ISSN 0189-0514
J. Anim. Prod. Res. (2018) 30(1):179-187

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EFFECT OF COOKED AFRICAN LOCUST BEAN SEED MEAL DIETS ON PERFORMANCE, HAEMATOLOGICAL PROFILE AND NUTRIENT DIGESTIBILITY OF FINISHER BROILER CHICKENS

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ABSTRACT

This study was conducted to investigate the effect of cooked African locust bean seed meal diets on the growth performance, haematological profile and nutrient digestibility of broiler chicken**.** One hundred and twenty (120) five weeks old broiler chickens (Marshall Strain) were fed five broiler finisher diets containing cooked African locust bean seeds meal (CALBSM) at dietary level 0, 7.5, 15, 22.5 and 30% designated as T1, T2, T3 ,T4 and T5 respectively. Birds were allotted to five dietary treatments in a completely randomized design (CRD). Each treatment was replicated 3 times containing 8 chicks per replicate. The experiment lasted for 4 weeks. The results of growth performance showed significant differences ($P<0.05$) in the final body weight, (2585.75– 2976.69g) and total weight gain (957.70g - 1369.70g), feed cost per kilogram gain (181.32 ₦/kg - 239.27 ₦/kg). The values of cost per kg gain and feed conversion ratio were better for birds fed 15% CALBSM diets (181.32₦/kg and 2.45 respectively) compared to others dietary treatments. No significant differences ($P>0.05$) observed for pack cell volume. haemoglobin and total protein across the dietary treatments. The red blood cell (2.90- 3.83 $X10^6$/l) and white blood cell (2.58 - 4.43 $X10^3$/mm) counts were significantly ($P< 0.05$) affected by the dietary treatments. The nutrients digestibility showed that the crude protein (73.02- 86.58%) and crude fibre (58.25 - 66.18%) digestibilities were significantly ($P<0.05$) affected by the treatments. The digestibilities of some nutrients reduced as the level of CALBSM increased beyond 15%. Based on this study, it can be concluded that African locust bean seeds meal cooked for four hours can be included in the diets of finisher broiler chickens up to 15% without any adverse effect on the growth performance, haematological profile and nutrients digestibilities**.**

Keywords: Broiler chickens, cooked African locust bean seeds, growth performance, haematology and nutrients digestibility**.**

INTRODUCTION

Nigeria like many developing countries of the world has protein deficiency gap, especially that of high quality animal protein. This low animal protein intake has very serious implications on the health status and well-being of the citizenry (Oyawoye, 1989). Christopher *et al.* (1997) reported that Nigerians consume only 15g of animal protein per day as against 35g recommended by FAO (1997). It is therefore necessary to look for cheaper and simple ways of getting animal proteins required for normal body growth and functions (Ayanwale *et al.*, 2006). Ani and Diegwu (2005) suggested that a solution to the problem of inadequate consumption of animal protein in Nigeria is by intensifying the production of

highly reproductive animals with short generation intervals. Broiler chickens production is one of the ways of achieving adequate animal protein supply for the Nigerian populace due to their short generation interval and rapid growth rate (Bamgbose *et al.*, 2004). This is due to their genetic make-up when adequately nourished and managed (Uzegbu *et al.*, 2007).

Feed is the most important input in a profitable poultry production. It accounts for 70-80% of total cost of production (Kehinde *et al.*, 2006). At present, the high cost of conventional feedstuffs has brought about the need to have alternative feedstuffs that can replace the expensive ones in order to reduce the cost of livestock production (Longe, 2006 and Bamgbose *et al*., 2011). The search for alternative sources of protein from legume crops in lieu of expensive ones has been advocated (Adebowale and Lawal, 2004). However, legume seeds contain anti-nutritional factors like enzymes inhibitors, phytate, oxalates, saponin and polyhenolic compounds, which limit their utilization (Salunkhe, 1982 and Vijayakumari *et al*., 1997). Fortunately, remarkable improvement in the nutritive value and quality of legume seeds has been achieved by the application of various processing methods through research efforts ((Dike and Odunfa, 2003). The African locust bean tree is a leguminous plant which produces seed grain that is often cheaper and readily available in northern Nigeria. It grows in the savannah region of Nigeria, to the southern edge of Sahel zone (Oyenuga, 1968; Campbell-Platt, 1980). African locust bean seed is rich in protein and is used as a flavor intensifier for soups and stew (Dike and Odunfa, 2003).The protein content of seeds varies between 25 and 30% and has the potential to be utilized in livestock feeding (Olomu, 2011). This research aimed at investigating the nutritive value of African locust bean (*Parkia biglobosa*) seeds as a source of feed ingredient for broiler chickens.

MATERIALS AND METHODS

Experimental Site

This experiment was conducted at the Teaching and Research Farm of the Department of Animal Science, Faculty of Agriculture and Agricultural Technology, Kano University of Science and Technology, Wudil. It is located in the Sudan savannah region of Nigeria. The farm is located on latitude 11^0 37'N and longitude 8^0 58'E at an altitude of 403m above sea level. The annual rainfall ranges from 850 - 870mm, while minimum and maximum temperature ranges between 26^0 and 33^0C. The relative humidity of the region is always low and ranges between, 40- 51.3% (Olofin *et al.*, 2008).

Processing of test ingredient

Samples of African locust bean seeds were cooked for different time (1, 2, 3 and 4 hours). The cooked African locust bean seeds (CALBS) samples were removed at intervals of one hour while heating was being applied. The samples were oven dried and subjected to proximate analysis (A. O. A. C. 1990). Locust bean seed cooked for 4 hours was considered in this experiment as presented in Table 1. The cooked seeds were oven- dried, milled and incorporated in the diets (broiler finisher).

Table 1: Proximate composition of raw and differently cooked African locust bean seeds

	Cooked African bean seed meal				
Parameters	**Raw**	**1hour**	**2hours**	**3hours**	**4hours**
Dry matter (%)	96.36	95.40	93.33	96.02	94.53
Crude Protein (%)	24.31	24.68	26.25	27.76	29.91
Crude fibre (%)	13.55	13.52	7.34	6.33	5.03
Ether extract (%)	4.97	3.15	3.19	3.14	3.18
Ash (%)	4.85	3.15	7.33	9.35	8.24
NFE (%)	52.75	55.26	54.65	53.47	53.69

Table 2: Composition of broiler finisher diets containing graded levels of cooked African locust bean seed meal (CALBSM)

	Levels of inclusion				
Ingredients (%)	**T1 (0%)**	**T2 (7.5%)**	**T3 (15%)**	**T4 (22.5%)**	**T5 (30%)**
Maize	61.00	55.50	51.00	46.00	42.30
Groundnut cake	18.00	16.00	13.00	10.00	6.70
CALBSM	0.00	7.50	15.00	22.50	30.00
Soya bean Full-fat	10.00	10.00	10.00	10.00	10.00
Fish meal	3.00	3.00	3.00	3.00	3.00
Wheat offal	4.00	4.00	4.00	4.00	4.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Salt	0.30	0.30	0.30	0.30	0.30
Lysine	0.20	0.20	0.20	0.20	0.20
Methionine	0.25	0.25	0.25	0.25	0.25
*Vitamin-mineral premix	0.25	0.25	0.25	0.25	0.25
	100	100	100	100	100
Calculated analysis (%)					
Crude protein	21.00	21.00	21.00	21.00	21.00
M. E.(Kcal/kg)	3016	3017	3018	3019	3023
Crude fibre	5.72	3.85	4.62	5.39	6.15
Ether extract	5.72	5.73	5.75	5.76	5.77
Ash	3.05	3.19	3.33	3.47	3.60
Ca	1.34	1.35	1.36	1.36	1.38
P	0.92	0.92	0.91	0.90	0.89
Lysine	1.12	1.17	1.23	1.30	1.33
Methionine+ cystein	0.56	0.60	0.64	0.68	0.72
Feed Cost ₦ /kg	75.16	74.56	73.96	73.36	72.77

*Biomix premix supplied the following per kg of diet: Vit A, 10000 i.u.; Vit D3 2000 i.u.; Vit E, 23mg; Vit K,2mg; Vit K2mg; B1 (thiamine) 1.8mg; Vit B2 (Riboflavin), 5.5mg; Vit B6 (Pyridoxine),3.0mg; Vit. B12, 0.015mg; Pantothenic acid, 7.5mg; Folic acid, 0.75mg; Biotin, 0.06mg; Choline chloride, 300mg; Cobalt, 0.2mg; copper, 3mg; Iodine, 1mg; Iron 20mg; manganese, 40mg; Selenium 0.2mg; Zinc, 30mg; Antioxidant, 1.25mg; M.E = Metabolisable Energy, ALBSM = African locust bean seed meal.

Experimental Diets

Five isonitrogenous and isocarloric broiler finisher diets were formulated and compounded containing four hours cooked African locust bean seeds meal (CALBSM) at dietary levels of 0%, 7.5%, 15%, 22.5% and 30% designated as T1, T2, T3 , T4 and T5 respectively. Five broiler finisher diets were formulated and compounded using locust bean seed cooked for 4 hours as presented in Table 2.

Experimental Animals and Design

One hundred and twenty (120) five weeks old broiler chickens (Marshall Strain) were used in this experiment. Eight (8) birds were allocated to each pen as experimental unit measuring 2.10m length, 2.10m wide and 1.25m height. Wood shavings were properly spread on the floor of each pen as litter material to absorb moisture. Birds were allotted to five dietary treatments in a completely randomized design (CRD). Each treatment was replicated 3 times consisting of 8 chicks (24 birds/treatment.

DATA COLLECTION

Growth performance

The birds were initially weighed at the beginning of the study and weighed on weekly basis to determine the weight gain of the birds fed with different diets. A known quantity of feed was offered to birds daily and the feed consumption was determined by subtracting a leftover from the quantity of feed fed to chicks every day. Birds were placed into an empty bucket and weighed with 10kg weighing scale on weekly basis to determine the daily weight gain. The feed conversion ratio was calculated as ratio of daily feed consumed to daily weight gain. At the 4^{th} week of the feeding trial the final body weights of birds were also recorded. The initial body weight was subtracted from the final body weight for determination of total weight gain by birds within the period of the feeding trial.

Blood profile

Blood samples were collected from each replication at week eight (8) via a wing vein to determine the effect of experimental diets on blood compositions. Two types of sampling bottles were used for blood collection. The first set are bottles containing anti-coagulant, ethylene diamine tetraacetic acid (EDTA) for determination of pack cell volume (PCV), red blood cells (RBC), haemoglobin (Hb), white blood cell (WBC) and its differentials, The second set bottle are plane bottles without anti-coagulant for determination of total glucose (TG) and total protein (TP) (serum metabolite). All blood samples were put in an ice packed and analyzed in the Faculty of Veterinary Medicine, haematology laboratory of the Ahmad Bello University, Zaria.

Nutrient digestibility

A digestibility trial was carried out at the end of finisher phase in which four birds were used in each replication and allotted to five treatments in a completely randomized design for two weeks. A known quantity of feeds were offered to birds daily and the leftover feeds were also weighed back to determine the quantity of feeds consumed by birds. The samples of the diets and droppings of birds were conveyed, oven-dried and analyzed for proximate compositions as described by A.O.A.C. (1990). Apparent nutrient digestibility of dry matter, crude protein, ether extract, crude fibre, ash and nitrogen free extract were determined using the following equation:

Apparent nutrient digestibility (%) =

$$\frac{\text{Nutrient intake} - \text{Nutrient output}}{\text{Nutrient intake}} \times 100$$

Data Analysis

Data collected was subjected to Analysis of variance (ANOVA) using a general linear model of statistical analysis system package (SAS, 2002) and Duncan multiple range test was also was used for means separation where significant differences exist.

RESULTS AND DISCUSSION

Table 3 shows the result of the growth performance of broiler chickens fed graded levels of cooked African seed meal. There were significant differences (P<0.05) in the final body weight and total weight gain of birds. The final body weight was higher in birds fed diets containing 15% CALBSM (T3) and 22.5% (T4) having 2966.68g and 2976.69g respectively. However, the lowest final body weight was obtained in birds fed diet containing 30% CALBSM (T5). The total weight gain was found highest in T3 (1369.70g) and lowest in T5 (957.70g). Sarwatt*et al.* (1991) reported a decrease in the final body weight and weight gain for broiler finisher as the level of lablab in their diet increased. The observation in this study disagreed with report of Damang (2007) who reported that cooked locust bean seed meal had no significant effect on the final body weight and feed consumption of broiler chickens when included at 10% during finisher phases. There was no significant difference (P > 0.05) in the feed intake across the treatments. However, there were significant differences (P < 0.05) in the feed conversion ratio and feed cost in naira per kilogram gain with T3 had better values (2.45 and 181.32 ₦/kg respectively) compared to values recorded for birds in other dietary groups. This also agreed with report of Doma (1998) who reported that the lower the feed conversion the better the diets in monogastric animals.

Table 3: Performance of broiler chicken fed Cooked ALBSM diets at finisher phase

	Inclusion level of cooked African locust bean seed meal					
Parameters	**T1 (0%)**	**T2 (7.5%)**	**T3 (15.00%)**	**T4 (22.5%)**	**T5 (30%)**	**SEM**
Initial body weight (g)	1607.11	1607.09	1607.12	1607.10	1607.13	0.54
Final body weight (g)	2856.80^{a}	2966.68 ^{a}	2976.69 ^{a}	2786.87^{ab}	2585.75^{b}	61.57
Total weight gain (g)	1249.74^{b}	1359.68 ^{a}	1369.70 ^{a}	1179.86^{b}	957.70^{c}	130.00
Total feed intake (g)	3170.60	3391.40	3215.40	3215.40	3199.50	105.77
Feed conversion ratio	2.56^{b}	2.49^{c}	2.45^{c}	2.84^{b}	3.42^{a}	0.15
Feed cost ₦/kg gain	192.63^{b}	186.00^{c}	181.3^{c}	208.47^{ab}	239.27^{a}	13.12
Mortality rate (%)	4.16	4.18	4.17	0.00	8.33	3.72

abc= mean with different superscripts on the same row are significantly different (P<0.05), SEM= Standard error of means.

The results of haemotological parameters are presented in Table 4. There was no significant differences (P>0.05) in pack cell volume, haemoglobin and total protein of broiler chickens fed CALBSM diets. However, the PCV value was highest T3 (25.35%) compared to other treatments. The PCV values were within the normal range (22-35%) as reported by Banerjee (2007). The values also agrees with normal range of PCV (28-37%) in chickens reported by Suchint *et al*. (2004) who worked on hematological parameters of chickens. The values of haemoglobin fallowed the same trend a cross the dietary treatments. There was significant difference (P<0.05) in the total glucose. The total glucose was highest (165

g/dl) in T3 and lowest (143.82g/dl) in T4. The red blood cells and white blood cells counts were significantly (P<0.05) influenced by dietary inclusion of CALBSM in diets. The RBC values agreed with normal range for chickens as established by Banerjee (2007). Birds fed T4 had highest WBC (4.43 $X10^6$/mm) while birds on T1 had the lowest WBC (2.58 $X10^6$/mm). The values of WBC counts are within the normal range of chickens as reported by Suchint *et al*. (2004). The differential WBC showed significant differences (P<0.05) in the neutrophils and lymphocyte cells. The higher value (44.69%) for neurtrophils was obtained in bird fed T3 and lowest (33.93%) in T4. This agreed with report that processing by cooking improves the quality of legume seeds in monogastric animal's diet. (Balogun*et al*., 2001: Bawa *et al.,* 2003a).

Table 4: Haematological and serum parameters of broiler chickens fed cooked ALBSM diets during finisher phase

	Inclusion level of cooked African locust bean seed meal					
Parameters	**T1 (0%)**	**T2 (7.5%)**	**T3 (15.00%)**	**T4 (22.5%)**	**T5 (30%)**	**SEM**
Pack cell volume **(%)**	24.66	25.33	25.35	24.00	24.67	1.77
Haemoglobin (g/dl)	8.27	8.40	8.30	7.96	8.20	0.39
Total protein (g/dl)	3.60	3.53	4.20	3.60	4.00	0.30
Glucose (mmol/l)	162.12^{ab}	143.62^{b}	165.75^{a}	143.82^{b}	144.96^{b}	0.74
Red blood cell ($X10^6$/l)	3.52^{ab}	3.83^{a}	3.57^{ab}	3.43^{ab}	2.90^{b}	0.20
White blood cell ($X10^3$/mm)	2.58^{c}	3.40^{b}	2.86^{c}	4.43^{a}	4.03^{ab}	0.39
Neutrophils **(%)**	35.99^{b}	36.52^{b}	44.69^{a}	33.93^{b}	34.96^{b}	2.51
Lymphocytes **(%)**	57.76^{bc}	55.39^{c}	62.23^{a}	59.87^{ab}	48.26^{c}	2.07
Monocytes **(%)**	2.61	3.69	4.07	4.10	3.27	0.88
Eosinophils**(%)**	1.44	1.45	1.28	1.19	2.28	0.47

abc= mean with different superscripts on the same row are significantly different (P<0.05), SEM= Standard error of means,

The results for apparent nutrient digestibilities are presented in Table 5. There were significant differences (P<0.05) in digestibilities of the dry matter, crude protein and crude fibre of diets. Dry matter digestibilities were higher (89.81%) in birds fed T3 and lowest value (79.25%) recorded for birds in T5. This might be due to effect of dietary inclusion of CALBSM which increased digestibility as cooking destroys some the anti-nutritional factors in the seed coat. Damang (2007) also observed that the seed coat of ALBS might affect the digestibility of some nutrients by reducing the surface area for enzymes to act upon substrates. The digestibility of crude fibre reduced as the level of CALBSM increased beyond 15%. The crude protein digestibility was found better for broilers fed 15% CALBSM and tend to reduce beyond this level in the diets. This reduction may be due to the residual effect of anti-

nutrients present in the CALBSM. Bressani and Eliase (1979) reported that the low protein digestibility in grain legumes is often associated with the presence of trpsin inhibitors, haemaglutinin and tannin. It can also lead to reduced absorption of amino acids and mineral availability (Liener and Kakade 1980, Gatel and Grosgean, 1990).There were no significant differences (P >0.05) in the ash, ether extract and nitrogen free extract digestibilities.

Table 5: Apparent digestibility of nutrient by broiler chickens fed diets containing cooked ALBSM

	Inclusion level of cooked African locust bean seed meal					
Parameters	**T1 (0%)**	**T2 (7.5%)**	**T3 (15.00%)**	**T4 (22.5%)**	**T5 (30%)**	**SEM**
Dry matter (%)	87.25^{a}	86.81^{b}	89.81^{a}	82.83^{b}	79.25^{c}	2.03
Crude protein (%)	79.62^{b}	80.11^{ab}	86.58^{a}	81.89^{ab}	73.02^{c}	2.53
Crude fibre (%)	69.30 ^{a}	64.11^{b}	66.18^{ab}	66.19^{ab}	58.25^{c}	1.02
Ether extract (%)	81.09	84.76	86.22	80.51	81.34	1.99
Ash (%)	75.47	73.78	70.96	65.51	66.82	3.97
Nitrogen free extract (%)	79.29	80.27	81.83	77.68	76.50	1.89

abc= mean with different superscripts on the same row are significantly different (P<0.05), SEM= Standard error of means.

CONCLUSION

Having the performance of broiler chickens in this study, it was concluded that CALBSM can be included finisher broiler diets up to 15% without any deleterious effect on the growth performance, haematological parameters and nutrient digestibility.

RECOMMENDATION

Based on this study, African locust bean cooked for four hours can be included in the diets of broiler chicken up to 15% without any adverse effect on the growth performance, haematological profile and nutrients digestibility.

REFERENCES

A. O. A. C. (1990). Official Methods of Analysis, Association of official Analytical Chemist, Washington DC.Pp. 423-858.

Adebowale, K .O. and Lawal, O. S. (2004). Comparative study of the functional properties of Bambara groundnut (*Voudzea subterranean*), Jack bean (*Canavaliaensiformis)* and Mucuna bean (*Mucuna pruperien*). *Food Research International*, 37:355-365.

Ani, A. O. and Diegwu, L. I. (2005). The feeding value of Velvet bean (*Mucuna pruriens*) to weaner rabbits In: proceeding of the 30th Annual Conference of the Nigerian Society for Animal production. 20th -24th March University of Nigeria Nsukka, Nigeria. pp186 -189.

Ayanwale, B. A., Adebimpe, O. M. and Kudu, Y. S. (2006). An evaluation of feather meal as a protein sources in rabbit diets. In: proceedings 31st Annual Conference Nigerian Society for Animal Production 12th -15th March 2006, Kano State, pp 234-238.

Balogun, T. F., Kaankuka, F. G. and Bawa, G. S. (2001).Effect of boiling full fat soyabean on its amino acid profile and on performance of pigs. Proceedings of the 28''' Annual Conference of the Nigerian Society for Animal Production, pp. 213-214.

Bamgbose, A. M., Isah, O. A., Sobayo, R. A., Oso, A. O., Okeke, E. N. and Alonge, A.S. (2011). Utilization of bovine Blood rumen digesta mixture based diets by cockerels chicks. In:Proceeding of 36th Annual conference of the Nigerian Society for Animal Production, 13th- 16th March, Abuja. pp 391-394.

Bamgbose, A. M., Ogunbero, S. D., Obasohan, E. E., Aruna, A. M., Oleku, L.T. and Igene, U. F. (2004). Replacement value of maize offal /Cashew nut for maize in the diet of broilers In: proceeding of 29th annual conference of the Nigerian Society for Animal Production, pp 219-221.

Banerjee, G. C. (2007). A Text book of Animal Husbandry, Oxford and IBH Pvt. LTD. New Delhi. pp118-144.

Bawa, G. S., Tegbe T. S. B. and Ogundipe S. O. (2003a).The effect of duration of cooking Lablab seeds on the level of some anti-nutritional factors. Proceedings of the 28th Annual Conference of the Nigerian Society for Animal Production, pp. 213-214.

Bressani, R. N. and Eliase, O.T. (1979). Grain quality of common beans, *Food Review International* 9:217-297.

Campbell-platt, G. (1980). African locust bean and its West African fermented seeds in Nigeria. *Journal of Agricultural Food Chemistry*.34:189-192.

Christopher, D., Pierre, C. and Claude, C. (1997).Impact of livestock and fisheries on food availability and demand in 2020.*American Journal of Agricultural Economics*. 9(5):147-150

Damang, P. J. (2007). Nutritional evaluation of African locust bean (*Parkia* species) seeds in the diets of Broiler chicken.. M.Sc. Thesis Unpublished, submitted to the Department of Animal Science, Ahmadu Bello University Zariia, Nigeria pp 92-97.

Dike, E. N. and Odunfa, S. A. (2003). Microbiology and biochemical evaluation of fermented soya bean products.(Soya dawadawa). *Journal of Food Science Technology*, 40:606-

Doma, U. D. (1998). Utilization of cowpea shell and maize cobs as sources of fibre for rabbits. A .M.Sc. Thesis report Submitted to AbubakarTafawaBalewa University, Bauchi. Pp. 63-67.

F.A.O. (1997). Food and Agricultural Organization, year book report, Rome, Italy, pp. 100-110.

Gatel, F. and Grosjean , F. (1990) Composition and nutritive value of peas for pigs . A review of European results. *Livestock Products Journal*,.26.; 155-175.

Kehinde. A. S., Babatude, T. O., Ayoola, O. A. and Temowo, O. O. (2006).Effect of different level of protein on the growth performance characteristics of broiler chicks. *In:* proceedings 31st Annual Conference of the Nigerian Society for Animal Production. 12th – 15th March, Bayero University kano, Nigeria, p 325 – 237.

Liener, I. E. and kakade, M. L. (1980) Protease inhibitors in toxic constituents of plant food stuffs. 2nd. Academy press inc. pp.1-71.

Longe, O. G. (2006). Poultry: Treasure in chest, an inaugural lecture delivered at University of Ibadan Nigeria.pp 1-10

Olofin, E. A., Nabegu, A. B. and Dambazau, A. M. (2008).Wudil within Kano region ; A geographical synthesis, 1st edition, Adamujoji publishers. Kano State, Nigeria, pp. 134-138.

Olomu, J. M. (2011).Monogastric Animal Nutrition; Principles and Practice. 2nd edition University of Benin, Jackson publishers. Nigeria. pp 160-165.

Oyawoye, E. O. (1989).Rabbit production as a means of supplying cheap animal protein in Nigeria.*Nigerian Livestock Farmers* 9:11 - 14.

Salunkhe, D. K. (1982).Legume in human nutrition. *Curriculum Science*, 51:387-394.

Sarwatt, S.V., Katunle, A. M. and Lugend, A.J .H. (1991). Effects of substituting dolichos bean meal for soyabean meal on the performance of broiler chickens. *Livestock Resource for Rural Development*, 3(1):143-150.

SAS (2002) Statistical Analysis System User Guide for Statistics Version 10. SAS institute Inc, Carolina, U.S.A.

Sunchint, S. Oranwan, C. and Warapol, A. (2004). Hematology, electrolyte and serum biochemical values of thai indigenous chickens (*Gallus domestica*) in northeastern Thailand. *Songkianakari Journal of Technology*, 26(3):427-430.

Uzegbu, H.O., Ndekekwute, E. K. and Abdu, L.S. (2007). Effect of inclusion of Bambara ground nut (*Voandezeasubteranemea*) waste meal on metabolizable energy and protein of broiler chickens. In: Proceeding of the 41st Annual Conference of Agricultural Society of Nigeria. pp 348-352.

Vijayakumari, K., Siddhuraju, P. and Janardhanan, K. (1997).Effect of domestic processing on level of certain anti-nutrients in *Prosopischilensis* (Molina) stuntz seeds.*Food Chemistry Journal* 59 (3):367 – 371.