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Evaluation of graded levels of cassava peels fortified with defatted moringa seed meal as replacement to wheat bran on performance, digestibility and blood profile of broilers

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***Target Audience:** The farmers, Agriculturists, Nutritional biochemist and Feedmillers*

Abstract

Evaluation of cassava peels fortified with defatted moringa seed at ratio 5:2 (C:MM) as a replacement to wheat bran at graded levels in broiler diet. Three diets were formulated, diet I with 0% C:MM and 20% wheat bran served as control, in diets II and III wheat bran was replaced at 50% and 100% respectively. Ninety 1 - day old broiler chicks were assigned unto these diets that lasted for nine weeks. The feed intake and body weight gain of birds on diet I and II were higher ($P < 0.05$) than III at both starter and finisher phases. Feed conversion ratio and apparent digestibility of those fed diets I and II were similar and differ from III. Among the hematological parameters determined, the packed cell volume (PCV), hemoglobin (Hb), Red blood cell (RBC) and lymphocytes were affected ($P < 0.05$). Birds fed diets I and II had similar hematological values and these were higher compared to those fed diet III. The serum metabolites values of all the chicks were within normal range. Conclusively, fortified C:MM could replace wheat bran up to 50% without adversely affecting the broilers.

***Keywords:** Moringa seed meal, cassava peels, wheat bran; broiler; performance; blood.*

Description of Problem

The rapid growth of human and livestock population, which is creating increased needs for food and feed in the less developed countries, demand that alternative feed resources must be identified and evaluated (1).

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 about 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 (2). The inclusion of non conventional feedstuff in the diets could help reduce feed cost and competition between man and the livestock industry for the available conventional feedstuffs. The economization of feed cost using cheaper and unconventional feed resources is an important aspect of commercial livestock production. The prevailing scarcity and high cost of conventional feed ingredients such as wheat bran have resulted in the recent high cost of poultry products in Nigeria (3). Positive steps must be taken in order to allow indigenous poultry livestock to contribute effectively to the poverty alleviation and food security improvement. It is essential to increase poultry productivity by improving strategies of feeding through unconventional and local feed resources utilization (4). Therefore, it becomes necessary that alternative high quality combination of non-conventional be sought from within our immediate environment. One of such combination is exploited for this study cassava peels and defatted moringa seed.

Plant products have been used by humans for centuries as sources of food and traditional medicine to treat diseases. Natural medicinal products originating from herbs and spices have been used as feed additives for farm animals (5). *Moringa oleifera* plant is of great potential that could be cultivated as economically profitable crop to contribute in poverty alleviation (6). *Moringa oleifera* leaves, fruits, immature pods and flowers are integrated into the traditional food of humans in several tropical and subtropical countries (7 and 8). However, the effect of *Moringa oleifera* seeds on broilers' performance was revealed to affect the performance during starter period (9). *Moringa oleifera* is a highly valued food plant characterized by a multipurpose use (10) and (11) reviewed the use of this tree in poultry diets. A report on *M. oleifera* seeds had shown their antimicrobial effects (12). In addition *M.oleifera* and *M. stenopetala* methanol and n-hexane seed extracts could control water-borne diseases as they produced inhibitory effect on *Salmonella typhii*, *Vibrio cholerae* and *Escherichia coli* (13).

Furthermore, *Moringa oleifera* seeds have been reported as good source of nutrients including fats, proteins and minerals (14). While cassava peels accounted for about 10% of waste generated when cassava tuber is processed into products like gaari and cassava pap (15). Cassava peel is the outer cover of the tuber which is usually removed manually with sharp knife with little or no pulp in the process of turning the raw pulp into the various human foods such as gari, fufu, lafun and tapioca among others in many tropical countries (16). Aside from the lower values of crude protein and energy of the peel, the greatest limitation in the use of cassava peel is that of its hydrocyanic acid (HCN) content which is harmful to monogastrics. The HCN content of fresh cassava peels (which is a breakdown product of hydrolysis of cyanogenic glycosides in the presence of linamarase) has to be reduced greatly in the peels in order to promote its acceptability and utilization. This study investigated cassava peels fortified with defatted moringa seed meal as a replacement to wheat bran with the major objective evaluating the effect on performance of broilers chickens.

Materials and Methods

Location of the Experiment

The study was conducted at the Teaching and Research Farm of Bowen University Iwo, Osun State of Nigeria. The university is situated on a 640 hectares site in Iwo (long. 7^0 38, 0, N, Lat.4^0 11, 0, E) in South west Nigeria.

Preparation of experimental diets

Cassava peels used for this study was collected sun and oven dried, ground to a fine texture with an hammer mill while deffatted moringa seed were purchased from an oil company in Bayelsa state. Cassava peel and defatted moringa seed powder were now mixed at ratio 5:2 to obtain a product tagged Cassava : Moringa Meal (C:MM). Three dietary treatments were formulated such that diet I contained 20% of wheat bran, 0% C:MM served as control. Diets II and III had the wheat bran portion replaced with C:MM at graded levels of 50 and 100%, respectively. Other ingredients used for formulating the diets were obtained from a reputable feed mill at Iwo.

Experimental animals

Ninety1 day old, unsexed commercial broiler chicks (Ross 308) were purchased from a reputable farm at Oyo and they were randomly allotted to three treatment groups with three replicates each. Each replicates having ten (10) birds in a completely randomized design. Three experimental isocaloric and isonitrogenous diets were formulated to meet the nutrient requirement of the birds. Routine vaccination and necessary medications were also administered. Records of mortality and feed remnants were taken daily while those of weight gain and feed intake were calculated taken on weekly basis.

Table1: Proximate composition of wheat bran and C:MM (test ingredient)

PARAMETERS	C:MM (5:2)	Wheat bran
Crude protein (%)	15.80	16.5
Crude fibre (%)	6.72	8.5
Fat (%)	3.80	-
Ash (%)	2.48	5.6
Metabolizable energy(kcal/kg)	2315	1535

Table 2: Gross composition of experimental diets

INGREDIENTS	TI	TII	TII
Maize	50	50	50
C:MM	0	5	10
Wheat bran	10	5	0
Soybean meal	24.3	24.3	24.3
Palmkernel cake	5	5	5
Fish meal	3	3	3
Bone meal	4	4	4
Oyster shell	3	3	3
Methionine	0.1	0.1	0.1
Lysine	0.1	0.1	0.1
Salt	0.25	0.25	0.25
Premix	0.25	0.25	0.25
Total	100	100	100
Metabolizable energy	2644,5	2741.7	2838.9
Crude protein	20.24	20.21	20.18

Each 2.5 kg vitamin-mineral premix provided the following: A 8,000,000 iu, D_3 2,000,000 iu, E 5000 mg, K_3 2000 mg, Folic acid 500 mg, Niacin 15,000mg, Calpan 5,000 mg, B_2 8000 mg, B_{12} 10,000 mg, B_1 1,500 mg, B_6 1,500 mg, Biotin 20 mg.

Blood Analysis

At four weeks of age, two birds per replicate were randomly selected for heamatological parameters. Blood samples were collected by vein puncture at the right wing of every bird into a sterile heparinized microhematocrit tubes. The packed cell volume (PCV) was appraised by hematocrit method (17) the total plasma protein was evaluated by refractometry (18).

Metabolic Trial

At the 8th week, broilers of similar weights from each dietary treatment were separately housed in metabolic cages. Equal quantity of 75g feed was served at 8.00am daily to each bird. The birds were routinely managed, droppings were collected and weighed daily separated from feed and other extraneous materials, then oven dried at 85^{o}c for 48 hours. The dried samples were kept for chemical analysis.

Carcass analysis

At the completion of the digestibility study two broilers with representative weights were selected from each replicate for carcass analysis. Birds were killed, eviscerated and viscera organs of interest were harvested, weighed using the sensitive digital balance (PGW453i-model) and expressed as percentages of the carcass weight.

Chemical analysis

The proximate composition of the test ingredients, experimental diets and droppings were determined by the methods of (19). While the gross energy values of the diets were determined using the bomb calorimeter.

Statistical Analysis

All the data were expressed as mean and standard deviation. The statistical analyses were carried out using the Minitab 13 for Windows packet program. Means and standard deviations were calculated according to the standard methods for all parameters. One-way ANOVA was used to determine the differences between means of the experimental groups, accepting the significance level at $P < 0.05$ (20).

Results and Discussion

The results of the proximate analysis of test ingredient are shown in Table 1. The metabolizable energy for C:MM mixture is higher (2315kcal/kg) than wheat bran (1535kcal/kg). Similarly, crude protein, crude fiber, and Ash contents were lower in C:MM when compared to wheat bran. The performance characteristics of the broilers at both phases are shown in Table 3. The feed intake of birds on diet I and II were similar and significantly lower ($P < 0.05$) than those fed diet III. Average daily weight gain also had a similar statistical trend as the feed intake. Feed conversion ratio had no particular statistical trend. No mortality was recorded at the starter phase. Feed conversion ratio was higher in treatment III while the birds on treatment II utilized the feed better. There was no mortality in the Control group while mortality occurred at treatment II and III at the finisher phase.

The results of apparent nutrients digestibility of broilers fed the experimental diet are shown in Table 4. It was observed that digestibility of crude protein in diets I and II were similar and significantly ($P < 0.05$) different from III. Fibers in diets I and II were similar and significantly lower than III. Fat and Ash digestibilities showed no significant difference ($P > 0.05$). Metabolizable energy differed significantly ($P < 0.05$) between treatments. Treatment I had the highest value (11.75) while II and III had 5.57 and 7.68, respectively.

The results of the hematological parameters are shown in Table 5. Packed Cell Volume (PCV), Hemoglobin (Hb), Red Blood Cell (RBC), Monocytes and Basophils all showed significant differences ($P < 0.05$) between treatments. The PCV, Hb, RBC and Monocytes of birds on treatment II had the highest value and III the lowest value. Basophils from control group had the highest value (0.83%) while treatment III had the lowest value (0.17%). White Blood Cell, Platelet, Lymphoctes, Heterophil and Eosinophil were not significantly ($P > 0.05$) different. Platelet on treatment III had the highest value ($2.1175X10^5$) while control group had the lowest value ($1.695X10^5$). Lymphocytes and Heterophils showed no significance difference ($P > 0.05$) across the diets. Eosinophil on the control group had the highest value (3.5%) while treatment II had the lowest value (2.5%).

Table 3 Performance characteristics of broilers fed experimental diets

STARTER PHASE	TI (0%)	TII(50%)	TIII(100%)	SEM
ADFI/bird(g)	50.83^{b}	50.60^{b}	49.03^{a}	0.91
ADWG/bird (g)	18.20	19.03	17.33	1.67
FCR	2.7	2.6	2.8	0.08
Mortality (%)	0.00	0.00	0.00	0.00
FINISHER PHASE				
ADFI/bird(g)	106.89^{a}	102.95^{a}	95.74^{b}	1.82
ADWG/bird(g)	39.70^{a}	39.75^{ab}	36.68^{b}	1.57
FCR	2.6^{b}	2.5^{ab}	2.6^{a}	0.13
Mortality (%)	0.00^{b}	0.67^{ab}	1.33^{a}	0.24

abc means with the same superscript along a row are not significantly different ($P > 0.05$).
Key: WFI (weekly feed intake), WWG (weekly weight gain), FCR (feed conversion ratio)

Table 4 Apparent digestibility of broilers on experimental diets

PARAMETERS	TI (0%)	TII (50%)	TIII (100%)	SEM
Crude Protein (%)	23.01^{a}	16.98^{a}	14.57^{b}	1.35
Crude Fiber (%)	22.88^{b}	23.09^{b}	25.67^{a}	0.64
Fat (%)	68.35	72.57	71.57	0.65
Ash(%)	55.33	51.45	51.15	0.44
Moisture content (%)	16.01^{a}	18.39^{b}	18.84^{b}	1.26
Metabolizable Energy (Kcal/Kg)	11.75^{a}	5.57^{b}	7.68 b	0.90

abc means with the same superscript along a row are not significantly different ($P > 0.05$)

Table 5: Hematological parameters of birds fed experimental diets

PARAMETERS	**TI (0%)**	**TII (50%)**	**TIII (100%)**	**SEM**
Packed cell volume(%)	24.33^{a}	27.83^{c}	21.17^{a}	0.84
Heamoglobin(g/dl)	7.62^{a}	8.70^{b}	6.82^{a}	0.24
Red blood cell(10^{6}ul)	2.30^{b}	2.76^{b}	1.40^{a}	0.18
White Blood Cell(10^{3}ul)	1.8325×10^{4}	1.713×10^{4}	1.8601×10^{4}	324.64
Platelet(10^{3}ul)	1.695×10^{5}	1.943×10^{5}	2.1175×10^{5}	9598.60
Lymphocytes (%)	63.17^{b}	61.67^{c}	58.33^{a}	1.12
Heterophil (%)	31.17	36.50	37.33	1.28
Monocytes (%)	3.00^{ab}	3.33^{ab}	2.33^{a}	0.19
Eosinophils (%)	3.50	2.50	3.00	0.26
Basophils (%)	0.83^{b}	0.67^{ab}	0.17^{a}	0.12

abc means with the same superscript along a row are not significantly different ($P > 0.05$).

The result of the serum metabolites are shown in Table 6. All parameters measured showed no significant (P > 0.05) difference.

It could be seen from Table 1 that C:MM had close proximate composition to wheat bran which agreed with the findings of (20). The chemical composition of the experimental diets shows that the diets were formulated to meet the nutrient requirement of broilers in the tropics.

In the past, the use of plants in monogastric diets was restricted because of some negative effect on feed intake and nutrient utilization attributed to phyto-chemical composition that varies greatly due to variety, location and climate (21, 22). Collectively, synergy between individual bioactive compounds in *Moringa oleifera* plant may affect broad aspects of physiology, with the ultimate objective being positive interactions with the biochemistry of the body (22, 23 and 24). In earnest, the effect on growth performance may not be consistent, for instance, in a number of cases where plant extracts have been used, FI (Feed Intake) and FCR (Feed Conversion Ratio) were not affected, although a positive effect on BW (Body weight), weights of organ and or energy utilization was reported by (25). In another experiment, (26) observed that supplementation of female broiler chickens diets with thymol and cinnamal dehyde had no positive effect on growth performance or macro nutrients digestibility. Feed intake of chicks was affected by the dietary treatments. Feed intake of the broilers on the experimental diets decreased progressively as the level of test ingredient increased. This result varies with the findings of (20) which showed an increasing trend in feed intake of the broilers fed cassava peels fortified with moringa leaves. The reduced weight gain observed in birds fed 100% C:MM diets could be attributed to anti-nutritional factors in the meal which is consistent with the findings of (27) who reported that the anti-nutritive properties of lupins are located in the cotyledon such as trypsin inhibitors, non starch polysaccharides and tannins have been reported to inhibit weight gain of broiler chickens (28, 29). Body weight of the treatment II was similar to control group but significantly higher than diet III perhaps this can be related to nutrient availability and density due to moringa (30). The lower weight recorded at treatment III agrees with the findings of (2) that increasing inclusion level of leaf meals in broiler diets results in depressed growth performance. Feed efficiency at both phases had a similar trend to body weight, feed was well utilized this is at variance with the report of (31) who reported that extracted kernel and extracted seed meal of *Moringa oleifera* have higher levels of phytate which hinder the utilization of nutrient.. Similar findings were reported by (2) in the study of effect of Moringa leaf meal (MOLM) inclusion in cassava based diets to broilers chicken. The absence of mortality among the birds at the starter phase might be due to anti-microbial and availability of vitamins, proteins and minerals in moringa plant and also good management practices. This is in line with the findings of (9) who reported no mortality among broilers fed moringa leaf meal at starter phase. Mortality recorded at finisher phase could not be traced to the experimental diets with birds fed 100% C:MM recording highest mortality. This corroborates the findings of (32) where a mortality rate of 40% was recorded in 100% (Moringa Leaf Meal).

The velocity at which the diet passes the digestive tract is a crucial digestion parameter, which varies on the basis of dietary fiber levels (33). Dietary fiber inclusion has been reported to significantly increase the coefficients of total tract apparent digestibility of all nutrients, including the dietary energy content (34). Digestibility measures the ratio of the nutrient retained to intake expressed in percentage. The similarity in digestibility of protein in control and treatment II could indicates that the test ingredient had reinforced the content of protein in the feed, however protein is readily degraded this is in agreement with findings of (35). The digestibility of crude fibre decreased slightly with increasing levels of C:MM. This does not agree with (36) who reported that the inclusion of leaf meal in the diets may be responsible for lack of variation in crude protein and crude fibre digestibility of the diets. The uniformly high digestion coefficient for ether extract probably reflects the preferential digestion for this feed nutrient, as its metabolism is associated with lower heat increment and more efficiently completed than carbohydrates.

Table 6: Serum biochemistry parameters of birds fed experimental diets

PARAMETERS	TRT I	TRT II	TRT III	SEM
Glucose(mg/dl)	159.17	184.57	192.55	8.70
Creatine (mg/dl)	0.92	0.89	0.98	0.02
Aspartate Transferase(I.U/L)	40.45	41.48	36.15	1.21
Alanine Transaminase (I.U/L)	7.39	7.61	7.84	0.27
Total Protein(g/dl)	5.55	6.40	5.75	0.28
Albumin (g/dl)	4.16	3.85	3.78	0.18
Cholesterol(mg/dl)	150.17	170.41	183.67	9.51

abc means with the same superscript along a row are not significantly different ($P > 0.05$).

Hematological and biochemical parameters are important indicator of the health status in animals and have been an indispensable tool in the diagnosis treatment and prognosis of many diseases. The blood in an animal serves as a transport medium. It transports food materials such as glucose, fatty acids, vitamins and electrolytes from the gastrointestinal tract to body tissues where they are utilized for body building and energy. Increase or decrease in body weight from the previous weight for a specific period is the principal measure of productivity in meat animal and depends on the quality and to a lesser extent the quantity of feed given (37).The following hematological parameters: PCV, HB, RBC and lymphocytes of broilers fed 100% C:MM were significantly ($P < 0.05$) affected. (38) reported that feed components affect blood constituents. The hematological parameters can thus be used to assess the effects of the test ingredient. Low hemoglobin and PCV observed in diet III could suggest normocytic iron deficiency anaemia since the values obtained for these parameters (PCV, Hb and RBC) in treatment III did not fall within the normal range values for healthy birds, as reported by (39; 40). The lower RBC and PCV obtained in birds fed 100% C:MM could also be due to tannin an anti- nutritional factor. Tannins have been reported to negatively affect feed intake as well as dry matter and protein digestibility (41and 42).The RBC counts according to (43) are influenced among other factors by nutrition and physical activities. WBC values for the broilers were also within the normal range for healthy birds. Lymphocytes are important in forming barriers against local disease conditions and may be involved in antibody formation (44).

The serum biochemical indices showed that there were no significant ($P > 0.05$) difference in the averages for the various biochemical component studied and values are within the range for normal birds as reported by (45), (46). This suggests that the test diet did not influence the biochemical component of the broilers negatively. The relative constant level of plasma cholesterol as seen in the chicks across the diets could be attributed to both hereditary and dietary factor since the chick came from the same stock; probably there are no much variations in their endogenous biosynthesis of cholesterol. This is in accordance with the observation of (47) that hereditary factor play the greatest role in determining an individual blood cholesterol concentration. The relative constant plasma protein level of the chicks across the diets could be as a result of adequate utilization of the diet in the groups. Although, (37) reported that Alanine Transaminase (ALT) level is usually elevated when damage is done to tissue cells, especially heart and liver and also in some muscle diseases, but in this study, all the values obtained falls within the normal range. Ultimately serum biochemical indices observed shows that there is proper utilization of diets and therefore the blood enzyme levels were not negatively affected by feeding the test ingredients.

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Conclusion and Application

1. The proximate composition of C:MM at ratio 5:2 used in this study had better nutrient composition when compared to wheat bran.
2. It can be included up to 50% as a replacement to wheat bran in broilers without any adverse effect on their health and performance.
3. This study in a way has expanded the number of alternative feed ingredients for broiler production. Utilization of cassava peels and deffatted moringa seed should be encouraged among farmers to bridge the existing gap between the scarce and expensive conventional feed ingredient and the non-conventional.

References

1. Odunsi, A.A. (2003). Assessment of Lablab (Lablab purpureus) leaf meal as a feed ingredient and yolk coloring agent in the diet of layers. *International Journal of Poultry Science, 2(1): 71-74.*
2. Olugbemi, T. S., S. K. Mutayoba and F. P. Lekule, (2010). Effect of Moringa oleifera inclusion in cassava based diets fed to broiler chickens. *International Journal of. Poultry. Science., 9: 363-367.*
3. Aderemi, F. A. Alabi, O. M. and Lawal, T. E. (2006). Utilisation of whole cassava leaf meal by egg-type chicken. Proceedings of the 11th Annual Conference of Animal Science Association of Nigeria (ASAN). Sept. 18 – 21, 2006, I. A. R. & T. Ibadan, Nigeria. Pp. 153 – 155.
4. Tewe, O.O and Bokanga, A (1993). Cost effective cassava plant-based rations for poultry and pigs, in: Proceedings of the 8th International Society for Tropical Root Crops Africa Branch Symposium, Ibadan, Nigeria, 2001, pp. 229-234.
5. Guo, F.C. (2003), "Mushroom and herb polysaccharides as alternative for antimicrobial growth promoters in poultry", Ph.D. Dissertation, Wageningen Institute of Animal Sciences, Department of Animal Nutrition, Wageningen University, Netherlands.
6. Fatima, G.H and Muna, A.I. (2013), "Moringa oleifera: Nature is most nutritious and Multipurpose Tree", *International Journal of Scientific and Research Publication, 3(4),1-5.*
7. Siddhuraju, P and Becker, K. (2003). Antioxidant properties of various solvent extracts of total phenolic constituents from three different agro-climatic origins of drumstick tree (Moringa oleifera Lam.) leaves. Journal of agricultural and food chemistry, 51: 2144-2155.
8. Anhwange, B. A., Ajibola, V. O and Oniye, S. J. (2004). Chemical studies of

the seeds of Moringa oleifera (Lam) and Detariummicrocarpum (Guill and Sperr). *Journal of. Biological. Sciences., 4: 711-715.*

9. Abbas, T.E., & Ahmed, M.E. (2012), "Use of Moringa oleifera seeds in broilers diet and its effects on the performance and carcass characteristics", *International Journal of Applied Poultry Research, 1, 1-4.*

10. Anwar, F., Latif, S., Ashraf, M. & Gilani, A. H. (2007). Moringa oleifera: a food plant with multiple medicinal uses. Phytother Res. 21(1):17-25.

11. Abbas, T.E. (2013), "The use of Moringa oleifera seeds in poultry diet", *Turkish Journal of Veterinary Science, 37,492-496.*

12. Eilert, U., Wolters, B. &Nahrsted, A. (1981), "The antibiotic principle of Moringa oleifera and Moringa stenopetala ", Planta Medica, 42, 55-61.

13. Walter, A., Samuel, W., Peter, A & Joseph, O.(2011), "Antibacterial activity of Moringa oleifera and Moringa stenopetala methanol and n-hexane seed extracts on bacteria implicated in water borne diseases", *African Journal of Microbiology Research , 5 (2), 153-157.*

14. Compaoré, W. R., Nikièma,P. A., Bassolé, H. I. N., Savadogo, A., Mouecoucou, J., Hounhouigan, D. J. &Traoré, S. A. (2011). Chemical Composition and Antioxidative Properties of Seeds of Moringa oleifera and Pulps of Parkiabiglobosa and Adansoniadigitata Commonly used in Food Fortification in Burkina Faso. Current *Research. Journal of Biological Sciences 3(1): 64-72.*

15. Aderemi F, (2010). Utilization of graded levels of biodegraded cassava peels in broiler ration, *Electronic Journal of Environmental, Agricultural and Food Chemistry (EJEAFChe) 9 (4) (2010) 672-678.*

16. IITA., (1990). Cyanide in cassava, its not there it just happens. Annual Report, International Institute of Tropical Agriculture, pp; 34-35.

17. Fraser, C. M, Bergeron J. A, Mays A, Aiello S. E (1991). The Merck Veterinary Manual, 7th edition. Merck and co. Inc. Rahway, N.J. USA. p. 17.

18. A.O.A.C. (2000) Official methods of analysis Association of Official Analytical Chemists Wasghinton D.C

19. SAS Institute, (2001). SAS/STAT guide for personal computers, version and edition (Cary North Carolina SAS Institute)

20. Aderemi, F. A. & Alabi, O. (2013). Effects of graded levels of cassava peels fortified with Moringa as a replacement to wheat bran on performance, Digestion and Blood profile of Broilers. *Journal of Agricultural Science and Technology. A 3: 210-215.*

21. Steiner, T and Weglutner, K., (2007). Natural growth promoters for gut health management. *World Poultry. Mag.23(7),22–24* ⟨www.WorldPoultry.net⟩.

22. Xiao, Z., Lester, G.E., Luo, Y., Wang, Q., (2012). Assessment of vitamin and carotenoid concentrations of emerging food products: edible microgreens. *Journal of Agricultural Food Chemistry. 60,7644–7651.*

23. Maiga, A., Diallo, D., Bye, R., Paulsen, B.S., (2005). Determination of some toxic and essential metal ions in medicinal and edible plants from Mali. *Journal of Agricultural, Food Chemistry.53, 2316–2321.*

24. Mbikay, M., (2012). Therapeutic potential of Moringa oleifera leaves in chronic hyperglycemia and

dyslipidemia:a review.Front.Pharmacology.3,1–12.

25. Wallace, R.J., Oleszek, W., Franz, C., Hahn,I., Baser, K.H.C., Mathe, A., Teichmann, K., (2010). Dietary plant bio-actives for poultry health and productivity. *British Poultry Science 51: 461–487*.
26. Lee, K.W., Everts, H.,Kappert, H.J., Frehner, M., Losa, R., Beynen, A.C., (2003). Effects of dietary essential oil components on growth performance, digestive enzymes and lipid metabolism in female broiler chickens. *British.Poultry.Science.44,450–457*
27. Ferguson, N. S., Guos, R. M and Iji, P. A Determining the source of anti-nutritional factor(s) found in two varieties of lupin (L. albus and L. angustifoilus) fed to growing pigs. University of KwaZulu-Natal, Animal and Poultry Science. Unpublished data.
28. Yu-Long, Hu, Meng-Kian Tee, Edward J. Goetzl, Nelly Auersperg, Gordon B. Mills, Napoleone Ferrara and Robert B. Jaffe. (2001). Lysophosphatidic Acid Induction of Vascular Endothelial Growth Factor Expression in Human Ovarian Cancer Cells.
29. Ologhobo, A. D., Mosenthin, R. &Alaka, O. O. (2003). Histological alterations in the internal organs of growing chicks from feeding raw jackbean or limabean seeds. *Vetenarian. Human Toxicology. 45 (1): 10-13*
30. Foidl, N., Makkar, H.P.S. & Becker, K. (2001). The potential of Moringa Oleifera for agricultural and industrial uses. In: Fugile, L.J. (ed). The miracle tree: the multiple attributes of Moringa. CTA. Publication. Wageningen, The Netherlands, pp 45-76.
31. Makkar, H.P.S & Becker, K. (1997). Nutrients and anti quality factors in different morphological parts of the Moringa oleifera tree. *Journal of Agricultural. Science. (Cambridge), 128:311 322.*
32. Gadzirayi, C. T, Masamha B, Mupangwa J. F &Washaya S, (2012). Performance of broiler chickens fed on mature Moringa oleifera leaf meal as a protein supplement to soyabean meal. *International Journal of Poultry Science, 11 (1): 5–10*. http:// 209.238.2.121/ fulltext/?doi=ijps.2012.5.10&org=11
33. Mateos, G.G., Lázaro,R.P., Gracia,M.I., (2002). The feasibility of using nutritional modifications to replace drugs in poultry feeds. *Journal Applied Poultry Resources 11,437–452.*
34. González-Alvarado, J.M., Jiménez-Moreno, E., González Sánchez, D.,Lázaro, R.,Mateos, G.G., (2010). Effect of inclusion of oat hulls and sugar beet pulp in the diet on productive performance and digestive traits of broilers from 1 to 42 days of age. *Animal Feed Science. Technology. 162,37–46.*
35. Anand, A. Ganguly P. Haldar, (2008). Potential value of acridids as high protein supplement for poultry feed, *International Journal of Poultry Science 7 (2008) 722-725.*
36. Ngiki, Y U; Igwebuike, J U; Moruppa, S M. (Jun 2014). *The International Journal of Science and Technoledge 2.6 : 48-59.*
37. Blood, D. C & Studdert, V. P (1999). Saunders comprehensive veterinary dictionary, 2nd Ed. W.B. Saunder, New York, p. 88.
38. Harper, A. F, Rodwell, V. W, Mayes P. A (1979). Review of Physiological Chemistry. 17th Ed. Lang. Medical, Los Atlos, California p. 9422.
39. Muhammad N.O, Oloyede O.B (2009). Haematological Parameters of Broiler Chicks Fed Aspergillusniger - Fermented Terminalia catappa Seed Meal-Based

Diet. *Global Journal Biotechnology Biochemistry*. *4 (2): 179-183*

40. Post J, Rebel J.M.J, TerHuurne, A.A. H.M (2007). Automated Blood Cell Count: A Sensitive and Reliable Method to Study Corticosterone-Related Stress in Broilers.ID-Lelystad, Institute for Animal Science and Health, Lelystad, The Netherlands. Pp. 777-781.
41. Knox A. I & J. M McNab, (1995). Selection between high and low-tannin diets by broiler chickens. *British Poultry Science, 36: 849 - 851.*
42. Gualitieri, M. & Rapaccinni, S. (1990). Sorghum grains in poultry feeding. *World's Poultry Science Journal, 46:246-254.*
43. Swenson, M. J (1990). Duke's Physiology of domestic animals, 9th ed. Comestock publishing Co. UK., pp. 15-40.
44. Frandson, R.D (1981). Anatomy and physiology of farm animals. Lea Febiger publishers, Philadelphia, 1st edition.
45. Anonymous, (1980). Guide to the Care and Use of Experimental Animals Vol. 1. Ottawa, Ontario, Canada, Canadian Council on Animals Care, pp: 85-90.
46. Udoyong, A. O., A. Kibon, S. M. Yakubu, B. Yakubu, C. Augustine & L. Isaac, (2010). Haematological responses and serum biochemistry of broiler chicken fed graded levels of enzyme (Maxigrain) supplemented cassava a peel meal (CPM) based diets. *Global Journal of Biotechnology. Biochemistry.*, 5(2): 116-119.
47. Mayes, P. A., (1993). Cholesterol synthesis, transport and excretion. In: Harpers Biochemistry, 23rd Edn., Prentice-Hall Int. Inc., pp: 273-277.