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RESEARCH ARTICLE

Nutritional value of *Jatropha curcas* seeds and the effect of some physical and chemical treatments- with special reference to Chhattisgarh State

■ PRASHANT SHARMA, PREETI KAUR AND S.K. SHUKLA

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 be used for bio-energy to replace petro-diesel, for soap production and climatic protection, and hence, deserves specific attention. In the present study physical characteristics of *Jatropha curcas* seeds were studied. The average of whole seed mass, kernel weight, shell weight, percentage kernel mass of whole seeds and percentage shell mass of whole seeds were 0.74, 0.51, 0.23, 70.88 gram and 29.12 per cent, respectively. Chemical composition proved that *Jatropha curcas* seeds are a good source of protein (32.91 %), oil (26.92 %) and carbohydrates (30.01 %). The seeds are rich in various micro-elements, that is manganese (Mn), iron (Fe) and zinc (Zn) which recorded 27.99, 0.41 and 45.90 mg/kg, respectively as well as macro-elements, that is potassium (K), calcium (Ca), sodium (Na), magnesium (Mg) and phosphorus (P), which recorded 102.79, 34.13, 8.46, 111.0 and 183.70 mg/kg, respectively.

Key Words : *Jatropha curcas* L., Nutrient, Mineral content, Physical-chemical properties

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Abundance and availability of energy resources largely determine the economic wellbeing of a country. Energy independence has to be our first and foremost priority (Abdul Kalam, 2005). One of the main crops currently being promoted for biodiesel production in several countries, globally, is *Jatropha curcas*. There have been substantial political and social pressures to promote the growing of such crops in particular *Jatropha curcas* in India, as a means of economic empowerment, social upliftment and poverty alleviation within marginalized communities.

Jatropha curcas is a multi purpose plant belonging to the family Euphorbiaceae with several attributes and considerable potential and has evoked interest all over the topics as a potential biofuel crop (Beet *et al.,* 2002). *Jatropha curcas* is native to Central America and has become naturalized in many tropical and subtropical areas, including India, Africa and North America. Originating in the Caribbean, *Jatropha curcas* was spread as a valuable hedge plant to Africa and Asia by Portuguese traders (Fairless, 2007). It is an all purpose, zero waste drought resistant photo insensitive perennial plant. The species grows in areas with extreme climates and soil conditions that could not be inhabited by most of the agriculturally important plant species (Chandhari and Joshi, 1999).

Jatropha curcas grows throughout most of the tropics. It survives on poor stony soils and can be used to reclaim land (Munch and Kiefer, 1989). *Jatropha curcas* plants start yielding from the second year of planting, but in limited quantity. If managed properly, it starts giving 4-5 kg of seed per plant tree production from the fifth year onwards and seed yield can be obtained up to 40-50 years from the day of

MEMBERS OF THE RESEARCH FORUM

Author to be contacted :
PRASHANT SHARMA, Biotech Lab Training and Demonstration Centre, AMBIKAPUR (C.G.) INDIA
Email: prashantbiotech@yahoo.co.in

Address of the Co-authors:
PREETI KAUR AND S.K. SHUKLA, Chhattisgarh Biofeul Development Authority, RAIPUR (C.G.) INDIA
Email: preeti_kaur97@rediffmail.com, mrshailendra.shukla@gmail.com

planting (Kumar *et al.*, 2003). The seed weights ranged from 0.53-0.86 gram and the kernel contains 22-27 per cent protein and 57-63 per cent oil (Oladele and Oshodi, 2008). These limits indicating that *Jatropha curcas* is a good nutritional value. The seed kernels are known to contain highly oil, which can be used as fuel directly or as a substitute to diesel in the transesterified form. The seed cake can be a good protein source for humans as well as for livestock (Makkar *et al*., 2008).

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). *Jatropha curcas* bush and have multiple uses it well to produce outstanding biodiesel as fuel and 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).

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. *Jatropha curcas* can help to increase rural incomes, self-sustainability and poverty for women, elderly, children and men, tribal communities, small farmers. It can as well help to increase income from plantations and agro-industries. All parts of *Jatropha curcas* used in traditional medicine (Dilara and Nath, 2000). Leaves and tender stems are used as a folk dye by tribal people (Srivastava *et al.*, 2008).

The objective of the present study was to demonstrate the nutritional quality of *Jatropha curcas* seeds.

MATERIALS AND METHODS

Sample materials :

Jatropha species (*Jatropha curcas* L.) were collected from project aria 'Demonstration of Promising Genotype of Jatropha in Chhattisgarh State, village-Sukhari, Dist- Surguja, Chhattisgarh' that harvested at March-April 2011. The sample was cleaned manually to remove all foreign materials such as dust, dirt, small branches and immature seeds. The cleaned and graded seeds were de-hulled to gain access to a cream-coloured endosperm, which is the sample material. The sample materials were blended to powder form with a high speed blender. The sample was stored in an airtight box and kept in a refrigerator prior to analysis.

Chemicals and reagents :

All chemicals and reagents were purchased from Merck, Merck Limited, Mumbai, India. The used water was distilled using water distillation apparatus. Micro elements, that is iron (Fe), manganese (Mn), cobalt (Co), copper (Cu), lead (Pb), zinc (Zn), cadmium (Cd), chromium (Cr) and nickel (Ni) as well as macro-nutrients, *i.e.* phosphorus (P), calcium (Ca), potassium (K), and sodium (Na) were provided by Merck Limited, Mumbai, India. The working standards were prepared from the individual stock solution (1000 mg/l).

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.

Sample preparation :

The kernel and whole seeds were grounded, using a mechanical grinder, and defatted in soxhlet apparatus, using diethyl ether for 16 hours. The defatted seed was air dried at room temperature and stored in a separate plastic container at 4^0C.

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 were 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).

RESULTS AND DISCUSSION

The experimental findings obtained from the present study have been discussed in 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 gram, and the average kernel weight was 0.51 gram, as well as the shell average weights was 0.23 gram. Data proved also, that the percentage kernel and shell mass to whole seeds were 70.88 per cent and 29.12 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 2. Data shows that a whole seed contains moisture 5.54 per cent, protein 32.91 per cent, oil 26.92 per cent, ash 5.60 per cent, fibre 3.85 per cent and total carbohydrates 30.01per cent, including reducing sugars 16.90 per cent and non- reducing sugars 13.11per cent. 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

Table 1: Physical characteristics of *Jatropha curcas* seeds

Parameter	Level (on dry weight basis)
Whole seed of weight (gram)	0.74
Kernel weight (gram)	0.51
Shell weight (gram)	0.23
Kernel, % of whole seed	70.88
Shell, % of whole seed	29.12

Mean of twenty five seeds

Table 2: Chemical composition *Jatropha carcass* seeds

Components %	Values (on dry weight basis)		
	Whole seeds	Kernel seeds	Shells
Moisture	5.54	4.47	6.51
Protein	32.91	30.02	4.28
Oil	26.92	45.14	1.23
Ash	5.60	5.39	6.25
Fiber	3.85	2.51	83.29
Reducing sugars	16.90	11.00	1.71
Non-reducing sugars	13.11	2.66	2.69
Total carbohydrates	30.01	13.66	4.40

#All values are means of triplicate determinations

Table 3: Mineral contents of raw seeds of *Jatropha curcas*

Elements	Concentrations mg/kg (on dry weight basis)		
	Whole seeds	Kernel seeds	Shell
Micro elements			
Manganese (Mn)	27.99	0.66	12.83
Iron (Fe)	0.41	o.46	7.33
Zinc (Zn)	45.90	41.70	1.04
Copper (Cu)	nd	nd	nd
Nickel (Ni)	nd	nd	nd
Lead (Pb)	nd	nd	nd
Macro elements			
Potassium (K)	102.79	108.40	34.37
Calcium (Ca)	34.13	51.33	27.97
Sodium (Na)	8.46	8.84	17.90
Magnesium (Mg)	111.0	101.37	5.02
Phosphorus (P)	183.70	166.00	3.01

#All values are means of triplicate determinations, nd- not determine

was the mainly composed followed by protein with low ash, crude fibre and total carbohydrates (Table 2). 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).

Table 2 proved that the shells of *Jatropha curcas* seeds composed mainly of fiber 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, fibers and carbohydrates contents.

High value of oil 45.14 per cent was recorded with kernel of *Jatropha curcas* seeds. This oil content is much higher than the value recorded for other much seeds. The crude fibre is very high 83.29 per cent in *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 30.02 per cent observed for whole and kernel *Jatropha curcas* seeds were obviously much higher than most legumes and grains. Carbohydrates content 30.01per cent of whole seeds of *Jatropha curcas* detected was 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 3. Results indicate that the highest mean level of micro elements in the whole seed and shell was manganese (Mn) which recorded 27.99 mg/kg and 12.83 mg/kg, respectively. However, in whole seeds, the highest mean level 45.90 mg/kg on dry weight basis was recorded with zinc (Zn). 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, copper (Cu), 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 rich by potassium (K) 108.40 mg/kg, calcium (Ca) 51.33 mg/kg, magnesium (Mg) 101.37 mg/kg and phosphorus (P) 166.0 mg/kg proved that kernel seeds with these elements compared with whole seeds and shell samples. However, the highest level of sodium (Na) 17.90 mg/kg was detected in shell samples. On the other hand, moderate levels of potassium (K), calcium (Ca), magnesium (Mg) and phosphorus (P) were observed in whole seeds. Beside, these elements were found at lower levels in shell samples except sodium (Na). 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).

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