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Phytochemical Screening and Nutritional Evaluation of African Oil Bean (*Pentaclethra macrophylla*) Seeds.

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Abstract: *The chemical composition, phytochemical screening and antinutrients composition of African oil bean (Pentaclethra macrophylla) seeds were determined. Matured seeds were collected, they were shelled and pulverized into a fine powder and kept in air tight sample bottle for further analysis. The seed is rich in protein (34.42±0.02%), oil (44.24±0.10%) and energy (577.04 Kcal/100g). the seeds can therefore be classified as oil seed. The most abundant elements in mg/100g of the seed are sodium (Na) (280.65 ±0.05), potassium (K) (235.65±0.05), magnesium (Mg) (210.70±0.50), calcium (Ca) (201.47±0.01) and phosphorus (P) (196.11±0.01) while iron (Fe) (8.71±0.02), zinc (Zn) (6.56 ±0.10), copper (Cu) (5.25 ±0.05) and lead (Pb) (3.54 ±0.04) were of lower concentrations. Arsenic (As) and cadmium (Cd) were not detected (ND). Tannin, saponin and flavonoid were present while cardiac glycoside and alkaloid are absent. Anti nutritional factors were low with the following values: phytic acid (0.72±0.01mg/100g), tannin (1.24±0.05mg/100g), trypsin inhibitor (2.01±0.01TIU^{A}/mg of protein) and haemaglutinin activity (1.89±0.10 HU^{B}/g sample). The result of the research work showed that African oil bean seed has a potential for dietary improvement in food industries.*
Keywords: *African oil bean, seed, mineral, protein, oil, anti-nutritional, phytochemical, dietary.*

I. Introduction

Consistent consumption of foods that contain significant levels of phytochemical and dietary fiber correlates with tangible health benefits [1]. It is important to enhance the consumption of health food by increasing the variety of foods rich in beneficial compounds and improving processing technology to enhance their organoleptic appeal. Phenolic compounds exist widely in plants and they are secondary metabolites which have been shown to possess positive effects on human health, for example, protection against coronary heart disease and carcinogenesis [2].

Animal proteins are expensive in terms of both market price and environmental impact, for example, land use and pollution, in addition, consumer confidence in animal proteins has decreased due to food safety problems related to diseases [3]. In recent times, the desire to conserve resources spent on importation of food materials for both domestic and industrial uses gave renewed efforts towards discovering new sources to complement the traditional ones. In Nigeria, there have been several attempts at overcoming the nutritional deficiency of carbohydrate products by fortifying them with other food materials (especially legumes) with good protein quality and quantity [4].

Seeds have nutritive and calorific properties which makes them important. The amount of energy provided by 1g of fat/oil when fully digested is more than twice as many Joules as do carbohydrates and proteins [5]. *Pentaclethra macrophylla* (African oil bean) seed is a leguminous tree (family leguminosae and sub family mimosoideae). *Pentaclethra macrophylla* has been cultivated in Nigeria since 1937 where it is relished as food [6]. It is planted or retained along the edges of home gardens and cultivated mainly for its edible seed from which oil can be extracted. The seed can be eaten boiled or roasted. They are also fermented to yield snack or condiment with a meaty taste which is very popular in South-western Nigeria [7]. The leaves contribute to soil fertility while the ripe fruits are applied externally to heal wound. The aim of this research work is to provide further information on the nutrient and anti-nutrient composition of Africa oil bean seeds.

II. Materials and Methods

2.1 Materials

2.2 Sampling and Preparation of the Sample for Analysis.

The pods of the Africa oil bean used for the research work were obtained from a local farm in Iree, Boripe Local Government Area of Nigeria. The seeds were removed from the pods, shelled and dried in air oven at 60^{o}C for 24h. The sample was turned to powder with a mechanical grinder, packaged in an airtight container and placed in a refrigerator prior to further analysis.

2.3 Analytical Methods

Proximate compositions and phytochemical screening of the powdered sample were determined using the methods described by AOAC, [8]. The antinutrient compositions for phytic acid, tannin were done by the methods of Adetunde and Onilude, [9] while trypsin inhibitor and haemagglutinin activity were carried out by methods of Mubarak, [10]. The Na and K was determined using flame emission photometer (FES) while others (Ca, P, Mg, Zn, Pb, As, Cd, and Cu, Fe) were analyzed by atomic absorption spectrometer (AAS).

III. Results and Discussion

3.1 Results of Proximate Composition of African Oil beans Seed.

Table 1: Proximate Composition of African Oil Bean Seed (%).

Parameter	Mean value ± S.D
Moisture	6.54 ± 0.01
Protein	34.42 ± 0.02
Ash	1.94 ± 0.01
Fat	44.24 ± 0.10
Crude fiber	2.56 ± 0.02
Carbohydrate	10.30 ± 0.20
Energy value* (Kcal/100g)	577.04

n =2 and *- calculated value.

The results of proximate composition of African oil bean (*Pentaclethra macrophylla*) seeds were presented in Table 1. The results showed clearly that the seed contained 6.54±0.01% of moisture, which was nearly three times higher than 2.7 ±0.1% recorded for Kargo seed [11].

The seed was found to contain 34.42±0.02% crude protein. This value is higher than 24.69 ±0.05% obtained for raw groundnut [12]. It was however a little bit lower than 36.2±0.04% reported for it by Odoemelam, [5]. The high protein content of the sample would make it suitable as protein supplement in food industries. The ash content of 1.94±0.01% was obtained for the sample. The low ash content may invariably affect the mineral content because ash content is a pointer to the mineral composition of a sample. The ash content of the seed is lower compared to 3.76% reported for mung bean seeds [10]. The fat content of the African oil bean seed was found to be 44.24 ±0.10%. The fat content was higher comparable to 36.7±0.1% obtained for cashew nut by Aremu *et al.,* [13]. The high fat content would be an advantage because it promotes fat soluble vitamin absorption in the body and also makes it ready source of oil like peanut and palm kernel. The crude fibre of the sample was determined to be 2.56±0.02%, this value is lower compared to the range of 2.95 - 3.22% reported for three varieties of cowpea [14], 5.98 ±0.36% for *Caesalpinia pulcherrima* seed [15] and 6.30±0.11% for *Treculia africana* seed [16]. Carbohydrate content of 10.30±0.20% was obtained, which is comparable to 9.60±0.05% reported for it by Odoemelam, [5]. The calculated energy content was found to be 577.04 Kcal/100g of sample. The value surpasses the 394.56 and 391.18 KCal/100g obtained for defatted peanut and popcorn flours [17]. This high energy value is an indication of its usefulness as cheap source of energy to the body.

Table 2: Results of Phytochemical Screening of African Oil Bean Seed.

Parameter	Observation
Tannin	+
Saponin	+
Flavonoid	+
Cardiac glycoside	-
Alkaloid	-

Note: + present and - absent.

Table 2 showed the phytochemical screening of the seed; tannin, saponin and flavonoid were found to be present while cardiac glycoside and alkaloid were absent. Consistent consumption of foods that contain significant levels of phytochemicals and dietary fiber correlates with tangible health benefit [1]. The presence of flavonoids in the seed is important because it has been linked with anti inflammatory, antitumor, antivirus, antibacterial and antioxidation functions [18]. Food-derived polyphenol compounds have been believed to be beneficial for human health due to the antioxidant and anti carcinogenic activities. It has also been demonstrated that some of them modulate oncogenesis and signal transudations pathways [19].

Table 3: Results of Antinutrient Composition of African Oil Bean Seed.

Parameter	Mean Value ± S.D
Phytic acid (mg/100g)	0.72 ± 0.01
Tannin (mg/100g)	1.24 ± 0.05
Trypsin inhibitor (TIU^A/mg protein)	2.01 ± 0.01
Haemagglutinin (HU^B/g sample)	1.89 ± 0.10

n = 2

Table 3 showed the contents of the selected toxicants. Phytic acid and tannin (mg/100g) were found to be 0.72 ±0.01 and 1.24 ±0.05 respectively. The values of phytic acid and tannin were lower than 1.35 ppm and 2.50 ppm reported for defatted peanut flour [17]. The lower value obtained for the phytic acid is desirable because when above certain level in the body, its affects the availability of minerals, solubility functionality and digestibility of protein [20]. Tannin when in association with proteins cause inactivation of digestive enzymes and reduce protein digestibility [17]. Trypsin inhibitor (TI) of 2.01 ±0.01 (TIU^A/mg protein) and haemagglutinin activity of 1.89 ±0.10 (HU^B/g) were very much lower compared to 15.80 and 26.70 obtained for mung bean seeds [10]. The value of TI is higher than 0.28mg/100g recorded for extra cotyledonous deposit of pride of Barbados [21]. High concentration of TI lowers digestibility of legume proteins. Prohp *et al.,* [21] recommended some traditional processes like cooking, dehulling, soaking, boiling, germination etc as means of reducing these anti nutritional factors in food materials.

Table 4: Results of Mineral Element Composition of the African Oil Bean (*Pentaclethra macrophylla*) seeds (mg/100g).

Parameter	Mean value ± S.D
Na	2.80.05 ± 0.05
K	235.65 ± 0.15
P	196.11 ± 0.01
Mg	210.70 ± 0.50
Ca	201.47 ± 0.01
Zn	6.56 ± 0.10
Fe	8.71 ± 0.02
Pb	3.54 ± 0.04
Cu	5.25 ± 0.05
As	ND
Cd	ND

n= 2, ND- not detected.

Table 4 showed the mineral element composition of *Pentaclethra marcrophyla* seed. The abundant minerals in mg/100g were sodium (280.05±0.05), potassium (235.65±0.15), magnesium (210.70±0.50), calcium (201.47±0.01) and phosphorus (196.11±0.01) while zinc (6.56±0.10), iron (8.71±0.02), copper (5.25±0.05) and lead (3.54±0.04) gave lower values. Arsenic and cadmium were not detected in the sample. The values obtained for Na, K Mg and Ca were higher than those reported for defatted groundnut flour [17], African yam bean seed [22] and pride of barbados seed [15]. Phosphorus value was lower than 391mg/100g obtained for mung bean seeds [10]. Calcium content of 201.47±0.01mg/100g is high enough for normal body functions and is associated with desirable retention of body calcium to reduce osteoporosis, a condition of reduced bone density and the underlying case of bone fragility [23].

The calcium and phosphorus contents were higher than values reported for African yam bean seed [22]. Calcium and phosphorus occurs together in the body to maintain body blood [24]. The presence of iron in the seed is beneficial because dietary iron has been strongly recommended as a secondary preventive intervention against lead toxic effects [25]. The zinc and iron values of 6.56±0.10mg/100g and 8.71±0.02mg/100g were very much higher than 0.8±0.1mg/100g and 0.6±0.1mg/100g recorded for the defatted cashew nut kernel [24]. Iron deficiency increases susceptibility to lead poisoning and both conditions are known to cause anemia. The copper content of 5.25±0.05mg/100g was found to be higher than 0.40mg/100g reported for *Agaricus bisporus* [26] and lower than 279.7mg/100g obtained for ginger root [27]. The value is also higher than 1.2mg/day RDA copper for an adult.

Copper occur naturally in most vegetables, meats and grains and its study in food items is of great concern because it plays a definitive role in the intrinsic mechanisms, regulating vital biological processes [28]. Copper is involved in hemopoiesis and in maintenance of vascular and skeletal integrity in addition to the structure and function of central nervous system. Lead (Pb) content of the seed was found to be 3.54±0.04mg/100g. The low concentration of pb is desirable because high concentration of it have been linked to human health problem including nervous system, dysfunction of fetus and infants and in adults, hemotoxic effects. Pb poisoning and iron deficiency is often two associated problems. Iron deficiency increases susceptibility of Pb poisoning. Both conditions are known to cause anemia and appear to produce a more severe anemia when in combination. Dietary iron has been strongly recommended as secondary preventive intervention against lead toxic effects in Korean lead workers [25].

V. Conclusion

The findings of this study showed that African oil bean (*Pentaclethra macrophylla*) seeds are rich source of protein, oil and appreciable number of some essential minerals. The above coupled with the presence of some phytochemicals and low anti nutritional properties of the seeds could be explored for inclusion as an addition to the existing nutritional supplements. This will go a long way in alleviating the menace of malnutrition currently ravaging the world today. The raw material been readily available locally will solve the problem of dependence on scarce imported raw material as source of nutritional supplement and the product will be affordable by the low income earners which constitute the cream of the nation's population.

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