

Some Aspects of the Nutritional Properties of the Seed and Raw Seed Oil of *Hura crepitans*

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ABSTRACT

The amino acids profile of the seeds, vitamins and antinutrients contents of the raw seed oil of *Hura crepitans* were studied in order to compliment information available in the literature and establish whether the oil can be used as edible oil, and the seed in food modifications and formulations. The seeds were collected along Nwaniba Road in Uyo Local Government Area of Akwa Ibom State, Nigeria. The oil was cold-extracted with n-hexane and used in the analysis of antinutrients and vitamins. The defatted seed flour was used in the determination of amino acids. The amino acids, vitamins and antinutrients were determined using standard methods. The results reveal that the antinutrients levels in the seed oil are relatively higher than their corresponding levels in conventional edible seed oils except phytate and oxalate. The oil is very rich in vitamin C compared to mustard and sunflower seed oils which are also edible oils. The seeds are richer in amino acids than the seeds of *A. hypogaea*, and *E. guineensis* which are conventionally used as food materials and their oils in cooking and frying. They are particularly rich in the essential amino acids except valine. The amino acids contents of the seeds compare reasonably (about 82%) with whole hen's egg. Although *H. crepitans* seeds are rich in amino acids and the oil in vitamin C, the high tannins and cyanide levels in the seed oil would limit its use in nutrition. However, the seed flour can be beneficial in food fortification processes and animal feeds production.

Keywords: *Hura crepitans*, Seed flour, Raw seed oil, Antinutrients, Vitamins, Amino acids, Essential amino acids

INTRODUCTION

Hura crepitans commonly known as *sandbox tree*, is an evergreen tree of the spurge family *Euphorbiaceae*^{1,2}. It is known

by its many dark, pointed spines and smooth brown bark. These spines have caused it to be called monkey no-climb. The tree grows to a height of about 60 metres³, and has large ovate leaves of about nine inches wide.

Besides being a source of seed oil, *H. crepitans* has edible uses, industrial applications and pharmaceutical importance⁴.

Fishermen use the milky, caustic sap from this tree to poison fish; the Caribs made arrow poison from its sap⁵. The wood is used for furniture under the name “*Hura*”. Before more modern forms of pens were invented, the trees’ unripe seed capsules were sawn in half to make decorative pen sandboxes (also called pounce pots), and hence the name ‘sandbox tree’⁵. *H. crepitans* tree is mainly used as a shade plant on highways and even in private compounds in Nigeria, and hence its abundance increases daily.

Seed oils are important sources of nutritional oils. The characteristics of oils from different sources depend mainly on their compositions; no oil from a single source can be suitable for all purposes⁶.

Seed oils are also of pharmaceutical importance⁷ and serve as important industrial and domestic materials for various processes particularly as the rise in price of crude oil has put a new shine on the biofuel sector⁸. Due to the increase in nutritional and industrial processes, the demand for oil has increased and this in turn has led to the search for alternative oil sources. The present restriction on the routes of importation of items into the country could add a further challenge.

The mineral elements composition of the seed oil was described by Okoli *et al.*⁹. Umoren *et al.*¹⁰ described the proximate composition of the oil. Oderinde *et al.*⁷ only determined the proximate composition of the seed and the physical properties of the seed oil. From the results, they advocated that the oil can be used among other things, in oil-based ice cream production. That advocacy was not backed with full nutrition

facts on the seed oil and is a huge gap in scientific research. Ice cream is a frozen dairy product made by freezing the ice cream mix with agitation¹¹. It is composed of a mixture of food ingredients like milk products, sweetening materials, stabilisers, colours, flavours, and egg products. Ice cream is liked by all age groups and is eaten as food in all countries of the world and by all races. It is an energy-rich product and may be a part of countless recipes and gastronomic specialties. While mineral elements are important constituents of foods, antinutrients are usually not desired. Recommendation of an item as a food component can only be based on nutrition facts about the item. To our knowledge, there is no record of the analysis for amino acids in the seeds and antinutrients and vitamins contents of the raw seed oil of *H. crepitans* to enable the use of the oil or seed

flour as a component of any food substance, hence the need for this study.

MATERIALS AND METHODS

Collection and extraction of the seed oil

Mature dry fruits of *H. crepitans* were collected along Nwaniba Road in Uyo Local Government Area of Akwa Ibom State, Nigeria. The seeds were carefully removed from the pods; good quality seeds were hand-picked to separate them from bad ones while the endocarp was gently removed to get the creamy white cotyledons inside. The cotyledons were later oven-dried at a temperature of 75°C. Finally, the dry cotyledons were ground into powder and used for the extraction of the oil. The oil was extracted using cold extraction method whereby the seed powder was soaked in n-hexane for 24h by adopting the method

described by AOAC¹². The supernatant was then decanted and allowed to settle. The decant which contained oil extract and the solvent was put in a rotary evaporator to recover the n - hexane.

Chemical analysis

Tannins were determined by following the method of Pearson¹³, hydrogen cyanide was determined by following the procedure of Onwuka¹⁴, oxalate was determined as described by Munro¹⁵, phytate was determined using the procedure of McCance and Widdowson¹⁶, vitamin A was determined as described by AOAC¹², vitamin C was determined as described by Wilson and Guillan¹⁷ while amino acids were determined by following the procedure of Vazquez-Ortiz¹⁸.

RESULTS AND DISCUSSION

Antinutrients contents of the raw seed oil of *H. crepitans*

The nutritional values of seeds and vegetables through the contributions of minerals, proteins and vitamins in human are repressed by the presence of anti-nutrients due to reduced bioavailability of these nutrition components by their interactions with anti-nutrients¹⁹. Most of the lesser known oilseeds are cooked and consumed, either directly as snack foods or fermented and used as condiments in soups and sauces. The levels of antinutrients in the raw seed oil of *H. crepitans* in comparison with those of conventional edible seed oils are included in Table 1.

Table 1: Antinutrients contents of the raw seed oil of *H. crepitans* in comparison with other edible seed oils

Antinutrients (mg/100g)	<i>H. crepitans</i> seed oil (This work)	<i>A. hypogaea</i> seed oil ¹⁹	<i>E. guineensis</i> seed oil ¹⁹
Phytate	1.25	418.00	0.337
Tannins	1,826.00	412.00	130.00
Cyanide	256.00	ND	ND
Oxalate	0.58	418.00	495.00

ND: Not Determined

Oxalates reduce bioavailability of calcium and zinc, affect calcium and magnesium metabolism and react with proteins to form complexes which have an inhibitory effect in peptic digestion. The oxalate level in the raw seed oil of *H. crepitans* is far less than those of other edible seed oils²⁰. *Arachis hypogaea* oil is widely used as frying oil while *Elaeis guineensis* oil is commonly used in cooking at low or high temperature; both have higher oxalate levels. Hence, *H. crepitans* oil can be considered to be nutritionally good for man. The level of oxalate in this seed oil is well below the toxicity level of 2-5g²¹.

The level of phytate in raw *H. crepitans* seed oil is higher than the level in *E. guineensis* seed oil but much lower than the content of *A. hypogaea* seed oil. Erdman²² stated that the greatest effect of phytic acid on human nutrition is its reduction of zinc bioavailability. The lethal dose of phytate has been reported to be in the range of 250 – 500 mg/100g²³. Hence, the level of phytate in raw seed oil of *H. crepitans* poses no health dangers if the oil is consumed by humans.

Tannins are believed to play a role in the resistance of plants nutrients by inhibiting enzymes produced by invading pathogens and by protein in the damaged plant tissues²⁴. Tannins have been found to interfere with

digestion by displaying anti-trypsin and anti-amylase activities. Helsper *et al.*²⁵ reported that condensed tannins were responsible for the testa bound trypsin inhibitor activity of faba beans. Tannins also have the ability to form complexes with vitamin B²⁶. Other adverse nutritional effects of tannins have been reported to include intestinal damage, interference with iron absorption and the possibility of tannins producing a carcinogenic effect²⁷. Also, as observed with the seed oil of *Pentaclethra macrophylla*, tannins usually form insoluble complexes with proteins, thereby interfering with their bioavailability²⁸,²⁹. The tannins level in the raw seed oil of *H. crepitans* is relatively higher compared with its level in other seed oils. From the data, it is observed that *E. guineensis* oil has the least value of tannins while *H. crepitans* oil has the highest value. Consumption of the oil by humans would therefore pose health challenges.

Cyanogenic glycosides are volatile toxicants, which liberate hydrocyanic acid on hydrolysis. HCN can cause dysfunction of the central nervous system, respiratory failure and cardiac arrest³⁰. The lethal dose of cyanide has been reported to be 35 mg/kg and above²¹. The cyanide level in the raw seed oil of *H. crepitans* is also included in Table 1. From the results in Table 1, it is seen that the cyanide level in the oil is relatively higher than those of other edible seed oils. Again, consumption of the oil by humans would pose health challenges.

Vitamins levels in the raw seed oil of H. crepitans

The levels of vitamins in the raw seed oil of *H. crepitans* in comparison with those of other edible oils are presented in Table 2. Vitamins are essential organic substances used in trace amounts by human beings, animals and microorganisms³¹. They have different functions and are from different sources. Vitamin A is required throughout life because

it participates in a variety of cellular activities. It is involved in vision, reproduction, embryonic development, growth, cellular differentiation and proliferation, tissue maintenance and lipid metabolism. It is an important antioxidant, a property shared with

vitamins E and C, the fat soluble and water soluble vitamins, respectively³². The vitamin A content of the seed oil is higher than those of other edible oils shown. The oil would contribute significantly to the diet of a man.

Table 2: Vitamins composition of *H. crepitans* raw seed oil in comparison with other edible seed oils

Vitamin (mg/100g)	<i>H. crepitans</i> seed oil (This work)	<i>B. nigra</i> seed oil ³⁵	<i>H. annus</i> seed oil ³⁶
A	19.42	0.00	0.00
C	102.72	0.00	0.00

Vitamin C, or ascorbic acid, is an essential dietary nutrient for a variety of biological functions. Under physiological conditions, it is fundamental in the biosynthesis of collagen by facilitating the hydroxylation of proline and lysine residues, thus allowing proper intracellular folding of pro-collagen for export and deposition as mature collagen^{33, 34}. As seen in Table 2, the raw seed oil of *H. crepitans* is richer in vitamin C than *Brassica nigra*³⁵ and *Helianthus annus*³⁶ seed oils which are all edible. On

this basis also, the oil would contribute significantly to the diet of a man.

Amino acids profile of the seeds of H. crepitans

The amino acids profile of the seeds of *H. crepitans* is presented in Table 3. The seeds contain 19 amino acids, 10 of which are the essential amino acids which are also present in reasonable percentages except methionine. As seen in Table 3, *H. crepitans* seeds are rich in glutamic acid, aspartic acid, leucine, arginine, proline, lysine, isoleucine, glycine, norleucine, and phenylalanine, but

deficient in methionine, a sulphur-containing amino acid and serine.

From Table 3, it is clear that glycine has the highest amino acid score while methionine is the limiting amino acid with

the least amino acid score. It is however particularly rich in valine, histidine, arginine, lysine and leucine compared with the seeds of *A. hypogaea*³⁷ and *B. nigra* (mustard)³⁸ which are commonly eaten.

Table 3: Amino acid profile of the raw seed of *H. crepitans* in comparison with other edible seeds and whole hen's egg

Amino acid (g/100g protein)	<i>H. crepitans</i> seed (This work)	<i>A. hypogaea</i> seed ³⁷	<i>B. nigra</i> seed ³⁸	Whole hen's egg ³⁹	Amino acid score (%)
Leucine	6.5	1.6	7.7	8.3	78.3
Lysine	4.6	0.9	6.3	6.2	74.2
Isoleucine	3.4	1.0	3.7	5.6	60.7
Phenylalanine	5.1	1.2	4.2	5.1	100.0
Norleucine	3.7	ND	ND	ND	-
Tryptophan	0.9	0.3	0.9	1.8	50.0
Valine	4.3	1.1	5.5	7.5	57.3
Methionine	1.2	0.2	1.8	3.2	37.5
Proline	4.9	6.4	10.0	3.8	128.9
Arginine	5.3	2.8	5.8	6.1	86.9
Tyrosine	2.4	0.9	2.5	4.0	60.0
Histidine	2.2	0.6	2.6	2.4	91.7
Cystine	0.9	0.3	2.4	1.8	50.0
Alanine	3.9	1.8	3.5	5.4	72.2
Glutamic acid	11.9	1.4	18.1	12.0	99.2
Glycine	4.5	1.2	5.6	3.0	150.0
Threonine	3.1	0.7	2.8	5.1	60.8
Serine	3.9	ND	2.8	7.9	49.4
Aspartic acid	8.9	3.5	8.0	10.7	83.2
Met. + Cys.	(2.1)	(0.5)	(4.2)	(5.0)	(42.0)
Phen. + Tyr.	(7.6)	(2.1)	(6.7)	(9.1)	(83.5)
Total	81.6	25.9	94.2	99.9	-

ND: Not Detected

The amino acids contents in *H. crepitans* seeds compare reasonably with whole hen's egg³⁹. Hence, the seeds of *H.*

crepitans would make a meaningful contribution to the diet of a man. Although, *H. crepitans* seed protein is deficient in

methionine, it cannot be said to be nutritively poor since this can be supplied by other components of a diet. The high level of leucine is particularly advantageous in the treatment of some ailments. A leucine-enriched amino acid supplement increased muscle mass, strength, and physical function in post stroke patients with sarcopenia⁴⁰.

CONCLUSION

This study provides supplementary nutrition data on the characteristics of the seeds and raw seed oil of *H crepitans*, a low-valued agricultural product in Nigeria. The raw seed oil contains higher levels of antinutrients compared to other edible seed oils. Due to its high cyanide and tannins contents, it can be concluded that the seed oil is not good for human consumption despite its richness in vitamins A and C but the seed flour has high nutritional potentials because of its richness in amino acids.

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