PJN
ISSN 1680-5194

PAKISTAN JOURNAL OF NUTRITION

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorpjn@gmail.com

Pakistan Journal of Nutrition 8 (4): 316-320, 2009
ISSN 1680-5194

Effect of Processing Methods on Nutritive and Antinutritive Properties of Seeds of *Brachystegia eurycoma* and *Detarium microcarpum* from Nigeria

Friday O. Uhegbu[1]*, Chioma C. Onwuchekwa[2], Emeka. E.J. Iweala[3] and Ijeoma Kanu[4]
[1,2,3]Department of Biochemistry, [4]Department of Microbiology,
Faculty of Biological and Physical Sciences, Abia State University, P.M.B. 2000, Uturu, Nigeria

Abstract: Proximate analysis of the seeds of *Brachystegia eurycoma* and *Detrarium microcarpum* were carried out on both the dehulled and undehulled samples of the flour. The protein content of the seeds are quite low 9.1;7.2 and 11.4;8.2 for undehulled and dehulled *Brachystegia eurycoma* and *Detarium microcarpum*, respectively. Crude fibre is less than 3% in each, while ash was less than 5% each per 100gm dry weight of sample. *Detarium microcarpum* has a higher crude fat composition 18.5±0.03, 15.5±0.02 while *Brachystegia eurycoma* 15.5±0.04, 14.0±0.01 for the undehulled and dehulled samples respectively. Moisture content is higher in dehulled samples 14.3±0.01 and 16.7±0.03 for both seed types. The available carbohydrate is equally higher in the dehulled samples 59.0±0.01 and 57.0±0.01, respectively for both seeds. The sodium, potassium, calcium and magnesium contents were less than 1% each, with calcium having the highest concentration, followed by phosphorous. The phytochemical analysis showed the presence of alkaloids, tannins, saponins and flavonoids. *Brachystegia eurcoma* showed no presence of tannin. The findings are of nutritional relevance since these seeds are used for soup thickening by many homes in the southeastern Nigeria.

Key words: Detarium microcarpum, *Brachystegia eurycoma*, phytochemicals, nutritive constituents, public health

INTRODUCTION

In West Africa, dietary pattern vary and is influenced by the vegetation belt. For example in the northern parts of Nigeria, cereals dominate, while in the south, legumes, nuts, seeds and starchy roots or tubers are the main food components (Ene-Obong and Carnovalue, 1982). However, processing of the cereals and starch roots into a form of paste and eaten with soups is the general practice. Among the legumes used in soups (mainly for emulsification and stabilization of soups) are *Brachystegia eurycoma* (achi), *Detarium microcapum* (ofor), *Mucuna pruriens* (ukpo) and *Irvingia gabonensis* (ogbono). Each of the soup thickeners differ in species from the others and so have their individual characteristic flavours, which they impart to soups. Often, choice depends on individuals, but *Brachystegia eurycoma* and *Detarium microcarpum* are favourite soup thickeners in South Eastern Nigeria.

Trowell (1975) reported the lowering effect on blood glucose level and blood cholesterol content by dietary fibre; while Pederson *et al*. (1980) reported that the supplementation of the diets of diabetic patients or those with impaired glucose tolerance with fibre in the form of bran, or guar gum or the use of naturally high fibre foods such as whole grains cereals or dried legumes resulted in an improvement in blood glucose profiles, reduction in urinary glucose and a decrease in the mean serum cholesterol level.

Experiments have shown that hydrocholloids physiologically function as soluble fibre when ingested and as such are very effective in reducing blood cholesterol levels and moderating glucose response in diabetics (Fumiwayo, 1985). Though hydrocholloids are good sources of soluble fibre, they have the ability to imitate and replace fat in processed food and so have been shown to be essential component in low fat and fat free products (Glicksman, 1982). Sources of hydrocholloids are mainly from plant materials. Two of such plants are *Brachystegia eurycoma* and *Detarium microcarpum* known locally in the South Eastern part of Nigeria as “Achi” and “Ofor”, respectively. *Brachystegia eurycoma* belongs to the family Caesalpiniaceae, phylum spermatophyte and order fabaceae. It is a dicotyledonous plant, classified as legume and grows commonly along river banks. It flowers between April and May and fruits between September and January. The fruits are very conspicuous and persistently woody. The seed flour of *Brachystegia eurycoma* have gelation proterties and imparts a gummy texture when used in soups, which is a desirable attribute necessary for the eating of garri, pounded yam, etc.

Detarium microcarpum belongs to the family caesalpiniceae, phylum spermatophyte and the order fabacea. It is particularly associated with dry savannah countries. It is known to flower throughout the wet season and fruits between November and January. The fruits are fleshy and quite edible (Keay *et al*., 1964). The bark of *Detarium microcarpum* has diuretic and anti-

inflammatory effects and reduces blood glucose levels in diabetic patients. The functional properties are quite similar to those of *Brachystegia eurycoma*, hence it is equally classified as a food gum (Fatope *et al.*, 1993).
The presence of phytochemicals alongside nutrients in plant materials is obvious. We thought it necessary to investigate the effect of processing methods on the nutritive and antinutritive properties of seeds of *Brachystegia eurycoma* and *Detarium microcarpum* and their probable effects on public health.

MATERIALS AND METHODS

Sample collection and pretreatment: The mature dry seeds of *Brachystegia eurycoma* and *Detarium microcarpum* were bought as sold in Okigwe market; and graciously identified by Dr. Bob Ezumah of the department of Plant Science and Biotechnology Abia State University, Uturu, Nigeria. The seeds were sorted to remove debris and unviable ones and stored in cellophane bags to avoid contamination.

Pre-dehulling treatments: The traditional methods of processing as described by Ene-Obong and Carnovalue, 1982) was adopted in the treatment of both types of seeds. The seeds after sorting were roasted for 10-15 minutes; then soaked immediately for at least 1 hour in cold distilled water after which the cotyledons were soaked overnight in distilled water. The water was drained off and the cotyledons sun-dried and finally ground into fine power. This represents the dehulled sample. The undehulled sample was prepared by simple cleaning the seeds and grinding into fine power without prior roasting or soaking in water.
For the seeds of *Detarium microcarpum*, they were boiled for 45-60 mins with distilled water and dehulled. The seeds were washed for 3 or 4 times with distilled water and soaked overnight in distilled water. The water was drained off and the seeds sun dried and then milled. The undehulled seeds were equally milled without roasting or soaking.

Proximate analysis: Standard conventional methods were employed in all the analysis. Crude fat was extracted by the soxhlet extraction method with petroleum ether (40-60°C) for 8 hours as described by James (1995). Crude protein content was determined by the micro kjeldahl method. Available carbohydrate, crude fibre, ash and moisture contents were estimated as described by the Association of official analytical chemists (AOAC, 20005).

Determination of mineral content: Calcium, sodium, potassium, magnesium and phosphorus were determined according to the method of Shahidi *et al.* (1999). The sound seed samples were sieved with a 2mm rubber sieve and 2g each of samples were weighed and subjected to dry ashing in a well-cleaned porcelain crucibles at 550°C, in a muffle furnace. The resultant ash was dissolved in 5ml of $HNO_3/HCL/H_2O$ (1:2:3) and heated gently on a hot plate until brown fumes disappeared. To the remaining materials in each crucible, 5ml of deionized water was added and heated until a colourless solution was obtained. The mineral solution in each crucible was transferred into 100ml volumetric flask by filtration through a whatman No 42 filter paper and the volume made to the mark with deionized water. This solution was used for elemental analysis by atomic absorption spectrophotometer. A 10cm long cell was used and concentration of each element in the sample was calculated on percentage of dry matter.
Phosphorus content of the digest was determined colorimetrically according to the method described by Nahapetian and Bassiri (1975).

Determiantion of phytochemicals: Alkaloids were determined by the method as described by Higuchi and Hassan (1973). Tannins were determined by the method of Price *et al.* (1978); Bainbridge *et al.* (1996), Saponins, flavonoids, glycosides and steroidal aglycon were variously determined by the method of Harbone (1973).

Statistical analysis: Values are expressed as mean±standard error of mean. Significant differences between values are determined using the student's T-test. Differences existed at $p < 0.05$ (Steel and Torie, 1986).

RESULTS

Result on Table 1 shows that both *B. eurycoma* and *D. microcarpum* have high content of carbohydrate 56.0±0.00, 52.5±0.01 and 59.0±0.01, 57.0±0.01 for undehulled and dehulled samples, respectively. Crude fat content is also high, 15.0±0.04, 18.5±0.03 and 14.0±0.01, 15.5±0.02 for the undehulled samples of both seeds. Moisture and crude protein content is equally high followed by Ash content. The crude fibre content is low in both seeds 2.9±0.01, 2.0±0.04 and 1.4±0.02, 1.1±0.02, respectively.
The seeds of B. eurycoma shows high content of calcium 0.80±0.30 and 0.72±0.01 for the undehulled and dehulled seeds, respectively as compared with 0.35±0.20, 0.34±0.01 for seed of *D. Microcarpum*. Magnesium and potassium are next in value 0.21±0.20, 0.16±0.20, 0.24±0.10, 0.21±0.04 and 0.17±0.10, 0.10±0.12, 0.18±0.02, 0.15±0.03 for undehulled and dehulled samples, respectively. The lowest mineral in these seeds is sodium, which has a value of 0.05±0.11, 0.11±0.02 and 0.14±0.10, 0.13±0.03 for undehulled and dehulled seeds of *B. eurycoma* and *D. nicrocarpum*, respectively. Phosphorus is present as 0.33±0.10, 0.30±0.25, and 0.18±0.22, 0.15±0.11, respectively.

Table 1: Nutritive Composition of *B. Eurycoma* and *D. Microcarpum* (mg/100gm dry weight)

	B. eurycoma		*D. microcarpum*	
	Undehulled	Dehulled	Undehulled	Dehulled
Crude Protein	9.1 ± 0.02	7.2±0.05	11.4±0.04	8.8±0.03
Crude Fiber	2.9±0.01	2.0±0.04	1.4 ±0.02	1.1 ±0.02
Ash	4.5±0.03	3.5±0.02	2.0±0.01	1.5±0.01
Crude Fat	15.0±0.04	14.0±0.01	18.5±0.03	15.5±0.02
Moisture	12.5±0.01	14.3±0.01	14.2±0.04	16.7±0.03
Available carbohydrate	56.0±0.00	59.0±0.01	52.2±0.01	57.0±0.01

Results are mean±SD of triplicate determinations.

Results on Table 3 shows that both seeds contain Tannins, Saponins, Flavonoids, Glycosides, Steroidal aglycon and Alkaloids.

DISCUSSION

Result on Table 1 shows the nutritive composition of *B. eurycoma* and *D. microcarpum*. Generally there seems to be a reduction in nutrient values when the seeds are processed; as shown by the difference in values for undehulled and dehulled samples. The protein content of *D. microcarpum*; (11.4±0.04, 8.2±0.03) for undehulled and dehulled samples is of significantly ($p < 0.05$) high level than that of *B. eurycoma* (9.1±0.02, 7.2±0.05) for the undehulled and dehulled samples, respectively. It could be said that in terms of protein contents, seeds of *D. microcarpum* should be preferred. The functions of protein which include supply of amino acids, body building and replacement of worn-out tissues may be achieved more with *D. microcarpum*.

Fibre content of B. *eurycoma* (2.9±0.01, 2.0±0.04) is significantly ($P < 0.05$) higher than that of *D. microcarpum* (1.4+0.02, 1.1±0.02). The higher content of crude fibre probably explains the bulky ash content of *B. eurycoma* (4.5±0.03, 3.5±0.02) as against (2.0±0.01, 1.5±0.01) for *D. microcarpum*. The difference is quite significant at ($P < 0.05$). However, both seeds are good source of dietary fibre. This finding is in agreement with that of Ene-Obong and Carnovale (1982) who reported high dietary fibre content 5.13g per 100g dry matter for *B. eurycoma* and 50g per 100g dry matter for *D. microcarpum*. Fibre in diet play very significant roles. Certain physiological responses have been associated with the consumption of dietary fibre e.g. increase in faecal bulk, lowering of plasma cholesterol, a blunting of the post-pranal increase in plasma glucose and a lowering of nutrient bioavailability (Ene-Obong and Carnovalue (1982).

The percentage crude fat of *D. microcarpum* (18.5±0.03, 15.5±0.02 is significantly ($P < 0.05$) higher when compared with those of *B. eurycoma* (15.0±0.04, 14.0±0.01). Hence, in terms of fat content the seeds of *D. microcarpum* may be preferred. The significance of fat in food may not be over-emphasized as it contributes greatly to the energy value of foods. It could also slow down the rate of utilization of carbohydrates. During starvation, fat could be metabolized by the process of beta oxidation to provide energy for the body and provides more energy when compared with carbohydrates. Fat is an important "vehicle" for fat soluble vitamins and also acts as lubricants in the intestine.

The available carbohydrate (which excludes non-starch polysaccharides which are not digested by the endogenous enzymes of the human upper digestive system) is not significantly ($P < 0.05$) different in *B. eurycoma* (56.0±0.00, 59.0±0.01) than in *D. microcarpum* (52.5±0.01, 57.0±0.01). Though this comparison may differ if the seeds are singly compared, since this assumption is based on the higher bulk density of one *D. microcarpum* seed to one *B. eurycoma* seed. The very high carbohydrate content of these seeds as well as their ability to form viscous gums at such low concentrations as 0.1-1% in sauce shows they belong to the class of food ingredients known as hydrocolloids (Ihekoronye and Ngoddy, 1985). Apart from the supply of energy, studies have shown that viscous polysaccharides can slow the rate of gastric emptying (Schwartz *et al.*, 1982). Within the small intestine, viscous polysaccharides which can form gel matrix, may slow absorption by trapping nutrients, digestive enzymes, or bile acids in the gel matrix and by slowing mixing and diffusion in the intestine. Leeds *et al.* (1999) have shown through animal experiments, that viscosity is necessary for gum to blunt the rise in plasma glucose load. Thus the high carbohydrate content of these seeds is quite significant to health.

The seeds are rich in minerals (Table 2). While *B. eurycoma* had (0.80±0.30, 0.72±0.01); *D. microcarpum* had (0.35±0.20, 0.34±0.01) for the undehulled and dehulled seeds, respectively for calcium. *B. eurycoma* had significantly ($P < 0.05$) higher calcium content compared to *D. microcarpum*. Magnesium content is equally high, with *B. eurycoma* having (0.21±0.20, 0.16±0.20) and *D. microcarpum* (0.24±0.10, 0.21±0.04) for the undehulled and dehulled seeds. The difference in magnesium content is not significant at ($P < 0.05$) in their content of these minerals; (0.05±0.11, 0.11±0.02) and 0.14±0.10, 0.13±0.03) for sodium and (0.17±0.10, 0.10±0.12); (0.18±0.02, 0.15±0.03) for potassium in *B. eurycoma* and *D. microcarpum*, respectively. *B.*

Table 2: Mineral Composition of *B. Eurycoma* And *D. Microcarpum* (mg/100g dry weight)

	B. eurycoma		*D. microcarpum*	
Minerals	Undehulled	Dehulled	Undehulled	Dehulled
Sodium	0.05±0.11	0.11±0.02	0.14±0.10	0.13±0.03
Potassium	0.17±0.10	0.10±0.12	0.18±0.02	0.15±0.03
Calcium	0.80±0.30	0.72±0.01	0.35±0.20	0.34±0.01
Magnesium	0.21±0.20	0.16±0.20	0.24±0.10	0.21±0.04
Phosphorus	0.33±0.01	0.30±0.25	0.18±0.22	0.15±0.11

Results are means±SD of triplicate determinations

Table 3: Phytochemical Composition of *B. eurycoma* and *D. microcarpum* (mg/100g dry weight)

	B. eurycoma		*D. microcarpum*	
	Undehulled	Dehulled	Undehulled	Dehulled
Tannin	-	-	0.51±0.35	0.36±0.04
Saponins	0.03±0.51	0.02±0.06	0.40±0.04	0.30±0.55
Flavonoids	1.56±0.20	1.45±0.30	1.82±0.06	1.58±0.05
Glycosides	0.02±0.01	0.01±0.03	0.04±0.02	0.02±0.01
Steroidal Aglycon	0.16±0.02	0.10±0.40	0.14±0.03	0.08±0.11
Alkaloids	1.56±0.11	1.25±0.33	1.05±0.01	0.90±0.35

Results are means±SD of triplicate determinations

eurycoma therefore could serve as a good source of calcium which is necessary for development of strong bones and teeth. Normal extra-cellular calcium concentrations are necessary for blood coagulation and for the integrity of intracellular cement substances (Okaka and Okaka, 2001). The use of these seeds especially *B. eurycoma* in the diet of children could serve as a rapid supplementation of calcium for children with calcium deficiency. The balance of ions in the tissues is often of importance e.g. normal ossification demands a proper ratio of calcium to phosphorus, the normal ratio between potassium and calcium in the extracellular fluids must be maintained to ensure normal activity to the muscle. Sodium and Potassium are the major factors in osmotic control of water metabolism.

The phytochemical content (Table 3) of these seeds shows that *D. microcarpum* has a higher total alkaloid content (1.56±0.11, 1.25±0.33) than *B. eurycoma* (1.05±0.01, 0.95±0.35) for the undehulled and dehulled seeds respectively. The total alkaloid content of these seeds is not significantly ($P < 0.05$) different.

The presence of alkaloids in these seeds is of interest. This is because alkaloids have dual functions. At high concentrations most alkaloids are toxic, while having pharmacological effects at low concentrations. Some alkaloids like colchicines and vinca are capable of inhibiting mitotic cell division, phagocytosis as well as having lymphotoxic activity that are dangerous to health even at low concentrations (Higuchi and Brocham, 1973). *B. eurycoma* contains tannins, with the undehulled seeds having a significantly ($P < 0.05$) higher content than the dehulled; while D. microcarpum showed no trace of tannin at least at detectable levels. The presence of tannin in *B. eurycoma* explains the darkening of soups within few days of preparation. Tannin being complex phenolic polymer is capable of enzymatic oxidation, hence the pigmentation or browning of foods that contain tannin as seen in some yam species which browns when cut. Tannins have stringent properties, hasten the healing of wounds and inflamed mucous membranes (Agoha, 1974).

Both seed types contain saponins probably in similar quantity. However, there seems to be little danger with the concentrations of saponins present, as the saponins ingested are destroyed in the gastro intestinal tract, hence very little is absorbed into the system if any. Both seeds have high flavoniod content (1.56±0.20, 1.45±0.30) and 1.82±0.06, 1.58±0.05) which are not significantly ($P < 0.05$) different. Flavonoids are potent water soluble antioxidants and free radical scavengers, which prevent oxidative cell damage, strong anticancer activity (Del-Rio *et al.*, 1997). In the intestinal, tract flavoniods lower the risk of heart disease, provide anti inflammatory activity (Okwu, 2004).

Generally, the low levels of these phytochemicals most of which are lost during processing, indicate an overall good quality of the two seeds nutritionally.

This study, therefore has provided some biochemical basis for the use of these food thickeners by the people of South-eastern Nigeria. As a rich source of nutrients, minerals and phytochemicals, they could be playing a major role in the nutritional status of this group of people.

ACKNOWLEDGMENT

The authors acknowledge the extensive literature supplied by Prof. A.I. Ukoha of the department of Biochemistry Federal University of Technology Owerri.

REFERENCES

Agoha, R.C., 1974. Medicinal plants of Nigeria. Offset Drakkerij Faculticitder Wiskunde in Naturwetsenschappen. The Netherlands, P: 41 and 43.

AOAC, 2005. Official methods of analysis. Association of official analytical Chemists. Washington D.C., W. Horowitz and G.W. Latin (eds). 18th ed, P: 14.

Bainbridge, Z., K. Tomlins, K. Willings and A. Wesby (Eds), 1996. Tannins; methods for assessing quality characteristics of Non-grain starch staples. (Part 3 laboratory methods. Chatham, UK. Natural Resources Institutions.

Del-Rio, A., B.G. Obdululio, J. Vastillo, F.G. Marino and A. Orluno, 1997. Uses and properties of citrus flavonoids. J. Agric. Food Chem., 45: 4505-4515.

Ene-Obong, H.N. and E. Carnovalue, 1982. Nigeria Soup Condiments: Traditional Processing and Potential as Dietary Fibre sources. Food Chemistry, 43: 29-34.

Fatope, M.O., H. Ibrahim and Y. Takeda, 1993. Screening of Higher Plants reputed as pesticide using the Brine Shrimp lethality Assay. Int. J. Pharmacognosy, 31: 250-254.

Fumiwayo, O.O., 1985. A review of the dietary fibre hypothesis and its relationship to Diabetes mellitus in Nigeria. Nig. J. Nutr. Sci., 6: 61-69.

Glicksman, M., 1982. Origins and classification of hydrocholloids: In food hydrocholloids, 1: 15-25. CRC Press Bocafla.

Harbone, J.B., 1973. Phenolic compounds; Nitrogen compounds in plants: In phytochemical methods, 33-97. Litton Educational Publication Inc.

Higuchi, T. and Brocham Hassan, 1973. Pharmaceutical analysis. In phytochemical methods, 100-116. Litton Educational Publication Inc.

Ihekoronye, A.I. and P.O. Ngoddy, 1985. Integrated food science and technology for the tropics, P: 283. University of Ibadan Press.

James, C.S., 1995. Principles and Techniques used in food analysis: In analytical chemistry of foods, 6-15. Blackie Academic and Professionals-an imprint of Champion and Hall, London.

Keay, R.W.J., C.F.A. Onochie and D.P. Standfield, 1964. Nigeria Trees vol. 1, Dept. of Forest Research, Ibadan Nigeria.

Leeds, A.R., N.R. Bolster, R. Andrew and A.R. Truswell, 1999. Meal viscosity, gastric emptying and glucose absorption in the rat. Proc. Nutr. Soc., 44A.

Nahapetian, A. and A. Bassiri, 1975. Changes in concentration and Interrelationships of phytate, P, Mg, Cu, Zu in wheat during maturation, J. Agric. Food Chem., 32: 1179-1182.

Okaka, J.C. and A.N.O. Okaka, 2001. Food Composition, spoilage and shelf life extension. Ocjarco Academic Publishers, Enugu, Nigeria, P: 54-56.

Okwu, D.E., 2004. Phytochemicals and vitamin content of indigenous species of South-eastern Nigeria. J. Sustain Agric. Environ., 6: 30-37.

Pederson, O., E. Hollund, H.O. Lindskor and N. Schwartz, 1980. Increased insulin receptors of monocytes from Insulin dependent Diabetes after high starch fibre diet. Diabetologio., 19: 306.

Price, M.L., S. Van-scoyoc and L.G. Butter, 1978. A critical evaluation of the vanillin reaction as an assay for Tannin in Sorghum Grain. Agric. Food Chem., 26: 1214-1218.

Schwartz, S.E., R.A.S. Levine, J.R. Schreidecker and N.S. Track, 1982. Sustained pectin ingestion delays gastric emptying gastroenterology, pp: 812.

Shahidi, F., U.D. Ghavan, A.K. Bal and D.B. Mckenzie, 1999. Chemical composition of Beach pea (*Lathyrus maritimus L.)*. Plant Parts Foods Chem., 64: 39-44.

Steel, R.G.D. and J.H. Torie, 1986. Principles and Procedure of statistics. A biometric approach. Mc Graw Hill, New York.

Trowell, H.C., 1975. Fibre, Hypothesis of the etiology of Diabetes mellitus. Diabetics, 24: 762-765.