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RESEARCH ARTICLE

CHEMICAL COMPOSITION AND NUTRITIVE VALUE OF *LEPTADENIA HASTATA* LEAVES

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ABSTRACT

This paper aimed at investigating the chemical compositions and mineral contents of Leptadenia hastate leaves. The proximate analysis shows moisture, ash, lipid, crude protein, crude fiber and carbohydrate contents to be (7.67, 17.67, 5.0, 14.88, 9.33, and 45.45) % respectively. The high percentage of carbohydrates indicates that Leptadenia hastata leaves could served as a good source of energy to the body. The elemental analysis was carried out using Atomic Absorption Spectrophotometer (AAS). Calcium recorded the highest concentration of 1845.66 $mgKg^{-1}$ and Zinc with the lowest concentration of 15.27$mgKg^{-1}$. Other elements includes; Na, Fe, K and Mg with concentrations of (72.54, 148.94, 1245.34 and 275.87) $mgKg^{-1}$ respectively. These results suggest that Leptadenia hastata leaves could served as good source of minerals such as Ca, Fe, and K that are essential for human and livestock.

Key Words: Leptadenia Hastate, Proximate Analysis, Mineral Contents, Atomic Absorption Spectrophotometer, Nutritive Value.

INTRODUCTION

Green leafy vegetables constitute an indispensable constituent of human diet in Africa generally, (Schmidt, 1971). Vegetables constitute an important part of the human diet since they contain carbohydrates, protein, vitamins, macro and trace minerals that are essential for the nutritional balances of living organisms. There has been increase awareness in Nigeria on the nutritional contents of most of these leafy vegetables. This has led to the domestication of most of these wild plants (Eka, 1987). *Leptadenia hastata* commonly known as Yadiya in Hausa belongs to the family Asclepiadaceae (APG: Apocynaceae) and is widely distributed in tropical Africa: from Mauritania and Senegal eastwards to Cameroon, Ethiopia, Northern Kenya and to Uganda reference in some locations, and in Ethiopia. It is also widely spread in Nigeria (Jansen, 2004). Everywhere in its distribution area, leaves, young shoots and flowers of Leptadenia hastata are eaten as cooked vegetable and in soups. In Uganda chopped and boiled leaves are mixed with beans, pigeon peas or cowpeas. In many parts it is a famine food, but poor people also eat this vegetable in normal times.
Leptadenia hastata is commonly used in Niger republic in day to day nutrition and is considered as hunger food due to its very important content of valuable nutrients (Freiberger *et al.,* 1998). According to Aquino *et al.,* (1996) and Freiberger *et al.,* (1998), *Leptadenia hastata* contains triterpenes, fatty acids, polypregnane, lutein, carotene, selenium and phosphorous. It is widely used traditionally in the management and treatment of many diseases (Bello *et al.,* 2011). *Leptadenia hastata* is a characteristic of dry savanna vegetable in semi – arid zones (Jansen, 2004). The leaves are more abundant and fresh during rainy season (Aliero *et al.,* 2001).

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Propagation is by seed and sometimes it is intentionally sown near houses so that it is available when the need arises. In some parts of Ethiopia the fresh vegetable is also marketed. *Leptadenia hastata* will remain an important emergency vegetable in Africa, still striving under circumstances when other plants die (Jansen, 2004). Many works on the nutritional contents of leaves of different plants are available in the literature. Hassan *et al.* (2007), carried out comparative analysis on the effect of drying method on the nutrients and non-nutrients composition of leaves of *Leptadenia hastata* (Aschipiadaceae) in Sokoto, Sokoto State, Nigeria with the aim of comparing the traditional sun drying with other drying methods and concluded that the leaves of *Leptadenia hastata* have the same types of valuable nutrients in fresh and dried samples and with reduction of some toxic non-nutrients by the drying methods. They also concluded that the solar drying method could be the most preferred method of drying the leaves of *Leptadenia hastata* because it is hygienic, faster and has no effect on the nutrients when compared with oven dried sample. Bello *et al.,* (2011). Carried out analysis on the evaluation of polyphenilic content and alphaghicosidase inhibitory effect of *Leptadenia hastata* in Sokoto, Sokoto State, Nigeria and the results obtained indicated that *Leptadenia hastata* leaves possess promising polyphenols component and antidiabatic potentials and could therefore be a source of lead compounds in the management of diseases caused by oxidative stress. The aim of this work is to investigate the chemical composition and mineral contents of *Laptadenia hastata* leaves using standard methods.

MATERIALS AND METHODS

Sample Collection and Preparation

Fresh leaves of *Leptadenia hastata* were collected from Tumfure in Gombe Local Government Area of Gombe State.

The leaves were plucked from their stems and dried at room temperature under shed. The dried leaves were ground using pestle and mortar and then sieved. The sieved samples were kept in an air tight polythene bag to protect it from moisture. The bag containing the sieved samples was kept in a dark and cool place.

Determination of Moisture Content

The moisture content was determined as described by Udo and Ogunwele's (1986) with some modifications. 2g of the sample were weighed (W_1) into pre-weighed crucible (W_o) and placed into an oven at 105 ^{0}C. The crucible was removed, cooled in desiccator and weighed. The process of drying, cooling and weighing were repeated until a constant weighed (W_2) was obtained. The percentage moisture content was obtained by the equation;

$$\% \, Moisture \; content = \frac{W_1 - W_2}{W_2 - W_O} \; X \; 100$$

Where: W_o = weight of the empty crucible (g)
W_1 = weight of fresh sample + crucible (g)
W_2 = weight of dried sample + crucible (g)

Determination of Ash Content

The method used was as described by James (1995) with modifications. 2 g of the powdered samples were weighed (W_1) into a pre-weighed empty crucible (W_o) and placed into a muffle furnace and was allowed to completely ashed at 600 ^{o}C. The crucible was removed and cooled in a desiccator and weighed (W_2). Percentage ash was calculated thus;

$$\% \, Ash \; content = \frac{W_2 - W_o}{W_1 - W_o} \; X \; 100$$

Where: W_o = Weight of empty crucible (g)
W_1 = Weight of crucible + sample (g)
W_2 = Weight of crucible + ash (g)

Determination of Crude Lipid Content

The crude lipid content in the sample was extracted using soxhlet extractor as described by Udo and Ogunwele (1986) with modifications. 2g of the sample was folded in a filter paper and placed into the extractor and extracted into a pre-weighed round bottom flask with low boiling n-hexane (69 ^{o}C) for about 8hours.

The solvent was recovered by rotary evaporation and drying was completed in a freeze dryer. Finally the flask and its content were heated at 90^{o}C in an oven for 2 hours and it was cooled in a desiccator and weighed. The process of heating and cooling was repeated until a constant weight was obtained. The percentage crude lipid was calculated as follows;

$$\% \, crude \; lipid = \frac{W_1 - W_2}{W_O} \; X \; 100$$

Where: W_o = Weight of sample (g)
W_1 = weight of flask + oil (g)
W_2 = weigh of empty flask (g).

Determination of Crude Fiber Content

Percentage of crude fiber was determined by the method described by Udo and Ogunwele (1986) with modifications. 2g of the sample was weighed (W_o) into a 1 dm^3 conical flask and 20 % H_2SO_4 was added and boiled gently for 30 minutes. The content was filtered. The residue was scrapped back into the flask with spatula and filter paper rinsed with distilled water. 20cm^3 of 10 % NaOH was added and allowed to boil gently for 30 minutes. The content was filtered and the residue was washed with HCl and rinsed twice with petroleum ether. It was allowed to dried and scrapped into a crucible and allowed to dry over night at 100 ^{0}C in an oven. It was then removed and cooled in a desiccator. The sample was weighed (W_1) and ashed at 600 ^{0}C for 90 minutes. It was removed and cooled in a desiccator and reweighed (W_2). The percentage crude fiber was calculated as follows;

$$\% \, crude \; fibre = \frac{W_1 - W_2}{W_O} \; X \; 100$$

Where: W_o = Weight of sample (g)
W_1 = weight of dried sample (g)
W_2 = weigh of ash (g)

Determination of Crude Protein Content

The crude protein of the sample was determined using the micro kjeldhal method according to AOAC, (1990). 2 g of the sample was weighed along with 20 cm^3 of distilled water into a micro kjeldhal digestion flask. It was shaken and allowed to stand for sometimes and then one tablet of selenium catalyst was added followed by the addition of 20 cm^3 concentrated sulphuric acid. The flask was heated on the digestion block until the content became clear. The flask was removed from the block and allowed to cool. The content was transferred into a 50 cm^3 volumetric flask and diluted to the mark with distilled water. An aliquot of the digestion (10 cm^3) was transferred into another micro kjeldhal flask along with 20 cm^3 of distilled water and placed in the distilling outlet of the micro-kjeldhal distillation unit.

A conical flasks containing 20 cm^3 of boric acid indicator was placed under the condenser outlet. Sodium hydroxide solution (20 cm^3, 40%) was added to the content in the kjeldhal flasks by opening funnel stopcock. The distillation started and heat supplied was regulated to avoid sucking back. When all the available distillate was collected in 20 cm^3 of boric acid; the distillation was stopped. The nitrogen in the distillate was determined by titrations with 0.01 M H_2SO_4. The end point was obtained when the colour of the distillate changed from green to pink. The crude protein was calculated using the equation:

$$\% \, Crude \; protein = \% \, Nitrogen \; X \; 6.25$$

The nitrogen content of the sample is given by the formula

$$\% \, N = \frac{T_V \; X \; N \; X \; 0.014 \; X \; V_1}{G \; X \; V_2}$$

Where: Tv = titre value of acid (cm^3)
N = concentration or normality of acid

V_1 = volume of distilled water used for distilling the digest ($50cm^3$)
V_2 = volume of the aliquot used for distillation (10 cm^3)
G = original weight of sample used (g)

Determination of Carbohydrate Content

The method described by James (1995) with modifications was adopted. This was done by using the equation;

$$\% CHO = 100\ \% - (\% \, crude \, protein + \% \, crude \, lipid + \% \, crude \, fibre + \% \, ash)$$

The calorific value of sample was determined by calculation as according to Mohammed *et al.* (2011), thus;

$$Energy\ (Kcal) = \{(\% \, CHO \, X \, 4) + (\% \, CP \, X \, 4) + (\% \, CL \, X \, 9)\}$$

Where: CHO, CP, and CL stand for carbohydrate, crude protein and crude lipid respectively.

Elemental Determination

Samples Digestion

The triple acid digestion method of Sahrawat *et al.* (2002) was employed. 2 g was weighed into a micro- Kjeldahl digestion flask to which 24 cm^3 of a mixture of concentrated HNO_3, H_2SO_4 and 60 % $HClO_4$ were added. The flask was put on a heating block and digested to a clear solution, cooled and the content transferred into a 50 cm^3 volumetric flask and made up to the mark with distilled water. The solution was used for determination of mineral elements, calcium, magnesium, potassium, iron, sodium and zinc using Atomic Absorption Spectrophotometer (AAS) Model 210VGP BULK SCIENTIFIC.

RESULTS AND DISCUSSION

The results of proximate analysis are presented in Table 1below

Table 1. Proximate Analysis of *Leptadenia hastata* Leaves

Moisture content (%)	7.67
Ash content (%)	17.67
Crude fiber content (%)	9.33
Crude lipid content (%)	5.00
Crude protein content (%)	14.88
Carbohydrate content (%)	45.45
Energy value content (kcal)	286.32

Each value is an average of triplicate determinations

The results revealed that the moisture content which is 7.67 % is lower than those of some common Nigerian leafy vegetables such as Xanthosem sagittifolium 14.7 %, Vernonia amygdaline 27.4 % and Adansonia digitata 9.5 % (Tunde *et al.,* 1998). This plant has low moisture content (7.67 %) below the value of 15 % which Hassan *et al.* (2005) reported that plants with moisture content up to and above this value favoured microbial activities during storage. Therefore the low moisture content of the sample is an indication that it has good storage property with minimum fungal and bacterial attack. The ash content of the sample was found to be 17.67 %, the value obtained is higher compared to 5.55 % obtained in chancapiedra plant (Gafar *et al.,* 2011) but lower than 19.61 % in Amaranthus hybridus (Nwaogu *et al.,* 2000).

The crude protein content of the sample is 14.88 % which is higher than 6.30 % in water spinach (Umar *et al.,* 2007), 4.6 % in Monordica foecide leaves consumed in Swiziland (Ogle *et al.,* 1985) but lower compared with 24.85 % in sweet potato leaves (Amita *et al.,* 2006). The recommended protein dietary allowance (RDA) for children, adult males, adult females and pregnant women are 28, 63, 50 and 60 g of protein daily (Ganong *et al.,* 2003). Therefore it requires 188.17 g, 423.38 g, 336.02 g, 403.22 g of *Leptadenia hastata* leaves for children, adult males, adult females and pregnant women respectively to meet their RDA for protein, if they would depend on *Leptadenia hastata* leaves alone for their daily protein supply. The leaves contain 5.0 % crude lipid which is the same with that of Indigofera astragalina (Gafar *et al.,* 2011), and lower than 11 % in water spinach leaves (Nwaogu *et al.,* 2000). Crude lipids are the principal sources of energy but should not exceed the daily recommended dose of 30 KCal so as to avoid obesity and other related diseases. One gram of lipid provides about 8.37 KCal (Asibey-Berko, 1999), which indicates that 100 g of *Leptadenia hastata* leaves should provide 41.85 KCal. The crude fibre content of 9.33 % was obtained which is higher than 2.67 % in Indigofera astragalina (Gafar *et al.,* 2011) but lower compared to 13 % in Tribulus terrestris leaves and 29.00 % in Balsam apple leaves (Hassan et *al.,* 2006). The value is within the range of 0.70 – 12.0 % for most leafy vegetables (Gafar *et al.,* 2011).

Dietary fibre helps to reduce serum cholesterol level, risk of coronary heart disease, colon and breast cancer and hypertension (Ganong, 2003). The recommended daily allowance (RDA) for fibre is 18-35 g for adult human beings. This means 100 g of *Leptadenia hastata* can provide 0.09 g of daily fibre for the body. The carbohydrate content of 45.45 % for *Leptadenia hastata* is considered higher compared to 35.5 % in Moringa oleifera (Olaofe *et al.,* 2011). Carbohydrates and lipids are the principal sources of energy, since carbohydrate content is the most abundant in the leaves, this shows that the leaves of this plant can serve as a good source of energy for the body. *Leptadenia hastata* leaves provide 286.32 Kcal of energy on dry weight which is within the range of 248.8 – 307.1 Kcal/100g reported in some Nigerian leafy vegetables (Isong *et al.,* 1999). This suggests that *Leptadenia hastata* can serve as a good source of energy supplement for the body. The results of mineral contents of *Leptadenia hastate* are presented in Table 2.

Table 2. Mineral contents of *Leptadenia hastata* Leaves

Minerals	Concentration ($mgKg^{-1}$)
Sodium (Na)	72.540
Potassium (K)	1245.339
Magnesium (Mg)	275.874
Calcium (Ca)	1845.664
Iron (Fe)	148.935
Zinc (Zn)	15.268

The potassium and sodium contents are 1245.34 and 72.54 $mgKg^{-1}$ respectively. The K/Na ratio in the diet assists in the prevention of hypertension and arterioscherosis and for normal protein retension during growth stages. The level should be within 3-4 (Gafar *et al.,* 2011), but K/Na in *Leptadenia hastata* leaves is 17.17, which is above the range. The ratio can be adjusted by addition of salt during cooking. The calcium content was found to be 1845.66 $mgKg^{-1}$ which is higher compared with calcium content 30.5 $mgKg^{-1}$ of Diosypyros

mesipiliformis (L) *(Hassan et al.,* 2004). The RDA value of calcium for adult men with 3000 Kcal/day, recommended energy intake is 12000 mg (NRC, 1989) and 100g of *Leptadenia hastata* leaves can contribute 15.4 % to the RDA. These values imply that calcium which is needed for growth and maintenance of bone, teeth, muscles and blood clothing can be supplemented from the leaves of *Leptadenia hastata*.

Magnesium is an important mineral element in connection with circulatory diseases such as ischemic heart disease and calcium metabolism in bone (Ishida *et al.,* 2000 and Hassan *et al.,* 2006). The magnesium content of the leaves is 275.874 $mgKg^{-1}$ which is higher compared with 25.6 $mgKg^{-1}$ in Diospyros mesipiliformis (Hassan *et al.,* 2004). The RDA value for Magnesium for adult men is 350 mg (NRC, 1989) and 100 g of *Leptadenia hastata* leaves contribute 7.9 % to the RDA. This implies that the leaves are poor source of magnesium supplement for human diet. The Zinc content of *Leptadenia hastata* leaves is 15.27 $mgKg^{-1}$ and was found to be higher than 0.2 $mgKg^{-1}$ in Diospyros mespiliformis (Hassan *et al.,* 2004). Zinc plays a vital role in gene expression, regulation of cellular growth and participates as a co-factor of enzymes responsible for carbohydrate proteins and nucleic acids metabolism. The RDA value of zinc for a male adult is 12.15 mg (NRC, 1989). 100g gram of *Leptadenia hastata* leaves can contribute 12.7 % of zinc to RDA. Iron is required for haemoglobin formation and its deficiency leads to anaemia (Turan *et al.,* 2003). The iron content of *Leptadenia hastata* leaves is 148.94 $mgKg^{-1}$ which is higher than 28$mgKg^{-1}$. The RDA value of iron for male adult is 10-15 mg (NRC, 1989). 100 g of the leaves of *Leptadenia hastata* can contribute 148.9 – 99.3 % of iron to RDA. This indicates that about 50 g of *Leptadenia hastata* leaves can provide the daily iron requirement for a male adult.

Conclusion

Leptadenia hastata leaves have higher concentrations of the minerals iron, calcium and a higher percentage of carbohydrate, based on these results *Leptadenia hastate* leaves could be used for bone formation in children; and by anaemic patients and could also serve as a good source of energy to the body.

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