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Proximate, Mineral and Amino Acid Analysis of the Leaves of *Abrus precatorius* L. (Hitch)

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ABSTRACT

The plant *Abrus precatorius* is a wild edible flowering legume of the *Fabaceae* family. The leaves are used traditionally to treat ailments such as fever, skin cancer, typhoid, cough and hepatitis in Nigeria and some other countries. They are also utilized as vegetable and sweetener. *A. precatorius* leaves were analyzed for the proximate, mineral, amino acid and anti-nutritional composition using standard procedures. The proximate analysis revealed high amount of fibre (14.62%), crude protein (12.85%), moisture (6.55%) ash (6.34%), fat (4.95%) and carbohydrate (54.69%). *A. precatorius* leaves contain all the essential amino acids and compares favourably with standard requirement level of the FAO/WHO (1991). However, the values for leucine and lysine were below the WHO standard. The plant sample contains significant amount of magnesium, manganese, sodium, potassium, calcium and copper. The anti-nutrients composition of the leaves of *A. precatorius* was also determined. The leaves contain oxalate (7.92 mg/100g), phytate (16.20 mg/100g), trypsin inhibitors (6.15 mg/100g) but cyanide were not detected. Although, the amounts of mineral elements, essential amino acids and protein in this food/medicinal plant can boost immensely the diets of natives in Nigeria. Information from this research can provide valuable data to public health officials in the region with knowledge that will be beneficial in advising locals on the nutritional importance of *A. precatorius* leaves.

Keywords: *Abrus precatorius*, Amino acids, Minerals, Proximate, Medicinal plant

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Introduction

Leguminous plants are found all over the world mainly in the wild, they are appreciated and recognized for their food value and relevance the world over. Legumes are an economical source of supplementary protein for humans apart from adding variety to diet.[1] Wild edible plants play a crucial role in the diets, cultural life and economy of communities in sub-Saharan Africa. The nutritional facts of these plants that are commonly used as "famine foods" are scarcely found in literature when there is severe shortage.

There are several food plants that grow spontaneously and are consumed by humans in diverse regions of the world. Legumes provide large amount of protein components of the average diet consumed in India.[1]

Legumes can have protein content as high as (20-26%) and are used as natural supplement to cereals. Legumes can provide protein contents only next in value to that of fish and is said to be "meat for the poor".[2]

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In underdeveloped economies, the accessibility and utilization of proteinaceous foodstuff are insufficient because of explosion in population and urbanization. This can lead to Protein Energy malnutrition (PEM), which can be eased by looking for cheaper sources of proteins.[2]

The growing interest in new sources of food, underutilized legumes that grow in the wild can be exploited but it is still somehow ignored. These wild plants are now receiving attention as new food resources due to their ability to resist diseases and pest, promising satisfying nutritional characteristics. They can become good sources of vegetable protein.

The utilization of wild legumes as protein source can also be limited by presence of antinutrients and toxic substances. To assess the nutritional significance of edible plants, proximate and nutritional analysis play a crucial role.[3] Since a lot of food material are from plant species, it will be beneficial to evaluate their nutritional significance since it will assist to know the value of these plant species.[4] World Health Organization (WHO) has laid emphasis on the need to assess the proximate and micronutrients composition of plants that are also used as medicine.[3]

Abrus precatorius is an underutilized leguminous food crop. It is a member of the *Fabaceae* (Leguminosae) family and is generally spread across the tropics. The plant is widely used in traditional medicine across different cultures globally. *Abrus precatorius* is known in various communities with different names such as coral-based plant, rosary pea or beads wild liquorice.[4 3]

In the Adamawa region, the Tupuri of northern Cameroon call it "Danrai" as the leaves and shoots act as sweeteners,[5] in Andaman Islands and Katharis regions of India, the plant is considered a favourable source of protein as even the seeds are cooked and consumed during extreme famine.[1]

Abrus precatorius is locally called "Idon Zakara" in Hausa, "Enyin Ndukpo (Inuen)" in Efik/Ibibio and "Anya Nunu" in Igbo. The leaves have medicinal properties, upon ingestion their sweet taste that last long on the tongue. The phyllon of *Abrus precatorius* is being used locally to treat many ailments both in animals and humans.[6]
This work is aimed at determining the proximate, mineral and amino acid composition of *Abrus precatorius* obtained in Mubi region of Nigeria.

Materials and Methods

Sample collection
Abrus precatorius leaves were collected fresh from the bushes of Mijilu 10º 25'08.18" N and 13º 25' 32.96" E in Mubi North L.G.A in Adamawa State, Nigeria in the month of October, 2018. The botanical identification and authentication were done in the Plant Biology and Biotechnology Department of the University of Benin by Dr. Akinnibosun Henry Adewale. The voucher specimen was assigned specimen number UBH-A001 and deposited at the plant biology and biotechnology department of the University of Benin herbarium.
Leaves of sample were thoroughly washed with clean water to remove dirt, foreign materials, seed pods and immature seeds. It was dried under shade for 4 days and pulverized with a blender into fine powder for storage and further analysis.

Preparation of extract
Methanol was used to extract ground sample. Whatman No. 1 filter paper was used to filter extract and concentrated to a dry mass using a rotary evaporator. The residue was kept in dark glass sample bottles for further use.

Proximate analysis
Proximate composition was determined in accordance with AOAC. Carbohydrate, crude fibre, protein, fat, moisture and ash were determined. Percent (%) carbohydrate was determined by subtracting the obtained fibre, protein, fat, moisture and ash. The percent (%) organic matter was computed by subtracting percent (%) moisture from one hundred (100).[7 8]

Elemental analysis
Five (5 g) gram of the crushed sample was digested in a mixture of 4 mL of 60% perchloric acid, 10 mL concentrated nitric acid and mixed with 1 mL of concentrated sulphuric acid. The digest was diluted in 50mL of distilled water. After cooling, it was filtered through Whatman No. 42 filter paper. Distilled water was added to filtrates in a glass volumetric flask to the 100mL mark. All minerals were analyzed by an atomic absorption spectrophotometer Buck 210 except for Na and K which were analyzed using a flame photometer (Jenway ME882) which uses air acetylene flame integrated mode. The concentrations of the elements were quantified using a calibrated standard graph.

Amino acid analysis
Sample preparation
Two grams (2 g) of the dried sample was accurately weighed and quantitatively transferred into a beaker. The beaker containing plant sample was then placed in a water bath at 40ºC. The digested sample was then transferred into a 50 mL flask and the volume was made up to mark by adding distilled water. The beaker was kept in an ultrasonic bath at 40ºC for 30min. The extract was centrifuged followed by the addition of 30 mL of distilled water to the residue which was sonicated for 30min. The filtrate was transferred to a 100 mL flask and volume was made up by adding distilled water. Finally, the solution was passed through a 0.22 µm Millipore membrane, and the filtrate used for further experiment such as the preparation of standard amino acid solutions and derivatives of the sample.
Chromatographic separation of prepared samples was carried out using a Buck scientific BLC10/11-model HPLC equipped with UV 338nm detector. A C18, 2.5 x 200nm, 5um column and a mobile phase of 1:2:2 (100mM sodium phosphate, pH 7.2: Acetonitrile: methanol v/v/v) at a flow rate of 0.45mL/minute and an operating temperature of 40ºC. Standard solutions were analysed in a similar manner.

Statistical analysis
Means were compared using Duncan's Multiple Range Test (DMRT). For each variable, Treatment was subjected to Analysis of Variance (ANOVA) at 5% probability using the SPSS software version 6.33.

Results and Discussion

Proximate analysis of *Abrus precatorius* leaves revealed moisture (6.55%), ash (6.34%), crude fibre (14.62%), crude protein (12.85%), crude fat (4.95%), carbohydrate (54.69%), and dry matter (93.45%) as shown in Table 1.
The protein composition of *Abrus precatorius* obtained in this study was slightly higher than 10.21%[5] and 7.96%.[9] *Abrus precatorius* from India contains 19.34% dry weight of proteins.[1] Proteins help in cell replication and restore damaged cells in adults. It is also important for growth and development in children, teens and pregnant women. Legumes are an excellent source of carbohydrates, protein, oil, and vitamins as their role in human nutrition especially in developing countries cannot be overlooked.[1]
In countries where animal protein is not enough, attention should be given to proteins from legumes. The level of crude protein in this study suggests that *Abrus precatorius* leaves can be a useful option for protein.
Ash and crude fibre composition of the *Abrus precatorius* leaves were 6.34% and 14.62% respectively. The sample from Mubi Nigeria is richer in crude fibre 14.62% compared to Cameroon 8.52% and India 6.24%. 8.05% has been reported for *Abrus precatorius* collected in Makurdi Benue State, Nigeria.[3] Dietary fibre also known as roughage. The fibre content helps in improving the general functions of the digestive health. It increases the weight and size of stool as well as soften it, which helps maintain healthy digestive system.[1] The dietary fibre intake advised by WHO is 22–23 kg/1000 Kcal of diet. Ash is also a good source of some essential minerals such as calcium, potassium, etc. represented in Table 2. *A. precatorius* leaves in this study has ash content of 6.34%.
Essential minerals and trace elements are crucial for the proper maintenance of the human body since they have direct impact on metabolic and physiological functions, thus, the need to determine them. Mineral composition of *A. precatorius* leaves shows the plant is rich in minerals. The heavy metals are absent which makes it good. Chromium, iron, copper and zinc are essential micronutrients for growth and development. Their role in human metabolism is vital. Reports show the connection between trace elements status and oxidative diseases have brought about an increased interest in these elements.
Calcium a bone building mineral in *A. precatorius* leaves is 38.83 mg/100 g. Selenium an essential element for humans, was below detectable limits and the heavy metal lead, cadmium and chromium were also below detectable limits. The leaves contain the essential elements in small quantities. The sodium – potassium ration (Na/K) is also presented in Table 2.

Table 1: Proximate composition of the leaves of *Abrus precatorius*

Parameters	Composition (g/100g)
Moisture	6.55 ± 0.01
Ash	6.34 ± 0.01
Crude Fibre	14.62 ± 0.01
Fats	4.95 ± 0.01
Crude Protein	12.85 ± 0.01
Total Carbohydrate	54.69 ± 0.01
Organic matter	93.45 ± 0.01

The results are presented as means ± standard deviation of triplicate analysis.

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Table 2: Mineral composition of *Abrus precatorius* leaves

Mineral Elements	*A. precatorius*	RDM	UL
Ca	38.83	1000 mg	250 mg
Fe	2.36 ± 0.01	9 – 15 mg	25 mg
Mg	152.26 ± 0.01	280 – 350	350 mg
Zn	1.05 ± 0.00	7 – 9 mg	25 mg
Cu	1.65 ± 0.00	900 µg	5 mg
Mn	22.92 ± 0.01	3 mg	1.8 mg
Na	3.60 ± 0.01	1.5 g	2300 mg
K	240.1 ± 0.01	3.5 g	3000 mg
Pb	BDL		
Cd	BDL		
V	BDL		
Cr	BDL		
Se	BDL		
Na/K	0.015		

The results are presented as means ± standard deviation of triplicate analysis.
RDA – Recommended dietary allowance for adults.
UL – Tolerable upper intake level for adults.
BDL – Below detectable level.

Table 3: Amino acid composition of *Abrus precatorius* leaves sample

Amino acids	*A. precatorius*
Tryptophan	3.01± 0.01
Histidine	1.05 ± 0.01
Leucine	2.96 ± 0.01
Isoleucine	3.04 ± 0.01
Phenylalanine	7.93 ± 0.00
Valine	3.87 ± 0.01
Lysine	3.85 ± 0.00
Methionine	3.26 ± 0.01
Threonine	3.45 ± 0.01
Asparagine	4.26 ± 0.01
Arginine	3.45 ± 0.00
Alanine	2.98 ± 0.01
Aspartate	5.81 ± 0.01
Glutamate	1.75 ± 0.00
Glycine	6.35 ± 0.01
Tyrosine	8.11 ± 0.01
Cysteine	3.05 ± 0.01
Proline	3.15 ± 0.01
Serine	3.01 ± 0.01
Total	74.4

The results above are means ± standard deviation of three trials.

To prevent high blood pressure, the Na/K ratio in the body is of significant importance. A Na/K ratio less than one is recommendable. Therefore, in this study with Na/K ratio of 0.015 the plant sample would probably lower high blood pressure. Foods high in animal-based products are likely to elevate the excretion of calcium in urine when phosphorous is also high.[1] The high content of potassium in diet are of advantage to individuals who are hypertensive and use diuretics which could lead to high rate of excretion of potassium through the body fluid.[1] Most of the mineral elements in this plant are below the recommended daily dietary allowance per day for adults.

Abrus precatorius leaves have all the indispensable amino acids and can be deemed complete protein for human nutrition as presented in Table 3.[10] Phenylalanine, glycine, tyrosine and aspartate are the most abundant with the values 7.93, 6.35, 8.11 and 5.81 mg/100 g respectively. *A. precatorius* leaves contain 7.44% protein. Table 4 compares the percentage amino acid in *A. precatorius* plant to the percentage amino acid in the WHO protein standard.[11] An amino acid with a 100 or more score means the plant protein complies or exceeds the percentage of amino acid in WHO standard protein. In this study the score for leucine and lysine being 60 and 70% respectively was below values for WHO standard. The scores for tryptophan, isoleucine, phenylalanine + tyrosine, methionine + cysteine and threonine percentage in this study exceeds that of the WHO standard.

Abrus precatorius leaves is eaten as vegetable in East and Central Africa. It is also used to sweeten cereals and is thus a good source of nutrients considering the proximate, mineral and amino acid composition.[12] Though a well-known medicinal plant, it is useful as food and sweetener if the sweet portion is extracted, characterized and the toxicological analysis done.

Antinutritional properties in a legume can cause some undesirable effects like digestibility which is characteristic of the interaction of some factors including phytates, oxalates and other antinutritional factors. There is concern over antinutrients level present in diet of people who consume more legumes than animal foods. This is why the antinutrient of the legume *A. precatorius* was determined.

Activities of digestive and hydrolytic enzymes such as amylase, chymotrypsin, lipase and trypsin can be inhibited by phenolic compounds. This can also lower the digestibility of proteins, carbohydrates and availability of minerals and vitamins.

Recent reports show phenolic compounds to be the foremost human dietary antioxidants and have lowered occurrence of chronic diseases. Although earlier considered as antinutritional compounds, phenols now have numerous nutritional benefits to man and are considered to have curative properties.[1] In this study the phenolic content of *A. precatorius* leaves is higher than what was reported for the seeds by Tresina and Morgan.[1] The cyanide level in this study is extremely under lethal levels

of 36 mg/100 g. Trypsin inhibitors are said to be heat liable, though they form irreversible in diets which lowers trypsin level in the intestine and shrinks dietary protein digestibility leading to retarded animal growth.[1] The trypsin inhibitor in this study 6.12 mg/100 g is lower than 35.30 mg/100 g reported for *A. precatorius* seeds by Tresina and Mohan.[1]

Conclusion

Based on the results obtained from analysis of the leaves of *A. precatorius* an underutilized legume, results show it is a valuable source of supplementary nutrition due to its adequate protein, minerals, carbohydrate and essential amino acids. The antinutrients detected and identified from analysis should not constitute a threat if ingested by humans.

Conflict of Interest

The authors declare no conflict of interest.

Authors' Declaration

The authors hereby declare that the work presented in this article is original and that any liability for claims relating to the content of this article will be borne by them.

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Table 4: Comparison of the essential amino acid content of *Abrus precatorius* leaves with World Health Organization idea pattern (% of total amino acids)

Amino acid	WHO ideal pattern	*Abrus precatorius*	EAAS
	(% of total)	(% of total)	(% of ideal)
Tryptophan	1.1	4.04	367
Leucine	6.6	3.98	60
Isoleucine	2.8	4.08	145
Phenylalanin+ Tyrosine	6.3	10.65	169
Valine	3.5	5.20	89
Lycine	5.8	5.17	175
Methionine+ Cysteine	2.5	4.38	136
Threonine	3.4	4.64	136

EAAS – Essential Amino Acid Score

Table 5: Antinutrients composition of *Abrus precatorius* leaves

Antinutrient	Composition
Oxalate	7.92 ± 0.01
Phytate	16.20 ± 0.02
Trypsin inhibitors	6.15 ± 0.01
Cyanides	0.000 ± 0.00

The results are presented as means ± standard deviation of triplicate analysis.

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