Biosci. Biotech. Res. Asia Vol. **3,** No.(**1**) 47-50 (2005)

CHEMICAL PROFILE AND ZINC BIOAVAILABILITY STUDIES ON 'HAUSA GROUNDNUT' (*Kerstingiella geocarpa*)

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(Received February 27, 2005; Accepted May 02, 2005)

ABSTRACT

The seeds of 'Hausa groundnut' (*Kerstingiella geocarpa)* were analysed for their chemical constituents. Result of proximate analysis (g/100g) showed that they contain high concentration of crude protein (21.33%) crude fibre; (6.2%), carbohydrate, (61.53%) and low fat concentration (0.98%). The most abundant element in the seeds was phosphorus (9.30mg/g). The seeds however contain moderately high amounts of other minerals; potassium, (7.67mg/g) calcium (8.84mg/g) and sodium (5.67mg/g). Total cyanide (mg/100g) and tannin (%TA) were found in low concentrations. The (Ca):(phytate)/(Zn) molar ratio obtained for the seed (0.02) was far below the critical value of 0.5mol/kg. This result indicates that the phytate concentration in the seeds is not as high as to affect adversely Zn bioavailability. The implications of these findings highlight the nutritive value and safety of these seeds

Keywords: *Kerstingiella geocarpa,* Hausa groundnut elements, tannin and cyanide.

INTRODUCTION

Legume seeds or pulses are major sources of nutrients to both humans and animals in most developing parts of the world [1].The forests of West Africa particularly Nigeria are full of leguminous plants whose seeds contain large quantities of proteins[2].Rapid population growth creates an ever-increasing need for protein. The grain legumes are the only concentrated sources of plant protein, which are less expensive than animal protein sources. Hence, as food prices rise, Legumes are likely to be the only low cost protein source. In recent times however, the conventional plant protein sources have become expensive. It has thus become necessary to evaluate novel alternative protein sources, which can serve in minimizing protein energy malnutrition especially among the vulnerable and the low-income groups.

Kerstingiella geocarpa, (Hausa groundnut) is an annual herb, which grows on sandy loam soils in savannah areas of West Africa from Senegal to Nigeria. It produces fruits which is a pod containing 1-3 brownish seeds with a helium and a relatively thick testa similar to that of groundnut[3]. Many cultivars of *Kerstingiella geocarpa* are tolerant to relatively poor soil conditions. This study aims at drawing attention to the nutritive value of the seeds. Such information will enhance the compilation of food composition table and might lead to increase in the seeds application to human diets and animal feed.

MATERIAL AND METHODS

Sample collection and preparation

Kerstingiella geocarpa seeds purchased from local markets in Ado-Ekiti were cleaned, powdered in a blender and stored in the freezer at -20°C prior to analysis.

Methods

Proximate compositions of mushroom samples were evaluated using standard AOAC [4] methods. With the nitrogen content evaluated using micro-kjeldahl method and protein determined as N x 6.25. The caloric value was estimated by multiplying the crude protein, fat and carbohydrate by 4,9,4 respectively[1].

Tannin estimation [5]

To 200g of powdered sample, 100ml of 70% acetone was added in a beaker in ice water bath shaking for 12 minutes. After cooling, content was centrifuged at 300 x g (4^0C) for 20 mins.The

supernatant collected was kept on ice. The standard solution of tannin was prepared by dissolving 25mg tannic acid in 50ml distilled water. Serial dilution of the standard was made and 0.5ml folin reagent and 2.5ml $NaCO_3$ added to both sample and standard solutions. The tubes were then shaken and absorbance was read at 725mm. Tannin concentration was extrapolated from the calibration curve.

Phytate [6]

8g of Powdered sample was soaked in 200 ml 2% HCl for 3hrs and filtered through 2 layers of hardened filter paper. 50mls of the filtrate was placed in a 400ml beaker with 10ml 0.3% NH_4SCN as indicator. About 107ml distilled water was be added. This was titrated with $FeCl_3$.

Cyanide[7]

A 4g sample was soaked in a mixture of 40 ml distilled water and 2 ml orthophosphoric acid. This was mixed and kept overnight at room temperature to free bound cyanide. The resulting solution was transferred into a distillation flask. 45ml distillate was collected in the receiving flask that contained 40 ml distilled water containing 0.1g NaOH pellets. The distillate was then transferred to a 50 ml volumetric flask, made up to mark with distilled water. 20 ml of distillate was transferred into a conical flask containing 1.6 ml of 5% Potassium iodide solution. This was titrated against 0.01M Silver Nitrate Solution. The blank was also titrated. The endpoint was indicated by a faint but permanent turbidity. Cyanide concentration was calculated as

$$\text{cyanide (mg/kg)} = \frac{13.5 \times (Vs - Vb)}{\text{wt. of sample}}$$

where, Vb = blank
Vs = sample titre

Mineral analysis

The mineral concentration were determined from aliquots of the solutions of the ash by established atomic and flame absorption spectrophotometer. Phosphorus was determined spectrophotometrically by the molybdovanadate method AOAC [4].

RESULTS AND DISSCUSSON

Table - 1 shows the % proximate composition of *Kerstingiella geocarpa* seeds. The low moisture content (6.17± 0.2) is desirable as it will discourage microbial proliferation and help in extending the seeds shelf life. The seed is a good source of carbohydrate (61.53±0.01), crude protein (21.35±0.25), crude fibre (6.2±0.0) but it is low in fat (0.98±0.03). The crude protein concentration (%) compares favourably with those obtained for protein rich foods: Beans (*Vigna unguiculata)* (20.5±1.64) [1], Lima beans, (*Phaseolus lunatus*) (22.7) [8], Pigeon pea, (*Cajanus cajan*) (20.4) [9], and groundnut (23.2) Ononogbu[10] had noted earlier that legumes are important sources of vegetable protein in the diet. The seed can thus be used to supplement human protein needs. The crude fibre concentration (%) in the seed (6.2 ±0.00) is higher than that reported for soybeans (1.9) and groundnut (2.9) [3].showing it to be a better source of crude fibre than most other conventional seeds. Fibre forms an important component of a healthy diet. It helps in slowing down the release of glucose into the bloodstream[11]. and has preventive action against colorectal carcinoma. [12].The calculated caloric value (Kcal/ 100g) is moderate (340.26) compared with those of soybeans (408.2) and groundnut (630.48). The crude fat concentration (0.98±0.03) is very low. It will be useful in the formulation of weight restriction diets. Table - 2 shows the mineral concentration (mg/g) of 'Hausa groundnut'. The seed shows an

Table - 1:Proximate composition (%) of 'Hausa groundnut' (*Kerstingiella geocarpa)* seeds

Component	Concentration
Moisture	6.17± 0.20
Crude protein (Nx6.25)	21.33±0.25
Fat	0.98± 0.00
Ash	3.79 ±0.10
Crude fibre	6.2 ±0.00
Carbohydrate	61.53± 0.01
Caloric value**	340.26

*means of triplicate determinations (on dry basis)
**(Kcal/100g)

Table - 2: Mineral composition (mg/g)* of *Kerstingiella geocarpa* seeds

Element	Concentration
Sodium	5.67 ±0.02
Potassium	7.67 ±0.07
Calcium	8.84 ±0.10
Phosphorus	9.30± 0.02
Iron	1.75 ±0.10
Zinc	2.8 ± 0.07

*means of triplicate determinations

array of various nutritive elements. Food legumes are generally good sources of calcium, iron, zinc and potassium. [13]. Phosphorus was found to be the most abundant (9.30±0.02) followed by calcium (8.84±0.1) and potassium (7.64±0.07).

Deficiencies of P and Ca can result in abnormal bone development[14]. The high concentration of these minerals may be due to their abundance in Nigeria soils. Chemical fertilizers may be required in the future to replace the large uptake. The seed could be beneficial in the diets of patients on diuretics for hypertension control who tend to lose excessive concentration of potassium in their body fluids. In addition, the seed presents a higher than 1 K/Na ratio. This is desirable since potassium is only taken from diet unlike sodium[15]. Zinc concentration was found to be lower than those of the other elements but higher than those reported for Lima beans (0.06mg/g) by Oshodi and Adeladun[8]. Though food legumes are important

Table - 3: Antinutrients composition* of *Kerstingiella geocarpa* Seeds

Component	Composition
Phytate**	225.64±0.02
Tannin (%TA)	0.98 ± 0.00
Cyanide (%)	0.28 ±0.02

*means of triplicate determinations (on dry basis)
** mg/100g

sources of proteins in the developing world, the acceptability and utilization of unconventional and little known legumes have been limited owing to the presence of certain antimetabolic factors [16]. Hence, Table - 3 presents the Tannin (%TA) and cyanide (%) and phytate (mg/100g) concentrations in the seed. Total cyanide concentration of the seed (0.26±0.02) was lower than that of kidney beans (2.0mg/100g) reported by Liener[13]. Tannins inhibit the activity of digestive enzymes. They interact with proteins to make them insoluble[17]. Percentage tannic acid concentration (0.98±0.12) was also low.

Table - 4: Calculated values of Phytate: Zn, Ca: Phytate, and [Ca] [Phytate] / [Zn] molar ratios of 'Hausa groundnut' *Kerstingiella geocarpa* Seeds

Molar ratio	Value
Phytate: Zn	0.08
Ca: Phytate	63.10
*[Ca] [Phytate] / Zn	0.02

* (mol/kg)

This concentration may not affect the seeds' overall nutritional potential since it was less than 10% of the total dry weight of the sample[18]. Phytate concentration (mg/100g) was 225.64± 0.00. This concentration is considered moderate compared with those obtained for some beans cultivars, which range between 240-1390 mg/100g [1] . Studies in animals and human subjects have shown that diets high in phytate can cause zinc deficiency and that phytate content is negatively correlated to zinc absorption. [19]. Calcium also, potentates the inhibitory effect on zinc absorption even at relatively low amounts of dietary phytate[20] Table 4 shows the molar ratios for the prediction of Zn and Ca bioavailabilities. The calculated phytate: Zn molar ratio was lower than the critical value of 12.5:1 [21] while the calculated Ca : phytate molar ratio was higher than the critical value of 6:1. However, the calculated (Ca): (phytate)/ Zn is a better index for predicting Zn bioavailability in view of the fact that a kinetic synergism exists between the Ca and Zn ions resulting in a Ca: Zn: phytate complex which is less soluble than the phytate complex of either ion alone[22]. The molar ratio obtained for the seed (0.02) was far below the critical value of 0.5mol/kg. This result indicates that the phytate concentration in the seeds is not as high as to affect adversely Zn bioavailability. From the foregoing, *Kerstingiella geocarpa* seed is a rich source of protein, fibre and nutritive elements that can enrich human diet. It contains Tannin, phytate and cyanide in concentrations that might not pose a risk to the consumer. We recommend it as an addition to human diet and animal feeds.

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