African Journal of Biotechnology Vol. 9 (2), pp. 183-186, 11 January, 2010
Available online at http://www.academicjournals.org/AJB
DOI: 10.5897/AJB09.152
ISSN 1684–5315 © 2010 Academic Journals

Full Length Research Paper

Effect of processing on the nutritional and toxicological components of *Cleome rutidosperma* seed

L. A. Nwaogu[1]* and A. C. Udebuani[2]

[1]Department of Biochemistry, Federal University of Technology, Owerri, Nigeria.
[2]Department of Biotechnology, Federal University of Technology, Owerri, Nigeria.

Accepted 17 February, 2009

The effect of processing on the proximate composition, antinutrient levels and mineral contents of (devil bean) *Cleome rutidosperma* seed were investigated. Quantitative analyses of the antinutrient composition revealed that boiling the bean for 1 h, changing and discarding the water twice reduced appreciably most of the antinutrient components in the bean including alkaloids, flavonoids, tannins, saponins, cyanogenic glycosides, oxalate, phytic acid and trypsin inhibitors. The treatment had no effect on the composition of ash, crude fibre and fats. The same treatment decreased the composition of protein from 26.95 ± 0.02 to 20.30 ± 0.03%, moisture from 12.80 ± 0.01 to 11.82 ± 0.02%. The same processing increased the carbohydrate content from 48.50 ± 0.05 to 50.35 ± 0.02%. There was no significant difference (P≤0.05) observed in the mineral elements studied as a result of the treatment. The minerals include calcium, potassium, sodium, magnesium and phosphorus.

Key words: *Cleome rutidosperma* seed, processing, antinutrient components, mineral compositions.

INTRODUCTION

Foods of plant origin constitute the major source of food for man due to mainly their availability and low cost (Obizoba, 1998). Most people in developing countries derive their protein supplies from legumes and cereals. In some part of the world like India, legumes constitute a major source of protein. Potential foods of plant origin were less obvious to early man than animal foods and less palatable but curiosity, hunger and the eating habit of other animals led to the sampling of leaves, fruits, seeds and all sorts of plants for food. Eventually the most appealing botanical items were included in food supply (Udedibe and Nwaiwu, 1988).

The crisis in Nigeria's poultry business began as an indirect result of the ban on importation of wheat and maize in 1982 and this resulted in an instant hike in the prices of poultry feed concentrates (Udedibe et al., 1995). This has led to the consideration of alternatives and the exploitation of other potential feed sources, particularly those that are underutilized and indigenous to the environment.

Cleome rutidospearm is a common weed climber, usually grown in the rain forest region of Nigeria. It is known locally as "Akugbara" in the Igbo speaking region unipinnate and sometimes trifoliate forms. It has a stinging nettle which causes itching when in contact with the human skin. It has a hard pod which when dry, splits open thereby liberating the seeds. The seeds are black in colour and vary in size from about 7 to 16 mm long (Onwueme and Sinha, 1991). *C. rutidospearm* seed is a highly nutritive bean. One of the problems associated with it is that it has some anti-nutritional components which make it toxic when raw. Like other legumes, *C. rutidospearm* contain antinutrients like tannins, trypsin inhibitors, saponins, alkaloids and cyanoglycosides which limit maximum utilization of the nutrients in the bean (Osagie, 1998).

Food processing especially boiling has been found to be invaluable in improving the nutritional quality of foods especially by deactivating the antinutrients in foods. Boiling for a long time for example is capable of denaturing some of these antinutrients thereby decreasing their levels in foods (Bressani, 2002). This study therefore investigated the effect of boiling for a long time and changing and discarding the water on the antinutrient composition in *C. rutidosperma* bean seed with the view to accessing its nutritive value and potential health hazards.

*Corresponding author. E-mail: nwogulinus@yahoo.com.

Table 1. Effects of boiling on some antinutrient components of C. *rutidosperma* seed.

Antinutrient components	Component unit value (± S.D*)	
	Raw	Boiled
Alkaloids	0.31± 0.03 mg/100gm	0.03 ± 0.01 mg/100gm
Flavonoids	0.38 ± 0.01 mg/100gm	0.03 ± 0.01 mg/100g
Tannins	0.28 ± 0.02 mg/100gm	0.16 ± 0.02 mg/100gm
Saponins	0.20 ± 0.01 mg/100gm	0.03 ± 0.01 mg/100gm
Cyanogenic Glycosides	18.50 ± 0.40 mg/100gm	1 0.20 ± 0.10 mg/100gm
Oxalate	0.37 ± 0:01 mg/100gm	0.35 ± 0.02 mg/100gm
Phytate	0.38 ± 0.02 mg/100gm	0.23 ± 0.01 mg/100gm
Trypsin Inhibitor	1.03 ± 0.02 Tiu/100mg	0.35 ± 0.01Tiu/100gm

*Values are means of standard deviation of triplicate determinations.

MATERIALS AND METHODS

Collection and preparation of plants material

Fresh and apparently uninfected seeds of *C. rutidosperma* were collected from their natural habitat in Umuahia, Abia State, Nigeria, in November, 2007. The bean seeds were identified by Prof. S. E. Okeke, a plant taxonomist of the Department of Plant Sciences and Biotechnology, Imo State University, Owerri, Nigeria.

The seeds of *C. rutidosperma* were carefully removed from their pods. 200 g of the seeds were dehulled manually and divided into two portions of 100 g each. One portion of dehulled beans in the ratio of 4:1 (v/w) was washed and boiled in distilled water for 1 h and the water was changed and discarded two times. The other portion was washed with distilled water without boiling. Each of the samples was dried and milled in a hammer mill (70 mesh screen) to a fine flour, packaged and labeled appropriately.

10 g of the flour was soaked in 100 ml of pre-boiled distilled water. This was covered, shaken vigorously every 30 min for 2 h and then allowed to stand for 2 h. The solution was subsequently shaken and filtered using Whatman's No. 1 filter paper. The extract was concentrated by freeze-drying and used for the various analyses.

Chemical analysis

Determination of antinutrients

Quantitative determination of tannins, saponins, alkaloids, flavonoids and cyanogenic glucosides were carried out by the methods of Harborne (1973) and Trease and Evans (1989). Oxalates were determined according to the method by Oke (1969). Phytic acid was determined by the method of Major et al. (1990). Trypsin inhibitor was determined using the method of Kakade et al. (1979).

Proximate analysis

The proximate analysis of the seed extract for moisture, ash, fibre carbohydrate, crude protein and fat contents were determined as described by AOAC standard assay method (AOAC, 1995).

Mineral analysis

The minerals; sodium, potassium, calcium, magnesium and phosphorus in the bean were determined by atomic absorption/emission spectrophotometer method (AOAC, 1995).

Statistical analysis

Data obtained were expressed as mean ± standard deviation and analyzed using student 't' test. Values for $P \leq 0.05$ were taken to be significant (Parker, 1979).

RESULTS AND DISCUSSION

Antinutrient compositions of the seed extract are presented in Table 1. The levels of alkaloids in the bean seed were relatively low and ranged from 0.31 ± 0.03 mg/100 g, when raw to 0.03 ± 0.01 mg/100 g when processed. The levels were reduced significantly by boiling when compared to the raw samples. Alkaloids are not strictly regarded as antinutrients but are rather grouped within natural food toxicants. Most alkaloids are known for their pharmacological effects rather than for their toxicity. However, when alkaloids occur in high levels in foods, they cause gastro-intestinal upset and neurological disorders (Okaka et al., 1992). Alkaloids generally act as stimulants by prolonging the action of several hormones.

Flavonoids are the least found in the processed samples (Table 1). Flavonoids are destroyed by heat processing methods like drying, roasting and boiling (McWilliams, 1979). Flavonoids are currently regarded as essential nutrients rather than as antinutrients. Some flavonoids like rutin are known to strengthen blood capillary and other connective tissues (Bowrne, 1990), while others like quercetins help to block the sorbitol pathway that is linked with many health complications associated with diabetes (Alais and Guy, 1991).

The levels of tannins in the extracts ranged from 0.28 ± 0.02 mg in the raw sample to 0.16 ± 0.02 mg/100 g in the processed sample. Like other legumes, *C. rutidosperma* seed contains tannins. Tannins have the capability of decreasing the digestibility and palatability of proteins because they form insoluble complexes with them (Osagie et al., 1996). Tannins can also interact with dietary iron by preventing its absorption. Tannins are not easily completely destroyed by heat due to their high

Table 2. Nutrient composition of raw and boiled C. *rutidosperma* seed.

Nutrient composition	% Mean composition (±S.D*)	
	Raw	Boiled
Ash	5.6 ± 0.02	4.90 ±0.01
Crude fibre	5.24 ± 0.02	5.08 ± 0.06
Moisture	12.80 ± 0.01	11.80 ± 0.02
Crude protein	26.95 ± 0.02	20.30 ± 003
Carbohydrate	48.50 ± 0.05	50.356 ± 0.02
Fat	1.16 ± 0.02	0.98 ± 0.03

*Values are means of standard deviation of triplicate determinations.

molecular weight (Price et al., 1987). Saponin levels in the processed sample were reduced significantly when compared to the raw sample (Table 1). Saponin is another antinutrient factor whose toxicological effects should be balanced with its benefits. Saponins have been shown to possess hypocholesterolemic effect as well as cause cytotoxic permeabilization of the intestines through its biological activities depending on the structure (Guthrie and Piciano, 1995).

Phytic acid in the samples (Table 1) ranged from 0.38 ± 0.02 mg/100 g in the raw sample to 0.23 ± 0.01 mg/100 g in the processed sample. Phytic acid has 12 replaceable hydrogen atoms and therefore could form insoluble salts with many metals like calcium, iron, zinc, magnesium and phosphorus thereby preventing the proper utilization of these minerals (Jack et al., 1985). Phytate is not easily destroyed by processing temperatures hence the result in Table 1. There are some beneficial effects of phytic acid. Studies indicate that there are interactions between phytic acid and heavy metals like lead and cadmium. It has been reported that the lowest accumulation was achieved when calcium and phytic acid were administered simultaneously and that phytate was responsible for a considerable decrease in the intestinal absorption of cadmium (Murray et al., 2003; Igbedioh et al., 1994).

The levels of oxalate in the samples decreased from 0.37 ± 0.01 mg/100 gm in the raw sample to 0.35 ± 0.02 mg/100 gm in the processed sample (Table 1). Oxalic acid as an antinutrient interferes with mineral availability particularly calcium. It binds with calcium and forms insoluble calcium oxalate which cannot be absorbed in the body (Giami et al., 1999).

Cynaogenic glycoside contents in the samples (Table 1) indicate that processing decreased significantly its levels from 18.54 ± 0.48 to 5.20 ± 0.10 mg/100 g in the raw and processed samples respectively. Cyanogenic glycosides are precursors of hydrogen cyanide, a well known natural toxicant in foods. The presence of this toxicant serves a note of caution due to its toxicity although the level is below the toxicity level.

Trypsin inhibitor levels of the samples were between the ranges of 1.03 ± 0.02 TIU/100 g in the raw samples to 0.35 ± 0.01 TIU/100 g in the processed sample. Trypsin inhibitor activities affect protein digestibility negatively. The reduction of trypsin inhibitors by processing is attributable to heat denaturation.

Table 2 presents the proximate composition of *C. rutidosperma* seed. The results revealed that processing had no significant effect (P≤0.05) on the following proximate composition in both the raw and the processed samples: ash, crude, fibre and moisture contents.

Crude protein levels in the samples decreased from 26.95 ± 0.02% in the raw sample to 2.30 ± 0.02% in the processed sample (Table 2). The decrease in crude protein could be attributed to leaching and denaturation caused by boiling. The protein levels in the processed samples fall within the range reported for other legumes (Elegbede, 1998).

Crude fat levels in the samples decreased from 1.16 ± 0.02% in the raw sample to 0.98 ± 0.03% in the processed sample. The slight decrease though not significant (P≤0.05) could be due to leaching occasioned by boiling. Boiling may also have brought about denaturation of the lipid fraction in the processed samples (Elegbede, 1998).

The carbohydrate content in the samples increased from 48.50 ± 0.05% in the raw sample to 50.35 ± 0.02% in the processed sample and this compares well with that reported for *Mucuna Sloane* seed (Ijeh et al., 2004).

The results of the mineral components of the raw and processed bean of *C. rutidosperma* are presented in Table 3. Living organisms require minerals. Diet must provide macro and micro elements. Legumes and cereals have relatively low mineral contents (Eggum et al., 1983). There was no significant difference (P≤0.05) between the raw and the processed samples in mineral components determined in this study.

Conclusion

This work supports the claim that processing improves nutrient potentials of leguminous seeds by reducing the level of antinutrient factors. It further indicates that well

Table 3. Mineral contents of raw and boiled C. *rutidosperma* seed.

Mineral contents	Composition (mg/100 g dry) weight ±S.D*	
	Raw	Boiled
Calcium	0.70± 0.02	0.71± 0.02
Potassium	0.36± 0.02	0.38± 0.02
Magnesium	0.67± 0.03	0.68± 0.03
Sodium	0.33'± 0.02	0.34± 0.01
Phosphorous	0.52± 0.01	0.53± 0.02

processed *C. rutidosperma* seeds could be a potential food that could be used to augment critical scarce protein sources especially in Nigeria's poultry feed industries as this bean seed is locally available and underutilized.

REFERENCES

Alais C, Guy L (1991). Food Biochemistry (1st ed) Aspen Pub. London pp. 120 – 125.

AOAC (1995). Official Method of Analysis, Association of Official Analytical Chemicals, Washington DC.

Bowrne AO (1990). Toxicity of Plant Foods (2nd ed). Ari. Publ. Compony Toronto, Canada pp. 231 – 326.

Bressani R (2002). Effect of Chemical changes during storage and processing of the Nutritional Quality of Common Bean. RH: W.W.W.unu Kaduna press/ food / 8fo51 e / 8fo51E06 / hfm.

Eggum BA, Monowas L, Bach Knadsen KE, Munck L, Astells J (1983). Nutritional quality of soybean and sorghum foods from Sudan. J. Cereals Sci. 1: 127 - 137.

Elegbede JA (1998) Legumes. In: Nutrition Quality of Plant foods. Osogie, A. U and Eka, O. U. (eds). Postharvest Res. Unit University of Benin, Benin city. pp. 53 - 83.

Giami SY, Adindu MN, Akusu MO (1999). Effects of Processing Methods on Protein and other Chemical constituents of fluted Pumpkin (Telferia accidentals) and African breadfruit (*Treculia africana*). Proceeding of the 23rd Annual NIFEST Conference. Abuja. 127 - 130.

Guthrie AG, Piciano MF (1995) Human Nutrition. McGraw Hills. U.S.A. pp. 222 – 234.

Harborne LB (1973). Phytochemical Methods. A Guide to Modern Technology of Plant Analysis (2nd ed) Chapman and Hall. New York. pp. 88 -185.

Igbedioh SA, Olugbemi KT, Akpapunam MA (1994). Effect of processing methods on phytic acid levels and some constituents of bombara groundnut (*Vigna subterraneae*) and Pigeon *pea* (*Cajanus cajoa*). Food Chem. 30: 147-151A.

Ijeh II, Unaegbu SO, Anaga AO (2004). Studies on some Nutritional and Toxicological properties of *Mucuna sloanei.* Bio - Research. 2 (1): 24 - 28.

Jack GA, Rambeck WA, Kollmer WE (1985). Retention of Cadmium in Organs of rats after single dose of labelled Cadmium - 3 - phytate. Biol. Trace Elem. Res. 6: 69 - 74.

Kakade ML, Bakis JJ, Mc Gec JE, Puski G (1979). Determination of Trypsin inhibitor activity of soy products: A collaboration analysis of an improved Procedure. Am. Assoc. Cereal Chem. 51: 376383.

Major EK, Simpson BK, Idowu JS, Oke OL (1990). Effects of Local food Processing on phytate levels in Cassava, Cocoyam and Maize. J. Agric. Food Chem. 38: 1580 - 1583.

McWilliams M (1979). Food Fundamentals: John Wiley and sons Inc. New York U.S.A., pp. 125 – 130.

Murray RK, Granner OK, Mayers PA, Rodwell VW (2003). Harper's Biochemistry (26th ed). McGraw - Hill. London.

Obizoba IC (1998). Fermented Food. In: Nutritional Quality of Plant Foods. Osagie AU, Eka, OU (eds). PostHarvest Res Unit, University of Benin City. pp. 160 -198.

Okaka JC, Enoch NJ, Okaka NC (1992). Human Nutrition. An Integrated Approach. Enugu State University of Technology Publ. Enugu pp. 130 – 152.

Oke OL (1969). Oxalic acid in Plant and Nutrition. World Review on Nutrition and Dietetics. No: 262 – 303.

Onwueme IC, Sinha TD (1991). Feed Crop Production in Tropical Africa. Principles and Practice. ITA Publisher Netherland. pp. 25 - 28.

Osagie AU (1998). Antinutritional Factors. In: Nutritional Quality of Plant Foods. Osagie AU, Eka OU (eds) Postharvest Res Unit, University of Benin, Benin City. pp. 221 - 244.

Osagie AU, Muzguiz M, Burbano C, Cuadsado C, Ayet G, Castano A (1996). Some antnutritional Constitution in ten staple Food items in Nigeria. Trop. Sci. 36: 109 -115.

Parker KE (1979). Introductory Statistics for Biology. (2nd ed). Arnold publisher Ltd. London. pp. 18 - 30.

Price KR, John IT, Fredrick GR (1987). The Chemical and Biological Significance of Saponins in Foods and feeding stuffs. Food Sci Nutri. 26: 27 - 90.

Trease GE, Evans WC (1989). Textbook of Pharmacognosy. (12nd ed) Balliese Tindal and Company Publisher, London. pp. 343 - 388.

Udedibe ABI, Nwaiwu Z (1988). The Potential of Jack bean (*Canavalia ensiformis*) as animal feed. Nig. Agric. J. 23.118 - 129.

Udedibe ABI, Esonu BO, Unachukwu C, Iwuoha NC (1995). Two - stage cooking as a method of improving the nutritive value of jack bean (*Canavalia ensiformis*) for broilers. Nig. J. Anim. Prod. 23: 107 - 110.