International Journal of the Physical Sciences Vol. 6(36), pp. 8079 - 8082, 30 December, 2011
Available online at http://www.academicjournals.org/IJPS
DOI: 10.5897/IJPS09.024
ISSN 1992 - 1950 ©2011 Academic Journals

Full Length Research Paper

Proximate chemical analysis of nutritive contents of Jujube (*Ziziphus mauritiana*) seeds

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Accepted 28 April, 2011

This study provided estimate of nutrient content of *Ziziphus mauritiana,* a lesser known tropical legume plant. Chemical analysis of the seeds collected from Bojude in Kwami local government area in Gombe State and Hanani in Bauchi local government area, Bauchi State in Nigeria, showed that, the crude protein, moisture, ash, crude fibre, lipids and carbohydrates were 36.10 ± 57, 4.21 ± 0.030, 2.79 ± 0.27, 11.04 ± 0.88, 27.40 ± 0.11 and 21.26 ± 0.63 mg per 100 g of the samples, respectively. The most important minerals were potassium, sodium and phosphorus with 589.08 ± 10.89, 154.79 ± 10.50 and 585.43 ± 412 mg/100 g of the samples, respectively. The seeds could be used as protein and mineral supplement for low protein legumes such as cereals. It was recommended that further protein and oil analysis of these seeds be made so as to ascertain anti-nutritive factors in the protein and fatty acids types available in the seeds.

Key words: *Ziziphus mauritiana* (Jujube), seeds, food nutrients.

INTRODUCTION

Food can be scientifically defined as that substance which is necessary to support growth, maintain body functions, repair or replace tissues and provides energy for living organism (Kristosikova and Wher, 1994). The nutrient content of any type of food is of importance for appropriate diet intake for man and animals. Nutrition begins at the beginning of mankind on this earth and many references to food and nutrition exist in man's earliest writings.

Early man had to see the fact for himself, largely by trial and error, as he chose his food from available plants and from plentiful supply of animal life all around him. It was not until the development of modern science in the eighteenth and nineteenth centuries that there began to be an appreciation of the essential nature of certain nutrients. Among the first nutrients to be recognized as essential were proteins, oxygen, calcium, iodine and scurvy preventing factor (later identified as vitamin C), most of these milestone were in the years of 1775 to 1825 (Doris and George, 1979).

Data from United Nation Food and Agricultural Organization (FAO), gave note of warning to countries in the world, especially Africa and Caribbean countries that, they should increase food production so that the increased populace nutritive needs would be adequately catered for (Alfred and Patrick, 1985).

In spite of such needs, less explored plants like Jujube (*Ziziphus mauritiana*) plants needs to be explored to ascertain the best nutritive contents for the general benefits of the entire developing countries in the world. The determination of nutritive contents of less explored food would go a long way to supplement quality and quantifiable balanced food to Nigeria and Africa at large. The food needs of people from developing countries are not different from those of the developed world.

Z. mauritiana or Jujube plant (English) or magarya (Hausa) is commonly found in northern Nigeria (Huwale, 1985). The species are native of tropical Africa and the leaves from the plant provide a good source of forage for domestic and wild animals (Mathur et al., 1993). Humans are also known to eat the fruit. Each large *Z. mauritiana* produces more than 5000 fruits per year (Schirarend, 1991). The fruit from *Z. mauritiana* is globe-shaped with a shiny brown skin that cannot be easily separated from

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the sweet whitish yellow edible flesh.

The fruit contains a hard woody nut that encloses the seed, a single seed or two are sometimes enclosed in a woody endocarp and less than 10% of a fresh seeds will germinate. Seeds are dispersed by several mammalian vectors like sheep, goats, antelopes, etc (Grice, 1996); however, it is sometimes disposed by man. Till date there had not been known chemical analysis for nutrients contents determination of the *Z. mauritiana* seeds. The objective of this study was to investigate the chemical composition of the seeds. This could help in assessing the actual nutrient composition of these seeds and also, help to supplement the nutrients needs and demand of man and other domestic animals.

MATERIALS AND METHODS

Collection and treatment of samples

Dry fruits of *Z. mauritiana* were obtained in the nearby bush from Bojude village in Kwami Local Government Area of Gombe State and Hanani village in Bauchi State, all in northern Nigeria. The matured fruits were collected from about ten different trees of *Z. mauritiana* (Jujube) plant. The fruits were crushed mildly (carefully) in a clean wooden mortar to release the fruit. The seeds were dried for better cracking of the woody seed shell, and these seeds were later crushed into powder, further dried for two days and then packaged in a clean well ventilated cardboard.

Analysis of the samples

Ash, crude fibre, crude lipids and moisture contents were determined as described by Chopra and Kanwar (1991). The crude protein was determined using micro-Kjeldahl technique. Carbohydrates were determined by difference of 100 (that is, the sum of moisture, ash protein and lipids contents). The determinations were carried out in triplicates and the results were expressed as dried weight bases.

Determination of moisture content

5 g of the sample was placed in porcelain crucible and heated in air circulating oven at 105°C and was allowed to stay for about 2 h. Thereafter, the sample was cooked, weighed and reweighed until a constant weight was obtained. The percentage moisture was obtained by the expression.

$$\% \text{ Moisture} = \frac{W_1 - W_2}{W_1 - W_0} \times 100$$

Where, W_0 = weight of the porcelain crucible, W_1 = weight of the crucible together with the wet sample, W_2 = weight of the crucible and the dried sample.

Determination of the ash content

5 g of the oven dried sample was placed in a porcelain crucible and ignited in a muffle furnace at 350°C until it was grey ash in colour. The ash was allowed to cool and the weight of the ash was taken.

The percentage of ash was obtained from the expression:

$$\% \text{ Ash} = \frac{\text{Weight of ash}}{\text{Weight of the sample}} \times 100$$

$$\therefore \% \text{ Ash} = \frac{M_2 - M_0}{M_1 - M_0}$$

Where, M_0 = weight of the crucible, M_1 = weight of the sample and the crucible, M_2 = weight of the crucible and ash

Determination of crude fat (lipid)

The soxhlet apparatus was set up and 20 g of *Z. mauritiana*, wrapped with filter paper was placed in the apparatus. 400 ml of petroleum ether was placed in 250 ml round bottom flask. Heating of the flask was carried out at 45 to 60°C for about 5 h. On completion of the extraction, the flask was disconnected and the filtrate was placed in a weighed beaker and the solvent was allowed to evaporate for two days. The weight of the beaker and fat was recorded until a constant weight was obtained. Increase in the weight of the beaker, gave the weight of the crude fat. The percentage of the crude fat was obtained from the expression as follows (Harold, 1991):

$$\% \text{ Crude} = \frac{\text{Weight of crude fat}}{\text{Weight of the sample}} \times 100$$

$$\% \text{ Crude} = \frac{B - B_0}{W_s} \times 100$$

Therefore, % B_0 = weight of empty the beaker, B = weight of the beaker and the crude fat, W_s = weight of the sample.

Determination of crude fibre

2 g of the sample residue obtained from lipid determination process was placed into a 100 ml volumetric flask and 200 ml of 1.25% H_2SO_4 was added and was allowed to boil for 30 min, after which it was filtered and washed with distilled water. The residue was transferred to the beaker and 200 ml of 1.25% NaOH was added and allowed to boil for 30 min after which it was filtered and washed with water until it was alkali free. The residue was filtered with hot water, 1% HNO_3 and was transferred to a weighed dish to be further dried to a constant weight at 100°C. The residue was heated to ash at a temperature of 450°C for 2 h 30 min and the weight, recorded. The crude fibre content was calculated as follows:

$$\% \text{ Crude fibre} = \frac{\text{Weight of a crude fibre}}{\text{Weight of the sample}} \times 100$$

$$= \frac{WR - WA}{Ws} \times 100$$

Where, W_R = weight of the crucible + residue, W_1 = weight of a crucible + ash, W_2 = weight of the sample.

Determination of phosphorus

Phosphorus was determined by placing 5 g of the dried sample in a crucible and then in a Muffle furnace at 450°C until it was grey in colour. The ash was extracted with hot concentrated HNO_3, washed and then made up to a volume of 100 ml. The mixture, 10 ml of concentrated HNO_3 and 30 ml of molybdate solution was gently stirred and was allowed to stay overnight. The canary yellow coloured precipitate of ammonium phosphomolybdate formed, was collected by filtration over a filter paper and the precipitate was washed by decantation, twice with 2% HNO_3 and then with $NaNo_3$ solution. Finally, it was washed with $NaNO_3$ solution over a filter paper until the filtrate was acid free as tested with a strip of litmus paper. Thereafter it was transferred to a beaker, dissolved, and the yellow precipitate was measured. The volume of 0.1 N NaOH solution measured was then added to the excess from the burette and phenolphthalein was used as an indicator. Excess NaOH was titrated with 0.1 N HCl. The percentage phosphorus was calculated using the formula explained by Chopra and Kanwar (1991) as follows:

Conversion Factor: 1 ml of 0.1 N NaOH = 0.0001351 g of P

or

1 ml of 0.1 N NaOH = 0.000309 g of $P_2 05$

$$\% P = \frac{\text{ml of 0.1 N NaOH used x 0.000135 x aliquot x 100 factor}}{\text{Weight of substance used.}}$$

Determination of mineral ions

Mineral ions like sodium, magnesium, potassium, zinc, manganese and iron were_determined by placing 2 g of the ash sample in a crucible at 450°C. 15 ml of concentrated HNO_3 and 8 ml of concentrated HCl were used to dissolve the residue and 4 ml of 30% H_2O_2 was also added. The undissolved carbon was filtered and the filtrate was diluted with distilled water to 100 ml. The solutions were taken for analysis using Buck Scientific Atomic Spectrophotometer VGP (variable giant pulse) system Model 210. The VGP uses a time specific modulation of the hollow cathode lamp (HCl) to produce an energy pulse that contained information of both the sample (analyte) absorbance and background absorbance. Atomic absorption spectroscopy is base on the ability of excited atoms of an element to absorb energy from the wavelength of light at the same frequency as the element. Each element has its own series of specific resonance wavelengths and these wavelengths will have specific characteristics for sensitivity, noise and linearity.

The optical system was set up with a hollow cathode lamp for the elements with appropriate slit wavelength selected for the elements. The solution with known concentration of the analyte was aspirated and the absorbance reading noted.

Determination of crude protein and nitrogen

Crude protein and nitrogen was determined by placing 0.2 g of dried sample in a long test-tube. 10 ml of concentrated H_2SO_4 acid and a mixture of 3 g of K_2SO_4 and $CuSO_4$ in 10:1 were added, respectively (Harold, 1991). The mixture was heated gently at 150°C for about 2 h 30 min and later at 370°C for about 3 h. A clear light blue solution was obtained which was allowed to cool, and then made up to 110 ml mark with distilled water, for each sample. The solution was transferred to 550 ml Kjedahl flask and a piece of granulated zinc was placed into the solution as 50 ml of 40% NaOH was added. The flask head was connected with distillation apparatus, 25 ml in H_2SO_4 acid was placed in receiving flask and it was distilled by heating the Kjedahl flask when two-third of the liquid has been distilled. The flask was removed and then titrated with 0.1 N NaOH solution using methyl red indicator.

Weight of Nitrogen $= 0.14 (1 - 10^{-2} VB)$
$= 0.14 (1 - 0.00 VB)$

Where, VB = volume of NaOH used, weight of protein = weight of nitrogen x 6.25.

$$\% \text{ Protein} = \frac{\text{Weight of protein}}{\text{Weight of sample}} \times 100$$

Equations of the reactions are shown below:

$$C_a H_b N_c + H_2SO_4 \longrightarrow {}_aCO_2 + \tfrac{1}{2}\, bH_2O + CNH_4SO_4$$

$${}_aNH_4\, HSO_c + NaOH_4 \longrightarrow {}_aNH_3 + {}_cNa_2SO_4 + H_2O$$

$$NH_3 + (c + d)\, H_2\, SO_4 \longrightarrow {}_c(NH_4)_2\, SO_4 + dH_2SO_4$$

$$dH_2\, SO_4 + 2(d)\, NaOH \longrightarrow 2H_2O + Na_2SO_4$$

(Food and Agricultural Organization of UNO, 1986). Note: Letter a, b, c and d denotes atoms number of that element.

RESULTS AND DISCUSSION

Proximate component of the seeds of *Z. mauritiana* are presented in Table 1. The protein content of the seeds is 36.10 ± 0.57% higher than *Amaranthus* sp. seeds which is 10.3 to 18.3% (Dhan and Pal, 1992). *Digitaris exilis* (1.3%) and melon seed (33.8%) (Afam and Jacob, 1993) (Unfermented).

The crude fibre contents and carbohydrate of *Z. mauritiana* are 11.04 ± 0.88% and 21.26 ± 2.63%, respectively, and these are higher than fermented melon seed with crude fibre content of 2.4% and carbohydrates of 7.3%.

The energy value of 100 g of the seeds containing 36.10 g of proteins, 27.4 g of lipids and 21.6 g of carbohydrates is 470.28 cal. (1967.66 Kj). This exceeds the energy content (value) of *Z. mauritiana* pericap with only 1547.14 Kj/100 g. Children, ages 1 to 10 years (19.33 kg) required an average of 2267 Kj (Brown, 1989) of protein per day, that means, they need to take about 68.47 g of *Z. mauritiana* seeds, if an allowance of 25% digestibility and limiting sulphur amino acids are to be made.

Table 2 showed that *Z. mauritiana* seeds contain higher amount of phosphorus than its fruit pericarp (Anthony and Effiong, 1998). Adult males weighing 66.60 kg required about 15 mg of zinc per day and this can be obtained from 0.426 kg of *Z. mauritiana* (Judith, 1990). For pregnant and lactating women, about 1200 mg of phosphorus is required per day. This implies that, they need to take about 0.2 kg of *Z. mauritiana* seed per day to maintain the recommended dietary allowances for phosphorus.

Table 1. Proximate composition (g/100 g dry weight) of *Ziziphus mauritiana* seeds.

Content	Dry weight (g/100 g)
Moisture	4.21 ± 0.30
Ash	2.79 ± 0.27
Protein	36.10 ±0.57
Crude fibre	11.04 ± 0.88
Lipids	27.40 ± 0.11
Carbohydrate	21.26 ± 0.63

Carbohydrates were estimated by difference. The values are means and standard deviation (SD) for those determinations.

Table 2. Mineral composition of the seeds of *Ziziphus mauritiana* (in mg/100 g).

Content	Dry weight (mg/100 g)
Sodium (Na)	154.79 ± 10.50
Magnesium (Mg)	6.23 ± 0.12
Potassium (K)	589.08 ±10.69
Zinc (Zn)	3.52 ± 0.05
Manganese (Mn)	1.15 ± 0.14
Iron (Fe)	1.21 ± 0.15
Phosphorus (P)	585.43 ± 41.29

The values are means and standard deviations for three determinations.

CONCLUSION AND RECOMMENDATION

The observed proximate and mineral composition of *Z. mauritiana* showed that, it has high protein contents than melon seeds. Amino acid analysis is recommended to be carried out (Doris and George, 1979) on *Z. mauritiana* seeds to find out whether it contains essential amino acids or not, so that the plant source of protein could be explored for better supplement in food, especially in the third world.

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