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Assessment of Proximate, Vitamins, Minerals and Anti-nutrients Compositions of Unprocessed *Vigna aconitifolia* (Moth Bean) Seeds

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Authors' contributions

This work was carried out in collaboration between all authors. Author CIO carried out the experiment under supervision, and wrote the first draft of the manuscript. Author ACCE approved the version and edited the first draft. Author CAO managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Proximate, vitamins, minerals and anti-nutrients compositions of unprocessed *Vigna aconitifolia* (moth bean) were assessed using standard procedures. Proximate compositions (%) of the sample were moisture, protein, fibre, fat, ash and carbohydrate, respectively were 12.87, 14.06, 3.52, 0.33, 3.52, 2.81 and 66.4 while vitamin (mg/100 g) contents were Vitamin A (14.65IU) Thiamin (0.23), Riboflavin (0.45) Niacin (0.47), Ascorbic acid (42.25) and Tocopherol (0.25). The mineral contents (mg/100 g) of the sample were: Potassium (51.57), Sodium (37.20), Magnesium (18.44), Calcium (16.38) Zinc (2.48), Iron (1.49), Cadmium (0.00), Lead (0.00) and Mercury (0.00) while the anti-nutrient (mg/100 g) contents were: Alkaloid (2.03), Saponin (0.65), Tannin (2.89), Flavonoids

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(1.31), Cyanide (0.45), and Phenols (0.15). Thus, raw *Vigna aconitifolia* seeds are devoid of known toxicants (lead, mercury and cadmium) and could serve as a good source of nutrients notably carbohydrate, protein, ascorbic acid, vitamin A, potassium, sodium and flavonoids. Further studies including on processing and on toxicological evaluation in animal models are warranted and recommended.

Keywords: Vigna aconitifolia; vitamin; mineral; anti-nutrients; proximate.

1. INTRODUCTION

Legumes which are mainly the edible dry seeds are one of the major classes of seeds that play an important role in human nutrition. They contain 25% protein thereby serving as substitute for meat [1]. Though the protein in legumes is not complete due to its low level of essential amino acids, they are complemented by taking legumes with some other foods such as rice, maize and plantain. They are rich source of vitamins and minerals which includes calcium, iron and zinc [2] and also some health protecting compounds [3] which has some physiological effects such as common metabolic disease (diabetes, cancer and coronary heart disease) prevention, lowering of plasma cholesterol level [4,5]. Legumes have been shown to serve as important source of folate; the vitamin involved in lowering of homocysteine blood level, proposing that legumes may have a positive correlation with the reduction of death as a result of coronary heart disease [6]. Legumes contain some anti-nutrients which inhibit the activity of protein splitting enzymes leading to poor protein absorption and digestion, but these anti-nutrients may be reduced or destroyed by presoaking process and heat treatment. Their pods are made up of essential fibres which can serve as animal feed [7].

Vigna aconitifolia belongs to the *Fabaceae* family and of the V*igna* genus. It is a minor leguminous crop commonly known as mat bean or moth bean produced and consumed especially in tropical and sub-tropical areas of Africa, Asia and Latin America [8]. It is also grown and consumed in the eastern part of Nigeria where it is known as *Odudu* by the Igbo tribe [9]. *Vigna aconitifolia* is a short semi-erect hairy annual bushy crop, with a prostrate creeping habit. It has bright yellow flowers and linear pods with green colour while fresh or brown when dried. The pod contains about four to ten small seeds which are light-brown, whitish-green or mottled in colour [10]. Before consumption, *Vigna aconitifolia* is being soaked overnight and then cooked; this presoaking activity and cooking may affect the nutritional quality of the beans [11]. It can improve the nutritional quality and also help inactive some heat labile anti-nutritional compounds thereby increasing the bioavailability of the legumes as well as permit the digestion and assimilation of proteins and starch [12]. It is often consumed as cooked whole seed, split peas or sprouts [10].

However, *Vigna aconitifolia* is one of the vigna species that is underutilized [13] unlike the properly utilized ones like *V. ungniculata*, *Glycine max, Vigna sinensis, Cajanus cajan,* etc. Evaluation of nutritional and anti-nutritional compositions of the seed of *Vigna aconitifolia* remains unexplored and hence scanty. Therefore, there is need to ascertain the nutritional and anti-nutritional compositions of this neglected and unexploited legume. These warranted this study aimed at assessing the proximate, vitamins, minerals and anti-nutrients compositions in the raw/unprocessed moth bean seeds.

2. MATERIALS AND METHODS

2.1 Sample Collection, Identification and Preparation

The *Vigna aconitifolia* sample used for this study was bought from a local market in Umuahia North local government of Abia State of Nigeria and was identified as *Vigna aconitifolia* in the Plant Science and Biotechnology Department of Imo state University Owerri. The seed of *Vigna aconitifolia* were properly air dried for 3 days after selection (removal of broken seeds, immature seeds and foreign particles) before it was ground into fine powder using a laboratory milling machine (Thomas Willey mill, ED-5, USA) and then package in a sterilized bottle. The packaged powdered sample was then taken to the laboratory for analyses.

2.2 Chemicals and Reagents

All Chemicals used were of analytical grade and products of reputable companies and was supplied by the research institute were the analyses were carried out.

2.3 Determination of Studied Parameters

2.3.1 Proximate analysis

Proximate analyses were carried out to determine protein, fibre ash, fat, moisture and carbohydrate content using the methods of association of analytic chemists [14].

2.3.2 Vitamin analysis

Vitamins C and E were determined by the method described by [15] while Vitamins A, B_1, B_2 and B_3 were determined by spectrophotometric method as described by [16].

2.3.3 Mineral analysis

Sodium and Potassium were determined using flame photometry. Phosphorus was determined by spectrophotometric method [17] while lead, mercury, cadmium, calcium, magnesium, iron and zinc were determined by atomic absorption spectrophotometric methods [14]. Each sample was analyzed twice and the mean data (mean ± SD) were reported herein.

2.3.4 Antinutrient analysis

The alkaloid and saponin content of the sample were determined by the colorimetric method [14]. The absorbance of each sample was measured at 420 nm (for alkaloid) and at 620 nm (for saponin) using spectrophotometer (Jenway 6305, England) and the quantity of the anti-nutrient estimated from a standard curve obtained by plotting the concentration of the standard anti-nutrient concentration against the absorbance. The flavonoid content was determined according to method of [18]. The cyanogenic glycoside content was determined by the alkaline picrate method [16]. A portion (5 g) of the sample, ground into paste was dissolved in 50 ml distilled water in a corked conical flask. The extraction was allowed to stay overnight (12 h). The sample was filtered and the filtrate was used for the cyanogenic glycoside determination. To 1 ml of the sample filtrate in a corked test tube, 4 ml of alkaline picrate was added and incubated in a water bath for 5 min. The absorbance was read at 490 nm. The absorbance of the blank (which contained only 1 ml distilled water and 4 ml alkaline picrate solution) was read and used to stabilize the spectrophotometer before taking the absorbance of the samples. The cyanogenic glycoside content was extrapolated from a cyanogenic glycoside standard curve and the cyanogenic glycoside content calculated using the formula:

$$\text{Cyanogenic glycoside (mg/100 g)} = \frac{\text{Absorbance x Gradient factor x Dilution}}{\text{Weight of sample}}$$

The follin-Denis Spectrophotometric method as described by [19] was used to determine the tannin content in the samples. The absorbance of the developed color was measured at 760 nm wavelength with the reagent blank set at zero.

The phenol content was determined by the method described by [20]. Phenol was extracted by filtering 0.2 g of the sample dissolved in methanol. Then, 1 ml of the filtrate was mixed with 1 ml of Folin Ciocalteu reagent and 2 ml of 20% Na_2C0_3 solution was added. The intensity of the developed color was measured at 560 nm using spectrophotometer. The standard phenol value was likewise determined and the phenol content in the samples calculated from the relation:

$$\text{Phenol content (mg/100 g)} = \frac{\text{Au-AbxCxD}}{\text{AS-Ab}} \times \frac{100}{1}$$

Where:

Au = Absorbance of the test sample
Ab = Absorbance of blank
As = Absorbance of standard phenol
C = Concentration of standard phenol
D = Dilution factor of any

2.4 Statistical Analysis

Proximate compositions, vitamins, minerals and anti-nutritional factors were estimated in duplicate determinations. Estimates of mean and standard deviation for the above mentioned parameters were calculated using simple MS excel.

3. RESULTS AND DISCUSSION

The proximate compositions of the seed were as shown on Table 1. Proximate analysis of food is of great importance in that it accounts for the food quality and it is usually the basis for the establishment of nutritional quality of food and its acceptability by consumers. The proximate results of the present research agree with report of other scientist on *Vigna aconitifolia* and other related *Vigna* species [21,22,1]. However, the crude protein content of the present investigated sample was lower than the values reported by [21] on *Vigna acontifolia* and *Vigna unguiculata*.

This could be as a result of difference in the location where the plants were obtained. Protein enhances the repair and replacement of worn out tissues and also plays vital role in immune regulation [23]. The carbohydrate content of the investigated sample was higher than those of *Glycine* max and *Phaseolus lunatus* [24] but lower than the value reported for *Grewia sapida* [25]. Food rich in carbohydrate provides more energy. The key function of carbohydrate in the body is to provide energy which is responsible for doing various day to day activities. Moisture content of a sample is used to measure its shelf life, the lower the moisture content, the longer the shelf life. The moisture content of the investigated *Vigna aconitifolia* compares with the value (11.25±0.11) reported by [26] for *M. pruriens* but higher than those reported for mung bean, chickpea and green pea [1,27]. The ash content compared with the values reported for Mash bean [22] and *Vigna aconitifolia* [21]. This implies that investigated *Vigna aconitifolia* contains nutritionally important mineral elements. The fibre content compares with the values reported for *Vigna unguiculata* and mash bean [21,22] but higher than that of *Grewia sapida* [25] thus, *Vigna aconitifolia* could serve as a source of dietary fibre. Fibre improves food bulk, appetite satisfaction, lowers cholesterol level and prevents constipation [28,29].

Table 1. Proximate composition of *Vigna aconitifolia*

Parameter	Concentration (%)
Moisture	12.87±0.03
Crude protein	14.06±0.01
Crude fibre	0.33±0.01
Crude fat	3.52±0.00
Ash	2.81±0.00
Carbohydrate	66.41±0.00

All values are mean of duplicate determination on a dry weight basis ± standard deviation

The result of the vitamin compositions of *Vigna aconitifolia* (moth bean) were as shown on Table 2. Vitamins are important in the body because of their involvement in human metabolism. However, their deficiencies can adversely affect human metabolism. The vitamin A content of the investigated *Vigna aconitifolia* recorded 14.65 IU. Therefore, the vitamin A content revealed by this study was below the RDA for Vitamin A but compared with the value reported by [30] on mango seed. Vitamin A also known as retinol is required for maintenance of healthy epithelia tissue, normal vision and the synthesis of transferrin. Deficiency of this vitamin could lead to anaemia, decrease resistance to infections and cancer as a result of compromise in the immune system [31]. Vitamin C, also Known as ascorbic acid is an enzyme cofactor required for synthesis of important biochemicals [32]. Vitamin C is a potent antioxidant which reduces oxidative stress; it is required for maintenance of normal connective tissue and involved in wound healing [33]. Its deficiency results to capillary fragility, scurvy and anaemia [32]. Among all the investigated vitamins, vitamin C had the highest concentration (42.25 mg/100 g). This value compared with the values 37.84 and 38.4 mg/100 g) reported on *G. max* by [34] and *Cajanus cajan* by [35], but was higher than the value reported by [36] for water melon seed. Therefore, the availability of vitamin C in the investigated *Vigna aconitifolia* suggests its high capacity of playing vitamin C mediated roles. These vitamin B complexes (B_1, B_2 and B_3) are classified as energy releasing water soluble vitamins, they are very essential for regulation of normal human metabolism especially in minute measure. Niacin prevents the disease; pellagra while the deficiency of thiamine causes the disease beriberi [33]. Deficiency of riboflavin does not result to a specific disease; however, there is the possibility of underestimating its importance. The symptoms of riboflavin deficiency include inflammation of the tongue and lesions in the eyes and lips [33,37]. The thiamine and riboflavin compositions compared with the standard recommended dietary allowance (RDA) for children while the niacin composition was lower than the values reported by [26] for *M. puriens* and *Vigna aconitifolia* and *V. unguiculata* by [21]. The vitamin E composition compared fairly with the value reported For *A. conyzoides* [38] but lower than that reported by [39] for *Ficus capanensis* and *Mucuna pruriens*.

Table 3 showed the mineral composition (mg/100 g) of *Vigna aconitifolia.* The various minerals determined were present except mercury, lead and cadmium which were not detected, this agrees with that reported by [21]. Among all the investigated minerals, potassium registered the highest value. This implies that the incorporation of *Vigna aconitifolia* into the diet of people who takes diuretics to control hypertension could be beneficial [40]. The value obtained for sodium in the present sample compared with that reported by [21], but higher than that reported by [27] for Mung bean. The values registered for calcium, and phosphorus in the present sample were lower than the values reported by [21] for *Vigna aconitifolia* and Mung bean [27] but the magnesium content of the seed was higher when compared with that of chickpea, cowpea and green pea [1]. The Zinc content of the seed was higher than that reported for *Vigna aconitifolia* and *V. unguiculata* by [21] while the iron content was lower than that reported for chickpea and cowpea [1]. Cadmium, mercury and lead have no biochemical or physiological functions in human rather they are regarded as toxic pollutants. However, their absence in the investigated sample implies that the samples is free of toxic element and is not harmful to the consumers.

Table 2. Vitamin constituents of *Vigna aconitifolia*

Vitamins	Concentration (mg/100 g)
Vitamin A	14.65 ± 0.05 (IU)
Thiamin	0.23 ± 0.00
Riboflavin	0.45 ± 0.00
Niacin	0.47 ± 0.00
Ascorbic	42.25 ± 0.01
Vitamin E	0.25 ± 0.01

All values are mean of duplicate determination on a dry weight basis ± standard deviation

Table 3. The mineral constituents of *Vigna aconitifolia*

Minerals	Concentrations (mg/100 g)
Sodium	37.20 ± 0.02
Calcium	16.30 ± 0.01
Magnesium	18.44 ± 0.01
Potassium	51.57 ± 0.02
Phosphorus	31.13 ± 0.03
Iron	1.49 ± 0.00
Zinc	2.48 ± 0.00
Cadmium	ND
Mercury	ND
Lead	ND

All values are mean of duplicate determination on a dry weight basis ± standard deviation.
ND = Not Detected

Table 4. Anti-nutrient composition of *Vigna aconitifolia*

Anti-nutrients	Concentration (mg/100 g)
Alkaloid	2.03±0.02
Saponin	0.65±0.05
Tannin	2.89±0.01
Flavonoid	1.31±0.01
Cyanogenic glycoside	0.46±0.01
Phenol	0.15±0.01

All values are mean of duplicate determination on a dry weight basis ± standard deviation

The results of the anti-nutrients obtained in this investigation were as presented on Table 4. Legumes contain several anti-nutrients that reduce the bioavailability of nutrients, but these anti-nutrients can be reduced through conventional processing methods [41] including dehusking, roasting, cooking and soaking. Alkaloids are secondary plant metabolite with great pharmacological significance [42]. The alkaloid content of *Vigna aconitifolia* was higher than the value (1.44 ± 0.10) reported for *Vigna unguiculata* [43]. Alkaloids content greater than 20 mg are harmful for human consumption. The saponin content was comparably higher than the values (0.11 ± 0.10 and 0.17 ± 0.11) reported for *Vigna unguicalata* and *Glycine max* respectively [34] but lower than the value (6.0 ± 0.06) reported for *Punica granatum* seeds [43]. Saponins are known for their foaming properties in aqueous solution, astringent taste and haemolytic activity on red blood cells [44]. Tannin registered a higher value (2.89 ± 0.01) than those reported for *Mucuna pruriens* and water melon seed [45,46]. Tannins are involved healing of wounds and inflamed mucus membrane; they also exhibit astringent and antimicrobial potentials. The flavonoid content of *Vigna aconitifolia* was lower than the value (2.03 ± 0.2) reported for water melon seed [46] but higher than that reported for *Vigna aconitifolia* [9]. Flavonoid acts as antioxidants and free radical scavengers [47]. The value recorded for cyanogenic glycosides does not agree with that of [9]. The phenol content compared with the value reported by [36] for water melon seed.

4. CONCLUSION

Thus, raw *Vign*a *aconitifolia* seeds are devoid of known toxicants (lead, mercury and cadmium) and could serve as a good source of nutrients notably carbohydrate, protein, ascorbic acid, vitamin A, potassium, sodium and flavonoids. The limitations of the study, including the unproven representatives of the analyzed sample and the non-verification of the experimental result precision were noted and would be addressed in further studies.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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