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Nutritional Potential of the Seeds of Bauhinia Monandra (Linn)

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Abstract: The seeds of Bauhinia monandra (Linn) were analyzed for mineral elements, nutritional and antinutrition contents.The chemical properties of the oil extracted from the seeds and amino acids were also determined. The concentrations (mg/100g) of potassium, calcium, magnesium, sodium, sulphur, phosphorus and iron were 74.20, 77.90, 2.87, 2.319, 4.166, 1.594 and 1.71 respectively. The percentage composition of lipids, carbohydrate and fibre were 28.70, 33.09, 21.45 and 3.25 respectively. The seed contained 11.57mg/100g phytate, 03.2 mg/20g hydrogen cyanide, 6.0% tannins and 2.05% saponins. The iodine value, acid value, free fatty acid, saponification value, peroxide and ester values were 56.60, 6.77, 3.74, 196.12, 1.99 and 189.35 respectively. The amino acids, lysine, phenylalanine, leucine, isoleucine methronine, valine, threonine and cystine were 2.86, 3.77, 2.13, 2.31 1.54, 3.54, 2.70 and 1.11 mg/100g protein respectively. The study shows that the plant if popularized could serve as complimentary source of essential nutrients to man and livestock provide toxicants present in them are removed.

Key words: Nutrition, Seeds, Bauchinia monandra

Introduction

The plant, Bauhinia monandra, (Family: caesalpiriaceae) is an ornamental tree, commonly found in West Africa and India (Dalziel, 1955). Hutchinson (1967) observed that the leaves and pods are eaten as vegetable in China and India, while in Africa, the pods and seeds are sources of black and blue dyes. When the pods are pounded and boiled in water a laxative drink is produced, the crumble bark form a source of fibre for cordage in Eastern Sudan (Irvine, 1961). According to Shashinia (1989), the pod is used as an astringent for diarrhoea, dysentery, and cure for fever, a decoction of the root and bark is believed to cure leprosy and small pox, while the extract of the leaves are used to cure eye ailments. Keay (1989) also stated that anti-inflammatory balm is made from the bark.

Lack of comprehensive compositional data regarding the nutrient content of several wild indigenous plants has limited the prospects of their utilization. In this study, the seeds of Bauhinia monandra were analyzed for nutritional and anti-nutritional compositions and chemical properties of the seed oil.

Materials and Methods

Sample Collection and Preparation:The seeds of Bauhinia monandra were collected from villages around Samaru, Zaria, Kaduna State, Nigeria.The samples were deposited at the Herbarium of the Department of Biological Sciences, Ahmadu Bello University, Zaria for identification.

The seeds were obtained by breaking the pods and subsequently removing the seed coats. They were oven dried at 60°C in an air-circulated oven, ground with porcelain mortar and pestle to fine particles and stored in screw-capped plastic containers.

Elemental Analysis: The ground sample was ashed and pellets of 0.2983g and 19mm diameter were made by applying a pressure of 10 tons (204081.60Nm^2) on a hydraulic press using three drops of an organic binder (10% solution of styopore in toluene). The pellet were introduced into the x-ray fluorescence (XRF) generator (model SL12170) and analysed [Funtua, 1999]. Measurements are performed using an annular 25 mCi ^{109}Cd as the excitation source, that emits Ag-K X-rays (22.1 keV) and ^{55}Fe that emits Mn-K X-rays (5.89 keV), in which case all elements with lower characteristic excitation energies are accessible for detection in the samples. The spectra for the samples are collected for 3000 s with the ^{109}Cd source and the spectra were then evaluated using the AXIL-QXAS program(Bernasconi, 1996). Sodium and magnesium were analysed by Atomic Absorption Spectrometer (Unicam 969 AAS), while sulphur and phosphorus were analysed by standard colorimetric procedures (Allen *et al.*, 1974).

Determination of Nutritional Content: The samples were analyzed for proximate composition (lipids, crude protein, soluble carbohydrate and crude fibre). The oil was extracted with petroleum ether 40-60°C using a soxhlet for six hours. The micro-Kjedahl procedure was adopted for the determination of protein, while soluble carbohydrate was determined by the Anthrone procedure (Pearson, 1976 and AOAC, 1995).

Determination of Hydrogen Cyanide: Hydrogen cyanide was determined by the alkaline titration procedure (AOAC, 1995). 10g of ground sample was soaked in a mixture of 200cm^3 of distilled water and 10cm^3 of orthophosphoric acid. The mixture was left overnight to release all bounded hydrocyanic acid. The mixture was then distilled until 150cm^3 of the distillate was collected. 20cm^3 of distillate was taken into a conical flask containing 40cm^3 of distilled water. 8cm^3 of 6 mol dm^{-3} aqueous ammonia and 2cm^3 of 5% potassium iodide solutions were added. The mixture was titrated with 0.02 mol dm^{-3} silver nitrate to faint but permanent turbidity.

Determination of Phytate: 4g of ground sample was soaked into 100cm^3 of 2% hydrochloric acid for five hours and filtered. 25cm^3 of the filtrate was placed in a conical flask and 5cm^3 of 0.3% Ammonium thiocyanate solution was added. The mixture was titrated with standard Iron (III) chloride solution until a brownish – yellow colour persisted for five minutes (Reddy *et al.,* 1982).

Determination of Tannins: The vanillin – HCl catalysed reaction of tannins was adopted. The tannin content was determined colorimeterically at 500nm (Bagepallis *et al.,* 1982).

Determination of Saponins:

10g of the ground sample was poured into a conical flask containing 100cm^3 of 20% aqueous ethanol and agitated with a magnetic stirrer for twelve (12) hours at 55°C. The solution was filtered using whatman No.1 filter paper and the residue was re-extracted with 200cm^3 of 20% aqueous ethanol. The extracts were combined and reduced to about 40cm^3 under vacuum. The extract and 20cm^3 diethyl ether were transferred into a 250cm^3 separatory funnel and shaken vigorously. The aqueous layer was discarded. The process of purification continued until a colourless aqueous extract was obtained. The pH of the remaining aqueous solution was adjusted to 4.5 by adding 4g NaCl, and the solution was then shaken successively with 60cm^3 and 30cm^3 portions of n-butanol. The butanolic extract was washed twice with 10cm^3 of 5% aqueous sodium chloride evaporated to dryness in a fume cupboard, to give the saponin, which was weighed and expressed as percentage. (Hudson and El-Difrawi, 1979).

Determination of Chemical Properties of the Oil: The oil extracted from the seed was analysed for iodine number, acid value, free fatty acid, peroxide value, saponification value and ester value using standard procedure described by (Pearson, 1976 and AOAC, 1995).

Determination of Amino Acids Content: 3.0g of ground sample was extracted with petroleum either (40 – 60°C) using soxhlet extractor for six hours (Pearson, 1976). 30mg of the defatted sample was weighed into a glass ampoule and 7.0cm^3 of 60 mol dm^{-3} hydrochloric acid was added. Oxygen was expelled by passing nitrogen into the ampoule (to avoid possible oxidation of some amino acids during hydrolysis). The ampoule was sealed with Bunsen flame and placed in an oven preset to 105°C for 22 hours, after which it was allowed to cool. The ampoule was then broken at the tip and content filtered. The filtrate was evaporated to dryness at 40°C under vacuum in a rotary evaporator. The residue was dissolved with 5.0cm^3 of acetate buffer (pH 2.0), slotted in plastic bottle and kept in deep freezer before analysis. Five to ten microlitres of the hydrolysate was loaded on the Technician Sequential Multi-sample (TSM) amino acid analyzer (DNA 0209) made by Technician (Ireland) Ltd. This was dispensed into the Cartridge of the analyzer and analysis lasted for 76 minutes (Spaceman *et al.*, 1959).

Results and Discussion

Amongst the essential elements (K, Ca, Na, Mg, S, P and Fe) shown in Table 1, the concentration of calcium was the highest (77.90mg/g) followed by potassium (74.20mg/g). Concentration of phosphorous was the lowest (1.59mg/g). These elements are needed by the body because they constitute parts of the rigid body structure, soft tissue and body fluids. Smith *et al.* (1996) stated that essential elements such as calcium and phosphorus are needed for the building of healthy bones and teeth, while Fe assist blood formation and their deficiencies cause muscles weakness and bone pain. Na and K maintain water balance in cells, transmit nerve impulses and stimulate normal movement of the intestinal tract. Glew *et al.* (1997) reported that magnesium is essential because it maintains, repairs cell and provides energy and its deficiency may result in vertigo, convulsions, nervousness and heat palpitation. Iron assists the muscles to keep reservoir of oxygen and increases the body resistance to infection. Its deficiency result in anaemia, tiredness, is insomnia and palpitations. Generally, minerals work in combination with each other and with other nutrients, therefore deficiency of any mineral may cause health problems.

The result of the nutritional and anti-nutritional content is presented in Table 2. The lipid content was 28.70%, a value that compared favourably with other oil seeds like Soya bean (27%) (Ezeagu *et al.,* 1996). The search for new sources of lipids is been encouraged because lipid provide the body with maximum energy, insulate the body from cold, prevent heat loss through the skin and lend a pleasant taste and texture in food. According to Badifu (1993) essential fatty acids prevents dryness and scaling of skin, regulate the action of hormones and facilitate transmission of nerve impulses.

Table 1: Composition of essential elements in the seed of Bauhinia monandra.

Elements	Concentration (mg/g)
Potassium	74.20± 2.46
Calcium	77.9 ± 2.98
Magnessium	2.8 ± 0.02
Sodium	2.319 ± 0.07
Sulphur	4.166 ± 0.005
Phosphorus	1.594 ± 0.09
Iron	1.710 ± 0.11

Table 2: Nutritional and anti-nutritional content of the seeds of Bauhinia monandra

Lipids (%)	28.70 ± 0.20
Protein (%)	33.09 ± 1.33
Carbohydrate (%)	21.45 ± 0.12
Fibre (%)	3.25 ± 0.83
Phytate (mg/100g)	11.5 ± 0.47
Hydrogen cyanide (mg/100g)	0.32 ± 0.00
Tannins (%)	6.0 ± 0.09
Saponins (%)	2.052 ± 0.0

Table 3: Chemical properties of the oil of Bauhinia monandra

Iodine value	56.60 + 0.29
Acid value	6.77 + 0.10
Free fatty acid	3.74 + 0.12
Peroxide value (mg/kg)	1.99 + 0.02
Saponificiation value (g/koh)	196.12 + 0.50
Ester value	189.35 + 0.50

According to Young (1994), proteins are essential constituents of all body tissue and are important in the formation of new tissues during growth, during pregnancy and during healing of wounds. The protein content of Bauhinia monandara was 33.09% and this compares fairly with Soya beans (Glycine max) and groundnuts (Arachis hypogaea), which have 51.4 and 51.3 % respectively. This indicates that the plant is a good source of protein. Bauhinia monandra seed had 21.45% soluble carbohydrate and 3.25% fibre content. The carbohydrate content of the seed compares favourably with that of soybean (Glycine Max) 20.7% and peanut (Arachis hypogaea) 24.6% (Nielsen *et al.*, 1996). According to Madubuike *et al.*, 1994), fibre diet prevents constipation and also reduces cholesterol level in the blood.

The phytate content of B. monandra was 11.57mg/100g (Table 2). The presence of phytic acid causes phosphorus deficiency in monogastric animals by binding and forming indigestible phytates that make this element unavailable (Biehl *et al.*, 1997). It also affects the availability of calcium, magnesium and iron that are used to form the phytin complex. The hydrogen cyanide content was 0.32mg. Chandra *et al.* (1980), noted that chronic exposure to hydrogen cyanide diet causes neurological, respiratory, cardiovascular and thyroid debilities. It also causes focal necrosis in liver and kidney (Okolie and Sagie, 1999).

The tannin content of B. monandra was 60%. Tannins are known to impair the functioning of the rumen, wool growth and liver-weight gain, and reduces gastrointestinal parasitism (Chang *et al.*, 1994). It also affects protein utilization by binding to lysine and making it unavailable to mono-gastric animals (Bagepallis *et al.*, 1982).

Saponin content of B. monandra was 2.052%. This indicates that the plant has low saponin content. Saponin are haemolytic and are known interfere with the metabolism of vitamin E and also causes gastroenteritis, manifestested by diarrhoea and dysentery (Radositits *et al.*, 1997).In contrast, saponins are excellent foaming agents, used in beverages, such as root beer and slurries to provide foamy head. The surfactant properties that saponin possesses enhances its use industrially in mining (as in ore separation), in preparation of emulsions for photographic films, and cosmetics, such as lipstick and shampoo (Oakenfull and Sidhu, 1990). Saponins also reduce cholesterol level in the body (Hudson and El-Difrawi ,1979).

The iodine value (56.60) of the oil (Table 3) extracted from the seeds of B. monandra suggests that the oil is non-drying oil.

Table 4: Amino acid content (g/100g protein) of the Seed of Bauhinia Monandra

Lysine	2.86
Phenylalanine	3.77
Leucine	2.13
Isoleucine	2.31
Methionine	1.54
Valine	3.54
Cystine	1.11
Threonine	2.70
Glutamic acid	11.75
Arginine	6.75
Aspartic acid	6.02
Serine	4.58
Glycine	3.09
Alanine	2.99
Histidine	2.36
Proline	2.37
Tyrosine	3.18

Non-drying oil remain liquid for a long period with little oxidation (Eromosele (1993). Such oils may be used in soap making, cosmetics, lubricants, leather dressing and candle industries. The acid value and free fatty acid value were 6.77 and 3.74 respectively. The low acid value is an indication that the oil has a low deteriorating rate and high edibility. The free fatty acid value shows that the rate of development of objectionable flavour or odour (rancidity) of this oil is low (Ekpa, 1996). The peroxide value of the oil (1.99) was low. While the saponification value and ester value were 196.12 and 189.35 respectively. The saponification value compared well with that of palm oil (196-205) and Olive oil 185-196 (Badifu, 1993).

The concentration of the essential amino acids (Table 4), lysine, phenylalanine leucine, isoleucine, methionine, valine, thereonine and cystine were 2.86, 3.77, 2.13, 2.3, 1.58, 3.54 2.70 and 1.11 respectively. The concentrations of the non-essential amino acids, glutamic acid, arginine, aspartic acid and serine were 11.75, 6.74, 6.02 and 4.58 (g/100g protein) respectively. This result compliments the report of Di– Ciero *et al* .(1998) that B. monandra seeds are good source of essential amino acid.

Conclusion

The results of the study indicate that Bauhinia monandra seeds of Zaria-Nigeria are rich in nutrient and low in anti nutritional compounds. Inclusion of these seeds in animal or human diet may require further processing especially in reducing the cyanide and phytate levels to that which the body can be tolerated by the body. The seeds have high potential of serving as a complement source of protein, minerals and oil. The oil on the other hand can be a good source for industrial production of cosmetics, pharmaceuticals etc, because it will not easily become rancid.

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