IOSR Journal of Applied Chemistry (IOSR-JAC)
e-ISSN: 2278-5736.Volume 8, Issue 10 Ver. I (Oct. 2015), PP 42-45
www.iosrjournals.org

Proximate Composition and Mineral Analysis of *Mucuna utilis* (Velvet Bean)

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Abstract: *The standard procedures were followed to analyze the proximate composition and mineral analysis of Mucuna utilis. The caloric value was calculated from crude protein, crude fat, crude fiber, carbohydrate, moisture and ash content. The iron (Fe), zinc (Zn), calcium (Ca), manganese (Mn) and magnesium (Mg), sodium (Na), potassium (K) and phosphorus (P) were determined by Atomic Absorption Spectrophotometer. The results showed that Mucuna utilis contained ash (6.0%), crude protein (22.94%), crude fat (2.94%), crude fiber (12.50%), moisture (12.50%) and carbohydrate (43.11%). The energy calculated gave 290.75Kcal/100g. The mineral determination gave the data that Mucuna utilis contained calcium (5.25 mg/g), phosphorus (0.02 mg/g), magnesium (1.63 mg/g), manganese (0.0mg/g), iron (0.95 mg/g), sodium (1.17 mg/g), potassium (0.13 mg/g) and zinc (0.21 mg/g). This study concluded that the tested Mucuna utilis contained highest amount of carbohydrate and lowest amount of crude fibre. Similarly, among minerals tested, Mucuna utilis contained highest amount of calcium and no manganese at all.*

Keywords: *carbohydrate, mineral analysis, Mucuna utilis, protein, proximate composition*

I. Introduction

Mucuna and their accessions are herbaceous twining annual plants. They possess trifoliolate leaves (leaflets are broadly ovate, elliptic or rhomboid ovate and unequal at the base); flowers white to dark purple and hang in long clusters (pendulous racemes); pods are sigmoid, turgid and longitudinally ribbed, seeds ovoid (4-6 per pod) and black or white. *Mucuna* pods are covered with reddish-orange hairs, which readily dislodge and cause intense skin irritation and itch due to presence of a chemical called mucunain.

Many varieties and accessions of the wild legume, *Mucuna* are in great demand in food and pharmaceutical industries. Nutritional importance of *Mucuna* seeds as a rich source of protein supplement in food and feed has been well documented [1],[2]. *Mucuna* seeds constitute excellent raw material for indigenous Ayurvedic drugs and medicines due to the presence of 3,4-dihydroxy-L-phenylalanine (L-DOPA), which provides symptomatic relief in Parkinson's disease [3], and are in high demand in international market after the discovery of L-DOPA, which serves as a potential drug as anti-Parkinson's disease [4] and provides symptomatic relief [5] *Mucuna* seeds produce hypoglycemic effect and the fruits possess a weak neuromuscular blocking effect in rats but not in alloxan-treated rats [6]. The decoction of *Mucuna* seeds also lowers the cholesterol and lipids of plasma in rats [7]. The immature pods and leaves serve as vegetables, while seeds as condiment and main dish by ethnic groups in Nigeria [8].

Therefore, the present study was carried out to investigate the proximate composition and mineral content of *Mucuna utilis* and to evaluate its nutritional importance.

II. Materials and Methods

1. Plant collection: Fresh *Mucuna utilis* leaves were collected in Amoja Umudomi, Onicha-Igboeze in Ebonyi State, Nigeria. The leaves were confirmed by the Department of Botany, University of Nigeria Nsukka.

2. Sample preparation: The plant leaves were washed with clean cold water, air dried at room temperature for two weeks. The dried leaves were pulverized to a fine powder using laboratory mill at the Department of Crop Science, University of Nigeria Nsukka. The pulverized leaves were packed in air-tight glass jar and stored at 4^{o}C until analysis were carried out.

3. Extraction: The extraction was done using column extractor. 1.75 kg of the pulverized plant sample was packed into a column extractor. 2 L of analytical grade methanol were poured into the packed column and allowed to stand for 48 hours. The tap at the base of the column was opened and the solution was allowed to drop through the tap into a round-bottom flask. More methanol were poured to rinse the plant sample and to ensure complete extraction. The extraction was complete at the end of 72 hours. The extract was concentrated

using rotary evaporator at 75^{o}C under reduced pressure to give a crude methanol extract of the leaves of *Mucuna utilis.*

4. Proximate Analysis

4.1 Determination of ash content: This was done following the standard method by Association of Official Analytical Chemist (AOAC) [9]. A silica dish was heated to 600 ^{o}C, cooled and weighed. 2 g of the sample was transferred into the dish and weighed. The dish was placed in a muffle furnace and ashed (heated) at 600 ^{o}C in a furnace for 3 hours an allowed to cool. The percentage ash content was calculated using the formula below [10]:

$$\% \text{ ash } = \frac{\text{Weight of ash}}{\text{weight of fresh sample}} \times 100 \ldots (1)$$

4.2 Determination of crude protein content: This was done using the Micro-kjeldahl method. Oven dried ground plant material (0.5 g) was transferred into a 30 ml Kjedahl flask carefully and 15ml conc. H_2SO_4 added. The catalyst (mixture of selenium oxide and $CuSO_4$ (1.0 g) was also added. This was heated cautiously on digestion rack under fume wood until a clear greenish solution appears. After the digestion, the mixture was heated for another 30 minutes and allowed to cool. About 10ml of distilled water was added to avoid caking and then transferred to the Kjeldahl distilled apparatus. 10ml of 40 % NaOH was added to the mixture and allowed to distil. The distillate was later titrated to first pink colour with 0.01MHCl and the concentration of protein calculated using the formula shown below [9]:

$$\% \text{ Nitrogen} = \frac{\text{titre value} \times 14.1 \times 0.01 \times 100 \times 5}{1000 \times \text{weight of sample}} \ldots (2)$$

4.3 Determination of crude fat Content: This was done according to the method described by Janardharian and Lakshmanan, (1986) [11]. Soxhlet extractor was used. An extraction flask was thoroughly washed and dried in hot oven for 30 minutes. It was placed in a desiccator to cool. 2 g of the sample was weighed and transferred into rolled ashless filter paper and then placed inside the extractor thimble which was put inside the soxhlet extractor. Some petrol ether, about three quarter volume of the flask was added to the apparatus set up and then heated and allowed to run for 4 hours. The ether was recovered at the end of the extraction before the thimble was removed. The oil collected in the flask was dried at 100^{o}C in an oven and then weighed.

$$\% \text{ Fat} = \frac{C-B}{A} \times 100 \ldots (3)$$

Where:

A = weight of empty flask

B = weight of sample

C = weight of flask + oil after drying

4.4 Determination of crude fibre: This was done according to the method outlined by Association of Official Analytical Chemist (AOAC) thus: pre-heated H_2SO_4 (150ml) was added to 1.5 g of ground extract, then heated to boiling for 30 minutes, and then filtered. The residue was washed three times with hot water. To this was added 150ml pre-heated KOH and heated to boiling for 30 minutes and then filtered. The residue was washed three times with hot water, another three times with acetone. It was dried at 103^{o}C for 1 hour, weighed (W_2), heated at 500^{o}C, and then weighed again (W_3). The percentage of fibre was calculated using the formula as shown below:

$$\% \text{ Fibre} = \frac{W_2 - W_3}{W_1} \times 100 \ldots (4)$$

Where:

W_1 = weight of the ground sample

W_2 = weight of residue after drying at 103^{o}C

W_3 = weight of ash

4.5 Determination of moisture content: 2 g of the ground extract were dried to a constant weight at 600^{o}C in a hot air circulating oven for 24 hours. The moisture content was calculated as the difference in weight after drying as shown below:

$$\% \text{ Moisture} = \frac{W_1 - W_2}{W_1} \times 100 \ldots (5)$$

Where:

W_1 = weight of the ground sample

W_2 = weight of dried sample

4.6 Percentage of carbohydrate: The percentage carbohydrate was calculated by using:

% Carbohydrate = 100% - (% protein + % fats + % moisture + % ash + % fibre)

4.7 Energy calculation: The percent calories in selected samples were calculated by multiplying the percentage of crude protein and carbohydrate with 4 and crude fat with 9. The values were then converted to calories per 100 gm of the sample.

5. Mineral analysis

0.5 g *Mucuna* leaves sample was digested using aqua regia (a freshly prepared mixture of nitric acid and hydrochloric acid in the ratio of 3:1 respectively).Then the mixture was made up to 250 ml in a beaker using distilled water. The resultant solution was analyzed for various cations contained in the mixture using Atomic Absorption Spectrophotometer. The various cations were determined after due calibration of the machine using each cation's standard. For example, calcium was put in a hollow cathode lamp and introduced into the atomic absorption spectrophotometer and the atomizer absorbed all the calcium ion. The light emission was detected by the detector and the calibration graph was plotted according to Beer-Lambert's law.

III. Results and Discussion

Table 1: Proximate composition of leaves of *Mucuna utilis*

S/N	Nutrients	% Composition
1.	Moisture	12.50
2.	Ash	6.00
3.	Crude protein	22.94
4.	Crude fat	2.95
5.	Crude fibre	12.50
6.	Total carbohydrate	43.11
7.	Energy	290.75Kcal/100g

Using standard procedures, the nutritive values of *Mucuna utilis* were evaluated by determining the proximate composition of the leaves as shown in Table 1. The result showed the moisture content of *Mucuna utilis* to be 12.50 %, indicating high shelf life of the fresh plant hence long storage would not lead to much spoilage due to its susceptibility to microbial attack, especially after drying.

The ash content was found to be 6.0 %. According to Onwuka, 2005, the ash content is generally taken to be a measure of the mineral content of the original food [12]. The results showed that the leaves are rich in carbohydrate (43.11 %), comparable to what Ujowundu *et al* [13] found out. The energy in Kcal/100 g was found to be 290.75. Other results showed crude protein (22.94%), crude fat (2.94%) and crude fibre (12.50 %).

The recommended dietary allowance (RDA) crude fibre in food or plant is an indication of the level of non-digestible carbohydrate (cellulose) and lignin. They are needed in the diet to aid digestion and absorption of glucose and fat. Research has also found out that increased intake of dietary fibre can have beneficial effects against chronic diseases, such as cardiovascular diseases, diverticulosis, diabetes and colon cancer [14]. However, food fiber could displace nutrients, slow down the intake of food by requiring more chewing, reduce absorption of nutrients, and result in insufficient energy for growth in children [15]. The crude fibre was in line with the findings of Ujowundu *et al* [13].

The recommended dietary allowance (RDA) for protein is 56 g for individual weighing 70 kg and 46 g for adult weighing 50 kg; children may consume 2 kg/day. *Mucuna utilis* is a good source of protein that when supplemented with animal protein, the body will be adequately enriched with protein.

Table 2: Mineral element analysis

S/N	**Mineral Element**	**Composition (mg/g)**
1.	Calcium	5.25
2.	Phosphorus	0.02
3.	Magnesium	1.63
4.	Manganese	Nil
5.	Iron	0.95
6.	Sodium	1.17
7.	Potassium	0.13
8.	Zinc	0.21

The mineral element analysis (mg/g) shown in Table 2 include: Ca (5.25), P (0.02), Mg (1.69), Fe (0.95), Na (1.17), K (0.13) and Zn (0.21). Manganese was nil. Among all the mineral elements analyzed, calcium exhibited the highest value (5.23mg/g).

Calcium is essential for bone and teeth formation and development, blood clotting and for normal functioning of heart, nervous system and muscles. Calcium deficiency can lead to rickets, osteomalacia and tooth decay [16]. Magnesium is needed for healthy bones and blood vessels, aids muscle function, nerve transmission and energy formation. The daily requirement is 300 - 400 mg per day.

Though the values for this minerals in *Mucuna* plant are far below their normal daily requirement, the plant, in addition to other sources, can serve as a good supplement for these minerals

IV. Conclusion

This work, which investigated the proximate composition and mineral contents of *Mucuna utilis*, has justified its great demand in food and pharmaceutical industries. Also, the nutritional importance of *Mucuna* seeds as a rich source of protein supplement in food and feed well documented by has been justified.

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