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RESEARCH ARTICLE

Characteristic of *Jatropha curcas* seeds of different agro-climatic zone of Chhattisgarh state

■ **BHUPENDRA SINGH PAINKRA AND PRASHANT KUMAR SHARMA**

SUMMARY

Jatropha curcas can help to increase rural incomes, from plantations and agro-industries. *Jatropha curcas* is a valuable multi-purpose crop to alleviate soil degradation and aforestation, which can also of three agro-clamatic zone of chhattisgarh be used for bio-energy to replace petro-diesel production, climatic protection and hence, deserves specific attention. In the present study comparative study of *Jatropha curcas* seeds (*i.e.* northern hilly zones, chhattisgarh plain and bastar plates) were studied. The highest and lowest value of whole seed mass, kernel weight, shell weight, percentage kernel mass of whole seeds and percentage shell mass of whole seeds were 0.74 g (Northern Hilly Zone) and 0.70 g (Chhattisgarh plain), 0.54 (Bastar plates) and 0.49 g (Chhattisgarh plain), 0.23 g (Northern Hilly Zone), 0.18 g (Bastar plates), 71.31 per cent (Chhattisgarh plain), 70.16 per cent (Bastar plates) and 29.84 per cent (Bastar plates) and 29.12 per cent (Northern Hilly Zone), respectively. Chemical composition proved that *Jatropha curcas* seeds are a good source of protein 32.91 per cent (Northern Hilly Zone), oil 26.92 per cent (Bastar plates) and carbohydrates 30.22 per cent (Chhattisgarh plain), respectively. The seeds are rich in various micro-elements, that is manganese (Mn), iron (Fe) and zinc (Zn), respectively as well as macro-elements that is potassium (K), calcium (Ca), sodium (Na), Magnesium (Mg) and phosphorus (P), respectively.

Key Words : *Jatropha curcas* L., Mineral content, Chhattisgarh

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Jatropha curcas, a member of the Euphorbiaceae family is a multipurpose tree of significant economic importance because of its several industrial and medicinal uses (Makkar *et al.*, 2008).

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Jatropha curcas have multiple uses, it can produce biodiesel as fuel. Due to fires without emissions that pollute the environment, so called oil friend of the environments is also used for lighting and several other industrial purpose (Gamassy, 2008).

India is emerging very fast as a major force in global economy. During the present phase of accelerated development, it is inevitable that energy consumption increases many folds as compared to the present per capita energy consumption which is very low in comparison to the other developed countries. The oil import bill has serious consequences on the Indian

economy. This alarming situation calls for emphasis on the use of non-conventional energy sources in a big way. Petro-crops promise for a better eco friendly approach in this sector.

Chhattisgarh is the only state of the country, where about 43.85 per cent (59285.27 heq) of the total area of state occupied by the forest. Chhattisgarh state is divided geographically into three regions, namely Northern hills, Chhattisgarh plain and Bastar plateau. Recently there has been thurst on bio-diesel potential of *Jatropha curcas*.

Jatropha curcas can help to increase rural incomes, from plantations and agro-industries. *Jatropha curcas* is a valuable multi-purpose crop to alleviate soil degradation and aforestation, which can be used for bio-energy to replace petro-diesel, for soap production and climatic protection, and hence, deserves specific attention.

MATERIAL AND METHODS

Sample materials- *Jatropha curcas* L.:

Jatropha species (*Jatropha curcas* L.) were collected from project area 'demonstration of promising genotype of Jatropha in Chhattisgarh State, Village-Sukhari, dist- Surguja, Chhattisgarh, village- Lalipur, dist-Jagdalpur Chhattisgarh and Village-Ranigaw, dist-Bilaspur, Chhattisgarh.

Physical properties of *Jatropha curcas* seeds :

Twenty five seeds of *Jatropha curcas* were randomly taken and the average weight of the seeds was estimated. The seeds were cracked using a mechanical cracker, the shells were carefully removed and the weights of the kernel were recorded. Further, the average shell weight was calculated from the total seed weight minus kernel weight of the respective seeds.

Analytical methods :

All *Jatropha curcas* samples *i.e.* whole seeds, kernel and shell were analyzed for moisture, crude protein, oil and ash contents according to the standard methods of Association of Official Analytical Chemists (AOAC, 2000). The method of Pearson (1976) was used for the determination crude fibre. While total carbohydrates were determined by the phenolsulphoric acid method using glucose as standard (Dubois *et al*., 1956). Reducing sugars were estimated by 3,5-dinitrosalicylic acid (DNS) method using D-fructose as standard (Miller, 1959) and non-reducing sugars were expressed as difference between total carbohydrates and reducing sugars. The values of these compounds are reported on dry weight basis.

Minerals :

Mineral contents, that is iron (Fe), manganese (Mn), cobalt (Co), copper (Cu), lead (Pb), zinc (Zn), cadmium (Cd), chromium (Cr) and nickel (Ni) were determined according to the methods of Association of Official Analytical Chemists (AOAC, 2000) using atomic absorption spectrophotometer. The flame photometer was applied for macro-elements *i.e*. calcium (Ca), potassium (K) and sodium (Na) determination according to the methods described by Pearson (1976). While spectrophotometric method was used for determination of the phosphorus (P) content of the tested samples using ammonium molybdate as outlined in the Association of Official Analytical Chemists (AOAC, 2000).

Chemicals and reagents :

All chemicals and reagents used were purchased from Merck, Merck Limited, Mumbai, India.

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Physical properties of *Jatropha curcas* seeds :

Physical properties of *Jatropha curcas* seeds were determined (Table 1). Data presented that average mass of whole twenty five seeds was 0.74 g in northern hills zone, 0.70 g in Chhattisgarh plain and 0.72 g in Bastar plateau region. The average kernel weight was 0.51 g, 0.49 g and 0.54 g, respectively as well as the shell average weights was 0.23 g, 0.21 and 0.18 g comparatively all three parts of Chhattisgarh. Data also proved, that the percentage kernel and shell mass to whole seeds was northern hilly zone 70.88 per cent and 29.12 per cent, Chhattisgarh plain 71.31 per cent and 28.69 per cent and Bastar plateau 70.16 per cent and 29.84 per cent, respectively. Similar results reported by Herrera *et al*. (2006) and Azza *et al*. (2010). However, the values of the percentage kernel weights found in this study were larger than that detected by Makkar *et al*. (1998).

Chemical composition of raw *Jatropha curcas* :

Biochemical composition of the whole *Jatropha curcas* seeds, kernels and shells of untreated seeds of *Jatropha curcas* are presented in Table 5. Data show that a comparatively northern hills zone, Chhattisgarh plain and Bastar plateau whole seed contained moisture 5.54, 5.51 and 5.59 per cent, protein 32.91, 31.44 and 32.85, oil 26.92, 26.90 and 26.94 per cent, ash 5.60, 5.62 and 5.56 per cent, fibre 3.85, 3.90 and 3.88 per cent, in case of total carbohydrates 30.01, 30.22 and

Table 1 : Physical characteristics of *Jatropha curcas* seeds

Parameter	Level (on dry weight basis)		
	Northern hills	Chhattisgarh plain	Bastar plateau
Whole seed of weight (g)	0.74	0.70	0.72
Kernel weight (g)	0.51	0.49	0.54
Shell weight (g)	0.23	0.21	0.18
Kernel, % of whole seed	70.88	71.31	70.16
Shell, % of whole seed	29.12	28.69	29.84

#Mean of twenty five seed

Table 2 : Comparative study of whole seed from different part of Chhattisgarh

Sr..No.	Project area	District	pH	EC	OM	N	P	K	B	S	Mg	Mn	Co	Cd	Zn	Cu	Fe
1.	Sukhri	Ambikapur	4.01	0.03	0.6	283.1	0.1	9.33	0.2	0.1	0.1	0.3	0.2	0.2	0.1	0.3	0.2
2.	Lalipur	Jagdalpur	4.16	0.01	0.3	193.0	0.2	7.00	0.1	0.2	0.5	0.1	0.4	0.4	0.6	0.1	0.4
3.	Ranigaon	Bilaspur	4.19	0.01	0.2	157.5	0.3	6.85	0.2	0.3	0.2	0.4	0.2	0.3	0.2	0.4	0.5

*Trace elements-ppm kg/soil, # All values are means of triplicate determinations

Table 3 : Comparative study of kernel seed from different part of Chhattisgarh

Sr.No.	Project area	District	pH	EC	OM	N	P	K	B	S	Mg	Mn	Co	Cd	Zn	Cu	Fe
1.	Sukhri	Ambikapur	4.17	0.02	0.2	157.5	0.1	9.00	0.4	0.2	0.3	0.1	0.5	0.3	0.3	0.6	0.2
2.	Lalipur	Jagdalpur	4.04	0.01	0.3	194.0	0.3	8.70	0.2	0.4	0.1	0.3	0.1	0.1	0.1	0.3	0.5
3.	Ranigaon	Bilaspur	4.49	0.04	0.2	157.5	0.2	9.10	0.2	0.2	0.2	0.2	0.2	0.2	0.5	0.2	0.1

*Trace elements-ppm kg/soil, # All values are means of triplicate determinations

Table 4 : Comparative study of shell from different part of Chhattisgarh

Sr.No.	Project area	District	pH	EC	OM	N	P	K	B	S	Mg	Mn	Co	Cd	Zn	Cu	Fe
1.	Sukhri	Ambikapur	5.30	0.06	0.2	162.0	0.3	8.00	0.2	0.1	0.2	0.2	0.2	0.2	0.9	0.1	0.4
2.	Lalipur	Jagdalpur	5.50	0.04	0.4	225.0	0.2	6.20	0.4	0.3	0.3	0.4	0.2	0.3	0.7	0.2	0.6
3.	Ranigaon	Bilaspur	4.90	0.09	0.3	194.0	0.4	5.11	0.1	0.5	0.2	0.1	0.3	0.3	0.7	0.1	0.4

*Trace elements-ppm kg/soil, # All values are means of triplicate determinations

Table 5 : Chemical composition *Jatropha curcus* seeds from different part of Chhattisgarh

Components %	Values (on dry weight basis)								
	Northern hills			Chhattisgarh plain			Bastar plateau		
	Whole seed	Kernel seed	Shells	Whole seed	Kernel seed	Shells	Whole seed	Kernel seed	Shells
Moisture	5.54	4.47	6.51	5.51	4.44	6.49	5.59	4.50	6.55
Protein	32.91	30.32	4.28	31.44	30.20	4.30	32.85	30.30	4.26
Oil	26.92	45.14	1.23	26.90	45.10	1.19	26.94	45.05	1.12
Ash	5.60	5.39	6.25	5.62	5.34	6.33	5.56	5.41	6.23
Fibre	3.85	2.51	83.29	3.90	2.49	84.02	3.88	2.45	83.65
Reducing sugars	16.90	11.00	1.71	16.84	11.02	1.73	16.94	10.95	1.70
Non- reducing sugars	13.11	2.66	2.69	13.15	2.69	2.64	13.09	2.64	2.65
Total carbohydrates	30.01	13.66	4.40	30.22	13.64	4.37	30.07	13.55	4.42

All values are means of triplicate determinations

30.07 per cent including reducing sugars 16.90, 16.84, 16.94 per cent and non- reducing sugars 13.11, 13.15 and 13.09 per cent, respectively. These values are very similar to those reported by Makkar *et al*. (1998). However, Ogbobe and Akano (1993) reported that the seed of *Jatropha gossipifolia* contains crude oil 35.8 per cent, protein 13.40 per cent, fibre 9.25 per cent, and carbohydrates at levels 30.32 per cent. Regarding to kernel seeds data indicate that oil was the mainly composed followed by protein with low ash, crude fibre and total carbohydrates (Table 5). Moisture content was 4.47 per cent is obviously lower than the 10 per cent moisture content limit recommended for storage stability of flours (Makkar *et al.*, 1998). These results are agreement with that reported by Herrera *et al*. (2006). In case of oil percentage Bastar plateau showed higher oil percentage 26.94 per cent compared with 26.92 per cent northern hills and 26.90 per cent of Chattisgarh plain area.

Table 5 proved that the shells of *Jatropha curcas* seeds composed mainly of fibre with very little protein, oil and total carbohydrates, that indicating poorly nutritional value. However, the shells consider a good source of fuel as it has high gross energy. Moisture content less than 10 per cent could be partly responsible for the non-deterioration of seeds over a long period (Makkar *et al.*,1998). It could be concluded that significantly differences were detected between the whole seeds, kernel seeds and shells among the components of moisture, protein, oil, ash, fibres and carbohydrates contents. High value of oil 45.14 per cent was recorded with kernel of *Jatropha curcas* seeds in northern hills region compared with Chhattisgarh plain 45.10 per cent and Bastar plateau 45.05 per cent. This oil content is much higher than the value recorded for other much seeds. The crude fibre is very high 84.02 per cent in Chhattisgarh plain region *Jatropha curcas* shells and lowers in whole and kernel seeds. Fibre content is a significant component of the diet. It increases stool bulk and decreases the time that waste materials spend in the gastrointestinal tract (Eze and Ibe, 2005). Crude protein values of 32.91 per cent and 30.32 per cent observed for whole and kernel *Jatropha curcas* seeds are obviously much higher than most legumes and grains. Carbohydrates content 30.22 per cent of whole seeds of *Jatropha curcas* detected Chhattisgarh plain region is much higher than most grains. They are essential for the maintenance of plant and animal life and also provide raw materials for many industries.

Minerals contents of *Jatropha curcas* :

Mineral contents of *Jatropha curcas* seeds (whole, kernel and shell seeds) are shown in Table 2, 3 and 4. Results indicate that the highest mean level of micro elements in the whole seed was magnesium (Mg) which recorded highest 0.5 ppm/kg compared than kernel seed and shell seed. However, in shell seeds, the highest mean level 0.9 ppm/kg on dry weight basis was recorded with zinc (Zn) in northern hill regions. Regarding to iron (Fe) in whole seeds, manganese (Mn) and iron (Fe) in kernel seeds as well as iron (Fe) and zinc (Zn) in shell samples were detected at lower levels. On the other hand nickel (Ni) and lead (Pb) were not detected in any of the analyzed samples. The contents of macro elements varied in different samples.

Kernel seeds were reached highest by potassium (K) 9.10 mg/kg in Chhattisgarh plain region, magnesium (Mg) 0.3 ppm/kg in northern hilly regions and phosphorus (P) 0.3 mg/kg Bastar plateau proved that kernel seeds with these elements compared with whole seeds and shell samples. However, the highest level of nitrogen (N) 225.0 mg/kg was detected in shell samples. On the other hand, moderate levels of organic matter (OM), cadmium (Cd), magnesium (Mg) and phosphorus (P), cobalt (Co) and copper (Cu) were observed in whole seeds, kernel seed and shell seeds. Similar results were obtained by Oladele and Oshodi (2007). The seeds could, therefore, be referred to as a good source of calcium (Ca), potassium (K), magnesium (Mg), zinc (Zn) and phosphorus (P).

Conclusion :

In present investigation, it can be concluded that *Jatropha curcas* is of very high nutritional value as well as of great economic importance plants. It is very rich in reference to the element like nitrogen (N), phosphorus (P) and potassium (K) besides having very high oil content values. Due to these reasons, *Jatropha curcas* is presenting itself as the best option for petro-diesel, as it contains octane-91 as its component, which is a lead constituent of petro-diesel and as an eco-friendly substitute for chemical fertilizers due to its high N, P, K value.

From the present communications the fact arises that seeds of *Jatropha curcas* from Bastar platue showing highest oil content (26.94) as compared of *Jatropha curcas* from Chhattisgarh plains and Northern hilly zones

of Chhattisgarh. From this fact, it can be concluded that *Jatropha* from Bastar plateu region is best for its application as biodiesel as compared to the *Jatropha curcas* from Chhattisgarh plains and northern hilly zones of Chhattisgarh. High value of nitrogen, phosphorus and potassium in seeds of *Jatropha curcas* makes it better substitute for chemical fertilizers as it is eco-friendly besides its N, P, and K content. Thus, seeds along with its residues can be used as biofertilizers to increase the fertility of the soil. So *Jatropha curcas* may prove itself as cheap source of biofertilizers also.

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