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Original Research

Growth performance, cost benefit analysis, haematology and serum biochemistry of finisher broilers fed *Moringa oleifera* leaf meal

***[1]Kenneth-Chukwu, O.M.,[2] Ezeibe, F.O. [1]Unigwe, R., & [1]Eze, C.O.**

** [1]Department of Veterinary Biochemistry and Animal Production, [2]Department of Veterinary Physiology and Pharmacology Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria*

**Correspondence:* oluchikennethchukwu@gmail.com; +2348039421276

ABSTRACT

This experiment was conducted to determine the effect of *Moringa oleifera* leaf meal on growth performance, cost benefit analysis, haematology and serum biochemistry of finisher broiler chickens. One hundred and forty four (144) day-old were randomly allotted to 4 dietary treatments group of 3 birds per group each after 3 weeks brooding. Each replicate had 12 birds. The birds in T1 (control) group were offered a basal diet only; the T2 were given basal diet with 300g of *Moringa oleifera* leaf meal in 100kg of feed; T3 were given basal diet with 500g of *Moringa oleifera* leaf meal in 100kg of feed; T4 were given basal diet with 700g of *Moringa oleifera* leaf meal in 100kg of feed. The experiment lasted till the birds were 56 days of age. Significant differences were observed in the feed intake of the birds and body weight gain. The hematological parameters measured differ significantly. Alanine transaminase (ALT) differed among the dietary treatments. Significant differences were observed in the other serum biochemical indices measured. Cost incurred per kilogram weight gain was higher for birds on Moringa diets than birds on the control diet. The results of this study indicate that *Moringa oleifera* leaf meal significantly ($P<0.05$) enhanced growth performance - weight gain, feed intake and feed conversion ratio, in the treated birds compared to the control group with the best result at level 700 g inclusion. Feeding the birds with *Moringa oleifera* leaf meal brought about changes in the serum biochemical parameters but without any deleterious effect on them and should be considered as a good source of protein in livestock nutrition.

Keywords: Broiler chickens, blood profile, cost benefit, growth performance, *Moringa oleifera* leaf,

INTRODUCTION

Poultry has been identified as an important means of bridging the protein intake deficiency in Nigeria. The broiler chicken is a table bird or meat type bird. Chicken is generally acceptable to majority of Nigerians. It is the quickest source of meat and its production is easily managed in relation to other livestock enterprises (Taiwo, 2005). However, feed and feed ingredients are the major cost of the inputs in poultry production as it accounts for about 70 – 80% of the total cost of production (Ezema, 2014).

Thus, maximizing broiler performance and ensuring their overall health are critical aspect of poultry farming. Nutrition plays a vital role in achieving these goals; there is a constant quest for innovative dietary interventions to optimize broiler production.

Moringa oleifera, commonly known as the drumstick tree or horseradish tree, is a versatile plant native to South Asia widely cultivated in tropical and sub-tropical regions. It has gained considerable attention due its nutrient rich composition and potential health benefits. The leaf of *Moringa oleifera* contains essential amino acid and vitamins, minerals, antioxidant and bioactive compounds, medicinal use (Sarker *et al.*, 2017) and some have confirmed its ability to potentiate growth, weight gain and carcass yield of broilers (Zanu *et al.*, 2012; Nkukwana *et al.*, 2014). The nutritional profile of dried *Moringa oleifera* leave has shown high content of lipids, amino acids and antimicrobial effect which are important in poultry productivity (Makkar & Beller, 1997). Ayssiwede *et al.* (2011) found that *Moringa oleifera* meal inclusion in the diets up to 24% did not cause any adverse impact on live body weight, average daily weight gain, feed conversion ratio (FCR), mortality, carcass and organ characteristics in birds compare to their controls. Despite the potential nutritional and medicinal benefits of *Moringa oleifera* leaf meal, there is a limited understanding

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of its impact on broiler chicken performance, hematology and serum biochemistry.

Hence, this study is aimed at generating information on the effect of feeding diets containing different levels of *Moringa oleifera* leaf meal on the growth performance, cost benefit analysis, haematology and serum biochemistry of finisher broiler chickens.

MATERIALS AND METHODS

STUDY LOCATION

The study was conducted at the Poultry Unit of the Department of Veterinary Biochemistry and Animal Production, College of Veterinary Medicine, Michael Okpara University Agriculture, Umudike. Umudike located within the South East Agro-ecological Zone of Nigeria on latitude 50 29[1]North and longitude 7º 33' east and at an altitude of 122 cm above sea level. The area has an annual temperature of 25-30℃, relative humidity of between 65-80%, and annual rainfall of 2000-2484 mm; the soil is sandy loamy with average pH of 5.5 (Adiele *et al.,* 2005).

Protocol for this experiment was reviewed and approved by the ethical approval committee of the college of Veterinary medicine, Michael Okpara University of Agriculture, Umudike (Reference No: MOUAU/CVM/REC/202413)

MANAGEMENT OF EXPERIMENTAL BIRDS

One hundred and forty four day–old broiler chicks from a reputable source were used for the experiment. The chicks were brooded for three weeks before individually weighed and randomly allotted into four (4) dietary treatments with three (3) replicates each. Each replicate had 12 birds. The birds were reared in a well-ventilated poultry house on deep litter. Routine management procedures were followed while feed was supplied *ad libitum* and the birds had access to clean water. The experimental design was Completely Randomized Design and the experiment lasted for eight weeks.

MORINGA OLEIFERA LEAF MEAL PREPARATION

Fresh leaves of *Moringa oleifera* were harvested within Umudike metropolis, Abia State, Nigeria. The harvested leaves were dried under shade at ambient temperature in order to preserve most of the nutrients, green color and the phyto-chemicals in the leaves according to procedures suggested by Yang & Tsou (2006). The dried Moringa leaves were milled using a stainless steel harmer mill and sieved to 2mm particle size. The dried leaf powder was packaged in dry plastic container labeled.

There were 4 dietary treatments:

T1 (control) birds were given basal diet; T2 – Diet contained 300 g of *Moringa oleifera* leaf meal in 100 kg of feed; T3 – Diet contained 500 g of *Moringa oleifera* leaf meal in 100 kg of feed and T4 – Diet contained 700 g of *Moringa oleifera* leaf meal in 100 kg of feed.

Table I. THE INGREDIENT COMPOSITION OF THE BASAL DIET (FINISHER FEED)

Crude protein	17%
Crude fat	4%
Crude fibre	5%
Calcium	0.85%
phosphorus	0.38%
Metabolizable Energy	3000Kcal
Lysine	0.9%
Methionine	0.39%

DATA COLLECTIONBLOOD COLLECTION PERFORMANCE MEASUREMENTS

For calculation:

Total Feed Intake (g) = Total Feed supplied (g) – Total feed left over (g)

Average feed intake (g/bird) = Total feed Intake/ the number of birds

Total weight gain = Final weight – Initial weight

Feed conversion ratio = Total feed intake (g) /total weight gain (g)

CARCASS EVALUATION.

The birds were weighed on arrival and then weekly till the end of the experiment. Their live weights were taken, Also, average weight gain and feed conversion ratios (FCR) were calculated and recorded. For determination of carcass analysis, at the end of the study, about 8 am, five birds were randomly chosen from each replicates, they were weighed to obtain live weight, humanly euthanized by cervical dislocation thereafter were bled and scalded with hot water(90^oC) to remove the feathers, eviscerated and dressed. The birds were weighed, feet were removed and carcasses were manually eviscerated and the abdominal fat, and giblets (liver, gizzard, heart, spleen, abdominal fat, proventriculus) were removed. The organs and meat was washed with saline and were weighed to calculate dressing and edible organs weights according to (Ademola *et al.,* 2009).

BLOOD CHEMISTRY EVALUATION

At the end of the experiment, 5 ml of was collected from 3 randomly selected birds from each replicate via wing vein into specimen bottles. Blood samples for hematological analysis were collected into sterilized bottles containing ethylene diamine tetra acetic acid (EDTA) as anti-coagulant while those used for serum biochemical analysis were collected into tubes without EDTA and centrifuged before analysis. Packed cell volume (PCV) was determined using the microhaematocrit method while hemoglobin content

(Hb) was determined with the cyanomethaemoglobin, Red blood cell count (RBC) was determined using the Neubrauer haemocytometer while Aspartate transaminase (AST), Alanine transaminase (ALT) were determined with a spectrophotometer.

The chemical composition of Moringa oleifera leaf meal was determined using the analytical procedures by AOCS (1990).

STATISTICS ANALYSIS

All data generated were subjected to one-way Analysis of Variance (ANOVA) using the technique of Steel and Torrie (2006). and means where significant were compared using Duncan Multiple Range at 5% significance level as described by Obi (2002).

RESULTS

The results of proximate analysis of *Moringa oleifera leaf meal* on dry matter (DM) basis presented in Table II. The results revealed that Moringa leaves contained appreciable amounts of

Crude protein (22.04%), crude fiber (7.62%), ash (10.38%), ether extract (4.49%), Metabolizable energy (ME) (3091.05 kcal/kg)**.**

Result of the carcass weight is shown in the table III above. The carcass weight of T4 birds was 3.90kg/bird which was significantly higher (P<0.05) than other Treatment groups. Next to T4 was T2 carcass weight 3.02kg/bird. T4 was also had the highest dressing percentage of 92%. T1 (control) and T3 had the leas carcass weight of 2.90 and 2.23kg/bird while T3 had the least dressing percentage of 76.33%.

The FCR of T4 birds were lower than T2 and T3.

From the result, the cost of feed to produce 1kg live weight gain was cheapest in T1 (control) and most costly in T3. T4 bird cost ₦1,160 while T2 cost ₦1, 066.

The total feed intake consumed per bird was highest (4.617kg) in T4 and least (4.177kg) in T3.

Data on hematological and serum biochemical indices of broiler finishers supplied with dietary MOLW are presented in (Tables IV and V).

Birds on T4 recorded the highest hemoglobin value (12.30 g/dL) and this differed significantly (P<0.05) from birds on T2 and T3 which were similar (P>0.05) to each other in hemoglobin. There was no significant difference (P>0.05) between birds on T2 and T3 in hemoglobin. The lowest value in hemoglobin was observed in birds on T1. The PCV contents birds on T4 recorded the highest PCV value (28.00%) and this differed significantly (P<0.05) from birds on T2 and T3 which were similar (P>0.05) to each other in PCV. There was no significant difference (P>0.05) between birds on T2 and T3 in PCV. The lowest value in PCV was observed in birds on T1

Red blood cell content was significantly (P<0.05) higher in birds in T4 than birds T2 and T3. T1 is significantly (P>0.05) lower than all the treatment groups.

Birds on T4 recorded the highest Total white blood cell (TWBC) value (23.00 x109/L) and this differed significantly (P<0.05) from birds on T2 and T3 which were similar (P>0.05) to each other in Total white blood cell (TWBC). There was no significant difference (P>0.05) between birds on T2 and T3 in Total white blood cell (TWBC). The lowest value in Total white blood cell (TWBC) was observed in birds on T1.

MCH was affected (P< 0.05). T2 had the highest value and the lowest value followed by T4, and the similarity was noticed between T1 and T2 and also between T3 and T4 with P value (0.012).

In MCV content, T1 had the highest value and the lowest value followed by T3 and T4, and the similarity was noticed between T1 and T2 and also between T3 and T4 with P value (0.02).

The MCHC content in T1, T2, T3, were similar but birds in T4 were significantly (P>0.05) lower than T1, T2, and T3.

The result of the Total Protein shows that the T4 had a significant (p<0.05) increase in total protein compare to the control and other treatment groups.

There were no significant differences (P>0.05) among the treatment groups in initial Uric acid content

Broiler chickens on T1 recorded the highest numerical value of 3.42 Mmole/L. The lowest numerical value of 3.17 Mmole/L in Uric acid was observed in birds on T2.

The creatinine, content was significantly (P<0.05) higher in birds fed control diet (T1) than those fed 300g MOLM. However, there was no significant difference (P>0.05) between birds fed 300g diet and those fed 500g and 700g MOLM. The highest creatinine was observed in T1 (1.04 Mmole/L) while the lowest creatinine value of 0.81 Mmole/L was observed in T2. ALT content was significantly (P<0.05) higher in birds fed control diet (T1) than those fed 300g, 500g and 700g MOLM which were similar (P>0.05) to each other in serum ALT content. The lowest ALT value of 80.98 iμ/L was observed in birds fed 700g MOLM

In AST, there was a significant (P>0.05) difference between T1 and T2 and no significant difference (P<0.05) between T3 and T4.

DISSCUSSION

The data obtained based on the chemical composition of the *Moringa oleifera* leaf meal were similar to the findings of Aye & Adegun (2013), Tijani *et al.* (2015), and Alabi *et al.* (2017). The higher dry matter content (93.85%) in the *Moringa oleifera* leaf meal can be attributed to the loss of moisture content during processing. This is consistent with earlier reports of Mbah *et al*. (2012) and Egu (2019) who

processed Moringa leaves through sun-drying and shade drying methods.

Table II: Chemical composition of *Moringa Oleifera* leaf and experimental diets

Parameters	Moringa	T1 (control)	T2 (300g)	T3 (500g)	T4 (700g)
Dry matter (%)	93.85	94.83	94.99	94.97	94.90
Moisture (%)	6.15	5.17	5.01	5.03	5.10
Ash (%)	10.38	7.89	8.81	8.15	7.98
Ether Extract (%)	4.49	5.42	6.50	6.21	5.87
Crude protein (%)	22.04	21.20	19.55	20.10	20.55
Crude fibre (%)	7.62	6.18	7.01	6.92	6.81
Nitrogen free (%)extract	47.77	54.14	53.12	53.59	53.69
Metabolizable energy (kcal/g)	3091.05	3162.20	3139.80	3167.35	3177.25

TABLE III: Effect of *Moringa oleifera* Leaf Meal Supplemented Diets on Growth Performance and Cost Benefit Analysis of Finisher Broiler Chickens

PARAMETERS	T1 (CONTROL)	T2 (300g)	T3 (500g)	T4 (700g)	P value
Total feed intake	4.277[a]	4.379[a]	4.177[b]	4.617[a]	0.001
Live weight	3.316[b]	3.433[c]	2.925[a]	3.450[d]	0.001
Carcass weight	2.90[b]	3.02[c]	2.23[a]	3.19[d]	0.001
Dressing percentage (%)	87[b]	88[c]	76.33[a]	92[d]	0.001
Feeding conversion ratio (FCR)	1.70	1.71	1.97	1.68	
Cost of day old chick (₦470)	₦5,640	₦5,640	₦5,640	₦5,640	
Amount of feed/kg	₦51.324	₦52.548	₦49.728	₦55.404	
Cost of feed (₦440/kg)	₦22,582.56	₦23,121.12	₦21,880.32	₦24,377.76	
Cost of vaccination and medication (₦280)	₦3, 360	₦3, 360	₦3, 360	₦3, 360	
Cost of Moringa (₦10/g)	====	₦3, 000	₦5, 000	₦7, 000	
Miscellaneous cost	₦3, 158.256	₦3, 512.112	₦3, 588.032	₦4, 037.776	
Total cost of production	₦31, 440.82	₦38, 633.232	₦39, 468.35	₦44, 415.36	
Cost of production of a bird	₦2, 620.07[a]	₦3, 219.44[b]	₦3, 289.03[c]	₦3, 701.29[d]	0.001
Cost of production per kg	₦905.45	₦1, 066.04	₦1, 474.90	₦1, 160.00	

The difference subscript [(a, b, c, d)] across the row are statistical different (P > 0.05)

The high crude protein content in *Moringa oleifera* leaf meal is similar to reports of Mbah *et al*. (2012) on shade - dried Moringa leaves. However, the crude protein content in the MOLM is lower than the amount obtained in the Moringa seeds as reported by Moreki & Gabanakgosi (2014). The ether extract content (4.49%) was slightly lower than (5.50%) obtained by Alabi *et al.* (2017).

The birds on T1, T2 and 4 had higher fed intake than birds on T3. The results are in accordance with observation of Gadzirayi *et al.* (2012) who reported an increase in feed intake or broilers receiving solvent-extracted soybean meal supplemented with *Moringa oleifera* leaf meal.

According to authors, the observed increase in feed intake maybe attributed to increased bulkiness of the feed. Although birds on T2 and 4 had higher feed intake than birds on T3. But they compared well with birds in the control group in terms of feed intake.

Final weight, carcass weight differs significantly. This disagree with the findings of Juniar *et al.* (2008) who reported that the inclusion of *Moringa oleifera* leaf meal at amount up to 10% in broiler diets did not produce significant effects on body weight and carcass weight.

This agrees with the report of Fuglie (1999) who reported high performance of broilers fed Moring-based diets. The significant feed intake however affects other parameters except the feed conversion ratio.

Table IV: Haematological Indices of Finisher Broilers Offered *Moringa Oleifera* Leaf Meal

Parameters	TI (Control)	T2 (300g)	T3 (500g)	T4 (700g)	P value
Hb (g/dL)	10.60[a]	11.60[b]	11.50[b]	12.30[c]	0.022
PCV%	23.00[a]	25.00[b]	25.50[b]	28.00[c]	0.039
RBC($\times10^{12}$/L)	2.61[a]	2.83[b]	2.93[c]	3.20[c]	0.019
TWBC($\times10^{9}$/L)	20.08[a]	21.17[b]	21.48[b]	23.00[c]	0.001
MCV (fL)	91.84[b]	91.58[b]	90.22[a]	90.21[a]	0.02
MCH (pg)	40.80[b]	41.16[b]	39.23[a]	38.65[a]	0.012
MCHC (g/dL)	46.21[b]	46.41[b]	46.41[b]	41.26[a]	<0.001

The difference subscript [(a, b, c, d)] across the row are statistical different (P > 0.05)

Table V: Serum biochemical indices of finisher broilers offered *Moringa oleifera* leaf meal

Parameters	TI (Control)	T2 (300g)	T3 (500g)	T4 (700g)	P value
Total protein (g/dL)	2.44[a]	2.75[b]	2.92[c]	3.16[d]	0.02
Uric acid (Mmole/L)	3.42	3.17	3.41	3.20	4.98
Creatinine (Mmole/L)	1.04[b]	0.81[a]	0.99[a]	0.89[a]	1.14
ALT(iμ/L)	93.19[ab]	82.09[ab]	83.85[b]	80.98[a]	1.07
AST(iμ/L)	41.96[b]	40.02[a]	41.38	40.19	1.26

The difference subscript [(a, b, c, d)] across the row are statistical different (P > 0.05)

This could be because the amount of *Moringa oleifera* leaf meal added to the diets was such that it would have had noticeable effects of the performance parameters measured.

A Lower FCR value indicates higher efficiency (Ezeibe *et al.,* 2024). It is an evident from the result that the dietary intake of MOLM at 700 g in feed enhanced total weight gain and feed conversion ratio.

The hematological values obtained in this study however fell within the normal range for healthy chicken as reported by Aeangwanich *et al.,* (2004). This indicates that the dietary treatments were nutritionally adequate for the birds. It also agree with the work of Akinduro *et al.,* (2017) where in a related study, where it was revealed that certain medicinal herbs have the tendency to improve hematological parameters in birds.

Birds on T4 had the highest Red blood cell value which could be as a result of high level of *Moringa oleifera* leaf meal (700 g) present in the Diet. Red blood cells are responsible for the transportation of oxygen and carbon dioxide in the blood as well as the manufacture of hemoglobin, hence higher values indicates a greater potential for these functions and a better state of health (Olugbemi *et al.,* 2010).

According to the report of Hackbath *et al.* (1983) that increases RBC values were associated with high quality dietary protein and with disease free animals. *Moringa Oleifera* leaf meal contains iron (23 mg/100g) which is necessary for many functions in the body including the formation of hemoglobin and myoglobin.

Values of hemoglobin obtained in this study ranged from 10.60-12.30 g/dl and falls within the normal range (7-13 g/dl) by (Nkwocha *et al.,* 2018). Treatment 4 recorded the highest value (12.30 g/dl). This implies that within this concentration of *Moringa oleifera* leaf meal intake, the hemoglobin is still adequate to perform its function of conveying oxygen to the cells and transporting carbon dioxide from the cell back to the blood.

Packed cell volume is an index of toxicity reduction in the blood usually and suggests presence of a toxic factor which has adverse effect on blood (Oyawoye & Ogunkunle, 1998).

The values obtained for PCV across the treatment Treatments though it dif fered significantly but were within normal range (22-30%) as reported by (Bounous & Stedman, 2000). The value obtained for all the treatment Treatments indicate nutritional adequacy of all diets and presence of a toxic factor, since the values did not indicate mal or under nutrition (Church *et al.,* 1984). Also, it implies that inclusion of *Moringa oleifera* leaf meal in the diets of broiler birds as supplemented feed ingredients had no effect on the relative quantity of blood cells as compared with the total volume of blood (Onyekwere *et al.,* 2016). A reduction in PCV was suggestive of liver and kidney disease (Demoranville & Best, 2013).

White blood cell helps to protect the body from pathogen (Saladin, 2003; Osman *et al.,* 2004,). Total white blood cell ranged from 20.08-23.00 ($\times 10^{9}$/l) falls within the normal range (12-30($\times 10^{9}$/l)) by (Bounous & Stedman, 2000).

The MCV calculates the average erythrocyte size; the MCH measures the hemoglobin amount per blood cell and MCHC is to know the amount of hemoglobin relative to the size of the cell per red blood cell. The normal ranges for MCV (90-140), MCH (33-47Pg), MCHC (26-35g/dl) (Bounous & Stedman, 2000). The variability in the results for MCHC (41.26 - 46.41g/dl) will depend on multitude of factors

among which include the fact that most normal reference value are established in temperate countries whose data may not effectively reflect tropical animal characteristics due to environmental condition as well as genetic variability.

Serum biochemical parameters provide functional information for the evaluation of health status of birds and reflect many metabolic alterations of organs and tissues when feeding unconventional feed sources (Kudair & Al-Hussary, 2010). The serum protein values in this study were within the normal range for T4 (3.0-4.9 (g/dl)) as reported (Bounous & Stedman, 2000). The significant increase is serum protein of the diet in Treatment 4 suggest that the quantity of *Moringa oleifera* added to the feed increased protein digestion and utilization in broiler birds. However, Moringa leaves increased total protein, reflecting this plant's ability to metabolize protein and stimulate the regeneration of heptatic tissue in broiler birds, increasing protein synthesis in the liver and improving the functional status of liver cells. This shows the role it plays in maintaining the health and safety of liver cells. Low level in serum protein in T2 and T3 (2.75(g/dl) and 2.92(g/dl)) could be due to interference on normal protein metabolism (Bolu & Balogun, 2009). This protein metabolism interference could be ascribed to presence of residual anti-nutritional factors in Moringa leaf. Moringa leaf has phytotoxins such as lecithin, alkaloids, tannins, oxalate and phytate (Odetola *et al.,* 2012).

Uric acid is a nitrogenous waste product of protein degradation in the liver, filtered by the kidney. High level in blood uric acid may indicate renal impairment or protein hyper catabolism. The uric acid values in this study are within the normal range 2.0-10 g/dl reported by (Peters, 2002).

CONCLUSION

The results of the study showed that most of the parameters measured in birds fed diets containing *Moringa oleifera* leaf meal compared well with those placed on the control group and also the parameters are within the normal range. *Moringa oleifera* leaf meal is considered as a good source of protein in livestock nutrition

CONFLICT OF INTEREST

There was no conflict of interest.

REFERENCES

Ademola, S.G, Farinu, G, & Babatunde G.M. (2009). Serum lipid, growth and haematological parameters of broilers fed garlic, ginger and their mixture. *World Journal Agricultural Science*, 5, 99-104.

Adiele, J.G., Audu, H.O., Madu, T. & Nwaogwugwu, R.O. (2005). Weather in 2005 at Umudike and its possible impact on root crops production. In: National Root Crops Research Institute Annual Report. *Applied Rabbit Research,* 12, 252-255.

Aeangwanich, W., Simarakas, S., & Chinrasri, O. (2004). Haematological erythrocyte and serum biochemical value of the Thai indigenous chicken (*Gallus domesticus*) in North-eastern Thailand. *Songklanakarian Journal of Science Technology, 26* (3), 425-430.

Alabi, Q.K; O.S. Olukiran; Ma. Adefisayo & B.A. Fadeyi. (2017). Effects of treatment with nauclea latifolia root decoction on sexual behavior and reproductive functions in male rabbits. *Journal of Dietary Suppliments.* 15(5), 649-664.

Akinduro, V.O., Onibi, G.E., & Osho, I.B. (2017). Analysis of some phytochemicals in selected spices used in Nigeria pepper soup. *Uniosun Journal of Agriculture and Renewable Resourses, 1*, 68-75.

American Oil Chemists' Society (AOCS), 1990. Official Methods and Recommended Practices Fourth edition.

Aye, P.A. & Adegun, M.K. (2013). Chemical composition and some functional properties of moringa, leaucaena and gliricidia leaf meals. *Agriculture and Biology Journal of North America* 4(1), 71-77

Ayssiwede S.B, Dieng A., Bello H., Chrysostome C.A.A.M., Hane M.B., Mankor A., Dahouda M., Houinato M.R., Hornick J.L. & Missohou A. (2011). Effects of Moringa oleifera (Lam.) Leaves Meal Incorporation in Diets on Growth Performances, Carcass Characteristics and Economics Results of Growing Indigenous Senegal Chickens. *Pakistan Journal of Nutrition* 10 (12), 1132-1145

Bolu S.A & Balogun O.O (2009). Effects of improved (Addition of Antimicrobials and Antioxidants) locally produced Natural vitamins premix on performance, Haematology and some serum constituents of Broiler chickens. *Nigerian Journal of Animal production* vol 3 No 2.

Bounous D. I., & Stedman N. L., (2000). Normal avain heamatology: Chicken and Turkey In: feildman BF, Zinkl JG, Jain NC, editors. *Schalm's Veterinary heamatology.* New York Wiley, 2000 P. 117-1154.

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

Demoranville, V. E. & Best, M. A. (2013). Haematology: Haematocrit. Encyclopedia (2013). Available at en.wikipedia/wiki/haematolog

Egu, U. N. (2019). Effect of graded levels of *Moringa oleifera* leaf meal on performance and serum biochemical parameters of broiler chickens. *Journal of Animal Science and Veterinary Medicine* 4(1), 1-8

Esiegwu, A. (2019). The supplementary effect of *Moringa oleifera* leaf water on performance and blood indices of finisher broilers. *Direct Research Journal of Veterinary Medicine and Animal Science.* Vol. 4 (4), August 2019, ISSN: 4372-2601

Ezema C. (2014). Comparative study of the effects of Probiotic and commercial enzyme on growth rate, haematology and serum biochemistry of broiler

chicken. *Journal of Food Processing and Technology*.5, 367.

Ezeibe, F.I, Kenneth-Chukwu, M.O. & Akpan C.A.N. (2024). Tumeric paste enhances feed conversion ratios in broilers. *International Journal of Veterinary Sciences and Animal Husbandry*, 9(4), 337-340.

Fuglier L J. (1999). The miracle tree: *Moringa oleifera.* Natural nutrition for the tropics. *Church World Service*, Dakkar, Senegal, pp 68.

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):510. http://209.238.2.121/fulltext/?doi=ijps.2012.5.10&org=11

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

Juniar I, Widodo E, & Sjofjan O. (2008). Effect of *Moringa oleifera* leaf meal in feed on broiler production performance. *Journal Ilmuilmu Peternakan Brawijaya*, 18: 238–242. http://jurnal.ub.ac.id/index.php/jiip/article/view/62

Kudair, I. M. & Al-Hussary, N. A. J. (2010). Effect of vaccination on some biochemical parameters in broiler chickens. *Iraqi Journal of Veterinary Science*, 24: 59–64. http://agris.fao.org/agris-search/search.do?recordID=DJ2012047668

Makkar H.P.S. & Becker K. (1997). Nutrients and antiquality factors indifferent morphological parts of the Moringa oleifera tree. *The Journal of Agriculture Science*. Volume 128. Issue 3.

Mbah, B.O, Eme P.E & Paul A.E (2012) Effect of Drying Techniques on the Proximate and Other Nutrient Composition of *Moringa oleifera* Leaves from two Areas in Eastern.Nigeria. *Pakistan Journal of Nutrition* 11 (11), 1044-1048.

Moreki, J.C. & Gabanakgosi, K (2014) Potential use of *Moringa oleifera* in poutry diets. *Global Journal of Animal Scientific Research* 2 (2), 109-115.

Nkwocha, G.A., K.U. Anukam, E.O. Ahaotu & O.I. Prudent (2018).Performance and Hematological Profile of Broiler Chicks on Toasted Tiger Nut (Cyperus esculentus) Treated With Bakery Yeast. Proc. 43rd Annual Conference of the Nigerian Society for Animal Production, March 18th – 22nd 2018, FUT Owerri, Nigeria. Pp 484 – 487.

Nkukwana, T.T, Muchenje, V, Pieterse, E Masika, P.J, Mabusela, T.P, Hoffman, L.C, & Dzama, K. (2014). Effect of Moringa oleifera leaf meal on growth performance, apparent digestibility, digestive organ size and carcass yield in broiler chickens. *Livestock science* 161, 139-146.

Obi, I. (2002). Statistical methods of detecting differences between treatments mean and research methodology issue in laboratory and field experimentation A.P Company limited.

Odetola O.M, Adetola O.O, Ijadumola T.T, Adedeji O.J, & Adu O.A (2012). Utilization of Moringa leaf meal as a replacement for soya bean meal in rabbit diet. *Journal of Agricultural Science*, 2(12), 309 – 313.

Olugbemi, T. S., Mutayoba, S. K., & Lekule, F.P. (2010). Effect of Moringa (*Moringa oleifera*) inclusion in cassava based diets fed to broiler chickens. *International Journal of Poultry Sciences.* 9(4), 363-367.

Osman, Z.M., Gomaa, A.M., Hussein, H.M., Soliman, F.H & El-Shobaki, A.F. (2004). Association between retinol metabolism and diabetic retinopathy. *Polish Journal of food and Nutrition*; 13:54.

Onyekwere M.U., Okechukwu, S.O., Jiwuba, P. C,Onwujiariri, E.B. Ahaotu, E.O & Anukam K.U (2016). Effect of dried cocoyam Tubers (Colocasia esculenta) meal on growth performance and blood serum mineral profile fed broiler starter. Proc. 21st Ann. Conf. Animal Science Association of Nigeria.Porthacourt, Rivers State. 18th -22nd Sept, 2016. Pp 184 – 189

Oyawoye, E. O & Ogunkunle, M. (1998). Chemical analysis and biochemical effects of raw Jack beans on broiler. *Nigerian Society of Animal Production,* 23: 141-142.

Peters, S.S. (2002). Essentials of Avain Medicine and Surgery. A practitioner's guide 2nd edition by Peter S.Sakas.

Saladin, K. (2003). The male reproductive system. Anatomy and Physiology: the unit of form and function. New York: McGraw – Hill Pp; 1017-1047.

Sarker M., Bhowmick, S., Hussain, J., Hasan, M., & Hosain, S. (2017). Hot water extract of Moringa oleifera leaves protects Erythrocytes from Hemolysis and major organs from oxidative stress in vitro. *Journal basic Resources* 3(3), 120-126

Steel, R.G.D. & Torrie, J.H. (1980). Principles and Procedures of Statistics. A Biometric Approach 2nd Ed. M.C. Graw-Hill Book Co. Inc. New York.

Taiwo, L. B. (2005). Growth performance of cowpea inoculated with Glomus Mosseae and fertilized with Ogun rock phosphate (ORP) under heat treatment. *Nigerian Journal of Soil Science* 15 (2), 141-147.

Tijani, L.A, Akanji, A.M, Agbalaya, K, & Onigemo M.O (2015). Haematological and serum biochemical profiles of broiler chickens fed diets containing *Moringa leaf* meals. *Journal of Tropical Agriculture, food, Environment and Extension.* 14 (3), 7 – 11.

Yang, R.Y. & Tsou, S.C.S. (2006). Enhancing iron bio-availability of vegetables through proper preparation principles and applications. *Journal of International cooperation*, 1, 107-119.

Zanu , H.K., Asiedu, P., Tampuori, M., Abada, M., & Asante, I., (2012). Possibilities of using Moringa oleifera leaf meal as partial substitutue for fishmeal in broiler chicken diets, *Online Journal of Animal Feed Resources*, 2 (1), 70-75.