International Journal of Food, Agriculture and Veterinary Sciences ISSN: 2277-209X (Online)
An Online International Journal Available at http://www.cibtech.org/jfav.htm
2011 Vol. 1 (1) October-December, pp.38-44/Onu, and Aniebo
Research Article

INFLUENCE OF *MORINGA OLEIFERA* LEAF MEAL ON THE PERFORMANCE AND BLOOD CHEMISTRY OF STARTER BROILERS

Onu P.N.[1] and *Aniebo A. O.[2]
[1]*Department of Animal Science, Ebonyi State University, P.M.B. 053 Abakaliki, Ebonyi State, Nigeria*
[2]*Department of Animal Science, Anambra State University, P.M.B. 6059 Igbariam, Akwa, Anambra State, Nigeria*
**Author for Correspondence*

ABSTRACT
The effects of *Moringa oleifera* leaf meal (MOLM) on the performance and blood chemistry of starter broilers were investigated using 128 seven (7) day-old broiler chicks. The birds were randomly assigned to four dietary treatments containing MOLM at 0, 2.5, 5, and 7.5% (treatments 1, 2, 3 and 4) inclusion levels respectively, in a complete randomized design experiment. The effect of the dietary treatments on the performance and blood characteristics of the starter broilers was determined. Results showed that treatment effect on average final body weight, average daily gain, average daily feed intake and feed conversion ratio were significant ($P<0.05$). Birds fed MOLM gained significantly ($P < 0.05$) higher weight and superior feed conversion ratio than birds fed the control diet However, birds fed T_2 (2.5%) and T_3 (2.5%) diets recorded significantly ($P < 0.05$) the highest body weight gain. There were significant differences ($P<0.05$) among groups in Packed cell volume (PVC) and Red blood cell of the birds. The haemoglobin (Hb), MCV, MCH and MCHC counts showed no significant difference ($P>0.05$) among treatments. there was a significant ($P <0.05$) differences in the values of total protein while there was no significant ($P >0.05$) difference in the values of serum albumin and globulin Results showed that a MOLM could be included at 7.5% dietary level without any deleterious effect on performance and blood characteristics of broiler starters

INTRODUCTION
In Nigeria, commercial poultry meat production is expanding day by day. There is also a tremendous scope and opportunity for the Nigerian poultry industry to make profit. However, the recent hike in the prices of conventional feed ingredients is a major factor affecting net return from the poultry business. This is because 80% of the total cost of the operation is spent on feed. This scenario has compelled animal nutritionists to explore the incorporation of non conventional feedstuffs in poultry diets. Their inclusion in the diets could help reduce feed cost, cost of but also minimize the direct competition between man and the livestock industry for the available conventional feedstuffs. The economization of feed cost using cheaper and unconventional feed resources (Bhatt and Sharma, 2001; Muriu *et al.*, 2002) is an important aspect of commercial livestock production.

The incorporation of protein from leaf sources in diets for broilers is fast gaining grounds because of its availability, abundance and relatively reduced cost (Onyimonyi and Onu, 2009). According to (Opara, 1996) leaf meal do not only serve as protein sources but also provide some necessary vitamins, minerals and also oxycarotenoids which causes yellow colour of broiler skin, shank and egg yolk .

Moringa oleifera belongs to the single genus monogeneric family Moringaceae and is well distributed in Africa and Asia. Apart from being a good source of vitamins and amino acids, it has medicinal uses (Makkar and Becker 1999; Francis *et al.*, 2005). *Moringa oleifera,* otherwise regarded as a 'miracle tree' is reputed to have many medicinal properties (Ghasi *et al* 2000 and Matthew *et al* 2001), possesses hypocholesterolemic properties (Olugbemi *et al*., 2010a) and could substitute conventional feedstuffs as it possesses useful characteristics (Sarwart *et al.*, 2002). Its leaves and green pods are rich in carotene and ascorbic acid with good profile of amino acids (Makkar and Becker 1996). Kakenji *et al.* (2003) observed that *Moringa oleifera* leaf meal contains 86% DM, 29.7% CP, 22.5% CF, 4.38% EE, 27.9% calcium, 0.26% phosphorus and negligible amount of tannin (1.23g/kg). In addition, Oduro *et al*. (2008) reported that *Moringa oleifera* leaves contained crude protein 27.51%, crude fibre 19.25%, crude fat 2.23%, ash 7.13%, moisture 76.53%, carbohydrates 43.88%, and caloric value 1296.00 kJ/g (305.62 cal/g).Calcium and Iron content in mg/100 g (DM) were 20.09and 28.29, respectively. Foidl and Paull (2008) reported that the protein content of leaves is high (20–35% on a dry weight basis) and most important is that the protein is of high quality having significant quantities of all the essential amino acids. Murro *et al*. (2003) reported that the leaves are highly nutritious containing significant quantities of Vitamins A, B and C, Ca, Fe, P and protein. However, despite the high nutrient content of *Moringa oleifera* leaf meal, there are few reports in the literature on feeding trials with broilers. This tree according to Fahey *et al.* (2001) has in recent times been advocated as an outstanding indigenous source of highly digestible protein, calcium, iron, vitamin C, and carotenoids suitable for utilization in many of the so-called "developing" regions of the world where undernourishment is a major concern.

The ingestion of numerous dietary components has measurable effects on blood constituents (Animashahun *et al*, 2006; Bhatti *et al*., 2009). Although nutrient levels in the blood and body fluids may not be valid indication of nutrient function at cellular level, they are considered to be proximate measures of long-term nutritional status (Animashahun *et al*., 2006). According to Maxwell *et al*. (1990), blood parameters are important in assessing the quality and suitability of feed ingredients in farm animals. Esonu *et al.* (2001) had stated that haematological constituents reflect the physiological responsiveness of the animal to its internal and external environments which include feed and feeding. Animashahun *et al.* (2006) affirmed that the comparison of blood chemistry profile with nutrient intake might indicate the need for adjustment of certain nutrients upward or downward for different population groups.This study therefore aimed at evaluating the effect of *Moringa oleifera* leaf meal (MOLM) on the performance and blood chemistry of starter broilers.

MATERIALS AND METHODS

The experiment was carried out at the Poultry Research Unit of the Department of Animal Science, Ebonyi State University, Abakaliki, Ebonyi State, Nigeria with the approval of the Committee for Animal Experiments of the Institution.

Source and processing of Moringa oleifera leaf meal

The *Moringa oleifera* leaf meal used for this study was collected from Kpiri-Kpiri in Abakaliki, Ebonyi State, Nigeria. The harvested leaves were air dried in shade under a shed until they were crispy to touch, while retaining their greenish colouration. The dried leaves were then milled using a hammer mill to produce *Moringa oleifera* leaf meal (MOLM) suitable for incorporation into broiler starter diets.

Experimental Diets

Four experimental starter diets were formulated such that diet T_1 which served as the control contained O% MOLM, while diets 2, 3, and 4 contained 2.5%, 5% and 7.5% MOLM and designated as T_1, T_2, T_3 and T_4 diets respectively. Ingredient and nutrient composition (AOAC, 1990) of these rations are presented in Table 1.

Experimental Birds and Management

128 one week old broiler chicks of Anak breed were wing banded, weighed individually and distributed randomly to the four experimental diets with 32 birds per treatment. Each group was further subdivided into four replicates of 8 birds each. The birds were housed in deep litter pens. They were reared under similar managerial conditions, and were given the experimental diets from the end of the first week (7th day) to the 35th day. The experimental diets and clean drinking water were supplied to the birds *ad libitum* throughout the study period. Prior to the commencement of the experiment, the birds were weighed at the beginning of the study to obtain their initial body weights and thereafter they were individually weighed to the nearest gram at weekly intervals during the experimental period. Feed intake was recorded daily. Feed conversion ratio was calculated by dividing the feed intake by weight gain. Vaccination and other routine poultry management practices were carried out.

Blood Collection and Analysis

At the end of the feeding trial, two birds were randomly selected from each replicate, making a total of 16 birds. The sampled birds were bled using a sterilized disposable syringe and needle between 6.30 and 7.30 am from punctured vein to aspirate 7mls of blood from each bird from which 2mls of each was collected into bijon bottle treated with ethylene diamine tetra acetic acid (EDTA) for haematological assay. The remainder of each blood sample was allowed to coagulate to produce sera for blood chemistry measurements according to the methods of Okeudo *et al.* (2003). Blood samples were analyzed within 3 hours of their collection for total erythrocyte, haematocrit (PCV), haemoglobin (Hb) and differential leucocytes count according to the methods described by Dein (1984). Erythrocyte (RBC) count was done in a haemocytometer chamber with Natt and Herdrics dilluent to obtain a 1:200 blood dilution. The number of leucocyte was estimated as total WBC x 200. Packed cell volume (PCV) was measured as micro haematocrit with 75 x 16mm capillary tubes filled with blood and centrifuged at 3000 r.pm. for 5 minutes. The differential count of leucocytes was made from blood stained with Wrights dye and each type of cell countered with laboratory counter. Haemaglobin concentration (Hbc) mean corpuscular haemoglobin (MCH) levels were also calculated according to Bush (1991). The clotting time was also measured using the glass slide method (Benjamin, 1961). The coagulated blood was subjected to standard method of serum separation of the harvested total serum protein (TSP). Colorimetric determination of TP is based on the principle of Biuret reaction (copper salts in alkaline medium) in which cupric ions form a blue complex, in alkaline solution, with NH2 of two or more peptide bonds. The intensity of the blue colour formed is proportional to the protein concentration in the plasma or serum. Albumin concentration was determined by the Bromocresol Green (BCG) method (Peters *et al*., 1982); albumins (Ab) bind with BCG to form a green compound. The concentration of Ab is directly proportional to the intensity of the green colour formed. Globulin (Gb) concentration was computed as the difference between total protein and albumin concentrations.

Statistical Analysis

The data collected on various parameters were analyzed using the method of Snedecor and Cochran (1989). The difference in treatment means were separated using Duncan's New Multiple Range Test as outlined by Obi (2002).

RESULTS AND DISCUSSIONS

The performance of broiler chicks fed graded levels of MOLM is as shown in Table 2. Results showed that birds fed MOLM gained significantly ($P < 0.05$) higher weight than birds fed the control diet. However, birds fed T_2 and T_3 diets recorded significantly ($P < 0.05$) the highest body weight gain. The improved weight gain of birds fed MOLM diets could be attributed to higher protein content of the diets which were efficiently metabolized for growth.

The reduced weight gain of birds fed T_4 diet compared to birds fed T_2 and T_3 diets could be partly ascribed to the higher crude fibre content of T_4 diet which may have impaired nutrient digestion and absorption (Aderemi, 2003; Onu and Otuma, 2008; Onu, 2010). The lower weight gain of birds fed T_4 diet despite its higher crude protein content might also be due to the negative effect of the antinutritional factors present in MOLM on the birds. *Moringa oleifera* contain 1-23g of tannin in every 1 kilogram of leaves (Kakengi, 2003). Tannin has been reported to interfere with the biological utilization of protein and to a lesser extent available carbohydrate and lipids (Esonu, 2001). The depressed weight gain of birds fed the control diet may be due to the lower crude protein content of the diet, which may have been in adequate to enhance growth of the birds

There were significant ($P < 0.05$) variations in the feed intake of the birds among the treatments. There was significant ($P < 0.05$) increased in feed consumption with increase in inclusion level of MOLM. However, there was a marked reduction in the feed consumption of birds fed T_4 diet. The reduced intake of T_4 diet could be due to reduced palatability of the diet (Kakengi *et al*., 2003). Omekam (1994) observed that unpalatability nature of a feedstuff will consequently prevent chicks from consuming adequate quantity of the feed.

There was a significant improvement in the feed conversion ratio of the birds fed MOLM based diets. This suggests that birds fed MOLM based diets adequately utilized the nutrients they consumed. The various dietary treatments produced no significant (*p>0.05*) impact on the protein efficiency ratio of the birds.

The results of the haematological indices are presented in Table 3. There were significant differences (P<0.05) among groups in Packed cell volume (PVC) and Red blood cell of the birds. The Haemoglobin (Hb), MCV, MCH and MCHC counts showed no significant difference (P>0.05) among treatments. The values for RBC and PCV were significantly (P<0.05) lower for 7.5 % (T_4) MOLM diet compared to 2.5% and 5% inclusion levels. However, this did not vary significantly from the control. The lower RBC and PCV obtained in birds fed T_4 diet may be ascribed to the higher concentration of tannin in 7.5 % (T_4) MOLM diet. Tannins have been reported to negatively affect feed intake (Knox and McNab, 1995) as well as dry matter and protein digestibility (Gualitieri and Rapaccini 1990).

The values obtained for RBC of birds fed MOLM diets were higher than the range of 3.07 to7.50 x 10^6/mm^3 reported by Fudge (1999) but within 5–8 x 106/mm3 reported by Anon (1980). The higher RBC recorded for birds fed MOLM diets indicates a higher protein quality of these diets and that MOLM increased the blood quality. Hackbath *et al.* (1983) reported that increased RBC values were associated with high quality dietary protein and with disease free animals. Red Blood Cells (RBC) are responsible for the transportation of oxygen and carbon dioxide in the blood as well as manufacture of haemoglobin hence higher values indicate a greater potential for this function and a better state of health (Olugbemi *et al*., 2010b). The PCV values obtained in this study though it differed significantly among the group was within normal range (Merk Veterinary Manual, 1979). The values obtained for all the treatment groups indicate nutritional adequacy of all diets and presence of a toxic factor, since values did not indicate mal- or under nutrition (Church *et al.*, 1984) . PCV is an index of toxicity reduction in the blood usually and suggest presence of a toxic factor which has adverse effect on blood formation (Oyawoye and Ogunkunle, 1998).

Table 1: Composition of the Experimental Diet

Ingredient	T_1	T_2	T_3	T_4
Maize	50.00	50.00	50.00	50.00
Soyabean meal	26.00	24.00	22.00	20.00
Wheat offal	10.00	12.00	12.00	12.00
MOLM	0.00	2.50	5.00	7.50
Fish meal	3.00	2.50	2.00	1.50
Palm kernel cake	8.00	8.00	8.00	8.00
Bone meal	3.00	3.00	3.00	3.00
Salt	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25
Calculated Chemical Composition				
Crude protein	20.16	20.83	21.05	21.26
Crude fibre	4.35	4.80	4.97	5.17
Ether extract	3.84	3.81	3.83	3.85
ME (K cal/kg)	2864.00	2798.45	2752.55	2685.63

To provide the following per kg of diet vitamin A – 15,000.00,^{lu} Vitamin D_3 - 3, 000,000^{lu}, Vitamin E- 30,000,^{lu} Vitamin K- 3,000mg Vitamin B_1 3000,mg Vitamin B_2 6000mg, Vitamin B_6 5,000mg, Vitamin B 40mg, Biotin 200mg, Niacah-40,000mg, Pantothenic 15,000mg,Folic acid 2,000mg, choline 300,000mg,Iron 60,000mg, manganese 80,000mg, copper 25,000mg, Zinc 80,000mg cobalt 150mg, iodine 500mg, selenium 310mg, Antioxidant 20,000mg.

Table 2: Performance of Broiler Chicks fed MOLM

	T_1	T_2	T_3	T_4	SEM
Av. initial body weight (g)	106.37	103.03	110.20	104.00	1.28
Av. final body weight (g)	994.42^{c}	1290.00^{ab}	1339.96^{a}	1197.00^{b}	47.32
Av. body weight gain (g)	888.05^{c}	1186.97^{a}	1229.76^{a}	1093.00^{b}	45.55
Av. daily weight gain (g)	31.72^{c}	42.39^{a}	43.92^{a}	38.99^{b}	1.85
Av. total feed intake	2102.20^{c}	231196^{a}	2327.36^{a}	2067.52^{b}	43.49
Av. daily feed intake	75.24^{b}	82.57^{b}	83.12^{a}	73.84^{b}	1.69
Feed conversion ratio	2.37^{b}	1.95^{a}	1.89^{a}	1.89^{a}	0.52
Av. daily protein intake	15.16^{c}	16.45^{b}	18.55^{a}	15.50^{c}	0.04
Protein efficiency ratio	2.09	2.48	2.35	2.48	0.11

^{a,b,c,d,} Means with different superscripts on same row differ significantly (P < 0.05)

Table 3: Haematological and serum biochemical indices of broiler Chicks Fed MOLM

	T_1	T_2	T_3	T_4	SEM
Packed Cell Volume (%)	31.33^{b}	36.00^{a}	35.37^{a}	31.00^{b}	1.02
White Blood Cell (x10^2/µl)	32.63	33.37	34.07	32.07	1.06
Red Blood Cell (x10^2/µl	7.50^{b}	8.26^{a}	8.23^{a}	7.0^{b}	0.20
Haemoglobin (g/d)	10.76	12.33	12.33	10.83	0.38
MCV(µg)	41.60	43.57	42.41	40.00^{b}	1.56
MCH (%)	14.40	16.27^{b}	14.39	14.08	0.64
MCHC(%)	32.23	34.42	34.97	35.03	1.66
Serum Biochemistry					
Total Protein	5.43^{bc}	5.80^{b}	6.38^{a}	5.23^{c}	0.14
Albumin	1.79	2.02	2.45^{a}	1.72	0.13
Globulin	3.61	3.74	4.18	3.49	0.26

^{a,b,c,d,} Means with different superscripts on same row differ significantly (P < 0.05)

The values for WBC, MCV, MCH and MCHC were similar (P>0.05) among the treatment groups. The comparable WBC of birds suggests that the animals were healthy because decrease in number of WBC below the normal range is an indication of allergic conditions, anaphylactic shock and certain parasitism or presence of foreign body in circulating system (Ahamefule *et al.*, 2008). The general non significance of the WBC across treatments indicates that the experimental diets neither impaired nor enhanced the birds ability to wade off infection (Olugbemi *et al*., 2010b).

For serum biochemical indices, there was a significant (P <0.05) differences in the values of total protein while there was no significant (P >0.05) difference in the values of serum albumin and globulin (Table 3). According to Eggum (1970) total serum protein is usually a reflection of the protein quality fed. The higher total protein values obtained in 5% MOLM diet reflects the protein levels. The non significant (P >0.05) values for albumin and globulin obtained in this study suggests nutritional adequacy of the dietary proteins for starter broilers. It also suggests that the diets did not influence the serum albumin and globulin of the birds.

Conclusion

From these result, it is concluded that starter broilers could tolerate up to 7.5% *Moringa oleifera* leaf meal inclusion in their diets without adverse effects on their performance and blood characteristics.

REFERENCES

Aderemi, F. A. (2003). Effect of enzyme supplemented cassava siviete in cassava based diet on some visceral organs of pullet chicks. Proc. of the 8th Annual Conference of the Animal Science Society of Nigeria. Pp 57-59

Ahamefule F.O., Obua, B.E., Ukweni, I. A., Oguike, M. A. and Amaka, R.A. (2008). Haematological and biochemical profile of weaner rabbits fed raw or processed pigeon pea seed meal based diets. *African Journal of Agricultural Research*, 3(4): 315-319.

Animashahun, R. A., Omoikhoje, S. O. and Bamgbose, A. M. (2006). Haematological and biochemical indices of weaner rabbits fed concentrates and *Syndrella nodiflora* forage supplement. Proc. 11th Annual Conference of Animal Science Association of Nigeria. Institute of Agricultural Research and Training, Ibadan, Nigeria, pp: 29-32.

Anon, (1980). Guide to the Care and Use of Experimental Animal. Vol 1. Canadian Council of Animal Care.Ottawa Canada, pp: 185–190.

Benjamin, M.M. (1961). *Veterinary clinical pathology*. 2nd edition. Ames Iowa. The Iowa State University Press, U.S.A.

Bhatt, R.S. and Sharma S.R. (2001). Nutrient utilization and growth performance of broiler rabbit fed oat plant meal and tall fescue hay. *Asian-Australasian Journal of Animal Science,* 14: 1228-1232.

Bhatti, J.A, Younas, M., Abdullah, M., Babar, M. E. and Nawaz, H. (2009). Feed intake, weight gain and haematology in Nili Ravi buffalo heifers fed on Mot grass and Barseem fodder substituted with Saltbush (*Atriplex amnicola*). *Pakistan Veterinary Journal,* 29(3): 133-137.

Bush BM, (1991). *Interpretation of Laboratory Results for Small Animal Clinicians.* Blackwell Scientific Publications. London, UK, pp: 32–67.

Church, J. P., Judd, J.T., Yomg, C.W., Kebay, T. L. and Kim, W. W. (1984). Relationship among dietary constituents and specific serum clinical components of subjects eating self selecting diets. *Amer J Clin Nutr,* 40: 1338–1344.

Dein, F.J. (1984). Laboratory manual of Avian haematology. Association of Avian veterinaries. East-North port, USA.

Eggum, O. (1970). The nutritional value of feedstuffs. *British Journal Nutr*ition. 24:983-988.

Esonu, B.O., Emenalom, O. O., Udedibie, A.B.I., Herbert, U., Ekpor, C.F., Okolie, I.C. and Iheukwumere, F.C. (2001). Performance and blood chemistry of weaner pigs fed raw mucuna (velvet bean). *Tropical Animal Production Investigations*, 4: 49-54.

Foidl, N. and Paull, R. (2008). *Moringa oleifera*. In: The Encyclopedia of Fruit and Nuts. CABI, Oxfordshire, UK. Pp 509–512

Francis, G, Makkar, H. P. S. and Becker, K. (2005) Products from little researched plants as aquaculture feed ingredients. Retrieved February 24, 2005 from http://www.fao.org/DOCREP/ARTICLE/AGRIPPA/551_EN.HTM#TopOfPage

Fudge, C. S. (1999). *Laboratory Medicine: Avian and Exotic Pets*. WB Saunders, Philadelphia, USA.

Ghasi, S., **Nwobodo, E. and Ofili, J. O. (2000)** Hypocholesterolemic effects of crude extract of leaf of *Moringa oleifera* Lam in high fat diet fed wistar rats. *Journal of Ethnopharmacology* 69(1):21-25

Gualitieri, M. and Rapaccinni, S. (1990). Sorghum grains in poultry feeding. *World's Poultry Science J*ournal, 46:246-254.

Hackbath, H., Buron, K. and Schimansley, G. (1983). Strain difference in inbred rats: Influence of strain and diet on haematological traits. *Laboratory Animals*, 17: 7–12.

Kakengi, A.M.V., Shen, M. N., Sarwart, S. V. and Fujihara. T. (2003). Can *Moringa oleifera* be used as protein supplement to ruminant diet. *Asian-Australian Journal of Animal Science,* 18(1): 42-47

Makkar, H. P. S. and Becker, K. (1996). Nutritional value and antinutritional component of whole and extracted Moringa oleifera *leaves. Animal Feed Science and Technology,* 63: 211-223

Makkar, H. P. S. and Becker, K. 1(999). Plant toxins and detoxification methods to improve feed quality of tropical seeds - Review. *Asian-Australian Journal of Animal Science* (3): 467- 480

Matthew, T., Matthew, Z., Taji, S. A. and Zachariah, S. (2001) A review of Viricidal Ayurvedic Herbs of India for Poultry Diseases. *Journal of American Holistic Veterinary Medicine Association* 20(1): 17 – 20

Research Article

Maxwell, M. H., Robertson, W. Spener, S. and Maclorquodale, C. C. (1990). Comparison of haematological parameters in restricted and *ad libitum* fed domestic fowls. *British Poultry Science,* 31: 407–413.

McNitt, J.I., Cheeke, P. R., Patton, N. M. and Lukefahr, S. D. (1996). *Rabbit Production*. Interstae Publishers. Inc Danville, IL USA.

Merck Veterinary Manual, (1979). 5th edition. Merck and Co. Inc. Rahway, N.J. U.S.A., p. 21.

Murro, J. K., Muhikambele, V. R. M. and Sarwatt, S. V. (2002). *Moringa oleifera* leaf meal can replace cottonseed cake in the concentrate mix fed with Rhodes grass (*Chloris gayana*) hay for growing sheep. Livestock Research for Rural Development 15 (11)

Muriu, J.I., Njoka-Njiri, E.N., Tuitoek, J.N. and Nanua, J.N. (2002). Evaluation of sorghum (*Sorghum bicolor*) as replacement of maize in the diet of growing rabbit (*Oryctolagus cuniculus*). *Asian-Australisian Journal of Animal Science*, 15: 565-569.

Obi, I. U. (2002) *Statistical methods of detecting differences between Treatment means and research methodology issue in laboratory and field Experiments.* A.P Company Ltd.

Oduro, I., Ellis, W.O. and Owusu, D. (2008). Nutritional potential of two leafy vegetables: *Moringa Oleifera* and *Impomea batatas* leaves. *Scientific Research and Essay*, 3(2): 57-60.

Okeudo, N., Okoli, I. C. and Igwe, G.O.F. (2003). Haematological characteristics of ducks (carina moschata) of South Eastern Nigeria. Tropicultura, 21: 61-65.

Olugbemi, T. S., Mutayoba, S. K. and Lekule, F. P. (2010a). *Moringa oleifera* leaf meal as a hypocholesterolemic agent in laying hen diets *Livestock Research for Rural Development* 22 (4) 2010

Olugbemi, T. S., Mutayoba, S. K. and Lekule, F. P. (2010b). Effect of Moringa (*Moringa oleifera)* Inclusion in CassavaBased Diets Fed to Broiler Chickens. *International Journal of Poultry Science* 9 (4): 363-367,

Onu, P. N. (2010). Impact of heat treated sheep manure-based diets with or without exogenous enzyme on nutrient digestibility and economics of production of finisher broilers. *International Journal of Science and Nature*

Onu, P. N. and Otuma, M. O. (2008) Utilization of heat – treated sheep chopping in the diets of broiler finisher chicks. *International Journal of Poultry Science,* 7 (2): 169 – 173.

Onyimonyi, A.E. and Onu, E. (2009). An Assessment of Pawpaw Leaf Meal as Protein Ingredient for Finishing Broiler. *International Journal of Poultry Science*, 8 (10): 995-998

Opara, C.C., (1996). Studies on the use of *Alchornia ordifolia* leaf meal as feed ingredient in poultry diets. M.Sc Thesis, Federal University of Technology, Owerri, Nigeria, pp: 150-159.

Orji, B.I., G.C. Okeke and O.O. Ojo (1986). Haematological studies on the guinea fowl (Numida meleagric pallas): Effect of age, sex and time of breeding on the protein and electrolyte levels in blood serum of guinea fowls. *Nigeria Journal Animal Production*, 13: 100-106.

Oyawoye, E. O and Ogunkunle, M. (1998). Chemical analysis and biochemical effects of raw Jack beans on broiler. Proc Nig Soc Anim Prod, 23: 141-142.

Peters, T, Biomonte, CT, Doumas, B.T.(1982) Protein (total protein) in serum, urine and cerebrospinal fluid, albumin in serum: In selected methods of clinical chemistry, volume 9. W.R. Faulkner, S. Meites (eds.) ashington D.C. American Association of Clinical Chemist.

Sarwalt, S. V., Kaparge, S. S. and Kakengi, A. M. V. (2002). Substituting sunflower seed cake with *Moringa oleifera* leaves as supplement feed in Tanzania. *Agro Forestry System,* 56: 241-247.

Snedecor, G. W. and Cochran, G. W. (1978) *Statistical methods* 6th (Ed) the IOWA. University Press Ames IOWA, USA. 258-299