warming. These characteristics along with its versatility make it of vital importance to developing countries like Ethiopia subjected to decreasing tree cover and soil fertility because of increasing population and development pressures. Although Ethiopia is rich in biodiversity and production potential, large areas are under semiarid and arid conditions

with moderate-to-high risks of drought. Nearly three-fourth of the poorest people live on marginal lands with the number expected to increase from 83 million to 130 million by 2020. These areas are by definition isolated and fragile, with soils susceptible to erosion and subjected to environmental stresses of deforestation and prolonged droughts. Plants species like *Jatropha* that can grow on marginal lands and poor soils could improve the productivity of agriculture, supply raw material for industry, fuels for basic energy services and improve environment, and hence an obvious choice that needs to be assessed carefully and comprehensively.

The present work is therefore aimed at extraction, physicochemical and phytochemical analysis of Northern Ethiopia Tigray *Jatropha curcas* L. seed oil in order to justify its industrial and medicinal properties.

2. Material and Method

J. curcas seeds were obtained from rural area of Mekelle Abegele. The ripe seeds were collected and the damaged seeds were discarded. The seeds were cleaned, de-shelled and dried in an oven at 105°C for 30. The seeds were ground to powder using a grinder prior to oil extraction. All chemicals used in the study were analytical grade and used without further purification.

Moisture and Volatilities

About 5 to 6 g of seeds were accurately weighed in a petridish and kept in hot -air oven maintained at 110°C for 4 hrs. After cooling in a desecrator, the loss in weight was recorded in each case. This procedure was repeated till constant weight was obtained.

OIL Characterization

Extraction of Oil

The collected ripe seeds were collected and the damaged seeds were discarded. The seeds were cleaned and dried in an oven at 105°C for 30 minutes. The seeds were powdered and extracted thoroughly with light petroleum ether (60-80°C) in a Soxhlet extractor for 24-48 h in each case. Once more the remaining powdered seed was extracted to collect all oil in the seeds. Combined petroleum ether (60-80°C) extract was dried over anhydrous sodium sulphate and solvent was removed in vacuum at 40°C by using rotary evaporator to recover oil (Link 1975). The seed oils were filtered through what man filter paper No.1 to remove any foreign particles and pure oil preserved in cold storage properly. Official and tentative methods (1993) of AOCS Chicago were followed for the determination of physicochemical characteristics of seed oil (Mukherjee 2002).

2.1. Refractive Index

Refractive index was determined on Abbe's refractometer. The prisms were cleaned with xylene and dried. Place few drops of oil on the prism, close the prisms and allow to stand for 1-2 min, adjusted the instrument and light to obtain the most distinct reading and determine the refractive index. Refractive index of oil increases with the increase in

unsaturation and also chain length of fatty acid (Singhal & Sekiya 2003).

2.2. 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.

2.3. 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.

2.4. Saponification Value and Saponification Equivalent

Two gram of oil was weighed accurately by transfer method into a 250 mL round bottom flask. Freshly prepared 0.5N 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.

2.5. Phytochemical Screening of the Extracts of the Root and the Latex of *Jatropha Curcas*

The methods described by Odebiyi and Sofowora (1978) were used to test for the presence of saponins, tannins, phenolics and alkaloids, Lieberman Burchard reaction as described by Herburne (1973) was used to test for steroids, while the Salkowski test was used to test for the presence of glycosides.

Testing for saponins:

Each extract (0.5g) was mixed with water in test tube. Foaming which persisted on

Warming was taken as an evidence for the presence of saponins

Testing for tannins and phenolics:

Each extract (0.5g) was separately stirred with 10mL of distilled water and then filtered. Few drops of 5% FeCl₃ reagent were added to the filtrate. Blue-black or blue-green coloration or

Precipitation was taken as an indication of the presence of phenolics and tannins

Testing for alkaloids:

Each extract (0.5g) was stirred with 5mL of 1% HCl on a steam bath. The solution obtained

Was filtered and one 1mL of the filtrate was treated with a few drops of Mayer's reagent. The turbidity of the extract filtrate on addition of Mayer's reagent was taken as evidence of the presence of alkaloids in the extracts.

Testing for steroids:

0.5g of each extract was separately added with 5 drops of acetic anhydride and then a drop of

Concentrated H_2SO_4 . The mixture was steamed for 1 hour and neutralized with sodium hydroxide (NaOH), followed by the addition of chloroform. The appearance of a blue-green color indicated the presence of steroid.

Testing for glycosides:

0.5g of each extract was dissolved in 2mL of chloroform. Tetraoxosulphate VI acid (H_2SO_4) was carefully added to form a lower layer. A reddish brown color at the interface indicated the presence of a steroidal ring, that is, a glycone portion of the cardiac glycosides

3. Results and Discussion

Table 1. Physical characteristics of *Jatropha curcas* seed oil.

| Characteristics | Result |
|------------------------------------|---------------|
| % oil yield (wt/wt) | 42.19±0.35% |
| Color | golden yellow |
| Odor | Pleasant |
| Specific gravity | 0.93 |
| Physical state at room temperature | Liquid |

Table 2. Chemical characteristics of *Jatropha curcas* seed oil.

| Parameter | Value |
|---------------------------------|-------------|
| Peroxide value (meq/Kg) | 1.55 ±1.02 |
| Acid value (mg KOH/g) | 1.38 ±0.18 |
| Iodine value (g/100g) | 129.66±1.98 |
| Saponification value (mg KOH/g) | 114.49±0.51 |
| Free fatty acid (%) | 0.74 ±0.15 |

The values are mean±standard deviation (n=3)

Table 3. Phytochemical characteristics of *Jatropha curcas* L seed oil.

| Phytochemical analysis | Result |
|------------------------|--------|
| Tannins | - |
| Saponins | + |
| Flavonoids | - |
| Alkaloids | ++ |
| Steroids | +++ |
| Terpenoids | + |
| Phenols | - |
| Cardiac glycoside | + |

Note: +: Present in small concentration;

++: Present in a moderately high concentration;

+++; Present in a very high concentration;

-: not detected.

4. Discussion

The oil yield of *Jatropha curcas* seed oil was found to be 42.19% (wt/wt). However, the oil content of *Jatropha curcas* seeds oil in the present analysis was found to exceed those of

some conventional oil seed crops: cotton (15.0 – 24.0%), soybean (17.0 – 21.0 %), safflower (25.0 – 40.0%) and mustard (24.0-40.0%) [15]. such variation in oil content across species and locations might be attributed to the environmental and geological conditions of varied regions [16]. With this relative high percentage oil yield of 42.19% in the present study, the processing of the oil for industrial as well edible purposes would be of economic importance.

The chemical properties of the oil analyzed were presented on table 2. The saponification value was found to be 114.49mgKOH/g which is an indication that the oil has median weight fatty acid. Oil with a saponification value of 200mgKOH/g and above is regarded as high molecular weight fatty acid oil and is used in making of soaps [17]. According to Anchwagan et al. [18], saponification value is a measure of the equivalent weight of acid present and therefore it is an indication of purity. This type of oil with saponification value of 114.49mg KOH/g, is not a very good candidate in soap manufacturing industries. However, the oil can be subjected to refining processes in order to find place in soap making industries and to be used as emulsifiers [19].

The peroxide value for *Jatropha curcas* seed oil was found to be 1.55meq/Kg. According to Epka and Epke [21], high peroxide value is associated with high rancidity rate. Thus, with this fact, the low peroxide value obtained from the oil is simply an indication the oil is less liable to rancidity at room temperature.

An Acid value of 1.38 ±0.177mgKOH/g was obtained which signifies a maximum purity and made it suitable for soap production. Based on the acidity it can be edible since the value fall below maximum acceptable value of 4.0mgKOH/g of oil as recommended by Codex Alimentarius Commission for ground nut but only when it is detoxify [19].

The iodine value obtained was 129.66gI₂/100g; this is a measure of the average amount of unsaturation in fats and oils and is expressed in terms of the number of grams of iodine absorbed per 100 grams of oil sample. The oil shows a relatively high iodine value due to its high content of unsaturated fatty acids. And the oil may also be useful in oil paints manufacture and as a dietary supplement.

Free fatty acid value indicates the deteriorating condition and edibility of the oil [24]. The low value obtained for the free fatty acid indicates that the oil have low deteriorating rate and high edibility [18].

The phytochemical analysis conducted on the seed oil is presented on table 3. *Jatropha curcas* L. contains different secondary metabolites (phytochemical) with biological activity that can be of medicinal values. The qualitative phytochemical analysis of the oil extracts indicates the presence of saponins, terpenoids and alkaloids in small concentration; the presence of alkaloids in moderately high concentration; the presence of steroids in very high concentration; while tannins, flavonoids and phenols are absent. Saponins are known to produce inhibitory effect on inflammation. They also have the property of precipitating and coagulating red blood cells. Other characteristics of saponins include formation of foams in aqueous solutions,

hemolytic activity, cholesterol binding properties and bitterness [25, 26].

Steroids have been reported to have antibacterial properties and they are very important compounds especially due to their relationship with compounds such as sex hormones [27]. Alkaloids have been associated with medicinal uses for centuries and one of their common biological properties is their cytotoxicity [28]. Thus, based on the detected phytochemical, *Jatropha curcas* L. seed oil may have various medicinal values.

5. Conclusion

Jatropha curcas L. seed is a good source of oil due to its high percentage oil yield obtained in the present study. The oil has a good storage quality owing to its low peroxide, acid and free fatty acid values. In addition, the saponification value revealed that the oil may be used industrially for soap making. The phytochemical compounds present in the oil may qualify the oil to have therapeutic or medicinal potential.

Further research is recommended on *Jatropha curcas* seed oil with regards to toxicity and detoxification process for its potential use. Also, government should put effort in encouraging the production of the plant and also provide sound laboratory technique in order to reveal more of its potentials.

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