African Journal of Biotechnology Vol. 6 (16), pp. 1935-1938, 20 August 2007
Available online at http://www.academicjournals.org/AJB
ISSN 1684–5315 © 2007 Academic Journals

Full Length Research Paper

Levels of antinutritional factors in some wild edible fruits of Northern Nigeria

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Accepted 15 September, 2006

Sixteen wild fruits commonly consumed in northern Nigeria were assessed chemically for the presence of oxalate, phytate, saponin, and tannin. The highest level of oxalate was found in *Zizyphus spina-christi*, *Zizyphus mauritiana* and *Balanite aegyptiaca* (16.20±2.12%, 15.50±1.50% and 14.50±2.08%, respectively). Phytate was highest in *Sclerocarya birrea* (3.56±0.54%) and *Haematostaphis barteri* (3.30±0.10%). *B. aegyptiaca*, *Detarium microcarpum* and *Parkia biglobosa* had the highest saponin values of 16.01±0.02, 12.10±0.05 and 12.23±0.46% respectively. While tannin was highest in *B. aegyptiaca* (7.40±0.14%), closely followed by *Hyphaena thebaica* (6.39±0.5%) and *Borassus aethiopum* (5.90±0.13%). Though these antinutrients can interfere with nutrients utilization when in high concentration, the values obtained for the fruits analysed were not up to the toxic levels of the antinutrients. Fruits such as *Vittaleria paradoxum, Adansonia digitata, Diospyros mespiliformis Phoenix dactylifera* and young shoot of *Bor. aethiopum* are highly recommended for consumption as they contain low amount of the antinutrients analysed.

Key words: Wild fruits, antinutrients, oxalate, phytate, saponins, and tannins.

INTRODUCTION

In Nigeria, wild fruits are commonly consumed by both rural and urban dwellers especially during the dry season when most cultivated fruits are out of season. Wild and semi wild food resources are frequently consumed as the dominant source of fruits especially in rural communities (Barminas, 1998). Such wild fruits have helped to provide a steady supply of fruits during the dry season when cultivated fruits are scarce and expensive for low-income earners that traditionally have large family. Considerable interest has been generated by recent studies on the chemical composition of some wild fruits in Nigeria. Some of these wild fruits have higher nutritional values compared with levels found in cultivated fruits (Eromosele, 1991). However, some of these fruits contain antinutritional factors that can affect the availability of nutrients required by the body. The antinutritional factors interfere with metabolic process so that growth and bioavailability of nutrients are negatively influenced (Binita and Khetarpaul, 1997). Oxalate for instance binds to calcium to form complexes (calcium oxalate crystals). These oxalate crystals formed prevents the absorption and utilization of calcium by the body causing diseases such as rickets and osteomalacia (Ladeji et al., 2004). The calcium crystal may also precipitate around the renal tubules thereby causing renal stones. The formation of oxalate crystal is said to take place in the digestive tract (Thompson and Yoon, 1984).

Phytic acid (inositol hexaphosphate) is an organic acid found in plant materials (Heldt, 1997). Phytic acid combines with some essential elements such as iron, calcium, zinc and phosphorus to form insoluble salts called phytate, which are not absorbed by the body thereby reducing the bioavailability of these elements. Anemia and other mineral deficiency disorders are common in regions where the diet is primarily a vegetarian (Erdman, 1979).

Saponins are naturally oily glycosides occurring in wide variety of plants. When eaten, they are practically non-poisonous to warm blooded animals, but they are dangerous when injected into the blood stream and quickly hae-

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Table 1. Level of antinutritional factors in 16 wild fruits in percentage (%).

Fruits	Oxalate	Phytate	Saponin	Tannin
Adansopnia digitata (Baobab)	9.5 ± 0.42	0.69 ± 0.15[d]	10.51 ± 0.11	2.22 ± 0.32
Balanite aegyptiaca (Desert date)	14.50 ± 2.08[a]	1.90 ± 0.27	16.01± 0.02[e]	7.40 ± 0.14[g]
Borassus aethiopum (Toddy palm)	11.30 ± 1.70	0.65 ± 0.18[d]	7.04 ± 0.05	3.18 ± 0.30
Nuclea latifolia (African fan peach)	2.22 ± 0.42[b]	0.95 ± 0.19	9.01 ± 0.01	2.80 ± 0.12
Detarium macrocarpum (Tallow tree)	13.50 ± 2.16	2.13 ± 0.97	12.10 ± 0.05	3.54 ± 0.28
Diospyros mespiliformis (Monkey guava)	12.20± 1.70	0.92 ± 0.08	4.04 ± 0.10	2.61 ± 0.16
Haematostaphis barteri (blood plum)	6.30 ± 1.91	3.30 ± 0.10[c]	5.03 ± 0.15	2.13 ± 0.81
Hyphaena thebaica (Egyptian doum palm)	13.50 ± 5.73	1.18 ± 0.05	8.25 ± 0.31	6.39 ± 0.51[g]
Parkia biglobosa (Locust bean)	11.10 ± 3.52	2.13 ± 0.51	12.23 ± 0.46	0.93 ± 0.11[h]
Vitex doniana (Black plum)	10.10 ± 2.12	0.75 ± 0.16	6.14 ± 0.32	4.83 ± 0.15
Vittaleria paradoxum (Shea butter)	7.02 ± 1.20	0.92 ± 0.14	1.50 ± 0.10[f]	3.83 ± 0.32
Zizyphus mauritiana (Indian jijube)	15.50 ± 1.50[a]	1.57 ± 0.33	7.13 ± 0.21	2.42 ± 0.04
Borassus aethiopum (young shout)	02.20 ± 0.07[b]	0.72 ± 0.03	11.08 ± 0.02	5.90 ± 0.13
Phoenix dactylifera (Date)	6.90 ± 0.91	0.52 ± 0.03[d]	2.04 ± 0.01f	0.93 ± 0.21[h]
Sclerocarya birrea (African plum)	4.90 ± 1.70	3.56 ± 0.54[c]	7.35 ± 0.10	2.04 ± 0.30
Zizyphus spina-chrit *(Chinese date)*	16.20 ± 2.12[a]	0.88 ± 0.28	6.02 ± 0.03	5.28 ± 0.09

Results are mean of three (3) determinations ± SD.
a= significantly higher compare with other fruits under oxalate column ($p < 0.05$)
b=significantly lower compare with other fruits under oxalate column ($p < 0.05$)
c=significantly higher compare with other fruits under phytate column ($p < 0.05$)
d=significantly lower compare with other fruits under phytate column ($p < 0.05$)
e=significantly higher compare with other fruits under saponin column ($p < 0.05$)
f=significantly lower compare with other fruits under saponin column ($p < 0.05$)
g=significantly higher compare with other fruits under tannin column ($p < 0.05$)
h=significantly lower compare with other fruits under tannin column ($p < 0.05$).

molyse red blood cells (Applebaum et al., 1969). Tannins have the ability to precipitate certain proteins. They combine with digestive enzymes thereby making them unavailable for digestion (Abara, 2003; Binita and Khetapaul, 1997).

Despite the fact that wild fruits are widely consumed with no cultural inhibition and tend to be nutritious, there is lack of sufficient information on the antinutritional composition of these wild fruits and disorders associated with these antinutrients. This study was therefore undertaken to assess the level of antinutritional factors in some wild fruits commonly consumed in northern Nigeria.

MATERIALS AND METHODS

Collection and treatment of samples

Fruits of *Adansonia digitata, Balanite aegyptiaca, Borassus aethiopum, Detarium microcarpum, Diospyros mespiliformis, Haematostaphis barteri, Hyphaena thebaica, Parkia biglobosa, Vitex doniana, Vittaleria paradoxum, Zizyphus mauritia, Nuclea latifolia, Phoenix dactylifera, Sclerocarya birrea, Zizyphus spina-christi* and young shoot of *Bor. aethiopum* were collected in Numan Local Government Area of Adamawa State, Nigeria between the month of April and May, 2005. Samples were washed to remove dirt and dried at room temperature. Samples were pound to powder using mortar and pestle then sieved with 1 mm size sieve.

Analysis of samples

Total oxalate was determined according to Day and Underwood (1986) procedure. To 1 g of the ground powder, 75 ml of 15 N H_2SO_4 was added. The solution was carefully stirred intermittently with a magnetic stirrer for 1 h and filtered using Whatman No 1 filter paper. 25 ml of the filtrate was then collected and titrated against 0.1 N $KMnO_4$ solution till a faint pink colour appeared that persisted for 30 s.

Phytate was determined using Reddy and Love (1999) method. 4 g of the ground sample was soaked in 100 ml of 2% HCl for 5 h and filtered. To 25 ml of the filtered, 5 ml 0.3% ammonium thiocyanate solution was added. The mixture was then titrated with Iron (III) chloride solution until a brownish-yellow color that persisted for 5 min was obtained.

Saponin was determined using the method of Birk et al. (1963) as modified by Hudson and El-Difrawi (1979). 20 ml of 20% aqueous ethanol was added to 10 g of the ground sample and agitated with a magnetic stirrer for 12 h at 55°C. The solution was then filtered using Whatman No.1 filter paper and the residue re-extracted with 200 ml 20% aqueous ethanol. The extract was reduced to 40 ml under vacuum and 20 ml diethyl ether added in a separating funnel and shaken vigorously. The aqueous layer was recovered and ether layer discarded. The pH of the aqueous solution was adjusted to 4.5 by adding NaOH, and the solution shaken with 60 ml n-butanol. The combined butanol extracts were washed twice with 10 ml of 5% aqueous NaCl and evaporated to dryness in a fume cupboard to give a crude saponin which was weighed.

Tannin was determined using the method of Trease and Evans (1978). 1 ml of the methanolic extract was treated with 5 ml Folin-

Dennis reagent in a basic medium and allowed to stand for colour development. The absorbance of the reaction mixture of each sample was measured at 760 nm spectrophotometrically.

Statistical analysis

Results were presented as mean of simple percentages ± S.E.M. Student's t test was used to determine significant difference between two means. Values less than p< 0.05 were considered significant.

RESULTS AND DISCUSSION

Results of the phytochemical analysis of 16 wild fruits are presented in Table 1. The highest level of oxalate (16.20±2.12%) was observed in *Z. spinachristi* closely followed by *Z. mauritiana* (15.50±1.50%). *Bor. aethiopum* had the lowest level of oxalate (02.20±0.07%). According to Ladeji (2004), oxalate can bind to calcium present in food thereby rendering calcium unavailable for normal physiological and biochemical role such as the maintenance of strong bone, teeth, cofactor in enzymatic reaction, nerve impulse transmission and as clotting factor in the blood. The calcium oxalate, which is insoluble, may also precipitate around soft tissues such as the kidney, causing kidney stones (Oke, 1969). Though lost of calcium leads to degeneration of bones, teeth and impairment of blood clotting process (Badifu and Okeke, 1992), the values obtained for these fruits were below the established toxic level.

Values for phytate range from 0.52±0.03% in *P. dactylifera* to 3.56±0.54% in *S. birrea*. According to Oke (1966), a phytate diet of 1-6% over along period decreses the bioavailablity of mineral elements in mono gastric animals. Phytic acid can bind to mineral elements such as calcium, zinc, manganese, iron and magnesium to form complexes that are undigestable, thereby decreasing the bioavailability of these elements for absorption (Erdman, 1979). Phytic acid also has a negative effect on amino acid digestibility thereby posing problems to non-ruminant animals due to insufficient amount of intrinsic factor phytase necessary to hydrolyze the phytic acid complexes (Makkar and Becker, 1998). Phytate is also associated with nutritional diseases such as rickets and osteomalacia in children and adult respectively.

B. aegyptiaca had the highest level of saponin (16.01 ±0.02%) which is significantly higher p<0.05 com-pare to the lowest value observed in *V. paradoxum* (1.50±0.41). High saponin level has been associated with gastroenteritis manifested by diarrhea and dysentery (Awe and Sodipo, 2001). However, it was reported that saponin reduces body cholesterol by preventing its reab-sorption and suppresses rumen protozoan by reacting with cholesterol in the protozoan cell membrane thereby causing it to lyse.

Highest tannin level was observed in *B.* aegyptiaca (7.40±0.14%) while lowest values were observed in *P. biglobosa* (0.93±0.11) and *P. dactylifera* (0.93±0.21). The two values are statistically significant at p<0.05.Though most of the values are low, tannin in fruits impose an astringent taste that affect palatability, reduce food intake and consequently body growth. It also binds to both exogenous and endogenous proteins including enzymes of the digestive tract, thereby affecting the utilization of protein (Bagepallis et al., 1992; Aleto, 1993; Sotelu et al., 1995).

Though all the analyzed fruits contained these antinutrients, fruits such as *V. paradoxum*, *A. digitata, D. mespiliformis, P. dactylifera* and *B. aethiopum* contained lower amounts of all the antinutrients analyzed, hence, they are highly recommended for consumption.

In conclusion the antinutritional analysis of twelve wild fruits commonly consumed in northern Nigeria showed that all the wild fruits contained oxalate, phytate, saponin and tannin. However, values obtained for these fruits are lower than the established toxic level. Hence they can be consumed without any restriction. However, consumption in large amounts of fruits with higher levels of antinutrients should be avoided.

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