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Chemical and Biological Properties of *Jatropha curcas* and *Mucuna solan* Seed and Seed Oil

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Abstract: This study is on the chemical and biological properties of *Jatropha curcas* and *Mucuna solan* seeds and seed oil, highlighting some of the specific uses to which they can be put; the bioactive agents contained in them and hence, their potency in medicine, among other values. The properties of the seeds and seed oil being investigated include proximate compositions, physico-chemical properties, mineral composition, phytochemical constituents and antimicrobial activity. *Jatropha curcas* and *Mucuna solan* seeds were collected, processed and oil extracted from the seeds; tests on the respective properties were carried out using standard analytical methods. The results showed that both seeds are relatively rich in crude protein while the crude fat content of *Mucuna solan* seed is greatly minimal compared to that of *Jatropha curcas* viz; (29.29 and 26.42) and (45.50 and 3.68) respectively. However, the crude carbohydrate of Mucuna solan seeds trippled that of Jatropha curcas (18.61 and 58.50). Also, oils from both seeds are found to have pH values within the alkaline region and the seeds containing high concentrations of macro nutrients like Ca, Mg and K; and less Zn, Cu and Pb. The *Jatropha curcas* and *Mucuna solan* seeds are said to test positively to phytochemicals such as saponnis, alkaloids and cardenolides; and negatively to tannins and phenolics, flavonoids, antraquinone and phiobatannis. However, seeds of *Jatropha curcas* tested positively to terpenoids and steroids while that of the *Mucuna solan* tested negatively to terpenoids and steroids.The antimicrobial activity test revealed that the oil extracted from both seeds showed sensitivity reaction against *E. Coli* O_{157}:H_7 and *Streptococcus pyogenes* respectively.

Key words: Characterisation %Highlighting % Antimicrobial activity % PH % Macronutrients and microorganisms

INTRODUCTION

Jatropha curcas is a shrub of about 3meters high. When matured its leaves are green in colour and its twig is very rich in latex. Its seed coats are green when immature and yellow when ripe. It is multi-purpose in nature, drought resistant and; formerly a native of South America, but nowadays, it thrives all through Africa and Asia [1]. *Mucuna solan* on the other hand, is an annual climbing vine that grows to 3-18meters in height and it is indigenous to tropical regions especially Africa, India and the West Indies. Its flowers are white to dark purple and hang in clusters. The seed pods are covered with reddish orange hairs that are readily dislodged and cause intense irritation to the skin. *Jatropha curcas* belongs to the family *Euphobiaceae* wile *Mucuna solan* belongs to the family Fabaceae.

Jatropha curcas finds usefulness in reclaiming eroded areas because of its drought resistant nature. It is also used as boundary fence or live hedges in arid and semi-arid areas. Medicinally, it has been reported that the latex of *Jatropha curcas* contained jatrophine, which is used in the treatment of cough, skin diseases and rheumatism. The latex is also known to heal wound and possessed antimicrobial properties. Its roots are known to serve as an antidote for snake bike and the extract from its leaves has an external application for piles. The roots of *Mucuna pruriens* and not *Mucuna solan* have been used

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as diuretic, tonic and stimulant. Its roots have also been used for elephantiasis treatment and; it is said to absorb scorpion poison when applied to the part of stung [2].

This study presents a detailed chemical and biological investigations of *Jatropha curcas* and *Mucuna solan* seeds and seed oil viz; proximate compositions, physico-chemical properties, mineral composition, phytochemical constituents and antimicribial activity. The results from this study is believed, would further highlight the nutitional values of *Jatropha curcas* and *Mucuna solan* seeds and seed oil as well their industrial or commercial values.

MATERIALS AND METHODS

Preparation of Samples for Analysis: The matured seeds of both *Jatropha curcas* and *Mucuna solan* were dehusked after cracking their pods and then dried. The dried seeds were ground using hand mill. The ground seeds were sieved to homogenous particle sizes using a sieve, which was after stored in a stoppered jar ready for use for analysis.

Proximate Composition: Moisture, ash contents and crude fibre of the seed samples were determined as described by [3] . The total protein was determined using the Micro-kjeldahl method as described by [4] and converted to crude protein by multiplying by 6.5 while the crude carbohydrate was estimated by difference.

Physico-chemical Properties: The oil from both the *Jatropha curcas* and *Mucuna solan* seeds was extracted for 6 hours by soxhlet extractor method with analytical grade hexane . Solvent hexane was removed under vacuum in a rotary evaporator and the percentage oil yield determined [5].

The specific gravity of the oil samples was determined by using a universal hydrometer while the peroxide value was determined as described by [6]. The acid, saponification and iodine values were determined as described by [7].

Phytochemical Constituents: Tannins and phenolic, Terpenoids, Anthraqinones, Cardenolides and Phiobatannis were determined as described by [8]. The methods of [9-11] were used to determine Saponins; Alkaloids and Steroids; and Flavonoid respectively.

Mineral Composition: The mineral composition of both the seeds and shaft of the Jatropha curcas and Mucuna solan was determined by acid digestion as described by [12] and the concentrations of the respective metals estimated from the resulting acid solution using Perkin Elmer 420Atomic Absorption Spectrophotometer.The mineral elements determined include Ca, Mg, K, Na, P, Mn, Fe, Zn, Cu and Pb.

Microbiological Activity: The antibacterial activity of the oil extracted from both the *Jatropha curcas* and *Mucunan solan* was determined using the Agar Well Diffusion Method [13]. Six milimetre cork borer was used to bore holes into the sensitivity agar (Muller Hinton Agar). 0.3mL of the test organisms were streaked evenly over the sensitivity agar. The test organisms used for the screening test include *Escherichia coli* O_{157}:H_7, *Klebsiella pneumonia*, *Streptococcus pyogenes*, *Staphylococcus aureus* and *Salmonella typhi*. The *Mucuna solan* and *Jathropha curcas* oils were dispensed into the wells in the sensitivity agar. The zones of inhibition were measured after 24 hours of incubation; and these were compared with that of Standard Chart to interpret the results [13].

RESULTS AND DISCUSSION

The results of the proximate composition, physico-chemical properties, phytochemical constituents, mineral composition determinations and microbiological activity study of the Jatropha curcas and Mucuna solan seeds and seed oil are presentenced in Tables 1,2,3,4 and 5 respectively.

Proximate Composition: The proximate composition data showed that *Jatropha curcas* was very rich in crude fat and protein, had relatively high crude carbohydrate, with very low values of moisture content, ash content and crude fibre while on the other hand, *Mucuna solan* was very rich in crude carbohydrate and protein and had low moisture content and very low crude fat, ash content and crude fibre values (Table 1).

As a nutrient, fat is known to serve five purposes: it is a source of energy (9 kcal/g); makes a diet palatable; provides basic building blocks for cell structure; provides essential fatty acids (linoleic and linolenic); and acts as a carrier for fat-soluble vitamins (A, D, E and K) [14]. While proteins are essential in the diet of animals for the growth and repair of tissue [15].

Table 1: Analytical Data for Proximate Composition

	Jathropha curcas Seed	*Mucuna solan* Seed
Moisture Content (%)	3.60	7.60
Ash Content (%)	2.40	3.20
Crude Fibre (%)	0.60	0.60
Crude Protein (%)	29.29	26.42
Crde Fat (%)	45.50	3.68
Crude Carbohydrate (%)	18.61	58.50

Table 2: Analytical Data for Physico-chemical Properties

	Jathropha curcas Seed-Oil	*Mucuna Solan* Seed-Oil
Yield(%)	45.10	3.70
pH	8.20	9.01
Specific gravity(g)	0.841	1.80
Acid value(%)	0.66	1.76
Saponification Value	105.18	148.66
Peroxide value(MeqKgG^{1})	1.70	2.30
Iodine value	0.84	1.97

Table 3: Analytical Data for Phytochemical Constituents

Phytochemicals	*Jathropha curcas* Seeds	*Mucuna solan* Seeds
Tannins and phenolics	Negative	Positive
Saponnins	Positive	Positive
Alkaloids	Positive	Positive
Flavonoids	Absent	Absent
Terpenoids	Present	Absent
Antraquinone	Absent	Absent
Steroids	Present	Absent
Philobatannins	Absent	Absent
Cardenolides	Present	Present

Table 4: Analytical Data for Mineral Composition

	Jathropha curcas Seed			*Mucuna solan* Seed		
	Seed mgKgG^{1}	Seed(Shaft)mgKgG^{1}	Metal Transfer %	Seed mgKgG^{1}	Seed(Shaft)mgKgG^{1}	Metal Transfer %
Calcium (Ca)	156.39	2.12	98.66	159.74	3.25	98.01
Magnesium (Mg)	139.74	0.96	99.32	141.37	1.31	99.08
Potassium (K)	91.02	0.49	99.47	94.61	0.70	99.27
Sodium (Na)	159.99	89.72	64.07	153.92	97.44	61.23
Phosphorus (P)	95.03	67.74	58.38	89.33	72.09	55.34
Manganese (Mn)	85.30	54.93	60.83	76.02	56.81	57.23
Iron (Fe)	99.98	25.12	79.92	107.93	29.06	78.78
Zinc (Zn)	78.78	18.40	81.07	71.30	21.08	77.18
Copper (Cu)	59.88	6.95	89.61	54.13	8.15	86.92
Lead (Pb)	0.26	1.03	20.15	0.05	2.003	2.25

Table 5: Zones of inhibition (mmSD) for the seed-oil against various bacterial isolates

	Escherichia coli O_{157}:H_7	*Klebsiella pneumonia*	*Streptococcus pyogenes*	*Staphylococcus aureus*	*Salmonella typhi*
Jathropha Curcas(Oil)	15.0 ±0.7mm	R	8.0±0.7mm	R	R
Mucuna Solan(Oil)	10.0±0.7mm	R	10.0±0.6mm	R	R
Control (Amoxycillin)	R	18.0±0.7mm	18.0±0.5mm	7.0±0.6mm	18.0±0.7mm

Key: R= resistance; SD= standard deviation.

Table 6: Comparism of the proximate composition data of some seeds with those of *Jatropha curcas* and *Mucuna solan* seeds

Seeds	Crude Protein Value (%)	Crude Carbohydrate Value (%)	Crude Fat Value(%)	Crude Fibre Value(%)
Mucuna pruriens	20-29	50.00	6-7	8-10
Parkia clappertoniana	46.00	17.00	24.00	2.59
Glycine max	24.50	26.3.0	17.12	3.85
Anacardium occidentale	23.80	24.30	29.12	3.63
Arachis hypogea	24.90	20.60	36.00	16.00
Jatropha curcas	29.29	18.61	45.50	0.60
Mucuna solan	26.42	58.50	3.68	0.60

Source:

. Crude Protein Value- *Mucuna pruriens, Parkia clappertoniana, Glycine max, Anacardium occidentale* and *Arachis hypogea* [17].

. Crude Carbohydrate Value- *Mucuna pruriens, Parkia clappertoniana, Glycine max, Anacardium occidentale* and *Arachis hypogea* [17].

. Crude Fat Value- *Mucuna pruriens, Parkia clappertoniana, Glycine max, Anacardium occidentale* and *Arachis hypogea* [17].

. Crude Fibre Value- *Mucuna pruriens, Parkia clappertoniana, Glycine max, Anacardium occidentale* and *Arachis hypogea* [17, 18].

Table 7: Comparism of the Physico-chemical property data of some seeds with those of *Jatropha curcas* and *Mucuna solan* seeds

Seed-oils	Saponification value	Iodine value	Specific gravity	Peroxide value (meqKgG^{1})	Acid value
Glycine max	186.54	120.45	0.881	-	-
Elaeis guineensis	245.44	15.44	0.876	2.10	17.03
Actinida chinensis	188.20	93-100	0.914-0.920	4.00	-
Cocos nucifera	246-280	8-10	0.926	1.15	-
Malvaceae gossipium	165-196	74-94	0.915-0.918	0.70	-
Jatropha *curcas*	105.18	0.84	0.841	1.70	0.66
Mucuna solan	148.66	1.97	1.80	2.30	1.76

Source:

. SaponificationValue- *Glycine max, Elaeis guineensis, Actinida chinensis, Cocos nucifera* and *Malvaceae gossipium* [19].

. Iodine Value- *Glycine max, Elaeis guineensis, Actinida chinensis, Cocos nucifera* and *Malvaceae gossipium* [19].

. Specific Gravity- *Glycine max, Elaeis guineensis, Actinida chinensis, Cocos nucifera* and *Malvaceae gossipium* [20].

. Peroxide Value- *Glycine max, Elaeis guineensis, Actinida chinensis, Cocos nucifera* and *Malvaceae gossipium* [7].

. Acid Value- *Glycine max, Elaeis guineensis, Actinida chinensis, Cocos nucifera* and *Malvaceae gossipium* [7].

By this finding *Jatropha curcas* and *Mucuna solan* seeds can be found as excellent sources of plant nutrients. Also, Mucuna solan can find usefulness in poultry feed production as recent studies had shown that the addition of small amounts of certain dietary fiber or oligosaccharides changes the bacterial populations in the lower gastrointestinal tract and reduces the amount and form of nitrogen excretion, which subsequently reduces odour in poultry production [16].

The proximate composition data of Jatropha *curcas* and *Mucuna solan* compare favourably with those of some seeds already published (Table 6).

Physico-chemical Properties: The result showed that both the *Jatropha curcas* and *Mucuna solan* seed oils had high saponification values and low peroxide, iodine, specific gravity and acid values respectively. However, the percentage yield for *Jatropha curcas* seed oil is 45.10% while that of *Mucuna solan* is 3.70% (Table 2). The data suggests that both oils are of good quality oil and with high saponification values can find usefulness in soap making, but for the percentage yield of *Mucuna solan.*

A comparism of the physico-chemical property data of some seed-oil with those of Jatropha *curcas* and *Mucuna solan* seed-oils is given in Table 7.

Phytochemical Constituents: The Phytochemical constituent test showed that saponnins, alkaloids, terpenoids, steroids and cardenolides are contained in *Jatropha curcas* seed-oil while tannins and phenolics, saponnins, alkaloids, cardenolides are found in *Mucuna solan* seed-oil. Also, the result revealed that phytochemicals like tannins and phenolic, flavonoids, antraquinone and phiobatannis; and flavonoids, terpenoids, antraquinone, steroids and phiobatannis are absent in both the *Jatropha curcas* and *Mucuna solan* seed-oil respectively (Table 3).

Phytochemicals are invaluable sources of raw material for both traditional and orthodox medicine. The phytochemical screening of seeds helps to highlight the bioactive agents contained in them and hence, their potency in medicine. Seed-oils containing bioactive agents such as saponnins, alkaloids, terpenoids, steroids, cardenolides and tannins and phenolic thus, readily present themselves as a good source of raw material in

modern and traditional medicine. Steroids are known for body building and performance-enhancing; cardenolides have anti-tumour effects on prostrate and breast cancers; saponnins are said to possess anti microbial and anti-inflammatory activities and have effects on serum cholesterol and; alkaloids, terpenoids, tannins and phenolics are said to exhibit strong biological activities [21-25]. The presence of these arrays of phytochemicals in *Jatropha curcas* and *Mucuna solan* seed oils suggests that they will find relevance in the field of orthodox and traditional medicine.

Mineral Composition: The results of the mean concentrations ($mgKg^{-1}$) of major elements (Ca, Mg, K, Na and P); and trace elements (Mn, Fe, Zn, Cu and Pb) in the *Jatropha curcas* and *Mucuna solan* seeds and shaft are contained in Table 4. For *Jatropha curcas* seed- the highest mean concentration among the major elements was recorded for Na (159.99 $mgKg^{-1}$) and the least for P (95.03 $mgKg^{-1}$) while for *Mucuna solan* seed, the highest mean concentration was recorded for Ca (159.74 $mgKg^{-1}$) and the least for P (89.33 $mgKg^{-1}$). All the major elements estimated for both seeds recorded high metal transfer percentage ranging from (58.38-99.32%) for *Jatropha curcas* and (55.34-99.08%) for *Mucuna solan*.

The highest mean concentrations among the trace elements was recorded for Fe and the least for Pb (Fe=99.98 $mgKg^{-1}$; Pb=0.26 $mgKg^{-1}$) and (Fe=107.93 $mgKg^{-1}$; Pb=0.05 $mgKg^{-1}$) for the *Jatropha curcas* and *Mucuna solan* seeds respectively. Also, all the trace heavy elements (excluding Pb) estimated for both seeds recorded high metal transfer percentage ranging from (60.83-89.61%) for *Jatropha curcas* and(55.57.23-86.92%) for *Mucuna solan*. The high metal transfer percentage recorded for both the major and trace heavy elements in this study reveals that the oil extracted from both seeds is an effective reserve of both classes of elements; and as such could serve as a good supplement source for the elements. Elements contribute to neurochemical transmission among other benefits, where the carrier elements are identified as food constituents of biological molecules, co-factors for various enzymes and in various metabolic processes [26].

The mean concentration of Pb in both seed samples is 0.26 $mgKg^{-1}$ for *Jatropha curcas* and 0.05 $mgKg^{-1}$ for *Mucuna solan*. The concentration of Pb in these seeds is extremely low. The permissible limit Pb for medicinal plants based on Accepted Daily Intake (ADI) for Pb is 10mgL^{-1}. The seeds under investigation accumulated Pb below this level [27]. The levels of Pb obtained in the present study do not pose any potential health hazard to users.

Microbiological Activity: *E.coli* O_{157}:H_7 and *Streptococcus pyogenes* are killed by both the *Jatropha curcas* and *Mucuna solan* seeds-oil respectively. An inhibition zone of 15.0mm was recorded for *Jatropha curcas* seed oil while that of *Mucuna solan* was 10.0mm. Further observation showed that *Jatropha curcas* seed oil was more effective than the *Mucuna solan* seed soil against *E.coli* O_{157}:H_7. On the other hand, *Mucuna solan* is more effective than *Jatropha curcas* in their action against *Streptococcus pyogenes* with the zone of inhibition of 10.0mm and 8.0mm respectively. Also, *Klebsiella pneumonia*, *Staphylococcus aureus* and *Salmonella typhi* showed resistance against both the *Jatropha curcas* and *Mucuna solan* seed oil while *E.coli* O_{157}:H_7 showed resistance against the control sample (Amoxycillin).

The action of *Mucuna solan* seed oil against the test bacteria may not be unconnected with the fact that it contains tannins and phenolics (Table 3), which are renowned for their antimicrobial activities [25]. *Jatropha curcas* seed oil showed antimicrobial activity against *E.coli* and *Streptococcus pyogenes* without containing tannins and phenolics (Table 3) -suggesting that the oil cannot be used as a disinfectant, but can find usefulness as a chemotherapeutic agent [28].

CONCLUSION

The Study Revealed That: The seeds of both *Jatropha curcas* and *Mucuna solan* have great nutritional values with bioactive agents such as tannins and phenolics, saponnins, cardenolides etc. which are of medicinal importance

The oils are of good quality; possess high concentration of both the major and trace elements and could serve as an efficient supplement source for these elements. They also possess strong antimicrobial activity.

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