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PROXIMATE ANALYSIS AND MINERAL COMPOSITION OF *SCLEROCARYA BIRREA* FRUITS

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Abstract

The samples of sclerocarya birrea fruits from five (5) different local government areas were investigated for their proximate analysis and mineral composition. The entire samples contain high moisture contents (81.80±1.35 to 87.10±0.36 %).The ash contents is also high(10.40 ± 0.20 to 15.40 ± 0.20 %), crude protein values are in good agreement for all the samples. Available carbohydrate are within the same range for all the samples (55.97±6.74 to 60.68±1.4 %). Calorific value significantly differs for all the samples .Mineral composition of sclerocarya birrea fruit revealed that the fruit could be a potential source of food supplements while values for mineral elements such as Ni, Mn, Cu, and Fe differs significantly from others at 95 % confidence level. This study indicates that the samples are good source of protein. The results compared well with those of other edible fruits.

***Key words**: proximate analysis, mineral elements, sclerocarya birrea, fruits*

INTRODUCTION

Many wild plant food resources are eaten across Africa in addition to the commonly known agricultural foods. The significance of the edible wild indigenous plants to the diets of many people living in Africa is increasing. Africa continues to be visited by drought and other weather related calamities such as floods, which reduce yields of staple grains such as maize, sorghum, millet etc, therefore edible wild indigenous plants become an alternative source of food to supplement the

existing ones. Report has shown that some of wild indigenous plants are good source of vitamins, proteins and some minerals (Mallert, 2001). Furthermore, edible wild plants promote developments in rural areas as they contribute to food security (particularly during periods of seasonal food shortages), community upliftment, and job creation (Bartons, 2001).

Sclerocarya birrea (plate 1.1) commonly known as Morula (Northern Sotho) (Hausa – Nunu or Loda or Daniya) is an integral part of the diet; tradition and culture of rural communities in West Africa (Glew *et al*., 2004). The genus name *Sclerocarya* is derived from two Greek words, "*Skeleros*" and "*Karyon*" meaning hard and nut respectively and refers to the hard stone of the fruit, species name "*birrea*" comes from the word "*birr*" the common name for the tree in Senegal (Venter, 1996). *S. birrea* is a member of the *Anacardiacea* family normally about 10m tall but on favourable sites grows up to 20m (Kokwaro, 1986). Palgrave, (1988) reported that the distinctive feature of the tree is the pale gray bark, flaking in patches and exposing the underlying light yellow tissue. The bark of young trees is smooth and gray; the inner bark is red or pink with darker stripes (FAO, 1988).

Plate 1.1: Ripe fruits of *Sclerocarya birrea*

The plant is widespread in Africa from Ethiopia in the north to Zambia in the south. In South Africa it is more dominant in the Baphalaborwa area in the Limpopo. It occurs naturally in various types of wood land, on sandy soil or occasionally sandy loam (Glew *et al*., 2004). In Nigeria, *S. birrea* is found in the northern part, Katsina, Kaduna, Kebbi, Zamfara, Sokoto, etc. Nutritionally, the edible fruits of *S. birrea* are an important source of vitamins, minerals, glucose, sucrose, fibre, proteins and also a good source of poly unsaturated fatty acids (Palgrave, 1988).This study determines the proximate and mineral composition of ***Sclerocarya birrea*** fruits.

MATERIALS AND METHODS

3kg of matured fresh Sclerocarya birrea fruits were collected in June, the beginning of the rainy season of 2008 from five different local government areas of Sokoto State. These are:(i) Margai in Kebbe (ii) Gidan in Kare Tureta (iii) More (Kware) (iv) Kwannawa in Dange/Shuni (v) Takakume in Goronyo. These sites were chosen because they have more abundant trees of this plant. In each area, five trees were randomly selected and the fruits collected from different branches of the selected tree, as described in the method by (Ayaz et al., 2002; and Asaolu and Asaolu, 2002).

The samples were thoroughly washed with distilled water and the residual moisture evaporated at room temperature. About 2kg representative samples were obtained using alternate shovel method (Alan, 1996). Each sample was divided into two portions, from the first portion, the juice, peels and seeds were separated manually while the second portions were air dried, trashed to separate the seeds and the powder (peels + Juice). The powder was sieved to pass through 80-meish sieve and stored in air tight polyethylene bags inside desiccators until they were analysed.

Biochemical Analysis: The methods recommended by the Association of official analytical chemist (AOAC, 1990) for proximate analysis was adopted. Two grams of the fresh fruit were weighed into a Petri dish, dried in an oven at 105^{o}C for 24 hours, cooled in a desiccator and then weighed (Greenfield and Southgate 2003). All analysis were carried out in triplicate and reported as mean ± standard deviation on dry weight (DW) bases. The energy value was also determine,using equation 1 below:

Energy = $(g_1 \times 2.44) + (g_2 \times 8.37) + (g_3 \times 3.57)$ - - -(1)

Where g_1, g_2, and g_3 represent the mass of protein, lipids, and available carbohydrate respectively (Asibey-Berko and Tayte; 1999).

Mineral analysis was carried out after wet digestion of two grammes of each powder samples with Nitric/ Perchloric /Sulphuric acid mixture in ratio 9:2:1. Phosphorus was determined colorimetrically, using phosphate Vanodomolybdate method (Dosunmu, 1997). Calcium and magnesium was also analyzed by EDTA method. Sodium and potassium was analyzed by flame photometer (Ademoroti, 1996). While Ca, Mg, Fe, Zn, Cu, Mn and Ni were determined using AAS method.

The pH of the juice extract was determined using a standardize pH meter.

RESULT AND DISCUSSION

The moisture content of edible portion of *S. birrea* fruit ranges from 81.80%-87.10%. Samples from Tureta and Kware have the highest and lowest moisture contents respectively. These values were higher than 78.6% reported in mango fruits (Jadele *et al*., 2003). The values were however lower when compared to the moisture contents in *S. birrea* fruit (91.7%) of Republic of Zambia (Grivetti, 1981). Similarly, the values were higher compared to *Zizyphus sonorensis* (47% dry weight) fruits reported by Marcelino *et al* (2005). High moisture content is associated with a rise in microbial activities during storage (Hassan and Umar, 2004), therefore, *S.birrea* fruit should be dried before storing.

The ash content which is an index of total mineral matter content, ranges from 10.40% to 15.40% dry weight. The values were higher compared to that in mango fruits (0.75% dry weight) reported by

Jadele *et al* (2003). The values were also higher than that from *Zizyphus sonorensis* (3.4% dry weight) fruits and apples (1.6% dry weight) as reported by Marcelino *et al* (2005). The values were also higher than the one reported by Grivetti (1981) in *S. birrea* fruit (0.48% dry weight) of Republic of Zambia.

The crude protein contents of *S. birrea* fruit ranges from 9.08%-9.93% dry weight. Higher and lower value was observed in sample from Dange/Shuni and Kebbe respectively. The values recorded were higher than the one observed in *Zizyphus sonorensis* (8.5% dry weight) fruits and in apples (1.18% dry weight) fruits as reported by Marcelino *et al* (2005). However, the values were lower compared to that of *Azanza garckeana* fruits (12.0%). The values are higher than that of mango fruits (1.3%) and *S. birrea* fruits (4.1%) as reported by Jadele *et al* (2003) and Grivetti (1981) respectively.

The crude lipid contents ranges from 0.9%-1.20% dry weight recorded in sample from Kebbe and Tureta respectively. The values observed were generally low and are comparable to the value obtained in *Azanza garckeana* (1.1% dry weight) fruits as reported. The values were higher compared to *Zizyphus sonorensis (*0.56% dry weight) reported by Marcelino *et al.* (2005). Similarly, the values were higher than that reported by Jadele *et al.* (2003) and Grivetti (1981) in mango fruit (0.19%) fruits and in *S. birrea* (0.24% dry weight) fruit respectively.

The values recorded for crude fibre ranges from 6.46%-7.03% dry weight. High value was observed in sample from Tureta while lower value was observed in sample from Goronyo. These values were lower compared to the value recorded in *Azanza garkeana* fruits (45.3% dry weight) and in *Zizyphus sonorensis* (35% dry weight) fruits as stated by Marcelino *et al.* (2005) respectively. Consequently, the values were higher compared to those reported by Jadele *et al.* (2003) and Grivetti (1981) in mango fruits (2.24% dry weight) and in *S. birrea* fruit (1.2% dry weight) respectively. High fibre content in food causes intestinal irritation and lower nutrient bioavailability (Umar,2007).The low fibre content of *S. birrea* fruit make its consumption safe especially for people living in rural areas (palgrave, 1988).

Sclerocarya birrea fruit have high available carbohydrate contents ranging from 55.97%-61.28% dry weight obtained in sample from Kware and Kebbe respectively. The values are higher compared to that reported by Marcelino *et al.*,(2005) respectively.The calorific value ranges from 273.16-294.02kcal/100g dry weight in *S. birrea* fruits from Kware and Goronyo respectively. However, the energy value provided by the edible portion of *S. birrea* fruit were higher than that obtained from Mango (168.3kcal/100g dry weight) as reported by Jadele *et al.* (2003) and are lower than adult energy requirement (3000kcal/day) Cole, 1980).The variations in proximate compositions of *S. birrea* fruit analysed and that reported by Grivetti (1981) could be attributed to the climatic conditions on which the plant grows genetic variations, fertilizer application as well as the sampling methods.

Table 1.0 Proximate Composition of *Sclerocarya birrea* Fruit (% DM)

Parameters	Tureta	Kware	Dange/Shuni	Goronyo	Kebbe
Moisture Content ‡	87.10 ± 0.36[a]	81.80 ± 1.35[b]	86.33 ± 0.38[a]	84.93 ± 0.60[c]	83.50 ± 0.30[d]
Ash	10.40 ± 0.20[a]	15.40 ± 0.20[b]	14.10 ± 0.10[c]	15.26 ± 0.21[b]	13.23± 0.25[d]
Crude Protein	9.34 ± 0.41	9.13 ± 0.52	9.93 ± 0.37	9.67 ± 0.59	9.08 ± 0.33
Crude Fibre	7.03 ± 0.15[a]	6.50 ± 0.20[b]	6.50 ± 0.10[b]	6.46 ± 0.41[b]	6.90 ± 0.36[b]
Crude Lipid	1.20 ± 0.20	1.20 ± 0.30	1.10 ± 0.10	1.06 ± 0.25	0.90 ± 0.22
Available Carbohydrate	60.55 ± 1.46	55.97 ± 6.74	60.41 ± 0.68	60.68 ± 1.4	61.28 ± 0.95
Calorific Value (Kcal/100g)	293.05 ± 2.67[a]	273.16 ± 1.90[b]	292.38 ± 1.03[a]	294.04 ± 2.74[c]	289.58 ± 0.70[a]

The data are mean ± standard deviation (SD) of three replicates.
Value within a row with different superscript are significantly ($P < 0.05$) different. ‡ value expressed as % wet weight.
DM = Dry Matte

Mineral Composition

The concentration of Sodium in *S. birrea* fruit follows the trend: Kware>Dange/Shuni>Kebbe>Goronyo>Tureta. The highest and lowest value were recorded in sample from Kware (41.01mg/100g dry weight) and Tureta (36.64mg mg/100g dry weight) respectively. The values obtained were higher compared to that in S. birrea fruit of Zambia Republic (0.1 mg/100g dry weight) (Grivetti, 1981). Similarly, the values were higher compared to the recorded concentration in apples (1.0 mg/100g dry weight), but lower compared to that of *Z. sonorensis* (400 mg/100g dry weight) as reported by Marcelino *et al.* (2005). Sodium is associated with potassium in the body in maintaining proper acid-base balance and nerve transmissions. The sodium recommended dietary allowance is 500mg (NRC,1989);This shows that, *S. birrea* fruit collected from Tureta, Kware, Dange/Shuni, Goronyo and Kebbe possess 7.3%, 8.2%,8.16%,7.8% and 7.9% of the daily allowance.

The potassium content ranges from 69.54-250.34mg/100g dry weight for *S.birrea* fruit collected from Kebbe and Tureta respectively. The values were lower compared to that of *Z. sonorensis* (870mg/100g dry weight) (Marcelino *et al*., 2005). Calcium and phosphorus are associated with each other for development and proper functioning of bones, teeth and muscles (Dosunmu, 1997).The respective calcium and phosphorus contents ranges from (317.33-842mg/100g dry weight) and (0.23-0.37 mg/100g dry weight). For calcium high value was observed in *S. birrea* fruit collected from Goronyo and low value in *S. birrea* fruit collected from kebbe, while for phosphorus, high and low value was observed in *S. birrea* fruit collected from Kebbe and Tureta/Kware respectively. The concentration of phosphorus in *S.birrea* fruit were relatively lower compared to that in mango (12.14mg/100gdry weight) as reported by Jadele *et al.* (2003), The concentration of calcium in *S. birrea* fruit were generally higher compared to the value observed in *S.birrea* fruit of zambia Republic (14.94 mg/100g dry weight) reported by Grivetti (1981) and also higher than those reported in mango (11.93 mg/100g dry weight) (Jadele *et al*., 2003). For phosphorus, the *S. birrea* fruit analysed possess 0.02%-0.03% of the daily allowance, while for calcium, the *S. birrea* fruit analysed possess 26.4%-70.2% of the daily allowance (NRC, 1989).

The concentration of magnesium in *S. birrea* fruit ranges from 9.27-12.93 mg/100g dry weight in *S. birrea* collected from Kebbe and Goronyo respectively. However, the values were relatively lower than the observed value in *S. birrea* fruit of Zambia Republic (25.3 mg/100g dry weight) (Grivetti, 1981). The magnesium recommended dietary allowance is 350mg (NRC, 1989), this shows that, the *S. birrea* fruit analysed possess 2.65%-3.69% of the dietary allowance. Although, the concentration of magnesium in *S. birrea* fruit were generally low, but is a good source of magnesium that is known to activate many enzyme systems and is involved in the maintenance of electrical potential in nerves (jadele et al., 2003).

The concentration of nickel in *S. birrea* fruit collected from Kware and Dange/Shuni is 5.80mg/100g dry weight and 0.43 mg/100g dry weight respectively. The values were comparable with the concentration of nickel reported by Grivetti (1981), which shows that, *S. birrea* fruit of Zambia Republic contain nickel ranging from 1mg/100g - 6.5mg/100g dry weight. Although, nickel is an essential mineral but high human consumption could have adverse effects such as allergies and cancer (Grivetti,1981). The upper limit consumption of nickel goes from 0.2mg-1.0mg/day.

The edible portion of *S. birrea* fruit is a poor source of manganese ranging from 0.67mg/100g - 1.43mg/100g dry weight recorded in sample collected from Kware and Goronyo respectively. On the other hand, the values recorded were comparable to that reported by Grivetti (1981) in *S. birrea* fruit of Zambia Republic (1.1 mg/100g dry weight). When compared with 2-5mg set as recommended dietary allowance (NRC, 1981), the contribution made by *S. birrea* fruit is: 19.14% and 40.86% for *S. birrea* fruit collected from Kware and Goronyo respectively.

The concentration of copper is relatively high in *S. birrea* fruit collected from Kware (1.20 mg/100g dry weight) and low in *S. birrea* fruit collected from Kebbe (0.31 mg/100g dry weight). The value recorded in *S. birrea* fruit from Kware is higher compared to that recorded in *Z. sonorensis* (0.53 mg/100g dry weight) and that of *S. birrea* fruit from Kebbe is lower compared to the said value as reported by Marcelino *et al.,* (2005). The copper contents were higher than in apples (0.26 mg/100g dry weight) and also higher than in *S. birrea* fruit of Zambia Republic (0.04 mg/100g dry weight) Grivetti (1981). The values obtained indicate that, *S. birrea* fruit collected from Kware and Kebbe possess, 53% and 13% of the recommended dietary allowance of 1.5-3mg (NRC, 1989) respectively.

The amount of zinc in *S. birrea* fruit ranges from 0.41mg/100 -1.22 mg/100g dry weight recorded in sample from Kebbe and Tureta respectively. The values were lower compared to that in *Z. sonorensis* (4.2 mg/100g dry weight) and lower compared to that in *S. birrea* fruit of Zambia Republic (Grivetti, 1981). The United States National Research Council, NRC (1989) set the recommended dietary allowance of zinc to be 12-15mg, thus, the mean contribution to the dietary allowance from *S. birrea* fruit collected from five local government are; 9.0%, 8.1%, 6.0%, 3.1% and 3.0% respectively. Zinc is known to plays a role in gene expression, regulation of cellular growth, and participates as a co-factor

of enzymes responsible for carbohydrates, proteins and nucleic acid metabolism (Camara and Amaro, 2003).

The results obtained shows absence of iron in all the *S. birrea* fruit analyzed, but a result reported by Grivetti (1981) indicates that *S. birrea* fruit of Zambia Republic contain 0.1mg/100g dry weight of iron.

Table 1.1: Mineral Composition of *Sclerocarya birrea* Fruit (mg/100gDM)

Element	Tureta	Kware	Dange/Shuni	Goronyo	Kebbe
Na	36.64 ± 0.45	41.01 ± 0.90	40.80 ± 0.94	38.87 ± 1.31	39.42 ± 1.31
K	250.34 ± 3.38^{a}	69.54 ± 0.90^{b}	215.55 ± 6.66^{c}	213.64 ± 3.71^{c}	184.70 ± 0.81^{d}
P	0.23 ± 0.06	0.23 ± 0.06	0.28 ± 0.11	0.24 ± 0.04	0.37 ± 0.29
Mg	9.56 ± 1.68	9.79 ± 2.14	9.32 ± 2.87	12.93 ± 6.55	9.27 ± 1.29
Ca	590.70 ± 9.35^{a}	632.10 ± 1.29^{a}	781 ± 2.25^{b}	842 ± 2.59^{b}	317.33 ± 21.73^{c}
Ni	ND	5.80 ± 4.46^{a}	0.43 ± 0.23^{b}	ND	ND
Mn	ND	0.67 ± 0.23^{a}	ND	1.43 ± 0.50^{b}	ND
Cu	ND	1.20 ± 0.7a	ND	ND	0.31 ± 0.34b
Fe	ND	ND	ND	ND	ND
Zn	1.22 ± 0.95	1.10 ± 0.88	0.81 ± 0.48	0.42 ± 0.34	0.41 ± 0.23

The data are mean value ± standard deviation (SD) of three replicate.
Values within a row with different superscript are significantly ($P < 0.05$) different.
ND = Not detected. DM = Dry Matter

Table 1.2: pH of juice extracted from *Sclerocarya birrea* fruit

Sample	Tureta	Kware	Dange/Shuni	Goronyo	Kebbe
pH	4.0	4.2	4.2	4.3	4.1

The result above shows that the pH of the extracted juice, the juices from all the samples were found to be mildly acidic.

CONCLUSION

The result of preliminary studies indicates that, this perception is not so as the samples analysed are good source of protein supplement, dietary lipids, fibre, carbohydrate and some minerals. Thus, if consumed in sufficient amount could contribute greatly towards meeting human nutritional requirement for normal body growth and adequate protection against diseases as a result of malnutrition.

However, if the objectives were achieved, fruits of *Sclerocarya birrea* could find a placed in the food basket of the nation. It should be noted that, nutritional content is seldom used as criteria for judging food quality unless other wise levels of antinutritional and toxicant were evaluated.

REFERENCES

Ademoroti, C.M.A. (1996). Environmental Chemistry and Toxicology. Foludex press Ltd, Ibadan.pp 89-97.

Alan, W. (1996). Soil and the environment: An introduction, Cambridge University press.

AOAC. (1990). Official methods of analysis, 14th edition, Association of Official Analytical Chemists, Washington DC.

Asaolu, M.F. and Asaolu, S.S. (2002). Proximate and mineral compositions of cooked and uncooked *Solanum melangena*. *International Journal Food Sciences and Nutrition*. **53:** 615-624.

Asibey-Berko, E. and Tayie, F.A.K. (1999). Proximate analysis of some under utilized Ghanian vegetables. *Ghana Journal of Science*.**39:** *91*-92.

Ayaz, F.A., Hung, H.S., Chuang, L.T., Vander Jagt, D.J. and Glew, R.H. (2002). Fatty acid composition of Medlar (*Mespilus germanical L.*) fruits at differents stages of development. *Italian Journal of Food Sciences*. **14(4):** 439-446.

Barton, S. (2001). Marula resource management sustainable harvesting and community forestry. In Marula work shop, report and abstracts.University of Pretoria, Pretoria. pp 26-27.

Camara, F and Amaro, C.A. (2003). Nutritional aspects of zinc availability. *International Journal of Food Sciences and Nutrition*. **54:**143 -1

Dosummu, M.I. (1997). Chemical composition of the fruit of *Tetrapleura* and Physico-chemical properties of its oil. *Global Journal of Pure and Applied Sciences*. **3(1):** 61-67.

FAO. (1988). Non timber uses of some selected arid zone trees and shrubs in Africa. Food and Agricultural Organization, conservation guide 19, Rome. Pp.333.

Greefied, H and Southgate, D.A.T. (2003). Food Composition data, 2nd Edition, Food and Agriculture Organisation, Rome, pp. 97-99.

Grivetti, L.E. (1981). Perspective on dietary utilization of wild plants, nutritional status and agricultural development. Fresno, California: International Geographical Union Commission of Rural Development (Symposium). Pp. 23-25. .

Hassan, L.G. and Umar, K.J. (2004). Proximate and mineral composition of seeds and pulp of African locust bean (*Parkia biglobosa L.*). *Nigerian Journal of Basic and Applied Sciences.* **13:** 15-2.

Jadele, S, Hau AM and Von Oppen, M. (2003). An analysis of the world market for mango and its importance for developing countries. Conference on International Agricultural Research for Development. http://en.Wikepedia.org/Wiki/file:mango. Retrieved on 9th February 2009.

Kokwaro, J.O. and Gillett, J.B. (1980). Notes on the Anacardiaceae of East Africa. Kew Bull. 34(4): 756.

Kokwaro, J.O. (1986). Flora of Tropical East Africa. A.A.Balkema, Rotterdam. C.PP.206..

Mallert, J.A. (2001). Nutritional Composition of some wild plants, foods and honey used by Hadza foragers of Tanzania. *Journal of food composition and analysis*. **14:**13-14.

Marcelino E.O, Muller H.G and Tobin G. (2005). Proximate Analysis of *Zizyhus sonorensis* fruits. *Journal of Agriculture and Food Chemistry*. 30:1126-1130.

National Research Council, NRC. (1989). Recommended Dietary Allowance. Nutrition Academy press, Washington DC.

Nordeide, M.B., Hatloy, A., Folling, M., Lied, E. and Oshaug, A. (1996). Nutrient composition and nutritional importance of green leaves and wild food resources in an agricultural district, Koutiala, in southern Mali. *International Journal of Food Sciences and Nutrition*. **47:** 455-468.

Palgrave, K.C. (1988). Trees of Southern Africa, Struck publishers. Cape Town. Pp-33

Tayie, F.A.K. and Asibey-Berko, E. (2001). Mineral content of some indigenous vegetables of Ghana. *Ghana Journal Of Science*. **41:**49-54..

Umar, K.J. (2007). Nutritional, Toxicological and Phytochemical Analyses of some lesser known wild leafy vegetables. A PhD Research proposal (unpublished). Usmanu Danfodiyo University, Sokoto.

Venter, F. and Venter, J. (1996). Making the most indigenous trees. Brizer publication, Pretoria.

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