PROXIMATE COMPOSITION AND ANTI-NUTRITIONAL CONSTITUENTS OF DIFFERENT FORMS OF RAW, SOAKED OR COOKED AFRICAN LOCUST BEAN (*Parkia biglobosa*)

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ABSTRACT
Proximate composition and anti - nutritional constituents of different forms (whole, depuled and dehulled) of raw, soaked and cooked African locust beans (*Parkia biglobosa*) were evaluated. Cooked, whole meal (CWM) and cooked dehulled meal (CHM) recorded significantly ($p<0.05$) lower moisture content (12.41 and 13.35%) than other groups. CHM produced a significantly ($p<0.05$) higher crude protein value (49.60%) than other groups. Cooked, depulped meal (CDM) recorded the highest (27.75%) ether extract value which was similar ($p>0.05$) to values obtained for Soaked, depulped meal (SDM). Crude fibre did not show any significant ($p<0.05$) changes although the values tended to increase with soaking and cooking. Cooking significantly ($p<0.05$) reduced the ash content of all forms of the African locust beans. Cooked, whole beans (CWM) produced the significantly ($p<0.05$) higher nitrogen free extract (21.33%) than other groups. Phytic acid values increased in Soaked, whole meal (SWM), Soaked dehulled meal (SHM), and CHM treatments. Tannin content recorded significant ($p<0.05$) reduction in CDM, CHM, SHM and SDM. Soaking and cooking produced significant reduction ($p<0.05$) in hydrocyanide content of the beans compared to raw beans. Cooking and soaking produced significant ($p<0.05$) reduction in Trypsin Inhibitor Activity (TIA) with 100% reduction recorded for all forms of cooked beans. It would appear that cooking for 1 hour has significant benefits in improving the proximate composition and anti-nutritional constituents of African locust beans.

Key Words- Proximate composition, Anti-nutritional factors, Processing, African locust bean.

INTRODUCTION

The conversion of feed into meat, milk, egg and other animal products is the major goal in the livestock industry therefore feed is a major input. Basically, feed is composed of the same elements which go to form the animal's body and its product (Williamson and Payne, 1995). In Nigeria, there is a general need to improve the level of consumption of these animal products which are the major sources of animal protein. A disincentive to the consumption of the animal products is the prohibitive cost especially to majority of Nigerians whose daily income is less than USD 1.00 per day. (Esonu, *et al*., 2007, Esonu, *et al*., 2010). The high cost of animal products predictably results from the cost of input principally feed which is estimated to account for 70 - 80 % of production cost in poultry enterprises (Esonu, 2015). High feed cost is caused mainly by the food – feed competition between human and livestock /poultry for the available grain and legume which serve as human food, feed for animal and industrial raw materials. Particularly, the protein feedstuff contribute significantly to this high cost of feed (Esonu, *et al*., 2007).

Recent efforts have therefore been concentrated on diversifying the sources of protein feedstuff for livestock and poultry (Esonu, 2015). Since conventional feedstuff are sometimes scarce and very expensive, there is the need to evaluate the characteristics and quality potentials of existing non utilized material for use in livestock feed. The major drawback in the utilization of these non – conventional protein sources are the anti – nutritional factor inherent in them especially the legumes (Udedibie and Carlini, 1998). There is also lack of basic information on the availability and composition of these materials especially when subjected to processing in an attempt to reduce or eliminate anti – nutritive factors.

African locust bean (*Parkia biglobosa*) is an important edible leguminous seeds, rich in protein and usually fermented to a tasty food condiment called Dawadawa and is used as a flavor intensifier for soup and stew (Dike and Odunfa, 2003). The seed has been reported to have a proximate composition of 24 – 31% crude protein, 6.60 – 17.7% ether extract, 4.0 – 11.7% crude fibre, 2.00 – 5.40% ash and 35.0 – 51.2% carbohydrate (Omafuvbe *et al*., 2004; Grewal and Jood. 2006). However, the use of locust bean seed and other legumes as protein source in livestock especially in non – ruminant diet is limited by the presence of anti-nutritional factors. Anti-nutritional compounds in African locust bean tend to cause poor protein digestion and other deleterious effect in man and his livestock. Studies by (Grewal and Jood. 2006) showed that African locust bean contains some anti-nutritional factors/toxin such as phytic acid, crude saponins, tannins, hydrocyanic acid and trypsin inhibitor. These Anti nutritional factors tend to severely reduce feed intake, nutrient availability and utilization (Osagie, 1998). The efficient utilization of African locust bean therefore, depends on the complete elimination or considerable reduction of the anti – nutritional factors since feed is the largest item of cost in livestock production. (Omeje, 1999). Improving the nutritional quality and organoleptic acceptability of cheaper leguminous seed which are rich in protein could make available cheaper feedstuff for feed production in order to maximize livestock production at least cost.

Different processing techniques have been employed to reduce or destroy these anti-nutritional factors in legumes (Apata and Ologhobo, 1997). Some commonly used processing techniques include soaking in water (Emenalom *et al*., 2004), roasting/toasting (Etuk and Udedibie; 2002; Etuk, and Ohiagbaji; 2006), dehulling (Emenalom *et al*., 2008; Esenwah and Ikenebomeh,, 2008), boiling and cooking (Udedibie and Carlini, 1998; Etuk, *et al*., 2005, Etuk and Udedibie, 2006; Esonu *et al*., 2013; Ahiwe *et al*., 2014), soaking in water (Emenalom *et al*., 2010), microwave treatment and steam bleaching and fermentation (Emenalom *et al*., 2011).

This study was therefore designed to determine the proximate and Anti-nutritional constituents of different forms of raw, soaked or cooked African locust bean (*Parkia biglobasa*).

MATERIALS AND METHODS

The study was conducted at the Poultry Unit, School of Agriculture and Agricultural Technology (SAAT) Teaching and Research Farm, Federal University of Technology, Owerri and the Nutrition Laboratory, Department of Animal Production and Health, Federal University of Technology Akure, Nigeria. The African locust beans (*Parkia biglobosa)* used for this study was procured from Ikakumo village, Akoko Edo Local Government Area, Edo State, Nigeria. The beans were packed in feed bags and transported to Owerri for processing.

The raw African locust beans were divided into three portions of 1kg each. One portion was stored whole after drying for a day to obtained the raw whole bean (RWB). The other two portions were processed by depulping (removal of the pulp). This was achieved by soaking the beans in tap water for 45 minutes to soften the adhering pulp and then rubbing the soaked bean between the palms to remove the soft pulp. The beans were thereafter sun dried for 72hrs to obtain the raw depulped beans (RDB). One portion of the RDB was further processed by dehulling. Dehulling was achieved manually by cracking the hull with the aid of a small hammer to facilitate the removal of the hard hull to obtain raw dehulled bean (RHB)

The RWB, RDB and RHB were subsequently subjected to the following treatments:

Treatment 1

Raw: 100g each of RWB, RDB and RHB were measured from the prepared sample, hammer milled to obtain raw whole meal (RWM), raw depulped meal (RDM), raw dehulled meal (RHM), respectively. Each was stored in air - tight sample bottles for further analysis.

Treatment 2

Soaking: 100g each of the RWB, RDB and RHB were measured and soaked for 24hrs in separate containers. After 24 hours the residue water were drained off and samples were sundried for 48hoursand hammer milled to obtain soaked whole meal (SWM), Soaked depulped meal (SDM) and soaked dehulled meal (SHM), respectively. Each sample was stored in air tight sample bottles for further analysis.

Treatment 3

Cooking: 100g each of the RWB, RDB and RHB were measured into separate containers and cooked for 1 hour. The residue water was then drained and the beans allowed to cool and sun dried for 48hours. The dried beans were hammer milled to obtain cooked whole meal (CWM), Cooked depulped meal (CDM) and cooked dehulled meal (CHM).

Laboratory analysis of samples

All the processed/treated samples were divided into 2 replicates and analyzed for proximate composition and anti - nutritional constituents.

The moisture content, ash content, crude fibre and ether extract (fat) and total nitrogen free extract (NFE) were determined according to AOAC (1990), while the crude protein content was determined according the method of (Pearson, 1976). Tannin content was determined by the method of (Markkar and Good Child, 1996). The phytic acid content was determined according to the method of (Wheeler and Ferrel, 1971). The trypsin inhibitor activity (TIA) was determined by the method of (Smith *et al*., 1980). The hydrogen cyanide (HCN) content was determined by the standard method (Smith *et al*., 1980).

Means of the values obtained in each treatment were subjected to analysis of variance (ANOVA). Where significantly effects were observed, the means were separated using Least Significant Difference (LSD) (Obi, 1990).

RESULTS AND DISCUSSION

Proximate composition of processed African Locust Beans: The results of the proximate composition of the different forms and differently treated Africa Locust bean are presented in Table 1.

Moisture content (MC): The MC of whole, depulped and dehulled African locust bean treated as raw, soaked or cooked ranged from 12.41 – 20.67%. These values were very much higher than the 8.60% reported by (Omafuvbe *et al*., 2004). The disparities in the value could perhaps be attributed to the drying process and/or stage of maturity of the beans (Zanakis *et al*., 1994). Apart from the cooked beans, MC values for raw or soaked beans indicated a low moisture content of whole beans (RWM, SWM) than the dehulled or depulped meals (RDM, RHM and SDM, SHM). This agrees with the report of (Emenalom *et al*., 2001) which indicated a higher MC content of dehulled and cooked *Mucuna pruriens* seeds compared to the raw seeds. The raw beans (RWM, RDM and RHM) recorded higher MC than the corresponding samples of soaked or cooked beans. However, only CWB and CHB recorded significantly (p<0.05) lower MC than other groups. It is possible that cooking enhanced the drying process (Emenalom *et al*., 2001).

Crude protein (CP): CP of processed African locust bean in this study ranged from 33.60 to 49.60%. The dehulled beans (RHM, SHM and CHM) recorded significantly (p<0.05) higher CP values than other forms of raw, soaked or cooked African locust beans. Dehulling and cooking for 1 hour (CHM) produced a significantly (p<0.05) higher CP value than all forms and treatment/processing methods. Among the depulped beans, the raw (RDM) produced significantly (p<0.05) higher CP than soaked and cooked bean. The soaked whole bean (SWM) produced significantly (p<0.05) higher CP than the RWM and CWM. Cooking appeared to reduce the CP content of the bean except for the dehulled bean (CDM). This agrees with Emenalom *et al*. (2005) who reported a significant reduction in CP of *Mucuna pruriens* seeds after cooking. It is possible that cooking induces leaching of unstable nitrogen out of the beans. (Omafuvbe *et al*., 2004) obtained similar result with African locust bean. It is also possible that dehulling increased the concentration of the CP in the bean.

Ether extracts (EE): Ether extract values ranged from 21.48 – 27.75 % for all forms and treatment/processing methods. Dehulling and Depulping increased the EE content of soaked and cooked beans with cooked and depulped (CDM) beans recording the highest value (27.75%) but similar (p>0.05) to soaked and depulped beans SDM. Soaking and cooking might have resulted in the cleavage of the protein and lipid linkages thereby facilitating easy extraction of the oil by the extracting solvent. This agrees with the findings of (Addy *et al*., 1995) and (Omafuvbe *et al*., 2004).

Crude fibre: (CF) Whole (RWM, SWM and CWM) produced higher CF values than other forms of the processed bean except SDM. It appears that the different forms and treatment methods did not produce any significant (p>0.05) changes in the CF content of the African locust bean except RHB which produced a significant (p<0.05) reduction. Emenalom *et al.* (2010) reported a significant reduction in CF of dehulled and cooked *Mucuna puriens* seeds.

The CF values obtained were however close to the 3.5% reported for cowpea by (Ojimelekwe *et al*., 1999).

Ash: The ash content of raw, soaked and cooked African locust bean ranged from 2.00 – 4.92%. Cooking significantly (p<0.05) reduced the ash content of all forms of the bean. Similarly soaking of the depulped and dehulled beans reduced the ash content of the beans .These reductions might have resulted from leaching of soluble organic salts into the water used in soaking and cooking (Omafuvbe *et al*., 2004). Cooking and dehulling according to the reports of Emenalom *et al*. (2001) and Emenalom *et al*., (2005) did not significantly affect the ash content of *Mucuna puriens* seeds.

Nitrogen Free Extracts: Cooked whole beans (CWM) produced the highest NFE value (21.33%) which was significantly (p<0.05) higher than the values obtained for all forms and treated/processed beans. Conversely, cooked, dehulled beans (CHM) produced the least NFE value (6.68%). It is possible that the removal of the hull might have facilitated the leaching of carbohydrate into the cooking water. Etuk (2001) reported a reduction in NFE value of pigeon pea when cooked in boiling water for 60 minutes.

Anti - nutritional Factors in African Locust Bean: The effect of forms and treatment methods on antinutritional constituents of African locust bean are presented in Table 2 and Figure 1, 2, 3.

Phytic Acid: The phytic acid content of all forms of raw and treated African locust beans ranged from 54.78 to 86.91 mg/g. These values were much higher than the phytic acid of raw, cooked, autoclaved and roasted African yam bean, Bambara groundnut, Kidney bean, Lima bean, Pigeon pea and Jack bean (Apata and Ologhobo, 1997). Soaking and cooking produced significant (p<0.05) increases of phytic acid in whole [(SWM, 27.82%) and (CWM, 23.31%)] and dehulled (SHM, 2.90%) African locust bean in this study. Significant (p<0.05) reduction in phytic acid content were also obtained for SDM (8.15%) and CDM (5.82%) (Fig 2). Mbajunwa, (1995) reported a reduction in phytic acid content of soaked African locust bean. Emenalom *et al*. (2010) similarly reported a reduction in phytic acid content of fermented *Alchornea cordifolia* seeds. The 5.82% and 8.15% reduction in phytic acid content with soaking and cooking of depulped African locust bean agrees with the report Apata, and Ologhobo (1997) that cooking, roasting and autoclaving resulted in a minimum of 2.7% and a maximum of 10.4% loss of phytic acid. The unexpected increase in phytic acid of soaked whole meal, (SWM) cooked whole meal (CWM) and soaked dehulled meal (SHM) could not be explained.

Tannin: The tannin content of all forms of raw and processed African locust bean ranged from 0.03 to 0.84%. These were within the range of values obtained by Apata, and Ologhobo, (1997) for some raw and processed legumes. Soaking and cooking produced a significant (p<0.05) reduction in tannin content of dehulled (SHM and CHM), depulped (CDM and CDM) and only cooked, whole (CWM) beans. The percentage reduction of tannin with soaking and cooking (Fig. 1, 2, 3) were much higher than values obtained by (Apata and Ologhobo, 1997). However, the result was in agreement with their report that cooking produced the highest level of loss of phytic acid.

Hydrogen cyanide (HCN): HCN content of all forms of raw and treated (soaked and cooked) African locust beans ranged from 0.23 to 1.00 mg/g. Soaking and Cooking expectedly resulted in significant ($p<0.05$) reduction in the HCN content of all forms of the beans with soaking producing the highest loss in whole (SWM) and dehulled (SHM) beans. It is probable that the relatively long period of drying after soaking and cooking might have contributed to the reduction in HCN in the bean (Mbajunwa, 1995).

Trypsin Inhibitor Activity (TIA): TIA ranged from 0.39 to 2.26 mg/g in all forms of raw, soaked or cooked African locust bean. These values were much lower than that reported by Udedibie and Carlini (1998) for raw and processed (toasted, 25% dry urea treated, 5% dry urea treated, urea solution treated and boiling for 1 hour) *Canavalia ensiformis* and *Canavalia braziliensis* .The 100.00% loss of TIA (Fig 1,2,3) obtained with 1 hour cooking in this study agrees with (11) who similarly reported 100% loss of TIA in African yam bean, Bambara groundnut, Kidney bean, Lima bean, Pigeon pea and Jackbean cooked in water for 1 hour 50 minute. Soaking for 24 hours however, resulted in a TIA loss of 53.57, 56.29 and 76.55% for SWM, SDM and SHM, respectively.

CONCLUSION

The various forms and treatment/processing method affected the nutritional value of African locust bean. The higher crude protein, fat and carbohydrate obtained for some forms and treated African locust bean, confer improvements on its nutritional quality. Cooking, completely removed trypsin inhibitor activity though other anti-nutritional factors were not reduced to tolerable levels. Also, cooking and soaking produced significant reduction in tannin and HCN concentration. The reductions did not however appear significant enough for efficient utilization of same in poultry diet. It will be advisable to attempt other forms of treatment such as fermentation to further reduce the anti-nutritional and possible increase the proximate values for use by farmers and feed manufacturers.

REFERENCES

Addy, E.O.H., Salami, L. I., Igboeli, L. C., Remawa, S. H. (1995). Effect of processing on nutrient composition and anti-nutritive substances of African locust ean (*Parkia biglobosa*) and baobab seed (*Adansonia digitata*). *Plant Food Nutri*tion, 48:113 – 117.

Ahiwe, E. U., Emenalom, O. O., Etuk, E. B., Okehie, U. N. (2014). Performance of broilers fed a diet containing boiled Christmas bush (Alchornea cordifolia) feed meal. Proc., 39th Ann. Conf. Nig. Soc. Anim. Prod. March 16 – 19, 2014. Babacock University, llishan Remo, Ogun State. Pp. 398 – 402.

AOAC (1990). Association of Official Analytical Chemist, Official Methods of Analysis. 15th edn. Washington DC.

Apata, D. F. and Ologhobo, A. D. (1997). Trypsin inhabitors and other anti – nutritional factor in tropical legume seeds. Tropical Science, 37: 52 - 59.

Dike, E. N. and Odunfa S. A. (2003). Microbiological and biochemical evaluation of a fermented soya bean product – soya dawadawa. Journal of Food Science and Technology, 40: 606 – 610.

Emenalom, O. O., Udedibie, A. B. I., Esonu, B. O. (2001). Comparative evaluation of raw, dehulled and cooked Mucuna puriens (velvet bean) seeds on the diets of weaner rabbits. Proc. 26th Ann. Conf., Nig. Soc. For Anim. Prod. (NSAP). 4th March, 2001. Pp. 187 – 188.

Emenalom, O. O., Udedibie, A. B. I., Esonu, B. O., Etuk, E. B., Emenike, H. I. (2004). Evaluation of unprocessed and cracked and cooked Velvet beans (Mucuna pruriens) as feed ingredients for pigs. Livestock Research for Rural Development 16: Article No 33. http://www.cipav.org.co/lrrd16/5/enem/6033.htm.

Emenalom, O. O., Udedibie, A. B. I., Esonu, B. O., Etuk, E. B. (2005). Evaluation of processed Velvet bean (Mucuna puriens) as a feed ingredient in starter diets for broiler chickens. Journal of poultry Science, 42: 301 – 307.

Emenalom, O. O., Etuk, E. B., Esonu, B. O; Udedibie, A. B. I. ,Obiora, B. A. (2008). Evaluation of fermented Alchornea cordifolia seed meal in the diet of broiler chicks. proc., 13th Ann. Conf. Anim. Sci. Assoc. Nig. (ASAN) September 15 – 19, 2008. Ahmadu Bello University, Zaria. Pp. 381 – 383.

Emenalom, O. O., Etuk, E. B., Esonu, B. O., Nwaiwu, L. C. (2010). Phytochemical and nutritional evaluation of raw and fermented Alchornea cordifolia seed meals on the performance of broiler chicks. Nigerian Journal of Animal Production. 36: 52 – 60.

Emenalom, O. O., Obiora, A. B., Okehie, U.N. (2011). Antinutritient factors, Performance and serum biochemistry of broiler chicks fed raw and fermented Alchornea cordifolia seeds. Online Journal Animal and Feed Research, 2: 17 – 22.

Esenwah, C. N. and Ikenebomeh, M. J. (2008). Processing effect on the anti – nutritional contents of African locust bean (Parkia biglobosa) seed. Pakistan Journal of Nutrition. 7: 214 – 217.

Esonu, B. O. (2005). Evaluation of raw and cooked pigeon pea seed meal as feed ingredient for weaner pigs. Bulletin Animal Health. Production in Africa, 53: 125 – 129.

Esonu, B. O., Nnaemeka, A. A.,Azubuike,J. C., Uchegbu, M. C., Ezeokeke C.T. (2007). Performance and economic analysis of broiler starters fed dried rumen digesta. International Journal of Agriculture and Rural Development, 9: 77 – 79.

Esonu, B. O., Osegbe ,A. I., Udedibie, A. B. I., Emenalom, O. O., Azubuike J. C., Ayo – Enwerem, C. M ., Etuk , E. B. (2010). Effect of enzyme supplementation on performance of broiler fed dried rumen digesta meal: Book of abstract, 5th All Africa Conf., Anim. Agric. And 18th Ann. Meeting of the Ethiopian Soc. of Anim. Prod. (ESAP). 25 – 28, 0ctober, 2010, Addis Ababa. Pp. 110.

Esonu, B. O., Anumni, P. E., Udedibie, A.B.I., Emenalom,O. O., Etuk, E. B., Odemelam, V., Okorie, R.C. (2013). Evaluation of two – stage cooked Canavalia pliagiosperma (Piper) Seed meal as feed ingredient in layer diets. Nigerian. Journal of Animal Science, 15: 95 – 103.

Esonu, B. O. (2015). Animal Nutrition and Feeding. A Functional Approach 3rd ed. Rukzeal and Ruksons Associate, Owerri. Pp. 165 – 166.

Etuk, E. B. (2001). Determination of the optimal replacement level(s) of soyabean meal and maize with toasted and cooked pigeon pea (Cajanus cajan) seed meal for broilers. M.Sc Thesis. Federal University of Technology, Owerri. Pp. 50 – 51.

Etuk, E. B. and Udedibie, A. B. I. (2002). Substitution value of toasted pigeon pea (Cajanus cajan) for soyabean and maize in broiler starter diet. International Journal of Agricultural and Rural Development, 3: 92 – 97.

Etuk, E. B. and Ohiagbaji F. (2006). Performance of weaner rabbits fed diets containing milled toasted pigeon pea seed. Bulletin of Animal Health and Production in Africa, 53: 125 – 129.

Etuk, E. B. and Udedibie, A. B. I. (2006). Effect of cooked pigeon pea seed meal on the performance, dressed and organ weight characteristics of broilers. Nigerian Journal of Animal Production, 33: 16 – 22.

Etuk, E. B., Chidebere, P. Opara, Uchegbu, M. C, Emenalom,O. O. and O.

and Esonu, B. O.(2005). Evaluation of raw and cooked pigeon pea seed meal as feed ingredient for weaner pigs. Bulletin of Animal Health and Production in Africa, 53: 125 – 129.

Grewal, A. and S. Jood. (2006). Effect of processing treatments on nutritional and anti-nutritional contents of green gram. Journal of Food Biochemistry, 30: 535-546.

Markkar A. O. S and Good Child, A. V. (1996). Quantification of tannin. A Laboratory Manual International Centre for Agricultural Research in Dry Areas (ICARDA) Aleppo, Syria 1 .Pp. 25.

Mbajunwa, O. K. (1995). Effect of processing on some anti – nutritive and toxic compound on the nutritive composition of the African oil bean. (Pentaclethra macrophylla Benth). Journal of Science and Food Agriculture 65: 153 – 158.

Obi, I.U. (1990). Statistical methods of detecting differences between treatment means. 2nd edition. Snaap press, Enugu, Nigeria.

Ojimelekwe, P. C., Onweluzo, J. C., Okechukwu, S. A. (1999). Effects of infestation on the nutrient content and physiochemical properties of two cowpea (Vigna unguiculata) varieties. Plant Food for Human Nutrition, 53: 321 – 332.

Omafuvbe, B. O., Falade O.S., Osuntogun N. A., Adewusi S. R. A. (2004). Chemical and biochemical changes in African locust bean (Parkia biglobosa) and Melon (Citrullus vulgaris) seed during fermentation to condiment. Pakistan. Journal of Nutrition, 3: 140 – 145.

Omeje, S. I. (1999). Issues in Animal Science. 1st ed. Paykenedy Scientific Publishers Enugu. Pp. 83 - 100.

Osagie, A. U. (1998). Anti – nutritional Factors In: Osagie A. U. and O. U. Eka (Eds), Nutritional Quality of Plant Foods. Post – Harvest Research Unit. Department of Biochemistry, University of Benin – City, Nigeria, Pp. 221 – 244.

Pearson, D. (1976). Chemical analysis of Food. 7th edition, Longman, Singapore. Pp. 7 – 11.

Smith, C., Megan, V. M., Twaalfhoven, L., Hitchcock. C. (1980). The determination of trypsin inhibition level in food stuffs. *Journal* of the *Science* of *Food* and *Agriculture*, 31:341 – 350.

Udedibie, A. B. I. and Carlini, C. R. (1998). Crack and Cook (CAC): A simple and quick process for elimination of Con Canavalin A (Con A) from Canavalia seeds. Animal Feed Science and Technology; 74: 179 – 184.

Wheeler, E. L and Ferrel, R. E. (1971). A method for phytic acid determination in wheat fraction. Cereal Chemistry, 48:312 – 316.

Williamson, G. and Payne, W. J. A. (1995). An Introduction to animal husbandry in the tropics. 1st edn. Longman, London, Pp 1 – 5.

Zanakis, G. Ellis R.H., Summerfield R.J. (1994). Seed quality in relation to seed development and maturation in three genotypes of soybean (Glycine max). Experimental Agriculture, 30:139-156.

Table 1: Effect of forms and processing methods on the proximate composition of African locust beans (% DM)

Processing methods	Forms of locust beans	Constituents					
		MC (%)	CP (%)	EE (%)	CF(%)	ASH (%)	NFE (%)
RAW	Whole (RWM)	18.64[ab]	38.87[af]	25.86[ac]	3.44[ab]	3.19[ac]	10.02[ab]
	Depulped (RDM)	19.21[ac]	39.59[ac]	24.59[ac]	3.29[a]	3.79[a]	9.55[abc]
	Dehulled (RHM)	20.67[a]	44.23[b]	21.48[b]	2.44[b]	N/A	N/A
SOAKED (24HRS)	Whole (SWM)	16.34[b]	42.83[bc]	25.80[ac]	3.50[ab]	4.92[d]	7.25[bc]
	Depulped (SDM)	17.02[bc]	35.99[df]	27.01[d]	4.23[a]	3.18[a]	11.96[b]
	Dehulled (SHM)	18.84[ab]	44.17[b]	22.88[bc]	3.56[a]	2.00 [b]	8.56[abc]
COOKED (1HR)	Whole (CWM)	13.35[d]	33.60[d]	25.47[a]	4.25[a]	2.02[b]	21.33[d]
	Depulped (CDM)	18.63[ab]	35.63[df]	27.75[d]	3.39[ab]	2.36[bc]	10.46[ab]
	Dehulled (CHM)	12.41[d]	49.60[e]	25.34[a]	3.39[ab]	2.64[bc]	6.68[c]
SEM		0.83	1.13	0.69	0.36	0.81	1.17

[a-f] Means with different superscripts, within a column are significantly different ($p<0.05$).
MC= Moisture content, CP = Crude protein, NFE = Nitrogen free extract, EE = Ether extract, CF = Crude fibre, N/A = Not available, SEM = Standard error of mean.

Table 2: Effect of forms and processing methods on the anti-nutritional content of African Locust Beans

Processing method	Form of locust beans	Constituents			
		Phytic acid (mg/g)	Tannin (%)	TIA(mg /g)	HCN (mg/g)
RAW	Whole (RWM)	54.78[b]	0.16[f]	1.00[b]	0.84[c]
	Depulped (RDM)	70.85[c]	0.84[ab]	0.90[ab]	1.35[a]
	Dehulled (RHM)	84.46[d]	0.79[b]	0.93[ab]	2.26[d]
SOAKED (24HRS)	Whole (SWM)	70.02[c]	0.19[f]	0.44[cd]	0.39[bc]
	Depulped (SDM)	65.08[a]	0.38[c]	0.48[c]	0.59[bc]
	Dehulled (SHM)	86.91[d]	0.22[ce]	0.65[d]	0.53[bc]
COOKED (1HR)	Whole (CWM)	67.55[a]	0.03[d]	0.51[cd]	0.00
	Depulped (CDM)	66.73[a]	0.83[ab]	0.44[cd]	0.00
	Dehulled (CHM)	58.08[b]	0.26[ce]	0.76[d]	0.00
SEM		1.63	0.28	0.23	0.43

[a-f] Means with different superscripts, within a column are significantly different ($p<0.05$).HCN =Hydrogen cyanide, TIA =Trypsin Inhibitor Activity

Figure 1: Effect of soaking and cooking on anti-nutritional constituents of whole African locust beans

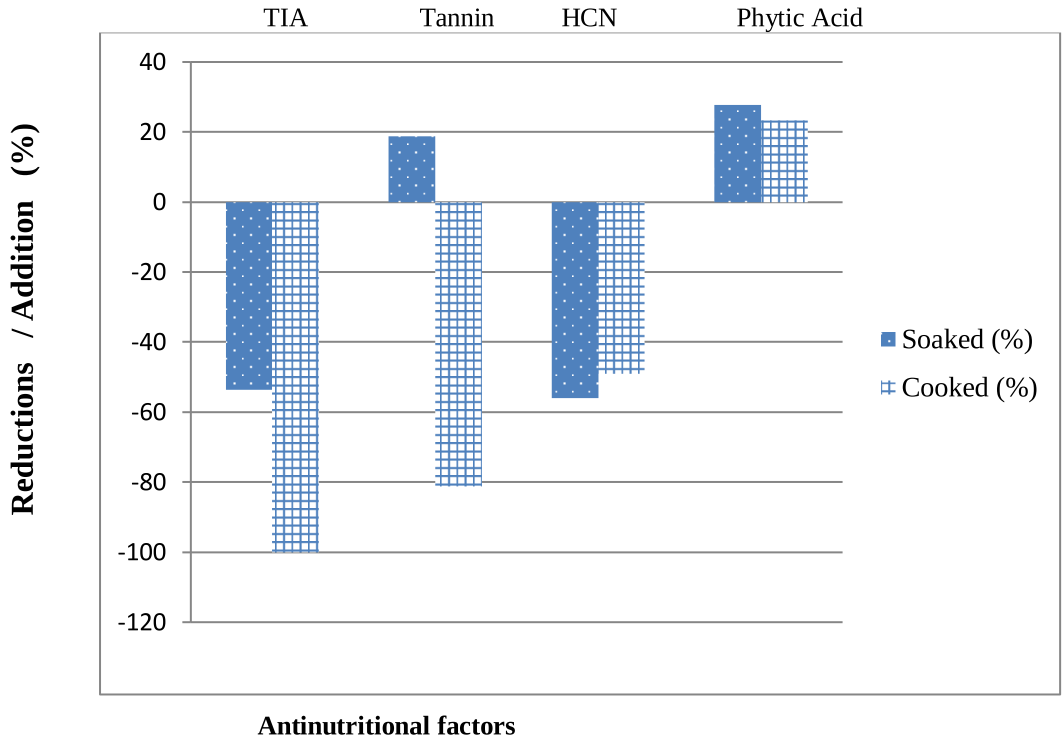

Figure 2: Effect of soaking and cooking on anti-nutritional constituent of depulped African locust beans

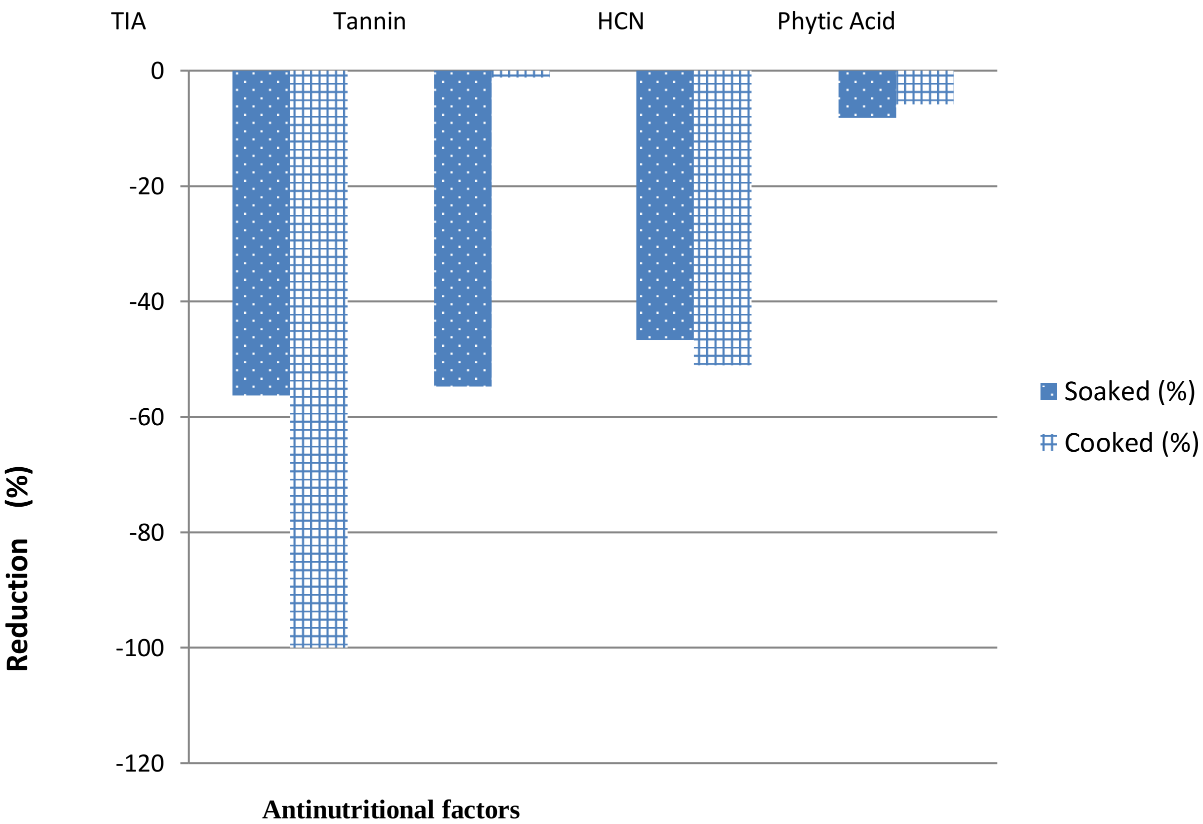

Figure 3: Effect of soaking and cooking on anti-nutritional constituents of dehulled African locust bean.