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Research Article

PHYSICOCHEMICAL CHARACTERIZATION OF *JATROPHA CURCAS* L. SEED OIL FROM BULACAN, PHILIPPINES

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ABSTRACT

Seeds of *Jatropha curcas* L. collected from the locality of Sta. Maria, Bulacan, Philippines were utilized in the study. The oil was extracted using n-hexane by Soxhlet apparatus and physicochemical characteristics and fatty acid composition were determined using standard methods. The physicochemical characteristics showed: oil yield 45.07%, refractive index 1.4651, acid value 31.5, saponification value 195.7, and iodine value 92. Gas Chromatography with Flame Ionization Detector (GC-FID) analysis of *J. curcas* L. seed oil indicated the presence of palmitic acid (13.5%), stearic acid (6.9%), oleic acid (51.8%), linoleic acid (26.6%) and linolenic acid (0.2%). Due to its high percentage yield and of good quality as determined by its physicochemical properties, *J. curcas* L. seed can be a sustainable source of oil for agricultural, industrial and medicinal uses.

Keywords: *Jatropha curcas* L., Soxhlet, GC-FID, fatty acids.

INTRODUCTION

Jatropha curcas L., locally known as kirisol or tubang-bakod, is a large shrub up to 5–7 m tall belonging to the Euphorbiaceae family and has an average life span of up to 50 years[1, 2]. The *J. curcas* L. plant is drought-resistant and has the capability to grow on marginal soils. It is a hardy and highly adaptable crop that can grow in marginal soils and capable to reclaim wasteland[3].

Ethnopharmaceutical uses from *J. curcas* L. leaves and roots include anticancer, diuretic, purgative, abortifacient, antiseptic and hemostatic while the seeds contain oil used in biofuel production and treatment of skin diseases[4,5]. The seeds are also used as livestock feeds, but potentially toxic if untreated[6]. Despite the plant's usefulness as food and medicine, the toxicity of the plant has been associated with the presence of some anti-nutrients like tannin, saponin, lectin, protease inhibitors, phytate and phorbolester. Phorbolesters which were identified as major toxic contents in Jatropha plant are bioactive diterpene derivatives with multitude effect on rats[5].

Jatropha curcas L. can be utilized in cultivating wastelands and producing oil suitable for agricultural, industrial and medicinal purposes. Despite its rich biodiversity, large areas in the Philippines are in semiarid and arid condition and further aggravated by erosion, deforestation and prolonged droughts. The Jatropha plant's ability to grow on marginal lands and deprived soils could improve the productivity of agriculture, offer fuel source for basic energy services and provide potential medicinal values, hence, an obvious choice that needs to be assessed carefully and comprehensively[7].

This study focused on extraction and physicochemical characterization of *Jatropha curcas* L. seed oil cultivated in Sta. Maria, Bulacan, Philippines to support its industrial and medicinal potentials.

MATERIALS AND METHODS

A. Plant Collection and Identification

Jatropha curcas L. seeds were obtained during the month of November, 2014 from the locality of Sta. Maria, Bulacan, Philippines. The plant material was taxonomically identified and verified by the Bureau of Plant Industry-Manila, Philippines.

B. Preparation and Extraction of Plant Material

Ripe seeds were collected and damaged ones were discarded. The seeds were thoroughly washed with water, de-shelled and air dried for 7 days. The dried seeds were grounded using electric grinder and sieved at 100 mesh size. The powdered material was macerated for 7 days using n-hexane and extracted thoroughly in a Soxhlet apparatus for 6 hours. The extract was passed through Whatman No. 1 filter paper and the filtrate was concentrated under vacuum in a rotary evaporator at 40^{o}C and stored at 4^{o}C for further use.

C. Physicochemical Characterization of *Jatropha curcas* L. seed oil

The extracted *J. curcas* L. seed oil was analyzed for physicochemical properties (organoleptic properties, solubility, refractive index, acid value, saponification value and iodine value) according to official and tentative methods (1997) of AOCS Chicago[8]. Gas Chromatography with Flame Ionization Detector (GC-FID) was used for the determination of the fatty acid profile of seed oil.

Fatty Acid Profile

The fatty acid composition was determined using the gas chromatography (GC), 17A Shidmadzu, Japan. About 0.1 mL oil was converted to methyl ester using 1 mL NaOMe (1M) in 1 mL hexane before injection into the GC. The chromatograph was equipped with BPX70 capillary column (30m ×0.25mm×0.25µm) and a flame ionization detector (FID) with temperature programmed at 245^{o}C. The column temperature gradient ranged from 120 to 245^{o}C at a flow rate of 0.3 mL/min and nitrogen was used as a carrier gas. The identification of the peaks was archived by retention times by means of comparing them with authentic standards analyzed under the same conditions [9].

RESULTS AND DISCUSSION

A yellowish odorless liquid obtained after extraction was evaluated for physical properties which are presented in Table 1. An oil yield of 45.07% (w/w) for *J. curcas* L. seed from Philippines is comparable with samples collected from Nigeria (42.19%)[10] but higher than those from Malaysia (60%)[9]. The oil content of *J. curcas* L. seed sample is greater than some conventional oil seed crops: cotton (15-24%), soybean (17-21%), safflower (25-40%) and mustard (24-44%)[11]. Environmental and geological conditions of different regions can affect these variations in oil content across species[12]. Due to the relatively high yield, processing of *J. curcas* L. seed oil for industrial as well as edible purposes would be of economic importance.

The chemical properties of the oil were presented in Table 2. Refractive index is an intrinsic characteristic and an indication of oil purity. The refractive index determined from the Philippine *J. curcas* L. seed oil have similar findings with those reported in Paraguay (1.4692)[13] and Malaysia (1.469)[9]. An acid value of 31.5 mg KOH/ g for *J. curcas* L. is relatively high making it makes it unsuitable for alkaline catalyzed tranesterification process in biodiesel manufacture[14]. It cannot be classified as edible since the value exceeded the maximum acceptable value of 4.0 mg KOH/ g of oil as recommended by Codex Alimentarus Commission for ground nut but only when it is detoxified [15].

The saponification value of the oil sample was found to be 195.7 mg KOH/ g, an indication that the oil has median weight fatty acid. Oils with saponification values of 200 mg KOH/ g and above are reported to possess low molecular weight fatty acids[16]. Saponification value is also a measure of the equivalent weight of acid present and an indication of purity[17]. This type of oil with saponification value of 195.7 mg KOH/ g is not a very good candidate in soap manufacturing industries. However, the oil can be subjected to refining processes to be suitable in soap making and to be used as emulsifiers[15]. The saponification value of the sample analyzed is comparable to those of Malaysian *J. curcas* seed oil (208.50 mg/g)[9] and Nigerian *J. curcas* seed oil (198.85 mg/g) [18].

The iodine value is a measure of the average amount of unsaturation of fats and oils[19]. The oil indicates a high iodine value (92) due to its high content of unsaturated fatty acids as shown in Table 3. The iodine value obtained places the oil in the non-drying groups and may find application as a raw material oil paint manufacture and as a dietary supplement[20]. Philippine *Jatropha curcas* L. seed oil has lower iodine value than those reported in Malaysia (135.85)[9] and Nigeria (129.66)[10]. Such differences might be due to the method of extraction used.

The fatty acid composition of the oil was analyzed using Gas Chromatography with Flame Ionization Detector (GC-FID). Table 3 shows the major long chain fatty acids present in *J. curcas* L. seed oil namely; palmitic acid (13.5%), stearic acid (6.9%), oleic acid (51.8%), linoleic acid (26.6%) and linolenic acid (0.2%). *J. curcas* seed oil contains high percentage of unsaturated fatty acid which is about 78.6%. The presence of high unsaturated oleic and linoleic acids makes *J. curcas* L. oil prone to oxidation in storage[21].

CONCLUSION

The present study showed *J. curcas* L. seed can be a sustainable source of oil for agricultural, industrial and medicinal uses due to its high percentage yield and of good quality as determined by its physicochemical properties.

Further researches are recommended on *Jatropha curcas* L. seed oil with regards to toxicity and detoxification process for its potential use. Also, production of these plants should be encouraged and sound analytical methods can be provided to reveal more of its potential medicinal uses.

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Table 1: Physical Characteristics of Philippine *J. curcas* L. seed oil

Characteristics	Result
% oil yield (w/w)	45.07%
Color	Yellowish
Odor	Odorless
Physical state at room temp.	Liquid
Solubility	Miscible in n-hexane, chloroform, acetone Immiscible in ethanol and water

Table 2: Chemical Characteristics of Philippine *J. curcas* L. seed oil

Characteristics	Result
Refractive index	1.4651
Acid value (mg KOH/g)	31.5
Saponification value (mg KOH/g)	195.7
Iodine value (g/100g)	921

Table 3: Fatty acid Composition of Philippine *J. curcas* L. seed oil

Fatty acid	Percentage Composition
Palmitic acid	13.5
Stearic acid	6.9
Oleic acid	51.8
Linoleic acid	26.6
Linolenic acid	0.2
Unidentified Components	1.0

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