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PROXIMATE AND CHEMICAL COMPOSITIONS OF LEAF SAMPLES OF *BURKEA AFRICANA* FROM MOLE NATIONAL PARK, GHANA

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ABSTRACT

Dry and rainy season leaf samples of *Burkea africana* were analyzed for proximate and mineral compositions, and anti-nutritional contents. Moisture contents of the dry season leaf samples of the plant were relatively low indicating good shelf life characteristics. High ash contents of dry and rainy season leaf samples of plant accounted for high mineral contents. High fibre and protein contents of leaf samples of plant indicate that the leaves could help treat constipation, improve general health and serve in growth and repair of tissues. The study revealed that leaves of the plant are rich in Ca, K, Na and Mg. Concentrations of trace metals in leaves of plant differ, with iron having the highest values of 481.03mg/Kg and 467.85mg/Kg in the rainy and dry season leaf samples respectively. Zinc concentrations range from 10.99mg/Kg in the rainy season leaf sample to 34.02mg/Kg in the dry season leaf sample of the plant. The high proximate and mineral compositions may be the factor to which elephants feed on the leaves of this plant. Also, results indicate that if leaves of *Burkea africana* are properly exploited and processed, they could be a high-quality and cheap source of feed for livestock especially ruminants.

Keywords: Proximate, elemental and anti-nitritional parameters, phytochemicals.

INTRODUCTION

Every mammal needs a daily supply of different types of food materials to enable it to live a healthy life. However, the productive value of any feed depends on the quantity eaten and the extent to which the feed consumed supplies the animals with the required energy, protein, minerals and vitamins.

There are differences among plant species and varieties, but the composition of a plant is also influenced by climate, soil fertility, and stage of maturity and method of feeding (Skerman and Howat, 1990).

However, various food materials are incorporated in plants to boost energy content when eaten by animals. Herbivores feed on different kinds of plants at different times depending on the nutritional content at a particular time or season. Some plants to some herbivores have been found to enhance growth, feed efficiency and improved the physical appearance of leaves which encourages consumption. Also, at any one time what an animal selects to eat is dependent on what is available. Thus, the degree of consumer pressure exerted on a particular plant species will be influenced by both the quality and the quantity of alternative food plants available in the vicinity.

There are many plant species of various classes. Many of these plants have been exploited over the years and from the basis for important feed. The plants also serve as nursery grounds for traditional herbal medicine. However there are lots of trees which serve as food for man and other lower animals in both humid and semi arid tropics, which have received much less attention from the scientific community (Cannel, 1989).

According to Abudu (2005) to avoid toxic build-up and sustain excellent health, each meal should give the body the following:

- Carbohydrate 90%
- Amino acids..... 4-5%
- Minerals..... 3-4%
- Fatty acids..... 1+%
- Vitamins ..... under 1%

Moreover a number of minerals are required by mammals in order to maintain good health. Some of these essential minerals are accumulated in different parts of plants as it accumulates minerals essential for growth from the environment (Oderinde *et al*., 2009). It has been reported that trace metals can be detected in plants and foodstuffs. Recently, plant species have been identified that contain nutrients displaying new beneficial medicinal and therapeutic properties (Almoaruf *et al*., 2000).

The occurrence of toxic or digestibility-reducing compounds could be an important factor restricting the utilization of otherwise nutritious plants by large

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herbivores. However, little factual information is yet available both on the occurrence of these chemicals in plants, and on their effects on mammalian consumers (Owen-Smith, 1982).

Large herbivores can exert a major impact on vegetation. They remove over 40% of annual grass production (Braun, 1973). This can radically alter the balance between grasses, and woody vegetation and even result in fire and desertification where animals are confined. Elephants in particular can directly change areas of woodland into open grassland (Laws *et al*., 1975).

Elephant dine on a wealth of plant parts; leaves, twigs, bark, shoots, fruits, flowers, roots, tubers and bulbs from as 80 different plant species. The digestive system of elephants is less efficient than those of other herbivores, such as antelope and buffalo. Food passes quickly through the digestive system before nutrients are absorbed, causing elephants to discard about half the plant material they consume. This inefficient digestive system means that elephants must eat large quantities of food to retain and absorb necessary nutrients for good health.

In the wild, elephants devote about three quarters of their day to feeding. An adult elephant eats 200 to 300kg (440 to 630 lb) of food each day. The African elephant species; *Loxodonta africana* and *Loxodonta cyclotis* weigh up to 7,000kg (15,400 lb) and stand up to 4m (13ft) tall (Gordon and Roach, 2009). Elephants do not feed indiscriminately. Some plants only assume importance to them at certain times of the year. For instance, elephants have only been observed to eat *Cordia gharaf* in quantity when the leaves begin to shrivel. Other plants such as the herb, *Digera alternifoli* are eaten at certain growth stage but later dry up and become unpalatable (Bax and Sheldrick, 1963).

Burkea africana is among the few 80 different plant species consumed by elephants. There is little information on the nutritional, anti-nutritional and mineral properties of this plant. The periodic feeding of elephants on *Burkea africana* may be influenced markedly by the extent to which the plant species supply energy, protein, minerals and vitamins. There is therefore the need to identify the various food materials present in the plant as there is no concrete information on it.

The Mole National Park authorities have been concerned over the extent of damages caused by elephants to vegetation for several years. In the dry season, many of the trees are smashed and the herbs and shrubs are eaten down to stumps. There is large scale destruction of *Burkea africana* and ring barking by elephants during this period.

It is considered important to study what elements of the vegetation are eaten as food. This is because an understanding of the reasons for this wide variation in the degree of utilization of the vegetation resources is an essential requirement for enlightened management, whether for secondary production or environmental conservation.

The purpose of this study is to explore salient features such as nutrient contents, toxins and structural attributes of the leaves of *Burkea africana* to which elephants are likely to respond. It is the aim of the work to compare the proximate and elemental components of rainy and dry season leaf samples of plant. The project is geared towards investigating whether there is the possibility of considering the leaves of *Burkea africana* as good source of proteins for mammals, and as mineral supplement to feed. Also, the project is carried out to qualitatively determine some phytochemicals in the dry season root samples of *Burkea africana* which possess anti-typhoidal property. It is known from basic knowledge that nutrients and other components in the soil are absorbed at the roots of plants and transported to other parts of plants.This is an indication that there is a high probability of finding components which are present in the roots of a plant in other parts of the same plant.

MATERIALS AND METHODS

Source of Materials

Leaf and root samples of *Burkea africana* were separately collected at random from Mole national park in the Northern region of Ghana. Parts of plant were identified by Dr. Isaac Sackey and Dr. Walters Kpipki, both from Department of Applied Biology, Faculty of Applied Sciences, University for Development Studies.

Plant Sample Preparation

Dry and rainy season leaf samples of *Burkea africana* were separately air dried for seven days at room temperature and then milled in to fine powder. Each of the prepared samples was later stored in an airtight polythene bag until required for analyses. Fresh dry and rainy season leaf samples were taken for moisture content estimation.

Proximate Analysis of Leaf Samples

Determination of Moisture Content

Moisture content was determined by accurately weighing 2.0g of fresh sample into a previously dried and weighed porcelain crucible. It was then dried in a thermostatically controlled forced convection oven at 105^{o}C for six hours to a constant weight. The porcelain crucible was removed and transferred into a dessicator for cooling after which it was weighed. Moisture content was determined by difference and expressed as a percentage (AOAC, 1990).

Determination of AshContent
Ash content was determined by accurately weighing 2.0g of prepared sample into a pre-ignited and previously weighed porcelain crucible, placed in a muffle furnace and ignited for 2 hrs at 600^{o}C. After ashing, the crucible and its content were cooled to about 105^{o}C in a forced convection oven before cooling further to room temperature in a desiccator. The crucible and its contents were weighed and then weight reported as percentage ash content (AOAC, 1990).

Determination of Crude Fat Content
Dried sample (2.0g) from moisture content determination was subjected to fat estimation by refluxing for 16 hours using a soxhlet extractor and 200ml of petroleum ether as the extracting solvent. A round-bottom flask containing a mixture of fat and petroleum ether solvent was detached from the soxhlet extractor and petroleum ether solvent was evaporated on a steam bath. The round-bottom flask and its content were heated to 105^{o}C in an oven for 30 minutes and later cooled in a dessicator. The weight of the extracted fat was determined and expressed as percentage crude fat (AOAC, 1990).

Determination of Crude Fibre Content
The sample (2.0g) from crude fat determination was transferred into a 750ml Erlenmeyer flask and about 0.5g of anti-bombing agent was added. 200ml of boiling1.25% sulphuric acid (H_2SO_4) was poured in to the flask and immediately transferred onto a hot plate with a cold finger condenser attached to the flask.

The sample was boiled for 30 minutes during which the entire sample was thoroughly wetted while any of it was prevented from remaining on the side of the flask and out of contact with the solvent. After 30 minutes the flask was removed, its content filtered into a conical flask through linen cloth in a funnel and washed with boiling water until the washings were no longer acidic. The content of the linen cloth was washed into another flask with 200ml boiling 1.25% sodium hydroxide (NaOH) solution. The flask was reconnected to the cold finger condenser and boiled for 30minutes. The content was again filtered through linen cloth in a funnel and washed thoroughly with boiling water then with 15ml ethanol. Anti-bombing agents were removed from the residue. The residue was transferred into a previously dried and weighed porcelain crucible dried in an oven at 100^{o}C for 1hour, cooled in a desiccator and weighed. The crucible and its contents were ignited in an electrical furnace at 600^{o}C for 30 minutes; cooled and reweighed. The loss in weight was reported as percentage crude fiber (AOAC, 1990).

Determination of Crude Protein Content
Prepared sample (30.40mg) was weighed into a digestion flask containing 1g catalyst mixture of selenium and potassium sulphate (1: 200), 2ml concentrated sulfuric acid (H_2SO_4) and 2ml 30% hydrogen peroxide (H_2O_2).

The prepared sample in the mixture was digested for 30 minutes, cooled and a minimum quantity of distilled water was added to dissolve solids. They were then allowed to cool at room temperature. The digests were transferred to the distillation apparatus, making sure none remain in the flask by rinsing five times with 2ml portions of distilled water.

A 125ml Erlenmeyer flask containing 6ml boric acid solution and 3 drops of indicator solution (methyl orange) was connected to a condenser whose tip extends below the surface of the solution.

8ml of dilute sodium hydroxide solution was added to still and steam distilled until about 50ml distillate collects. The distillate was titrated with 1.0N HCl to violet end point.

Blank determinations were made, using boric acid and indicator. The values obtained were used to calculate the total nitrogen and the percentage crude protein (AOAC, 1990).

Determination of Carbohydrate Content
This was calculated by the difference method.

Elemental Analysis of Leaf Samples
Digestion of Sample
Prepared sample (1.0g) was weighed and transferred into a 100ml volumetric flask. 10ml of acid mixture of nitric (HNO_3) and perchloric ($HClO_4$) acids in the ratio 9:4 was added. The contents were mixed and swirled. The flask was placed on a hot plate in a fume hood and heated, starting at 90^{o}C and then the temperature was raised to 180^{o}C. Heating continued until production of red nitrogen (IV) oxide fumes ceased. The contents were further heated until mixture became colorless. The contents were cooled, and the volume was made up with distilled water to the 100ml mark, and filtered using No. 1 Whatman filter paper. The filtrate obtained was used for the elemental estimation.

Estimation of Calcium, Ca
A standard was prepared by weighing 0.2247g of $CaCO_3$ into a beaker and adding 5ml of deionised water to it. This was followed by addition of 10ml of concentrated HCl to ensure complete dissolution of $CaCO_3$. The mixture was poured into a volumetric flask and was made up to 1000ml mark with deionised water to give a concentration of 100µg/ml of calcium solution. Concentrations of 5 µg/ml, 10 µg/ml, 15 µg/ml and 20µg/ml were prepared by measuring 5ml, 10ml, 15ml and 20ml of the stock in to different volumetric flasks and making up the volumes to 100ml mark with deionised water. Deionised water was

used for zero µg/ml concentration of calcium. The atomic absorption spectrophotometer was calibrated with a lamp current of 10mA, a slit width of 0.5nm and at wavelength 422.7nm. After setting the atomic absorption spectrophotometer the standard solution of different concentrations of calcium were atomized and the absorbance recorded for the respective concentrations of calcium. A graph of concentration of calcium against their corresponding absorbance was plotted. 5ml of the digested sample solution was poured into a 100ml volumetric flask and made up to the 100ml mark. It was atomized and the absorbance was recorded. The corresponding concentration for the absorbance was recorded which represents the content of Calcium in the sample solution.

Estimation of Magnesium, Mg

$MgSO_4$ (10.14g) was weighed into 250ml of deionized water in a 1000ml volumetric flask. The volume was made up to 1000ml mark. This gave a concentration of 1000µg/ml of magnesium solution. Under this procedure the preparation of standard curve the estimation and the calculation procedure are the same as described for calcium estimation. The atomic absorption spectrophometer was calibrated with a lamp current of 3mA, slit width of 0.7nm and a wavelength of 285.2nm.

Estimation of Zinc, Zn

Pure zinc (1.0g) was dissolved in 20ml of HCl (1:1), and later diluted to 100ml mark with deionized water in a volumetric flask. This gave 1mg/ml Zn stock solution. The working solution was obtained by diluting the stock solution from 100 to 1000 times to obtain 10µg/ml to 1µg/ml concentrations. The preparation of the standard curve, the estimation and the calculation procedure are the same as described for calcium estimation. The atomic absorption spectrophotometer was calibrated to a wavelength of 218nm and slit width of 0.7nm.

Estimation of Iron, Fe

Pure iron wire (1.0g) was dissolved in 30ml of HCl (1:1), and later diluted to1000ml mark with deionized water to obtain 1mg/ml of standard Fe. Working solutions of different concentrations were obtained by further dilution. The atomic absorption spectrophotometer was calibrated to a wavelength of 248.3nm and a slit width of 0.2nm. The preparation of the standard curve, the estimation and the calculation procedure are the same as described for calcium estimation.

Estimation of Copper, Cu

Pure copper metal (1.0g) was dissolved in 30ml of HCl (1:1), and later diluted to 1000ml mark with deionized water. This gave 1mg/ml copper solution. Further dilutions were done to obtain the working solutions.The atomic absorption spectrophotometer was calibrated to a wavelength of 324.7nm and a slit width of 0.7nm. The preparation of the standard curve, the estimation and the calculation procedure are the same as describe for calcium estimation.

Estimation of Manganese, Mn

Pure manganese metal (1.0g) was dissolved in 30ml of HCl (1:1), and later diluted to 1000ml mark with deionized water. This gave 1mg/ml Mn solution. Further dilutions were done to obtain the working solutions. The atomic absorption spectrophotometer was calibrated to a wavelength of 279.5nm and a slit width of 0.7nm. The preparation of the standard curve the estimation and the calculation procedure are the same as described for calcium estimation.

Estimation of Sodium, Na

Pure NaCl (1.806g) was dissolved in deionized water and made up to 1000ml mark. This gave 1mg/ml Na solution.100ml of this solution was diluted to 1,000ml, and this gave 100µg/ml Na solution. 5, 10, 15 and 20ml of the stock solution were poured into 100ml volumetric flasks top up to the 100ml mark. This gave 5, 10, 15 and 20µg/ml concentrations of Na respectively.The atomic absorption spectrophometer was calibrated to a wavelength of 589.0nm and a slit width of 0.2nm.The preparation of the standard curve, the estimation and the calculation procedure are the same as described for calcium estimation

Estimation of Potassium, K

Pure KCl (1.908g) was dissolved in deionized water and made up to 1000ml mark. This gave 1mg/ml concentration of K solution. 100ml of this solution was further diluted to 1,000ml to give 100µg/ml concentration of K. 5, 10, 15 and 20ml of the stock solution was diluted to 100ml to give 5, 10, 15 and 20µg/ml concentrations of K respectively. The atomic absorption spectrophometer was calibrated to a wavelength of 766.5nm, a lamp current of 6mA and a slit width of 0.5nm. The standard curve was prepared using 0, 5, 10, 15 and 20µg K/ml. A blank was prepared the same way without adding plant digested material. 5ml of the sample was further diluted to 100ml. It was atomize on the calibrated atomic absorption spectrophotometer on which the standard curve has also been prepared. The absorbance was recorded against each sample and the concentration of K for the particular absorbance observed for the sample was calculated.

Estimation of Lead, Pb

Pure lead (1.0g) was dissolved in 30ml of HCl (1:1) and later diluted to 1000ml mark with deionized water in a volumetric flask to give 1mg/ml concentration of lead solution. The working solution was obtained by diluting the stock from 100 to 1000 times to obtain 10µg/ml to 1µg/ml. The atomic absorption spectrophotometer was calibrated to a wavelength of 283.3nm and a slit width of 0.7nm. The preparation of the standard curve, the

estimation and the calculation procedure are the same as described for calcium estimation.

Estimation of Cadmium, Cd

Pure cadmium (1.0g) was dissolved in 30ml of HCl (1:1) and later diluted to 1000ml mark with deionized water in a volumetric flask to obtain 1mg/ml concentration of cadmium solution. Working solutions of different concentrations were obtained by further dilution. The atomic absorption spectrophotometer was calibrated to a wavelength of 228.9nm and a slit width of 0.7 nm. The preparation of the standard curve the estimation and the calculation procedure are the same as described for calcium estimation.

Anti-Nutritional Analysis

Determination of Hydrogen Cyanide (HCN)

Prepared sample (10g) was soaked in a mixture of 200cm^3 of distilled water and 10cm^3 of orthophosphoric acid. The mixture was left for 12 hours to release all bound hydrocyanic acid. Anti-bumping agents were added and the solution distilled until 150cm^3 of the distillate was collected. 20cm^3 of the distillate was taken into a conical flask and diluted with 40cm^3 of water; 8.0cm^3 of 6.0 mol/dm^3 ammonium hydroxide and 2.0$cm^3$of 5% (w/v) potassium iodide solutions were added. The mixture was titrated with 0.02 mol/dm^3 silver nitrate using a micro burette until a faint but permanent turbidity was obtained (1cm^3 0.02 mol/dm^3 $AgNO_3$ = 1.08mg HCN) (Anhwange *et al*., 2009).

Determination of Phytate

Prepared sample (4.0g) was soaked in 100cm^3 of 2% hydrochloric acid for five hours and was filtered. 25.0cm^3 of the filtrate was taken into a conical flask and 5.0cm^3 of 0.3%ammonium thiocyanate solution was added. The mixture was titrated with a standard solution of iron (III) chloride until a brownish-yellow colour persisted for five minutes (Anhwange *et al*., 2009).

Determination of Saponins

Prepared sample (10g) was taken into 100ml of 20% aqueous ethanol in water and mixture agitated with a mechanical shaker for twelve hours. The solution was filtered using Whatman No. 1 filter paper and residue was re-extracted with 200ml of 20% aqueous ethanol. The extracts were combined and reduced to about 40 ml vacuums using rotary evaporator. The extract and 20ml diethyl ether were transferred into a 250ml separatory funnel and was shaken vigorously. The aqueous layer was discarded. The purification process was continued until a colourless aqueous extract was obtained. The pH of the aqueous solution was adjusted to about 4.5 by adding sodium chloride, and the solution was shaken with butanol. The butanoic extract was washed twice with 10ml of 5% sodium chloride and was evaporated to dryness in a fume cupboard, to give the saponin, which was weighed and expressed in percentage (Anhwange *et al*., 2009).

RESULTS AND DISCUSSION

Results in table1 represent the proximate composition of dry and rainy season leaf samples of *Burkea africana*. The moisture contents of dry and rainy season leaf samples of this plant were obtained as 3.44% and 7.46% respectively, which are relatively low indicating good shelf life characteristics. The ash content recorded for the dry season leaf samples of the plant was 4.08%, whereas for the rainy season leaf samples the ash content was 4.31%.The ash content of rainy season leaf samples of the plant was higher than that of dry season leaf samples. The higher ash content of rainy season leaf samples can be due to the transportation of minerals by rain water from areas of high concentrations to where the plant is for absorption. In general, the ash contents of both the rainy and dry season leaf samples of *Burkea africana* determine their mineral compositions.

The crude fat content ranges from 2.99% to 3.5% with the rainy season leaf samples recording the least, and the dry season leaf samples recording the highest. The fibre content ranges from 11.30% to 15.85% with the rainy season leaf samples recording the least, and the dry season leaf samples recording the highest. These values were high for the leaf samples. Rainy season leaf samples of the plant recorded higher percentage values of protein than the dry season leaf samples. The dry and rainy season leaf samples of *Burkea africana* recorded percentage values of carbohydrate of 15.41% and 7.77% respectively. The sum of moisture and carbohydrate contents for the dry season leaf samples of *Burkea africana* was higher than that for the rainy season leaf samples of the same plant. The dry season leaf samples recorded 18.85% while the rainy season leaf samples recorded15.23%. The organic matter contents range from 95.69% to 95.92% for the rainy and dry season leaf samples repectively.

Table 2 shows the mean elemental contents of dry and rainy season leaf samples of *Burkea africana*. A total of ten elements (Ca, K, Na, Mg, Mn, Pb, Cd, Zn, Cu and Fe) were determined in the dry and rainy season leaf samples of the plant by Atomic Absorption Spectrophotometry (AAS). On the whole, the average elemental concentrations of dry season leaf samples were relatively higher than those of rainy season leaf samples. The lower concentrations of rainy season leaf samples can be attributed to elemental dilution by rain. The exceptional elements with lower average concentrations of the dry season leaf samples were K, Pb, Cd and Fe. This study shows that the leaves of *Burkea africana* are rich in Ca, K, Na, Mg, Cu and Fe.

Cadmium concentrations range from 1.91 mg/Kg to 2.51 mg/Kg with the dry season leaf samples having the least and the rainy season the highest. Cd and Pb are considered as heavy metals, while Cu, Fe, Zn and Mn are considered micronutrients. The WHO limits for these metals have not yet been established (Motsara *et al*., 2008). Allaway reported the ranges of Cu and Zn in agricultural products to be between 4 and 155ppm and 15 to 200ppm respectively. Comparably, the concentration of Cu in this study was found to be within this range for the rainy season leaf samples and not for the dry season leaf samples. This can be attributed to dilution by rain water. Zinc concentrations were within the stipulated range for both the dry and rainy season leaf samples (Allaway, 1968).

The results obtained indicated that both the dry and rainy season leaf samples of *Burkea africana* contain large amount of nutrients, rich in Ca, K, Na and Mg. The abundance of Ca, K and Mg in the result of this analysis is in agreement with previous findings that these three elements represent the most abundant element constituents of many plants (Canel and Saura, 1982). Lead concentrations range from 3.69 mg/Kg to 4.80 mg/Kg for the dry and rainy season leaf samples respectively. The permissible limit for plants, based on ADI (Acceptable Daily Intake) for lead is 10mg/Kg (Oderinde *et al*., 2009). *Burkea africana* accumulates this metal at a level appreciably below the permissible level.

Though much is known about the functional role of a number of elements, the mineral nutrition lies in obtaining the correct amount of supplementation in the right form at the right time. Mg and Zn have important role in the metabolism of cholesterol as well as heart diseases (Oderinde *et al*., 2009). The presence of Mn may be correlated with therapeutic properties against diabetic and cardiovascular diseases (Schwart, 1975). Mn is also known to aid formation of skeleton and cartilage. The appreciable high content of potassium signifies that if the leaves are taken, it will help in the regulation of body fluid and maintained normal blood pressure. It will also help in controlling kidney failure, heart oddities and respiratory flaw. Iron which carries oxygen to the cells and is necessary for the production of energy, synthesis of collagen and the proper functioning of the immune system, were found to be high in both samples of plant. Deficiency or excess of Cu, Mn, Zn, Ca, Mg and K may cause a number of disorders; they also take part in neurochemical transmission and function as cofactors for various enzymes in different metabolic processes (Oderinde and Ajayi, 1998).

Table 3 results represent the average anti-nutritional constituent of the dry season leaf sample of *Burkea africana*. The average concentration of hydrogen cyanide recorded was 1.49mg/g for the plant sample. This value falls within the threshold value (0.5-3.5 mg/g) reported as safety limit (Anhwange *et al*., 2009; Kumar, 1991).

Hydrogen cyanide is an extremely poisonous substance formed by the action of acids on metal cyanides. Cyanide is a fast-acting potentially deadly chemical that prevents the cells of the body from using oxygen properly. Gettle and Baine (1938) reported that intake of large dose of hydrogen cyanide can cause death within few minutes. Smaller dose intake may result to stiffness of the throat, chest, palpitation and muscle weakness. Phytate content was found to be 0.19mg/g for *Burkea africana*. This average value is lower when compared to 0.28mg/g concentration value reported for Musa sapientum (banana) peels by Anhwange *et al*. (2009). Phytic acid is a strong chelator of important minerals such as calcium and zinc despite its therapeutic effects as a protective against osteoporosis which makes it a beneficial phytochemical.

Saponin content for *Burkea africana* was 1.067×10^{-4} mg/g. This average value is relatively lower when compared to the 3×10^{-4} mg/g concentration value reported by Kumar (1991) as the minimum safe value for animals especially cattle. Eric (1978) observed that saponin consumption can result to paralysis of the sensory system. It is found to inhibit growth in swine and poultry; though it increases the excretion of cholesterol in the body (Anhwange *et al*., 2006).

Table 1. Percentage proximate composition of dry and rainy season leaf samples of *Burkea africana* (% by mass).

Parameter	Dry Season Sample	Rainy Season Sample
Moisture	3.44	7.46
Ash	4.08	4.31
Fat	3.50	2.99
Fibre	15.85	11.30
Protein	57.72	66.17
Carbohydrate	15.41	7.77

Table 2. Average mineral contents of dry and rainy season leaf samples of *Burkea Africana* (mg/Kg).

Element	Dry Season Sample	Rainy Season Sample
Ca	6108.92	5889.81
K	2772.02	3125.95
Na	230.93	221.36
Mg	2340.01	1944.02
Mn	33.00	32.00
Pb	3.69	4.80
Cd	1.91	2.51
Zn	17.02	10.99
Cu	239.84	138.27
Fe	467.85	481.03

Table 3. Average anti-nutritional constituents of dry season leaf samples of *Burkea africana* (mg/g).

Parameter	*Burkea Africana*
Hydrogen cyanide	1.49
Phytate	0.19
Saponin	$1.067x10^{-4}$

CONCLUSION

The present study shows that, the leaves of *Burkea africana* are good sources of organic matter and minerals. The low moisture content of the dry season leaf samples is an indication of good shelf life characteristics. The high protein content of the dry and rainy season leaf samples is an indication that leaves of the plant can serve as a good source of protein to mammals since protein is used for growth and repairs of warn out tissues. The high fibre content of the plant also indicates that the leaves could help prevent constipation, improve general health and well being. The ash content of leaves of plant is analogous to other staples measured as good sources of minerals. The macronutrient concentrations are high, while the toxic trace metal concentrations are relatively low for both leaf samples. The total elemental concentration of dry season leaf samples (12,21519mg/kg) is greater than that of rainy season leaf samples (11,850.74mg/kg). Concentrations of elements fall within ranges and standards. Thus, the leaves of *Burkea africana* plant are a good source of minerals. The high nutritional (especially the protein) and mineral contents may be the factor to which elephants feed on leaves of the plant. The anti-nutritional contents of the dry season leaf samples fall within acceptable threshold values. Thus, they have no influence on the nutritional and mineral compositions of the plant's leaves as sources of feed. These natural toxicants in foods inhibit the absorption and utilization of minerals and proteins, and also inhibit oxidative phosphorylation (Sinclair and Howat, 1980; Ross and Bacin, 1997). This means that with the low natural toxicant levels, the leaves of the plant can serve as a good source of feed for livestock if properly processed.

RECOMMENDATION

On the whole, it is recommended that the leaves of *Burkea africana* should be used as a source of both protein and *as* a source of minerals for livestock.

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