

Jatropha nana Dalz. & Gibs. : A plant for future energy

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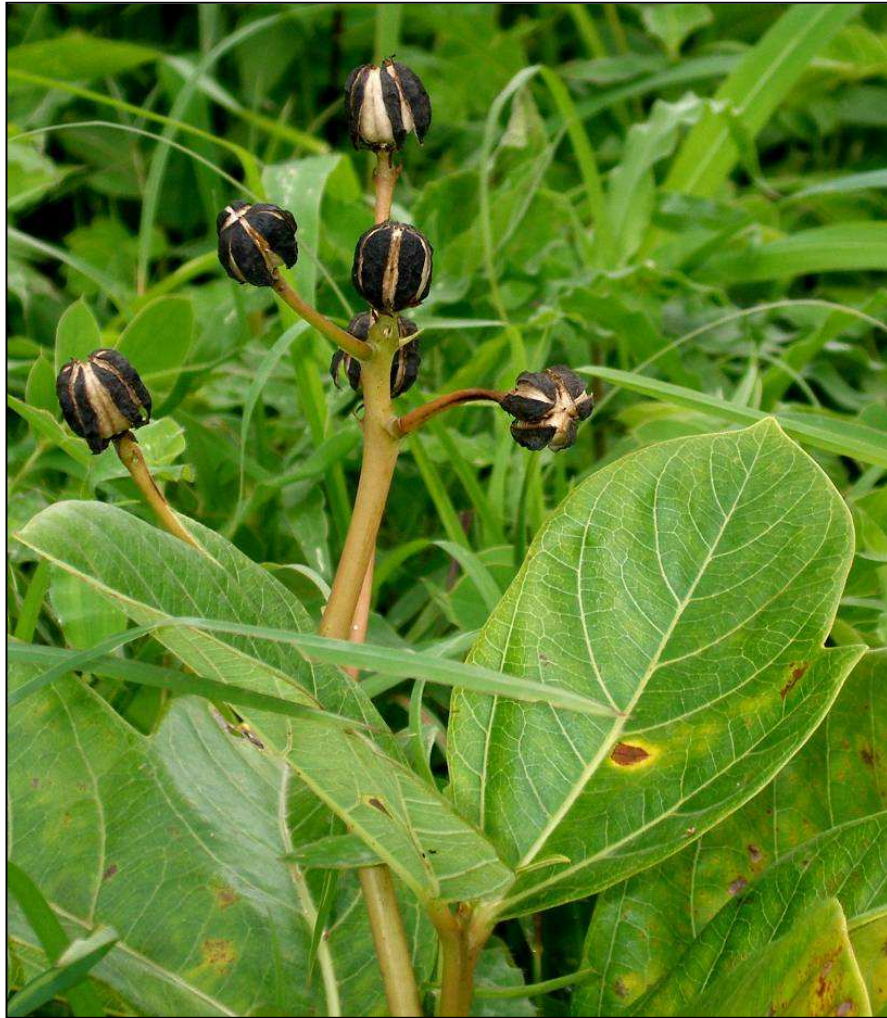


Photo near Pune, India, by Kulkarni

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Abstract

Jatropha species belongs to the Euphorbiaceae family and includes 14 wild and cultivated species in India. Four species viz. *J. nana* Dalz., (JN) *J. gossypifolia* L. (JGO), *J. glandulifera* Roxb. (JGL) *J. curcas* L. (JC) were collected from Pune, Solhapur and Ratnagiri regions of Maharashtra, India. Seed oil was studied for various physicochemical properties such as- oil content, ash content, moisture content, acid value (AV), saponification value (SV), iodine value (IV), free fatty acids (FFA), specific gravity (SG), mean molecular mass (MMM), Refractive Index (RI) as per standard methods. Total protein in seed and defatted cake, nitrogen content was carried with Kjeldhals method. Fatty acid (FA) determination and oxidative stability index (OSI) were carried out by gas chromatography (GC). A present finding gives importance of *J. nana* for future hybridization programme to get better *Jatropha* crop for energy.

Key words: *Jatropha* oil; Physico-chemical analysis; Fatty acid content; Oxidative stability index

Introduction

Genus *Jatropha* with 172 species having significant economic importance is native to Central America and distributed in Africa and Asia [1]. During our studies on “Germplasm collection of non-edible oil resources from Western Maharashtra” and “Studies on some *Jatropha* species for potential values” we came across some *Jatropha* species which found to be suitable for energy purpose. Among the various *Jatropha* species *Jatropha curcas*, *J. glandulifera*, *J. gossypifolia*, *J. integerrima*, *J. multifida*, *J. nana*, *J. podagrica*, and *J. tanzanensis* are widely distributed in India. *J. curcas*, *J. integerrima*, and *J. glandulifera* are native to America. Now days *Jatropha* species has received more attention for use in biodiesel purpose. In this context many researchers worked on oil properties of *J. curcas* but there are some other species which includes *J. nana*, *J. gossypifolia* and *J. glandulifera* [2-4] are not investigated in detailed. In present study *Jatropha* species found in wild [5] were properly collected and studied for their physicochemical properties. JC is a perennial shrub without glandular hairs distributed all over the world. The seed size is measured as length x breadth x thickness (L x B x T) are 1.69 x 1.4 x 0.84 – 1.84 x 1.31 x 0.85 mm with black color at maturity. *J. nana* is a small bushy ephemeral and is endemic to Maharashtra, Pune. It shows absence of glandular hairs. The seed size is 0.87 x 0.47 x 0.35

mm with yellowish cauracle and brown coat colour. In traditional medicine it is used as antiirritant in ophthalmia [6-8]. Seed oil from *J. nana* is used for energy¹. *J. gossypifolia* is a small shrub which grows widely in India with reddish leaves and flowers and glandular hairs throughout. It has small brown seeds with stripes; size of seed is 0.74 x 0.44 x 0.35 mm. Ethno botanical uses of *J. gossypifolia* reported for cancer, diarrhea, dysentery, skin diseases (leprosy), arthritis, ulcer, gum infections and wound healing [9-13]. Seed oil of *J. gossypifolia* is used in rheumatism and paralytic affections [14]. *J. glandulifera* is a small bushy shrub found all over India and has greenish-yellow flowers and green leaves. It has glandular hairs only in the axils of leaves. Seeds are small, cream-yellow with black dots throughout. Size of seeds is 0.74 x 0.54 x 0.34 mm. In ayurvedic literature, seeds, leaves, bark and roots were reported for its analgesic properties, inflammation, asthma and bronchitis [6-8]. Biological activity of shoots reported against cancer [9]. Present study was designed to investigate four *Jatropha* species with respect to oil content variation, physico-chemical analysis, FA determination and OSI.

Experimental

Seed samples:

Well dried and matured fruits were collected from Pune, Solhapur region of Maharashtra state in India during suitable period

Oil extraction:

Seeds dried under shade for few days and crushed in a grinder machine at normal temperature for few minutes. Oil was extracted with petroleum ether (60°-80°) in a Soxhlet apparatus for 6 hours at 70°C. Solvent was removed under reduced temperature and pressure. The yield of oil was calculated.

Physico-chemical properties:

The IV, SV and AV of the oil were determined by standard procedures [15]. The MMM was estimated from the relationships $(560/SV) \times 100$ [16-17]. RI was carried out by refractometer (Erma Tokyo no. 6343 at 20° C) Table 1. The FFA was calculated from the relationship given i.e.1 unit of acid value \neq 0.503 % FFA (calculated as oleic acid) [18]. The specific gravity was determined by the method [19] Table 1. Crude nitrogen was determined by Kjeldhals method [20] and protein was calculated by $N \times 6.25$. Ash content was carried out in muffle furnace at 560°C, and moisture content by sartorius MA 45 autoanalyser at 100 °C.

Powdered seeds of collected sample were used for determination of FA [21]. The FA estimation was done on Agilent 6890 N gas chromatograph with auto sampler and auto injector. OSI ratios were found out by monounsaturated fatty acids/ polyunsaturated fatty acids (MUFA/PUFA) method.

Results and Discussion

The oil content and the physico-chemical properties are shown in Table-1. The oil content of the seed is within the range obtained for cotton and castor seed oils [22-23]. Seed oil obtained from JN and JGL is yellow while that of JGO is cream in colour. JN and JGL remains in semi-drying and JGO in non-drying state at room temperature. IV is a measure of determining the degree of unsaturated fatty acids (UFA) in the oil. IV of various vegetable oils ranges from 10 for Coconut oil, 94-120 for Rapeseed oil, 117-143 for Soybean oil and 185 for Sardine oil [24-25]; the IV of JN, JGO and JC lies in the range given for above oils. IV of JGL is higher than that of reported values. AV up to 6.2 mg KOHg^{-1} is suitable for transesterification [2] all four species of *Jatropha* showed AV in similar range. The SV of the non edible oil ranges from 170 to 350 mg/g [26]; it could be used in liquid soap and hair shampoo. Nitrogen content in fatted cake is in range of 2.64 % to 3.66 % and defatted 4.19 % to 6.83 % and used as fertilizer. Crude protein is 24.60 % in JC [27]. Crude protein in fatted and defatted cake was in range of 16.51 % to 25.67 % and 26.16 % to 42.66 % respectively. OSI of JC was 0.75 to 2.1 and is higher than other three species. Composition of the FA esters is given in Table-2. The FA profile present in the mixture was identified by comparison against the standard FA esters. Among the saturated fatty acids (SFA) palmitic (16:0) and stearic (18:0) acids present in all species at approximately 13%. While unsaturated fatty acid (UFA) like oleic acid (18:1) and linoleic acids (18:2) were approximately 87%. These values compared with *J. curcas* FA. The FA profile showed similarities with many other oils of plant origin like *Madhuca indica*, *Pongamia pinnata*, *Euphorbia helioscopia* and *Mesua ferrea* [22]. FA determination by GC showed that all the oils are highly unsaturated and remains in liquid state for longer period. UFA in JN is 87% which is compared with JC 75-85 %. JN a bushy shrub is restricted to Pune, Maharashtra, India with lack of any research work was investigated for its properties. It is compared with other *Jatropha* species like- JGO, JGL and JC. Based on present findings it was concluded that JN an ephemeral plant species contains good percentage of oil and higher percentage of UFA. It also showed all oil characteristics within the

range of other oils. The great advantage of JN is its dwarf habitat suitable for hybridization studies. Thus, cultivation studies and breeding programme of JN will provide an economically viable crop with better future for energy, which needs special attention.

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Table 1 Physicochemical analysis of *Jatropha* species

Parameters	JN	JGO	JGL	JC
Oil content (%)	40.0	27.1	28.9	37.0
Ash %	0.97	0.91	0.96	0.93
Moisture %	4.3	2.05	3.1	4.86
AV (mg/g)	6.3 ± 0.2	4.3 ± 0.2	4.1 ± 0.2	1.9 ± 0.03
SV (mg/g)	26.7 ± 0.3	193.8 ± 0.6	192.1 ± 0.7	324.2 ± 0.6
IV (g/100g)	58.1 ± 0.5	142.5 ± 0.6	270.0 ± 1	139.0 ± 1
FFA (mg/g)	26.7 ± 0.2	11.8 ± 0.1	2.6 ± 0.1	10.4 ± 0.002
SG at RT (28°C)	0.926	0.892	0.929	0.922
MMM	209.9 ± 1.21	289.9 ± 0.11	290.0 ± 0.1	172.5 ± 0.002
RI (20° C)	1.478	1.474	1.474	1.474
Total Nitrogen in cake (%)	3.8 ± 0.1	3.6 ± 0.01	3.2 ± 1.6	2.6 ± 0.01
Nitrogen in defatted cake (%)	6.8 ± 0.03	5.8 ± 0.04	6.1 ± 0.12	4.2 ± 0.1
Total Protein % (fatted)	23.8 ± 0.4	22.7 ± 0.1	25.8 ± 1.3	16.5 ± 0.10
Protein % (defatted)	42.7 ± 0.2	36.5 ± 0.3	37.9 ± 0.8	26.2 ± 0.4

S. E. ± n= 3

Table-2 Percent fatty acids and OSI in *Jatropha* species by GC

Fatty acids	JN	JGO	JGL	JC
Palmitic(16:0)	6.76 ± 0.01	7.33 ± 0.4	6.76 ± 0.02	16.10 ± 0.9
Stearic(18:0)	6.03 ± 0.03	5.53 ± 0.2	5.43 ± 0.1	4.70 ± 0.1
Oleic (18:1)	12.77 ± 0.003	15.05 ± 0.4	14.27 ± 0.1	33.89 ± 1.7
Linoleic (18:2)	74.47 ± 0.003	71.92 ± 0.3	73.53 ± 0.1	45.29 ± 1.4
OSI	0.17	0.21	0.19	0.75

S. E. ± n= 3

