INTERNATIONAL JOURNAL OF NATURAL AND APPLIED SCIENCES (IJNAS), VOL. 5, NOS.1& 2 (2010); P. 67 – 73, 4 TABLE,

Effect of processing on nutritional and phytochemical compositions of *parkia biglobosa* (*Dawa dawa)*

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ABSTRACT

The effect of processing on proximate, mineral elements, antinutritional and phytochemical compositions of raw, cooked and fermented seeds of *Parkia biglobosa* seeds were carried out. The results of Proximate analysis revealed the following respective values for raw, cooked and fermented *Parkia biglobosa*, Moisture (8.02 ± 0.12, 17.50 ± 0.11 and 38.01 ± 0.11%w/w), ash (3.01 ± 0.11, 2.16 ± 0.12 and 2.30 ± 13%DM), Crude fibre (6.01 ± 0.12, 4.02 ± 0.11 and 4.00 ± 0.11%DM), Crude fat (10.00 ± 0.13, 8.01 ± 0.12 and 20.0 ± 0.12%DM), crude protein (29.00 ± 0.11, 26.17 ± 0.11) and 37.75 ± 0.11%DM) and Carbohydrate (51.78 ± 0.44, 59.70± 0.14 and 35.44 ± 0.54%DM). The proximate compositions result sugest that the seed samples could be a rich source of nutrients. The toxicant compositions of the seeds of *Parkia biglobosa* revealed the following respective values for raw, cooked and fermented samples, hydrocyanic acid (HCN) (60.01 ± 0.11, 58.01 ± 0.11 and 61.01 ± 0.12mg/100gDM), Phytic acid (18.02 ± 0.12, 16.01 ± 0.12 and 21.01 ± 0.13 mg/100gDM) and soluble oxalate (10.03 ± 0.11, 8.00 ± 0.11 and 12.01 ± 0.12 mg/100gDM). The mineral elements profile in mg/100gDM revealed approximately increased levels in Potassium (K), sodium (Na), Calcium (Ca) and Magnesium (Mg) while phosphorus (P), Copper (Cu) and Zinc (Zn) where low on all the studied samples. The phytochemical screening of the raw, cooked and fermented *Parkia biglobosa* extracts showed presence of alkaloids, cardiac glycosides, saponins, polyphenols, anthraquinones and reducing sugars. These secondary plant metabolites are known to have microbial activities as well as physiological properties.

INTRODUCTION

Food processing has revealed that anti-nutritional and flatas factors are removed considerably by utilizing methods such as boiling, cooking, sprouting, roasting and fermentation (Wang and Fieds, 1979). Effects of processing on nutrients properties of wild and cultivated plant foods have been investigated by several workers (Dahan *et al.,* 2000; El-Marki *et al., 2007 and Aremu et al.,* 2009). These antinutritional factors need to be removed or inactivated by extensive washing and heat treatment of the seeds or seed meals prior to use in the diet. Rincon *et al.* (1990) and Nikel *et al.* (1991) revealed that commercial processing of food leads to the loss of major constituents like polysaccharides, protein, vitamins and minerals. Germah *et al.* (2007) reported on the nutritional composition of the African locust bean (*Parkia biglobosa*) fruit pulp as influenced by processing. Influence of hydrothermal treatments on proximate compositions of fermented locust beans have also been investigated. Omololu *et al.* (1986) studied the nature of lipids in African locust beans (*Parkia ifilicoider welw.*) and changes occurring during processing and storage.

The locust bean seed (*Parkia biglobosa)* is a grain legume found growing in the savanna regions of Africa. It is fermented and added to soups and stew as condiments to enhance their flavour and nutritional values (Otunya, 1991). The seeds and pulp of this plant have been successfully used as food for livestocks. In the dry season, the trees are potential source for food, edible oil, fodder, lumber, firewood and manure. The Parkia tree plays a vital ecological role in cycling of nutrients from deep soils by holding the soil particles to prevent soil erosion. The locust seed is a major item of commerce across West Africa and the tree also provides shade for farmers (Campbell-platt, 1980).

Research findings have revealed that the seeds are used as foods and medicinal agents. It is known to provide ingredient that is used in the treatment of leprosy and hypertension. The leaves and roots are used in preparing a lotion for eye sore treatment. A decoction of the bark of *Parkia biglobosa* is used as bath for fever, mouth wash and toothache reliever. The pulp bark is used along with lemon for wounds and ulcer treatment. The fermented seeds are locally used in Nigeria as food seasoning (Achi, 2005).

The micro organisms associated with the fermentation process are staphylococcus, saprophytococus, xylolus and Bacilus substilis (Odunfa, 1981). The fruit, pulp and seeds are known to be rich in protein, amino acids and high concentrations of glutamic acids.

Parkia biglobosa (dawa dawa) seed is commonly utilized among the people of northern senatarial zone of the Cross River State. In many parts of this zone where the trees are cultivated and where protein calories mal-nutrition is a major problem it serves as the basic food supplement. Its socio-economic, nutritional and environmental importance cannot be over emphasized (Njoku *et al.,* 1991). The traditional people in this area prefer dawa dawa to imported taste enhancers. Thus fermented *Parkia biglobosa* remains the key constituents of diet throughout this region.

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Inspite, of the high nutritive and physiological importance of *Parkia biglobosa*, informations in the literature are very scanty. The present investigation was therefore, designed to study *Parkia biglobosa* obtained from Bekwarra, Cross River State with a view to assessing its nutritional and phytochemical compositions as affected by processing.

MATERIALS AND METHODS

Collection and preparation of samples

Seed samples of P*arkia biglobosa (dawa dawa)* were collected from a farm plantation from Bewarra, Cross River State in the South-South Geo-political Zone, Nigeria. The samples brought from the field were identified at the University of Calabar botanical Garden.

Raw samples

Cold water was added to 300g of *Parkia biglobosa* seeds, left for 5h and then dehulled. The dehulled seeds were dried in an Astell Hearson type oven to a constant weight at 60^{o}C for 24h.

Cooked Samples

The cooking was done using an aluminium pot, using one part of the raw seeds (300g) to 15 parts of distilled deionized water on a Gallon kamp thermostated hot plate. The seeds were considered cooked when they become soft to touch when pressed between the thump and fingers. At the end of the cooking, the water was drained and the seeds were oven-dried to a constant weight.

Fermented Samples

The dehalled raw seeds (300g) were wrapped in blanched banana leaves and allowed to ferment for 72h. The fermented seeds were picked, washed and dried on an Astell Hearson type oven to a constant weight at 60^{o}C for 12h. After all processing treatments were completed, all the raw and processed seeds samples were ground (separately) into fine powder with an electric grinder. The powdered samples were stored in desiccators until analysis.

Mineral composition analysis

A Pye-Unican atomic absorption spectrophotometer with acetylene flame was used to analyse for calcium, magnesium, iron, magnesium, copper, zinc, and phosphorus as described by A. O. A. C (1990). While sodium and potassium were determined by flame photometer (Galler Kamp) as described by Vogel (1962). The minerals were determined by first wet-ashing the samples (A.O.A. C., 1990). Sodium and potassium were determined by flame photometer (Galler Kamp). Calcium, manganese, magnesium, phosphorus, copper, zinc and iron were determined by atomic absorption spectrophotometer (Pye-Unican). Emarck concentrated volumetric solutions were used as standard metallic ions solution for the calibrations. All reagents used were of analytical grade and the water used was double distilled.

Proximate analysis

Proximate analysis was carried out on all the samples treated. Moisture, ash, ether extract (EE), crude fibre (CF) and nitrogen free extract (NFE) were determined by the method of (A.O.A. E. 1990). Nitrogen content was multiplied by a factor of 6.25 in order to calculate protein content. The estimation of available carbohydrate was done by difference as CHO = 100-(% ash + % crude protein + % crude fibre + % crude fat) while energy (Kcal) = % CHO x 4) + (%CP x 4) + %CL x9). Where CHO stands for carbohydrates, CP is crude protein and CL is crude lipid.

Toxicant analysis

Hydrocyanic acid (HCN) was estimated by the alkaline titration method of (A.O.A.C. 1975). Oxalate was determined by the method of (Dye, 1956) while phytic acid was extracted using 3% trichloroacetic acid. The extracts were prepared according to the method described by wheeler and Ferrel (1977). The absorbance was read at 480nm while the phytic acid was calculated by employing the method of Saturdi and Suckle (1985). On the basis that six atoms of phosphorus are contained in one molecule of phytic acid giving a 1:3.55 phosphorus: phytic acid molecule ratio (Phytic acid = $C_6H_{18}O_{24}P_6$).

Phytochemical screening

Phytochemical screening for the presence of alkaloids, saponins, flavonoids, tannins, anthroquinones, anthranoids, polyphenols, cardiac glycosides and reducing sugars were carried out according to the methods described by Harborne (1973) and Sofawora (1980).

RESULTS AND DISCUSSION

Table 1. shows the proximate compositions of the raw, cooked and fermented seeds of *Parkia biglobosa.* Moisture content was 8.02, 17.50 and 38.01%, ash was 3.01, 2.10 and 2.30%, crude fibre 6.01, 4.02 and 4.00%, crude fat 10.00, 8.01 and 20.01%, crude protein 29.00, 26.17 and 37.75% carbohydrate 51.98, 59.70 and 36.94% while energy was 413.92, 415.57 and 475.66Kcal for raw, cooked and fermented seeds respectively.

Table 1. Proximte Compositions of raw, cooked and fermented *Parkia biglobosa (dawa dawa)* seeds

Parameters	Raw Seeds	Cooked Seeds	Fermented Seeds
Moisture (%)	8.02 ± 0.12	17.50 ± 0.11	38.01 ± 0.11
Ash (%)	3.01 ± 0.10	2.10 ± 0.12	2.30 ± 0.12
Crude fibre (%)	6.01 ± 0.12	4.02 ± 0.11	4.00 ± 0.11
Crude fat (%)	10.00 ± 0.13	8.01 ± 0.12	20.01 ± 0.12
Crude protein (%)	29.00 ± 0.11	26.17 ± 0.11	37.75 ± 0.11
Carbohydrate (%)	51.98 ± 0.44	59.70 ± 0.64	35.94 ± 0.54
Energy (kcal)	413.92 ± 0.11	415.57 ±0.12	475. 66 ±0.11

The data are mean value ± standard deviation of triplicate determinations.

Table 2. Toxicant compositions (mg/100g) of raw, cooked and fermented *Parkia biglobosa (dawa dawa)* seeds.

Toxicants	Raw Seeds	Cooked Seeds	Fermented Seeds
Phytic acid	50.01 ± 0.11	58.01 ± 0.11	61.01 ± 0.12
Hydrocyanic-Acid (HCN)	18.02 ± 0.12	16.0 ± 0.12	21,.01 ± 0.13
Soluble oxalate	10.03 ± 0.11	8.00 ± 0.11	12.01 ± 0.11

The data are mean value ± standard deviation of triplicate determinations.

Table 3. Mineral elements (mg/100g) of raw, cooked and fermented *Parkia biglobosa (Dawa dawa)* seeds

Minerals:	Raw Seeds	Cooked Seeds	Fermented Seeds
Potassium	160.05± 0.11	186.01±0.11	193.01±0.12
Sodium	190.01±0.11	160.10±0.12	196.00±0.11
Calcium	168.01±0.12	8.02±0.11	177.01±0.12
Phosphorus	10.01± 0.11	8.02±0.11	12.01±0.11
Iron	9.01±0.12	6.01±0.11	14.01±0.11
Copper	12.01±0.12	10.01±0.12	13.01±0.12
Zinc	7.10±0.11	5.02±0.11	9.00±0.11
Manganese	50.01±0.12	46.01±0.12	66.01±0.12
Magnesium	160.00±0.11	155.01±0.11	166.01±0.12

Data are mean value ± standard deviation of triplicate determinations

Table 4. Phytochemical screening of the raw, cooked and fermented *Parkia biglobosa (Dawa dawa)* seeds.

	Raw seed		Cooked seeds		Fermented seeds	
Phytochemical	**Petroleumether Extracts**	**Water Extracts**	**Petroleum ether Extract**	**Water Extracts**	**Pet. Ether Extract**	**Water Extracts**
Alkaloids	++	+	++	+	-	+
Cardiac glycosides	++	+	++	+	+	+
Saponins	++	+	++	+	-	-
Tannins	-	-	-	-	-	-
Flavonoids	-	-	-	-	-	-
Polyphenols	++	+	++	+	++	+
Phlobatannins	-	-	-	-	-	-
Anthraquinones	++	+	++	+	-	-
Anthranoids	-	-	-	-	-	-
Reducing sugars	++s	+	++	+	++	+

Key: ++ = Present in excess quantity
+ = present in moderate quantity
- = Absent

Table 2 shows the toxicant composition of the seeds of *Parkia biglobosa* samples. The soluble oxalate ranged from 8.00 ± 0.11mg/100g to 12.01± 0.11mg/100g. The phytic acid contents ranged from 16.01 ± 0.12mg/100g to 21.01 ± 0.13 mg/100g while the hydrocyanite content (HCN) ranged from 58.01mg/100g to 61.01 ± 12mg/100g. Table 3 presents the mineral element compositions of *Parkia biglobosa* seeds while Table 4 presents the results of phytochemical screening of the raw, cooked and fermented *Parkia biglobosa* samples. The results obtained from this study revealed the presence of alkaloids, cardiac glycosides, saponins, polyphenols, anthraquinones and reducing sugars.

DISCUSSION

This study was designed to assess the potentials of the seed of *Parkia biglobosa* for nutritional utilization and physiological importance. The moisture contents of the fermented seeds was higher than that of the raw and cooked samples. The increase in moisture contents of the fermented samples may be attributed to soaking and metabolic activities of microorganisms during the fermentation period. (Omafuvbe *et al.*, 2000). The values obtained from this study agrees with other reports on African locust beans seeds (Omafurbe *et al.*, 2004). Moisture contents of food is usually used as a measure of stability and susceptibility to microbial contamination (Scott, 1980).

The ash contents of raw, cooked and fermented seeds were 3.01 ± 0.10, 2.10 ± 0.12 and 2.30 ± 0.12% respectively. The slight decrease in the ash content of fermented samples may be attributed to leaching of soluble minerals. A knowledge of the ash contents gives information about the mineral contents of the food.

The crude fibre contents were 6.01, 4.02 and 4.00% respectively. The fibre contents of the cooked and fermented samples in the present study were lower than that of the raw samples. The reduction in fibre values for cooked and fermented sample could be attributed to dehalling and boiling of the locust beans during processing.

The crude fat contents were 10.00, 8.01 and 20.01% DM respectively. The crude fat values of 9.57 and 21.17%DM has been reported for raw and fermented locust beans (Stephen *et al.*, 1996). The knowledge of fat contents of any food help to ascertain the shelf life of the food.

The crude protein contents were 29.00, 26.17 and 37.75%DM respectively. The protein contents of the fermented samples was higher than the raw and cooked samples. This increased in protein contents may be attributed to the reduction in the carbohydrate, crude fibre and ash contents. The values obtained on this study compared favourably with the values recorded by Omafuvbe *et al.*, 2004, and Odunfa, 1986 in their work on effects of processing on parkia biglobosa. Bacillus substallis is one of the microorganism involved in the fermentation of *Parkia biglobosa.* This microorganism showed proteolytic activity and may contribute to high protein value in the fermented samples. (Antai and Ibrahim, 1988). The daily protein

requirement for children and adults are 23-26 and 45-56g respectively (NRC, 1974).

The carbohydrate values are 51.98, 59.70 and 35.94% for raw, cooked and fermented samples. The raw and cooked samples have higher carbohydrate contents compared to the fermented samples. The decreased in carbohydrate value of the fermented samples is as a result of soaking and boiling. This values obtained from this study compared favouraly well with 33.53% reported for fermented Parkia biglobosa by Omafuvbe *et al*. (2004). Loss of carbohydrate contents during fermentation may arise as a result of utilization of some sugars by fermenting microorganisms for growth and metabolic activities.

The results of anti-nutritional factors are presented in table 2. The phytic acid values were 50.01, 58.01 and 61.0mg/100g for raw, cooked and fermented samples respectively. This result compares with the findings of Gernah *et al* (2007). The hydrocyanic acid (HCN) contentswas found to be 18.02, 16.01 and 21.01 mg/100g for raw, cooked and fermented samples respectively. These values are far below the lethal dose for man 50-60mg/kg body weight/day.

The soluble oxalate values were relatively low in all the samples studied. The values of 10.03, 8.00 and 12.01mg/100g for raw cooked and fermented samples respectively were far below the toxic levels of 2-5g oxalate (Munro and Bassir, 1969). Consumption of oxalate can cause corrosive gastroenteritis, shock, convulsive symptoms, low plasma and renal damage (Eastwood, 1986). The antinutritional factors such as phytate, hydrocyanate and the soluble oxalates are known to affect the complete absorption of many minerals (Oguntone, 1998).

The elemental compositions showed high level in potassium, sodium, calcium and magnesium and low levels in phosphorus, iron, copper zinc and manganese. Potassium concentration above tolerance limits in the body has been reported to influence iron utilization (Adedeye, 2002). Magnesium on the other hand, plays important function in relaxing muscle along the air ways to the lungs thus enabling asthma patients to breathe with relative ease, (Appel, 1999). Manganese has also been reported to support immune system, regulate blood sugar levels and involved in the production of energy (Anhwange *et al*. 2004). The importance of copper in the body system cannot be overemphasized. Copper deficiency causes cardiovascular disorder, anaemia and nervous system disorder (Mielcarz *et al.*, 1997). The phytochemical screening of the raw, cooked and fermented seeds of *Parkia biglobosa* revealed the presence of alkaloids, saponins, anthraquinones, polyphenols, cardiac glycosides and reducing sugars in both petroleum and water extracts. Tannins, flavonoids, phlobatannins and anthranoids were not detected in both petroleum ether and water extracts. These secondary plant metabolites are useful to man and the synthesis of pharmaceutical products. For instance alkaloids when administered to most animal produce striking physiological effects. Alkaloids have many uses in the medical fields; some alkaloids stimulate the central nervous system others cause paralysis, lowering of blood pressure or elevations. Certain alkaloids act as pain relievers, tranquillizers and also act against infection microorganisms (Solomon and Craig, 1998). Polyphenols are compounds that have hydroxyl groups directly attached to benzene ring. They are structurally similar to alcohol but are much stronger acids. They help in contracting the blood capillaries thus preventing certain hemorrhages (Solomon and Carg, 1998).

CONCLUSION

This study has presented the effect of processing on the nutrient and phytochemical compositions of *Parkia biglobosa.* The study showed that *Parkia biglobosa* seeds contained nutritionally useful ingredients. The anti-nutritional factors were virtually low in all the processes adopted. It was observed that the two processing methods applied in this study (cooking and fermentation) affected the nutrient contents of *Parkia biglobosa* seeds. Fermentation method can be recommended as the appropriate processing method for this important food crop.

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