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Research Article

INVESTIGATION OF THE CHEMICAL COMPOSITION OF *BRACHYSTEGIA EURYCOMA* HARMS PLANT PARTS USED IN HERBAL MEDICINE

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Abstract: *Brachystegia eurycoma* seeds and stem bark were analyzed for their vitamins, minerals and proximate composition. The results revealed the presence of ascorbic acid (1.14×10^{-2} - 4.5×10^{-3} %), niacin (2.2×10^{-3}-3.0×10^{-3} %), riboflavin (5.0×10^{-4}-2.0×10^{-4} %), thiamin (1.5×10^{-3}-2.2×10^{-4} %) and β-carotenoid (3.0×10^{-4}-3.0×10^{-4} %). The proximate compositions were crude protein (7.44-3.86 %), crude fibre (3.80-65.86 %), lipids (9.57-2.32 %), ash (8.05-10.11 %), moisture (10.36-7.74 %), carbohydrate (60.78-10.11 %) and food energy (359.01-76.76 g/calories). The plant parts are good sources of minerals such as potassium (0.83-0.93 %), sodium (0.19-0.13 %), magnesium (0.88-0.55 %), calcium (1.58-1.68 %), phosphorus (0.49-0.31 %), nitrogen (1.19-0.62 %), iron (3.2×10^{-2}-3.5×10^{-2} %), copper (6.0×10^{-3}-1.5×10^{-2} %) and zinc (2.2×10^{-2}-6.0×10^{-3} %). These results showed that the seeds of *B. eurycoma* are good sources of neutriceuticals and provide high degree of energy for body metabolism. The bark which is used in herbal medicine could be used in the management of colon cancer judging from its very high crude fibre content. The ascorbic acid and β-carotenoid content could be a contributory reason why the plant possesses antioxidant and anti-inflammatory activities in herbal medicine.

Key words: *Brachystegia eurycoma*, Chemical composition, Herbal medicine, Vitamins, Minerals, Proximate composition

INTRODUCTION

Investigation into the chemical composition of plants especially those used as food and medicine is not uncommon. This becomes necessary to have knowledge of the nutritional quality of the food we eat as well as the chemical constituent responsible for certain therapeutic function concomitant therefrom. This would enable nutritionists and dieticians give expert advice on feeding pattern to patients. The gainsaying that attention has completely shifted to modern artificial drugs should be upheld with alacritous tenacity because plants still provide humongous and invaluable phytochemicals for a wide and myriad of treatments against diseases, infections and disorders.

Brachystegia eurycoma is a tree that belongs to the family, *Fabaceae*. It grows in Western and Eastern Nigeria and in some other parts of West Africa usually along river banks and swampy areas and also on well-drained soils [1,2]. The seed is used in soup making as a thickening agent in mostly Eastern Nigeria. The seed and the stem bark have been reported to possess antioxidant, anti-inflammatory, antibacterial and antifungal activities [3,4,5]. The exudates from the plant have also been reported to facilitate wound healing [6]. *B. eurycoma* was selected for the analysis of its vitamins, minerals and proximate composition because of its uses as food and medicine in Eastern Nigeria.

MATERIALS AND METHODS

Plant Materials

Brachystegia eurycoma seeds were bought from Umuahia Ogwumabiri market in Abia State, Nigeria. Clean and wholesome seeds were selected, identified and authenticated by Mr. I. K. Ndukwe, a specialist in plant taxonomy of Taxonomy Section, Forestry Department, Michael Okpara University of Agriculture, Umudike, Nigeria. The seeds were weighed (1kg) and then decoated by soaking in water for 24 hours. The loosened hull was washed off with several changes of water. The dehulled seeds were air-dried before milling. The barks of *B. eurycoma* were harvested from the tree plant located at Umuovo village stream in Old Umuahia, Umuahia South Local Government Area of Abia State, Nigeria. The harvested barks were weighed (2kg) and then dried on the laboratory bench for 30 days. The seed endosperms and barks of *B. eurycoma* were milled into a uniform and fine powder by a mechanically driven attrition mill. The seeds gave 777.66 g weight of flour while the bark gave 1851.38 g. The powdered plant materials were dried and stored in airtight bottles and kept properly. The two powdered plant materials were analyzed quantitatively for vitamins, mineral elements and proximate compositions as shown below.

Determination of Plant Chemicals

Ascorbic acid was determined using the method of the Association of Vitamin Chemists described by Kirk and Sawyer [7]. The B-complex vitamins (thiamin, riboflavin and niacin) were determined according to the methods of SKALAR Analyzers method of Baraket *et al* [8] while carotenoid was determined according to the method described by James [9]. The macro and micro elements comprising potassium, sodium, magnesium, calcium, phosphorus, nitrogen, iron, copper and zinc were determined according to the method of Shahidi *et al* [10]. Protein, crud fibre, lipids, ash, moisture, carbohydrate and gross food

energy contents were determined by the method described by James [9].

Statistical Analysis

All measurements were replicated three times and standard deviations obtained.

RESULTS AND DISCUSSION

Table 1 show the vitamins content of *B. eurycoma* seeds and stem bark. These plant parts are good sources of ascorbic acid, niacin, riboflavin, thiamin and *β*-carotenoids. The seeds contained more ascorbic acid (0.0114%) than the bark (0.0045%). Ascorbic acid possesses antioxidant function and is able to detoxify carcinogens and may protect cell membranes and DNA from oxidative damage. In human, supplementation with 100 mg/day has been shown to minimize oxidative damage in lymphocyte DNA [11,12,13]. Wound healing is dependent on ascorbic acid and this vitamin is essential for the production and stabilization of collagen [14]. Ascorbic acid prevents scurvy which is characterized by skin hemorrhages, bleeding gums, fragile bones and death. This therefore furnishes the reason why ascorbic acid is used in wound healing [15]. The detection of 0.014% of ascorbic acid in the seeds of *B. eurycoma* shows that the seeds have high nutritional and medicinal values. The ascorbic acid content of this plant may have a contributory effect in the use of the plant's gel for the treatment of wounds in herbal medicine.

Table 1: Vitamins composition of *B. eurycoma* seeds and stem bark on dry weight basis

Vitamins (%)	*B. eurycoma* Seeds (%)	*B. eurycoma* Bark (%)
Ascorbic Acid	$1.14\times 10^{-2} \pm 1.0\times 10^{-3}$	$4.5\times 10^{-3} \pm 3.0\times 10^{-4}$
Niacin	$2.2\times 10^{-3} \pm 2.0\times 10^{-4}$	$3.0\times 10^{-3} \pm 3.0\times 10^{-4}$
Riboflavin	$5.0\times 10^{-4} \pm 8.0\times 10^{-5}$	$2.0\times 10^{-4} \pm 1.0\times 10^{-5}$
Thiamin	$1.5\times 10^{-3} \pm 2.0\times 10^{-4}$	$2.2\times 10^{-3} \pm 1.0\times 10^{-4}$
β-carotenoid	$3.0\times 10^{-4} \pm 1.0\times 10^{-5}$	$3.0\times 10^{-4} \pm 2.0\times 10^{-5}$

Data are means ± standard deviations of triplicate results

Table 2: Mineral elements composition of *B. eurycoma* seeds and stem bark

Elements (%)	*B. eurycoma* Seeds (%)	*B. eurycoma* Bark (%)
Potassium	0.83 ± 0.03	0.93±0.03
Sodium	0.19 ±0.01	0.13± 0.01
Magnesium	0.88± 0.02	0.55±0.02
Calcium	1.58±0.02	1.68±0.11
Phosphorus	0.49±0.09	0.31±0.01
Nitrogen	1.19±0.01	0.62± 0.01
Iron	$3.2\times 10^{-2}\pm 1.0\times 10^{-4}$	$3.5\times 10^{-2}\pm 2.0\times 10^{-3}$
Copper	$6.0\times 10^{-3}\pm 3.0\times 10^{-4}$	$1.5\times 10^{-2}\pm 1.0\times 10^{-4}$
Zinc	$2.2\times 10^{-2}\pm 1.0\times 10^{-3}$	$6.0\times 10^{-3}\pm 2.0\times 10^{-4}$

Data are means ± standard deviations of triplicate result on dry weight basis.

Table 3: Proximate compositions of *B. eurycoma* seeds and stem bark

Constituents (%)	*B. eurycoma* Seeds (%)	*B. eurycoma* Bark *(%)*
Crude protein Nx6.25	7.44± 0.06	3.86± 0.07
Crude Fibre	3.80 ± 0.20	65.86 ± 0.18
Lipids	9.57± 0.12	2.32± 0.03
Ash	8.05±0.13	10.11± 0.03
Moisture	10.36± 0.09	7.74±0.02
Carbohydrate	60.78± 0.13	10.11±0.08
Food Energy (g/calories)	359.01±0.10	76.76±0.06

Data are means ± standard deviations of triplicate results

The niacin, riboflavin, thiamin and beta-carotenoid contents of the seeds and bark of *B. eurycoma* were 0.0022%, 0.0005%, 0.0015%, 0.003% and 0.003%, 0.002%, 0.0022%, 0.003% respectively. Niacin functions as part of the coenzymes nicotinamide adenine dinucleotide (NAD) and nicotinamide adenine dinucleotide phosphate (NADP) or as their reduced states. It is involved in hydrogen ion (H^+) transport and in energy release. The coenzymes are also involved with protein metabolism and in Krebs's or citric acid cycle [16]. Riboflavin is concerned with energy metabolism and essential at all ages for general health. A deficiency of riboflavin affects the eyes, lips and tongue. Cracks appear at the corners of the mouth and the tongue becomes red and swollen. These symptoms, however, are not specific to riboflavin deficiency; they may be caused by a lack of other B vitamins or by other means [16]. Thiamin is necessary for the oxidation of glucose. If thiamin is deficient in the diet, glucose is only partially oxidized. The

breakdown stops at pyruvic acid. A build up of pyruvic acid in the blood causes muscular weakness, palpitations of the heart and degeneration of the nerves. These are the main symptoms of a disease called beriberi [17,18].

β-Carotenoids have the ability to quench singlet oxygen and thus function as antioxidants. Evolving evidence suggests that carotenoids may modulate processes related to mutagenesis, cell differentiation, and proliferation, independent of their role as antioxidants or precursors of vitamin A [19,20]. They also act on the differentiation and growth control of epithelial cells [21,22] and inhibit 1,2-diglyceride-induced growth and protease secretion [23]. Epidemiological data show that increased consumption of beta carotene-rich foods and higher blood levels of beta-carotene are associated with a reduced risk of lung cancer [24]. The detection of ascorbic acid, niacin, riboflavin, thiamin and β-carotenoids in the seeds and stem bark of *B. eurycoma* suggests the plant to be a good source of vitamins. Ascorbic acid and beta-carotenoids might have synergistically contributed in the antioxidative activities shown by the seeds and stem bark of the plant in herbal medicine in Nigeria.

The mineral composition of the seeds and stem bark of *B. eurycoma* is shown in Table 2 above. The results clearly indicate that *B. eurycoma* seeds and stem bark could be rich sources of mineral elements. This becomes important when the usefulness of such mineral elements like phosphorus, calcium, magnesium, potassium, nitrogen, iron, copper and zinc is considered. The potassium contents of the seeds and stem bark of *B. eurycoma* were 0.83% and 0.93% respectively. This result suggests that both the seeds and the bark could be good sources of potassium. Potassium plays vital role in normal cell formation including neurotransmission, muscle contraction and in maintaining acid-base balance. A deficiency of potassium although uncommon may arise through excretion via the kidney during renal disease, hyper-function of the adrenal cortex, diabetic acidosis and during treatment with mercurial diuretics. Losses via gastrointestinal tract may result from excessive vomiting and diarrhea. Deficiency symptoms of potassium appear as muscle weakness and paralysis [16]. The sodium contents of the seeds and stem bark of *B. eurycoma* were 0.19 and 0.13% respectively. Sodium functions in fluid balance, acid-base balance, osmosis, regulating muscle and nerve irritability and glucose absorption [25]. However, the low contents of sodium in the seeds and stem bark of *B. eurycoma* might be an advantage since excessive intake of sodium in human results in arterial hypertension. Urinary excretion is usually the only method of elimination, except where the person has been subjected to intense physical exercise or is put in a hot atmosphere [26].

Magnesium is important in tissue respiration, specifically in oxidative phosphorylation leading to the formation of adenosine triphosphate (ATP). It is an important enzyme activator for most reactions. Its deficiency is not usually a problem for humans who consume it as a component of chlorophyll in green leafy vegetables [16]. *B. eurycoma* seeds and stem bark are good sources of calcium. The seeds contained 1.58% while the bark contained 1.68% of calcium. Calcium was the highest element in the plant. It is quantitatively the largest mineral in the body and in the ionic form regulates transport across the cell wall. It involves in blood clotting. Calcium is also important in muscle contraction, neurotransmission and activates numerous enzyme systems of the body [16,25]. Other macro elements detected in the seeds and stem bark of *B. eurycoma* were phosphorus and nitrogen. The seeds contained 0.49% and 1.19% of phosphorus and nitrogen respectively while the bark contained 0.31% and 0.62% of phosphorus and nitrogen respectively. The seeds contained more phosphorus and nitrogen than the bark. In the body, phosphorus is always present as phosphate in the bones, phosphoproteins, phospholipids and nucleic acids in the cell [26]. Phosphorus is essential to the structure of every cell in the body fluids. Nitrogen is important for growth and repair of worn-out tissues [27].

The micro elements detected in the seeds and stem bark of *B. eurycoma* were iron, copper and zinc. Iron contents of the seeds and the bark were high. The seeds contained 0.032% while the bark contained 0.035% of iron. Iron is a component of haemoglobin, the oxygen carrying pigment of the red blood cells, myoglobin, the oxygen storing pigment in muscle of the cytochromes, a family of respiratory pigments present in tissues. The deficiency of iron results in anemia, a condition typified by tiredness, loss of health and palpitation in which subnormal levels of haeomoglobin are present in the blood [16]. *B. eurycoma* seeds and stem bark contained 0.006% and 0.015% of copper respectively. The plant is a good source of copper. In experimental animals, anemia, bone abnormalities, depigmentation of hair, defective production of elastin fibres resulting in blood vessel rupture have been demonstrated during copper deficiency. A reduction in the activity of copper containing enzymes is an accompanying outcome of copper deficiency. Copper occurs in the blood as cerruloplasmin, a specific copper transporting protein which has the ability to oxidize ferrous to ferric iron by virtue of its enzyme function [16]. The last micro element detected was zinc. The seeds contained 0.022% of zinc while the bark contained 0.006%. Zinc is required for many enzymatic functions, DNA synthesis, cell division and protein synthesis. Zinc is involved in enzyme activity, including carbonic anhydrase, alcohol dehydrogenase, alkaline phosphatase, lactate dehydrogenase, superoxide dismutase and pancreatic carboxypeptidase. It has long been believed that zinc is important for wound healing [18]. Zinc is important in carbohydrate metabolism. The zinc content of the plant could mean that the plant might play important role in the management of diabetes.

Results on the proximate composition and energy content of *B. eurycoma* seeds and stem bark are shown in Table 3 above. The seeds and stem bark of *B. eurycoma* contained high amount of protein, lipids, carbohydrates, fibre and calories of energy. 7.44% of crude protein was found in *B. eurycoma* seeds while 3.86% was observed in its stem bark. It means that the seed contains more protein than the bark. This attaches high nutritional value to the seeds of *B. eurycoma* in its use as food. Protein is essential in human system because it functions in the growth, support and

movement. It is also needed in the transportation of gas, organ components, water and in metabolic regulation. Protein also plays vital functions in the body defense system, the production of energy and amino acid [28]. The crude fibre content of *B. eurycoma* seeds was 3.80% while the stem bark contained 65.86%. From this result, the bark contained a very high quantity of crude fibre compared to the seeds. Dietary fibre is the portion of plant food that cannot be digested by human alimentary enzymes. However, dietary fibre helps to form softer bulky stools and has also been associated with protection against colon and rectal cancer [29]. Studies have demonstrated that dietary fibres lowered total cholesterol and the cholesterol involved in depositing fat in the arteries, thereby reducing coronary heart disease risk [30,31,32,33]. Consumption of foods high in dietary fibre has been associated with the lower risk of several gastrointestinal diseases [34]. The high value of crude fibre in *B. eurycoma* stem bark suggests that the plant might play important role in the treatment of colon and rectal cancer and reduction of cholesterol level in the body.

B. eurycoma seeds contained more lipids (9.57%) than the bark (2.32%). Lipids play significant role in the body metabolism. Apart from their energy yielding function, they also constitute a component of the membrane structure. They protect the body from mechanical injury when they are deposited in certain parts of the body, for example in the adipose tissue, and other subcutaneous area. Lipids especially fats, give palatability to food, and are essential emulsifiers for a number of drug preparations [35]. Lipids also function to transport the fat soluble vitamins (A,D,E and K including lipoic acid), and in combination with certain proteins called aproproteins mediate a number of enzyme activities [35]. The ash content of *B. eurycoma* seeds was 8.05% while the bark contained 10.11%. Ash residue is generally taken to be a measure of the mineral content of the materials [9,36].

The moisture contents of *B. eurycoma* seeds and stem bark were 10.36% and 7.74% respectively. Moisture content of food is of great importance to every food processor as a number of biochemical reactions and physiological changes in food depend very much on the moisture content [36]. The water content of a food is often an indication of the likely keeping qualities of that product. However, accurate determinations of moisture content are often difficult since the water present in foods is not all in the Free State [9]. The presence of water in food is essential because it serves as an ideal medium for the transportation of nutrient and is also actively involved in various metabolic reactions. Other functions of water in the human system are in the maintenance of heat within the body and in the control of body temperature [28]. *B. eurycoma* seeds contained a high value of food energy (359.01 g/calories) which was due to its high lipid content of 9.57%, carbohydrate content of 60.78% and protein content of 7.44% while the bark contained low value of food energy (76.76 g/calories) due to its low lipids (2.32%), carbohydrate (10.11%) and protein (3.86%) contents. The seed of *B. eurycoma* is a good source of carbohydrate needed in the body for the generation of energy.

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