PERFORMANCE AND NUTRIENT RETENTION OF FINISHER BROILERS FED GRADED LEVELS OF *Detarium microcarpum* (GUILL AND SPERR) SEED MEAL

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ABSTRACT

The feeding trial was conducted with two hundred and twenty five 28 days old 'Sayed' broiler chicks randomly allocated to five dietary treatments to investigate the performance and nutrient retention response of finisher broiler chicks fed diets containing 0, 5, 10, 15 and 20% cooked Detarium microcarpum seed meals (DMSM), respectively. The results of the growth performance, feed intake, feed conversion and protein efficiency ratios were similar (P>0.05) across the treatments. The percentage protein and other nutrients retention of birds fed the control and DMSM based diets did not differ significantly (P>0.05) among the treatments but an improvement was observed with increasing DMSM inclusion in the diets. The supplementation of GNC with DMSM however, reduced cost of feed per kg, cost of feed per kg weight gain.

Keywords: Performance, Nutrient retention, Cost benefit, *Detarium microcarpum* seed, Broiler chicks

INTRODUCTION

In Nigeria there is inadequate supply of grains, grain by-products, oil-seed cakes and other agro-industrial inputs to sustain small and medium scale poultry production**.** There is need to explore and provide information on many non-conventional feed ingredients that abound in our environment, with a view to ascertaining their suitability in poultry rations. This need has arisen because of the high cost of the conventional feed ingredients such as soybean cake, groundnut cake, maize and fishmeal as well as the desire to diversify and expand the feed raw materials resource base for poultry ration formulation (Abeke *et al*., 2008). According to Fadipe (1996), the search for cheaper source of feed ingredients for livestock feeding in Nigeria and many developing countries will continue as long as protein requirement in human diet has not been met. One of such cheap and locally available ingredient is *Detarium microcarpum* seeds. Like other legume seeds, *D. microcarpum* seeds are also limited by the presence of anti-nutritional factors (ANF) which interfere with the utilization by monogastric animals (Anhwange *et al*., 2004; Uhegbu *et al*., 2009). These ANFs can be eliminated or reduced to the barest minimum through adequate heating of the seeds. Cooking improved the nutritive value by destroying most of the ANFs (Amaefule and Obioha, 2001) and utilization of protein and energy in the legumes (Kankuka *et al*., 2000; Abeke *et al*., 2008). Cooking process is common, simple and easy to adopt, cheap and effective (Abeke and Otu, 2008). Some researchers (Obun *et al*., 2008; Uhegbu *et al*., 2009) reported the impacts of

several methods of processing especially roasting and boiling on the elimination of the anti-nutritional factors (ANFs) in *D. microcarpum* seeds.

These authors reported an improved performance and *in-vivo* protein digestibility (IPD) when Buffalos and growing chickens were fed heat treated *D. microcarpum* seeds compared with those fed an untreated *D. microcarpum* seed meals (Onweluzo *et al*., 2003; Obun, 2007; Obun *et al*., 2008).

This study was designed to investigate the effects of dietary cooked DMSM on the growth performance, nutrient utilization, digestibility coefficient and cost benefit of finisher broilers fed the dietary supplementations.

MATERIALS AND METHODS

Study Area: This study was conducted in the Poultry Unit, Teaching and Research Farm, Federal College of Wildlife Management, New Bussa, Niger State. The building is of open sided type that permits cross-ventilation in the animal house, with a concrete floor and zinc-roofing sheet. It is located between latitude 70 80´northern parts of the country and 100 00´N longitudes 40 30´ and 40 33´E. The temperature and relative humidity averaged 34^{o}C and 60 % during the period of the study.

***Detarium microcarpum* Seed Meal:** Dry *Detarium microcarpum* fruits were collected from New Bussa and Ibbi, Niger State, Nigeria. The fruits were taxonomically identified (Keay, 1965) and confirmed as *D. microcarpum* fruits by a curator in the Botanical Unit, Federal College of Wildlife Management, New Bussa, Niger State, Nigeria, where voucher specimen (DDMF - 004) was deposited in the herbarium. The fruits were cracked open to collect the seeds. The seeds were cleaned of dirt before processing. Water was boiled (100^{0}C) under open drum using fuel wood fire before the seeds were poured into boiling water and allowed to cook for 1hr 20 minutes. The cooked seeds were partially dehulled to remove the seed coats, washed and sun-dried and milled with a grinding machine and referred to as *Detarium microcarpum* seed meal (DMSM).

Experimental Diets Formulation: Five (5) diets were formulated at different inclusion levels of 0, 5, 10, 15 and 20% DMSM, respectively supplementing with ground nut cake (GNC) component of the diet and presented as diets 1, 2, 3, 4 and 5, respectively (Table 1).

Experimental Design: Two hundred and twenty five 28 day-old 'Sayed' broiler chicks were randomly divided into five treatments of 45 birds each, replicated three times (15 birds each) in a complete randomized design (CRD).
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Management of Experimental Birds: Birds were raised under deep litter system of management using 2.5 × 1 m pen sizes. Feed and water were supplied *ad-libitum* while vaccination and medications were strictly adhered to as recommended by the broiler breeders' company. Initial body weights before commencement of the trial and weekly thereafter were recorded, while feed fed and left over every morning before fresh feed was served was also recorded. The growth performance and nutrient utilization indices were determined using the methods of Aduku (2004).

Nutrient Retention Trial: Nutrient retention study was carried out at the end of the 4th week of the experimental trial. Three birds per replicate were randomly selected and transferred to metabolic cages for five days adaptation period, followed by a 12 hours fasting and five days total collections of droppings. The droppings were oven dried, bulked and representative samples taken for chemical analysis. The percentages retention of the nutrients (dry matter, crude protein, crude fiber, ether extract and ash) were computed individually using the formula of Aduku (2004).

Mortality: Percentage mortality was determined by recording each dead bird in each replicate and the total in each treatment was

divided by the original number of birds allocated to each treatment and multiplied by 100.

Economic of Production: The market price of each experimental ingredient at the time of the study was used to calculate the total cost of the feed per kg diet and total cost of feed consumed per bird.

Chemical Assay: The proximate components (crude protein, ether extract, crude fibre, ash and moisture) and mineral fractions (Ca and P) of the experimental diets and faecal droppings were analyzed using AOAC (2006) procedures, while acid detergent fibre (ADF) and neutral detergent fibre (NDF) were determined using Van Soest *et al.* (1991) methods. Insoluble hemicellulose was calculated as differences in weight of NDF and ADF residue.

Statistical Analysis: Data were subjected to analysis of variance (ANOVA) using SPSS version 15.0 for windows. Statistical means were separated using least significance difference (Obi, 1990).

RESULTS

Nutrient Composition of Experimental Finisher Diets: The proximate compositions of the experimental diets indicated that the moisture content of the diets did not follow a definite pattern. The crude protein, crude fibre and its fractions (NDF and ADF), ash, ether extract and metabolizable energy increased with increasing DMSM inclusion levels while nitrogen free extract (NFE) decreased with increasing DMSM in the diets (Table 2).

Performance of Experimental Birds: The initial body weight of the birds were non significantly different (P > 0.05) among the treatments and the body weight gain (BWG) and daily weight gain (DWG) were equally statistically similar (P > 0.05) (Table 3). The values of BWG of treatments 1, 2, 3, 4 and 5 were 1275.41, 1266.81, 1246.35, 1257.81 and 1256.24g, respectively. However, treatments 1 and 2 had the highest BWG values of 1275.41 and 1266.81g. The daily feed intake (FI) of the birds fed diets 1 (101.67g) and 2 (100g) were similar (P > 0.05) but significantly (P<0.05) higher than those fed diets 3 (96.67g), 4 (91.67g) and 5 (91.66g) (Table 3). The FCR and PER of the birds were similar (P>0.05) among the diets but those on diets 4 and 5 had the best FCR and PER performance. The percentage mortality observed on birds fed diet 2 (2.22 %) had no relationship with the DMSM supplementation in the diets.

Nutrient Retention of Finisher Broiler Chicks: The nutrient retentions were similar (P>0.05) across the treatments. There were numerical improvements in ash, calcium and phosphorus retention values by birds fed diets 1, 2 and 3, but statistically similar (P > 0.05) to ash, calcium and phosphorus retention values of birds fed diets 4 and 5 (Table 4).

Cost Benefit of Finisher Broiler Production: The economic performance showed that the cost per kg of the feed reduced steadily as the level of DMSM increased in the diets from ₦69.25 in diet 1 to ₦64.45 in diet 5. Similarly, cost of feed intake and feed cost/kg weight gain followed the same trend. The revenue generated per kg live weight was statistically similar (P > 0.05) across the treatments, but higher numerical values were recorded in order of treatments 1 (₦573.94), 2 (₦570.06), 3 (₦560.08), 4 (₦566) and 5 (₦565.31).

DISCUSSION

This increased in the nutrient contents of crude protein, crude fibre, ash and ether extract in the experimental diets with increasing *D. microcarpum* seed meal may be due to the nutrient contents of the seed meal. However, the CF range values (4.12 – 5.20 %) in the diets are within the recommended values of 6.5 – 7.0 % (Ndife and Ndife, 1980). Calcium, phosphorus, methionine and lysine were within the range of nutrient requirement recommended for broilers in the tropics (NRC, 1994).

The comparative improvement in the performance of broilers fed the control and cooked DMSM supplementation could be that

Table 1: Experimental finisher broilers diets with graded levels of *Detarium microcarpum* seed meal

Percentage Composition	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
Maize	56.00	52.00	48.00	44.00	40.00
Maize offal	7.50	7.50	7.50	7.50	7.50
Wheat offal	7.50	7.50	7.50	7.50	7.50
Ground Nut Cake	20.00	19.00	18.00	17.00	16.00
DMSM	0.00	5.00	10.00	15.00	20.00
Fish meal	4.00	4.00	4.00	4.00	4.00
Oyster shell	2.00	2.00	2.00	2.00	2.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Lysine	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
***Premix**	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25

** To provide the following per Kg of feed: vit-A 100000 IU; vit. D_3 2000iu; vit. B;0.75mg; nicotinic acid-25 mg; Ca, panthothenate- 12.50mg; vit.B_{12}2.5mg; vit. K-2.5mg; vitE-25mg; Cobalt 0.4mg Biotin-0.50mg; Folic acid-1mg; Cholin chloride-25mg; Cu-8.00mg; Mg-64mg; Fe-32 mg; Zn 4mg; Iodine-0.80mg; Flavomyacin-100mg; Sapriomyin-5mg; Dl-methionine-50mg; Selenium- 0.16mg; 1-lysine 120mg. DMSM: Detarium microcarpum seed meal*

Table 2: Proximate composition of experimental finisher diets (% DM basis)

Components	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
Moisture	9.96	10.84	10.45	10.70	10.67
CP	19.20	19.34	19.47	19.53	19.67
CF	4.12	4.36	4.70	4.86	5.20
Ash	3.50	3.69	4.00	4.16	4.22
EE	4.00	4.28	4.50	5.23	6.29
NFE	69.18	68.33	67.66	66.22	64.62
NDF	23.18	25.55	26.30	26.81	26.93
ADF	15.78	16.20	17.40	17.88	18.00
Ca	1.00	0.99	1.01	1.06	1.10
P	0.42	0.40	0.38	0.40	0.40
***Methionine**	0.46	0.41	0.41	0.43	0.39
***Lysine**	0.88	0.84	0.84	0.86	0.87
ME (Kcal/kg)	3103.00	3115.00	3133.00	3157.00	3169.00

**Calculated, %* DM = *percentage dry matter*

Table 3: Performance of finisher broiler chicks' fed experimental diets

Parameters	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
Initial body weight (g/bird)	622.92	625.27	625.33	626.86	624.90
Final body weight (g/bird)	1898.33	1892.09	1871.68	1884.67	1881.14
Body weight gain (g/bird)	1275.41	1266.81	1246.35	1257.81	1256.24
Daily body weight gain (g/bird)	45.55	45.24	44.51	44.92	44.87
Daily feed intake (g/bird)	101.67^a	100.00^a	96.67^b	91.67^b	91.66^b
Feed conversion ratio (FCR)	2.23	2.21	2.17	2.04	2.04
Protein efficiency ratio (PER)	2.33	2.34	2.37	2.51	2.49
Mortality (%)	-	2.22	-	-	-

a, b, c, d and e = values on the same row with different superscripts are significantly (P<0.05) different.

Table 4: Nutrient retention of finisher broilers fed experimental diets (% DM basis)

Components	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
Dry matter (DM)	80.00	78.27	78.87	78.88	76.78
Crude Protein (CP)	80.58	80.96	80.94	81.86	82.76
Crude Fibre (CF)	73.23	72.16	73.79	74.35	71.09
Ash	73.89	73.69	72.21	70.11	70.02
Ether Extract (EE)	75.22	76.58	77.38	85.55	86.93
Nitrogen free extract (NFE)	76.77	75.07	77.82	76.58	73.54
Calcium (Ca)	72.00	71.31	71.78	71.49	70.66
Phosphorus (P)	74.68	72.95	71.32	71.15	70.96

a, b, c, d and e = values on the same row with different superscripts are significantly (P<0.05) different.

Table 5: Economy of broiler production fed experimental finisher diets

Cost Benefit	Diet **1**	Diet **2**	Diet **3**	Diet **4**	**Diet 5**
Feed cost/kg diet (₦)	69.25	68.05	66.85	65.65	64.45
Cost of feed intake/bird (₦)	197.13^{a}	190.54^{a}	180.94^{b}	168.50^{c}	165.42^{c}
Feed cost/kg weight gain/bird (₦)	88.32	86.21	83.32	82.58	80.96
Revenue generated / bird (₦450/kg LW)	573.94	570.06	560.08	566.00	565.31

a, b, c, d and e = values on the same row with different superscripts are significantly (P<0.05) different.

cooking for 80 minutes improved palatability of the diets by possibly eliminating the anti-nutritional substances as observed in previous studies (Obun *et al.,* 2008). The broilers performances in this study was similar to earlier reports on cooked soybeans (Tion and Adeka, 2000; Kankuka *et al*., 2000; Amaefule and Obioha, 2001). Omoikhoje (2008) and Mathew *et al.* (2010) had similar performances with rats fed cooked bambara groundnut and broilers fed cooked pigeon pea, respectively. The performance indices similarity between treatments in this study showed that the cooking time was optimal for near complete elimination of anti-nutritional factors inherent in the intact seeds. This observation lends support from earlier findings of Geevani and Theophilus (1980) who asserted that the nutritive value of a feedstuff does not only depend on the nutrient composition of the raw materials, but also on the degree of nutrient loss or retained during processing.

The reduction in feed intake (FI) may be due to the increase in the energy levels in the diets resulting from high fat contents in DMSM with increasing DMSM inclusion levels. The decreased in FI with increased dietary DMSM inclusion in the diets in this study agreed with report of Smith (1990) and McDonald *et al.* (2002) that the major dietary factor which affects FI was the concentration of energy in the diet, as increased in dietary energy led to decreased FI. Plavink *et al.* (1997) and Nahason *et al*. (2005) have also suggested that as dietary energy increases, birds satisfy their energy needs by decreasing FI. Linear decreased in FI with high energy in diets have been reported (Veldkamp *et al.,* 2005).

The FCR and PER obtained in this study compared favourably with those recorded by Olabode and Onyekwere (2010) for broiler chicks fed three different commercial poultry feed. FCR and PER are more important factors to consider when making statements on cost of production and derivable gross margin from a production business like poultry farming (Sonaiya *et al*., 1986; Ukachukwu and Anuga, 1995).

The absence of percentage mortality in all treatments except birds fed diet 2 (2.22 %) had no relationship with the DMSM supplementation in the diets, but rather an indication that the DMSM was not detrimental to the well-being of the broilers.

The non significant variations in CP,CF, EE and NFE retentions across the treatments was an indication of the efficacy of the cooking duration in detoxification of the anti-nutrients in

the seed meals. The slight decreased in the ash, Ca and P retentions with increased DMSM in the diets may be attributed to the presence of some traces of residual ANFs in the diets. The reduction in Ca and P retentions was in agreement with earlier findings by Pallauf and Rimbach (1997) that phytate in feeds interferes with absorption of important minerals such as Ca, Mg, Fe, Cu, Zn and Mn and protein by forming complexes with them. The interactions between the phytic acid and dietary minerals to form chelates and the inability of the birds to break down the chelates to release the minerals could be responsible for the decrease in apparent ash retention by birds fed diets 4 and 5.

The reduction in cost of feed/kg, cost of feed intake and feed cost /kg weight gain may be attributed to the lower demand and cost of *Detarium* seed during the trial period. The economy of production in this study was in agreement with report of Ekenyen (2002) that reducing feed cost/kg was only justifiable when production results are comparable with the standard (control).

Conclusion: The result revealed that as dietary DMSM level increased up to 20%, weight gain, nutrient utilization and nutrient retentions of broiler chicks were positively influenced. The cost feed/ kg, cost of feed intake per bird, feed cost per kg weight gain and revenue generated per bird reduced with increasing DMSM. Therefore, we recommend that DMSM be used in broiler starter diets at levels not exceeding 20%.

REFERENCES

ANHWANGE, B. A., AJIBOLA, V. O. and ONIYE, S. J. (2004). Chemical studies of *Moringa oleifera and Detarium microcarpum* seeds. *Journal of Biological Sciences,* 4(6): 711 – 715.

ABEKE, F. O., OGUNDIPE, S. O., SEKONI, A. A., ABU, A. and ADEYINKA, I. A. (2008). Effects of dietary levels of some anti-nutritional factors of *Lablab purpureus* beans. *Nigerian Journal of Animal Production,* 35(2): 217 – 223.

ABEKE, F. O and OTU, M. (2008). Anti-nutrients in poultry feed. Pages 396 – 399. *In:* BAWA, G. S., AKPA, G. N., JOKTHAN, G. E., KABIR, M. and ABDU, S. B. (Editors). *Proceedings of the 13th Annual Conference of Animal Science Association of Nigeria (ASAN)*, September 15 – 19th 2008, Ahmadu Bello University, Zaria, Nigeria.

ADUKU, O. A. (2004). *Animal Nutrition in the Tropics: Feed and Feeding, Pasture Management, Monogastric and Ruminant Nutrition*. Devon Computer, Kaduna, Nigeria.

AMAEFULE, K. U. and OBIOHA, F. C. (2001). Performance and nutrient utilization of broilers starters fed diets containing raw, boiled or dehulled pigeon pea seeds (*Cajanus cajan*). *Nigerian Journal of Animal Production,* 28(1): 31 – 39.

AOAC (2006). *Official Methods of Analysis of the Association of Official Analytical Chemists* (AOAC) HORWITIZ, W. (Editor), 18th edition, Association of Official Analytical Chemists, Washington DC, USA.

EKENYEN, B. U. (2002). Economic viability of raising weaner rabbits on guinea grass supplemented with graded levels of poultry growing ration. Pages 180 – 181. *In:* ALETOR, V. A. and ONIBI, G. E. (Editors). *Proceeding of the Nigerian Society for Animal Production,* 17 – 21st March 2002, Akure, Nigeria.

FADIPE, A. A. (1996). The Nigeria livestock sub-sector – reviving it. Pages 321 – 324. *Keynote Address at the 21st Annual Conference of the Nigerian Society for Animal Production*, University of Uyo, Nigeria, March 24 – 26th 1996.

GEEVANI, P. and THEOPHILUS, F. (1980). Effect of home processing on the protein quality of selected legumes. *Journal of Food Science,* 45: 707 – 710.

KANKUKA, F. G., BALOGUN, T. F. and YAAKUGH, I. D. I. (2000). Effect of duration of cooking of full fat soybean on dry matter digestibility and energy utilization by young pigs. Pages 191 – 193. *In:* UKACHUKWU, S. N.,

IBEAWUCHI, J. A., IBE, S. N., EZEKWE, A. G. and ABASIEKONG, S. F. (Editors). *Proceedings of Annual Conference of the Nigerian Society for Animal Production*, Umudike, Abia State, 19 – 23rd March, 2000.

MATHEW, U. D., TEGBE, T. S. B., OMAGIE, J. J. and ADYINKA, I. A. (2010). The effect of cooking pigeon pea (*Cajanus cajan)* seeds on the performance and carcass characteristics of broiler chicks. *Nigerian Journal of Animal Production,* 37(1&2): 13 – 24.

MCDONALD, P., EDWARD, R. A. and GREENHALGH, J. P. D. (2002). *Animal Nutrition,* 6th Edition, Longman Science and Technical Company, England.

NAHASON, S. N., ADEFOPE, A., AMENYENU, A. and WRIGHT, D. (2005). Effect of dietary metabolizable energy and crude protein concentrations on growth performance and carcass characteristics of French guinea broilers. *Poultry Science,* 84: 337 – 344.

NDIFE, M. C. and NDIFE, I. I. (1980). Protein and energy requirement of broiler chicks in the tropics. *Nigerian Journal of Animal Production,* 7: 97 – 105.

NRC (1994). *Nutrient Requirement of Poultry.* 9th Revised Edition, National Research Council (NRC), National Academy Press, Washington DC.

OBI, I. U. (1990). *Statistical Methodology of Detecting Differences between Treatment Means.* 2nd Edition, Snaap Press, Enugu, Nigeria.

OBUN, C. O. (2007). Response of starter broiler chicks fed differently processed *Detarium microcarpum* seed meal. Pages 449 – 451. *In:* AGIANG, E. A., AGWUNOBI, L. N. and OLAWOYIN, O. O. (Editors). *Proceedings of 32nd Annual Conference of Nigerian Society for Animal Production*, Calabar, Nigeria, March 18th -22nd, 2007.

OBUN, C. O., OLAFADEHAN, O. A., AYANWALE, B. A. and INUWA, M. (2008). Growth, carcass and organ weights of finisher broilers fed differently processed *Detarium microcarpum* (Guill and Sperr) seed meal. *Journal of Livestock Research for Rural Development*, 20(8): 1 – 7.

OGUNDIPE, S. O., DAMANG, P. F., DAFWANG, I. I. and ABU, A. E. (2008). Biochemical evaluation of raw and cooked African locust beans seeds for poultry. Pages 586 – 587. *In:* BAWA, G. S., AKPA, G. N., JOKTHAN, G. E., KABIR, M. and ABDU, S. B. (Editors). *Proceedings of the 13th Annual Conference of Animal Science Association of Nigeria (ASAN)*, September 15 – 19th 2008, Ahmadu Bello University, Zaria, Nigeria.

OLABODE, A. D. and ONYEKWERE, M. U. (2010). Growth performance and carcass characteristics of broilers fed three commercially produced diets. Pages 292 – 294. *In:* BABAYEMI, O. J., ABU, O. A. and EWUOLA, E. O. (Editors). *Proceedings of the 35th Annual Conference of Nigeria Society for Animal Production (NSAP)*, March14 – 18th 2010, University of Ibadan, Oyo state, Nigeria.

OMOIKHOJE, S. O. (2008). Assessment of the nutritive value of Bambara groundnut as influenced by cooking time. *Livestock Research for Rural Development*, 20(4): *Article #55.* Retrieved May 30, 2011, from http://www.lrrd.org/lrrd20/4/omoi20055.htm

ONWELUZO, P. P., PUTTARAJAPPA, Z. and NARASIMHA R. D. (2003). Suitability of *Detarium microcarpum* seed flour as a binder and partial fat substitute in Buffalo meat loaves. *Plant Foods for Human Nutrition,* 58(3): 1 – 12.

PALLAUF, J. E. and RIMBACH, G. (1997). Effect of supplementary microbial phytase to maize-soya beans on the availability of calcium, phosphorus, magnesium and zinc: *In-vitro* digestibility in comparison with apparent absorption in growing rats. *Journal of Animal Physiology and Animal Nutrition,* 77: 198 – 206.

PLAVNIK, I. E., WAX, D., SKLAN, D., BARTOV, I. and HURWTZ, S. (1997). The response of broiler chicks and turkey poults to dietary energy supplies either by fat or

carbohydrates, *Poultry Science,* 76: 1000 – 1005.

SMITH, A. J. (1990). *The Tropical Agriculturalist; Poultry*. The Macmillan Press Limited, London, United Kingdom.

SONAIYA, E. B., WILLIAMS, A. R. and ONI, S. A. (1986). A biological appraisal of broiler production up to 16 weeks. *Journal of Animal Science Research,* 6: 115 – 125.

TION, M. A. and ADEKA, I. A. (2000). The effect of raw or heat processed full fat soybean on broiler performance. Pages 197 – 199. *In:* UKACHUKWU, S. N., IBEAWUCHI, J. A., IBE, S. N., EZEKWE, A. G. and ABASIEKONG, S. F. (Editors). *Proceedings of 25th Annual Conference of Nigerian Society for Animal Production,* March 19 – 23rd 2000, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria.

UHEGBU, F. O., CHIOMA C., ONWUCHEKWA, C. C., IWEALA, E. J. and KANU, I. (2009). Effect of processing methods on nutritive and anti-nutritive properties of seeds of *Brachystegia euryeorna* and *Detarium microcarpum* from Nigeria. *Pakistan Journal of Nutrition,* 8(4): 316 – 320.

UKACHUKWU, S. N. and ANUGWA, F. O. L. (1995). Bio-economic of feeding raw or heated soya beans to broilers. *Nigerian Journal of Animal Production,* 22: 137 – 147.

VAN SOEST, P. J., ROBERTSON, J. B. and LEWIS, B. A. (1991). Methods for dietary fiber, neutral detergent fiber, and non starch polysaccharides in relation to animal nutrition. *Journal of Dairy Science,* 74(10): 3583 – 3597.

VELDKAMP, T. R., KWAKKEL, P., FERKET, P. R. and VERTEGEN, M. W. A. (2005). Growth response to dietary energy and lysine at high and low ambient temperature in male turkeys. *Poultry Science,* 84: 273 – 282.