



Blood Profile and Organ Weights of Broiler Chickens Fed Diets Containing Graded Levels of *Terminalia Mantaly* Leaf Meal

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Abstract

One hundred and fifty (150) day-old Anak broiler chicks were used to evaluate the effect of feeding *Terminalia mantaly* leaf meal (TLM) based diets on the blood profile and organ weights of broiler chickens. The birds were randomly assigned to 5 treatment diets (replicated into 3 of 10 birds/replicate) containing 0%, 1.5%, 3%, 4.5%, and 6% of TLM, respectively for 6 weeks after a 2-week period of stabilization. The results showed no significant ($P>0.05$) difference for most parameters considered for organ weights except for heart and kidney. For kidney, T_5 had the highest value (0.5867%) while T_2 had the lowest (0.4433%). For haematology, haemoglobin Concentration (Hb), red blood cell (RBC), mean cell haemoglobin (MCH) and mean cell haemoglobin concentration (MCHC) were significantly ($P<0.05$) affected. For haemoglobin Concentration, T_3 had the highest value (13.0000g/dl) which was closely followed by T_2 (12.1333g/dl), T_1 (12.0667g/dl) and T_4 (11.4000g/dl) and T_5 (10.6667g/dl). For RBC, T_3 (3.4400) was significantly ($P>0.05$) higher while T_5 (2.5467) was lowest. T_5 had the highest value (41.9233pg) for MCH while T_3 recorded lowest (37.8067pg). MCHC followed the same trend as MCH. Biochemical indices showed no significant difference except for total protein and cholesterol. For total protein, T_3 had highest value (3.3633g/dl) which was significantly ($P<0.05$) different from that of T_1 (control) (2.3733g/dl). For cholesterol, T_3 (110.3533mg/dl), T_2 (114.4267mg/dl) and T_1 (114.7567mg/dl) had higher values that were significantly ($P<0.05$) different from that of T_4 (103.1833mg/dl). In conclusion, T_3 (3.0% *Terminalia mantaly* leaf meal) with the optimal value in organ weight and better blood profile than others is therefore recommended.

Keyword: *Terminalia*, organ, mantaly, blood, haematology

Introduction

Intensive broiler production can help bridge the meat supply gap in Nigeria and ensure animal protein adequacy. Feed scarcity has remained a major limitation to livestock production and productivity (Agbede and Aletor, 2003). The high cost of animal feeds precipitated by the ever-increasing cost of feed ingredients has resulted in poor nutrition leading to declining productivity of animals in developing nations like Nigeria (Nodu *et al.*, 2014). According to Fetuga (1997) there is a disappointing rate and low level of performance in the Nigerian livestock

industry, due to high cost of feeds, poor quality feeds, inefficiency in production and distribution in the feed industry. The low level of livestock production has affected adequate protein intake.

Terminalia mantaly is a large tropical tree in the family *Combretaceae* that is native to the tropical regions of Asia. There is scanty information on the use of *Terminalia mantaly* as an ingredient for livestock feed formulation. However, some studies on the medicinal properties of the bark and wood have been reported in traditional medicine. The bark and

wood are used in treating dysentery. It is also an excellent spreading shade tree (Orwa *et al.*, 2009). Kokora *et al.* (2013) reported that the extracts of *T. mantaly* had the strongest inhibitory effect on two strains of *Staphylococcus aureus* and *Escherichia coli*. Zirihi *et al.* (2012) reported that the hydro-alcoholic extract of *T. mantaly* was slightly more active than *T. catappa* on *Aspergillus fumigatus*. Thus, it has high antibiotic properties. Therefore, in order to achieve maximum utilization of this feed resource by farm animals, the effects of feeding these tropical plants to farm animals should be assessed as it has been reported that dietary components have measurable effects on blood constituents which is an indicator of the health status of the animal. This will enable researchers to ascertain its suitability for use in diets of livestock, especially monogastrics at low costs.

Blood is a complex fluid containing large variety of dissolved suspended inorganic and organic substances specialized circulating tissues and cells suspended in the intercellular fluid substance (Dellman and Brown, 2006) which circulates in the arteries, vessels and capillaries of man and animals, and whose primary function is to transport oxygen from respiratory organs to body cells, distributing nutrients and enzymes to cells and carrying away waste products (Baker and Silvertown, 2002), thereby maintaining homeostasis of the internal environment (Bentrick, 2004). The various functions of the blood are made possible by the individual and collective actions of its constituents – the hematological and biochemical components. Generally speaking, both the hematological and biochemical blood components are influenced by the quantity and quality of feed and also the level of anti-nutritional elements or factors present in the feed (Akinmutimi, 2004). Biochemical components are sensitive to elements of toxicity in feeds. They can also be used to monitor protein quality of feeds.

Haematological components of blood are also valuable in monitoring feed toxicity especially with feed constituents that affect the formation of blood (Oyawoye and Ogunkunle, 2008). Efforts therefore were made in this study to assess the effect of *Terminalia mantaly* leaf meal on the organ weight, haematology and serum biochemistry of broiler chicken. The broad objective of this study, therefore was to evaluate the organ weight, haematology and serum biochemistry of broiler chicken fed diets containing graded levels of *terminalia mantaly* leaf meal.

Materials and Methods

Experimental Site

The study was conducted at the poultry Unit of the Teaching and Research Farm of Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria. The site is situated on latitude 05° 29' North and longitude 07° 33° East, in the rain forest zone of Nigerian. The climate of the region is characterized by a mean daily temperature of between 27 and 35 °C, all through the year. Average rainfall is about 2000 mm per annum with a double maxima pattern (NRCRI, 2006).

Experimental Animals and Management

A total of One hundred and fifty (150) day old broiler chicks were bought from a reliable source. The birds were allowed to stabilize for one week with commercial starter broiler diet before distributing them randomly into five experimental treatment groups in a completely randomized design. Each treatment group contained thirty (30) broiler chicks. Then each group was further divided into three replicates of ten (10) birds each. Heat was supplied with electricity and kerosene stove. Each group was randomly assigned to an experimental broiler diet. The experiment lasted for 6 weeks. Water and feed were supplied *ad libitum*. The birds were weighed at the beginning of the feeding trial to get their initial weight and

weekly thereafter. Feed intake was recorded daily by weighing the quantity of feed given and the left over the following morning.

Sourcing and Processing of *Terminalia mantaly* Leaf Meal (TLM)

The *Terminalia mantaly* leaves used in this experiment were harvested from its trees within the University vicinity. Fresh, succulent, greenish non-over matured leaves were harvested to ensure lower value of lignin and higher nutrient availability. The leaves were air dried in batches to about 10% moisture before passing through a 10 mm hammer mill and further used in the formulation of the experimental diets.

Experimental Diets

Five (5) experimental diets were formulated to meet the nutrient requirement of broilers birds as recommended by NRC (1998). The experiment was divided into 5 treatment groups with 30 birds per treatment with 3 replicates of 10 birds each.

Diet 1 (T₁) served as the control diet containing no *Terminalia mantaly* (TLM) while Diets 2 (T₂), 3 (T₃), 4 (T₄) and 5 (T₅) contained TLM at 1.5%, 3.0%, 4.5% and 6.0% inclusion levels, respectively as presented in Table 1.

Table 1: Composition of experimental diets

Ingredients (%)	T ₁ (0.0)	T ₂ (1.5)	T ₃ (3.0)	T ₄ (4.5)	T ₅ (6.0)
Maize	59.00	58.25	57.50	56.75	56.00
Soy bean meal (SBM)	30.00	29.25	28.50	27.75	27.00
Palm kernel cake (PKC)	3.00	3.00	3.00	3.00	3.00
Wheat offal	1.50	1.50	1.50	1.50	1.50
Bone meal	3.00	3.00	3.00	3.00	3.00
Fish meal	3.00	3.00	3.00	3.00	3.00
Salt	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
<i>Terminalia leaf meal</i>	0.00	1.50	3.00	4.50	6.00
Total	100.00	100.00	100.00	100.00	100.00
Crude protein (%)	22.13	21.90	21.83	21.72	21.59
Metabolizable energy (Kcal/kg)	3006.50	3000.84	2996.18	29909.90	2985.00

* Vit/Min premix (1kg) contained vitamin A (5000.00IU), vitamin A 3 (1,000.00), vitamin (16,00mg), vitamin K (800mg), vitamin B1 (1200mg), vitamin B2 (22,000mg), Niacin (22,000mg), calcium pantothenate (4600mg), vitamin B6 (2000mg), vitamin B12 (10g), folic acid (400mg), Biotin (32mg), choline chloride (200,000mg), Manganese (948,000mg), iron (40,000mg), Zinc (32,000mg), Copper (3400mg), Iodine (600mg), Cobalt (120mg), Selenium (48mg), Anti-oxidant (48,00mg).

Data Collection

Data were collected on these parameters;

- ❖ Organ weights
- ❖ Hematology
- ❖ Serum biochemistry

Organ proportions

The organ proportions were determined by slaughtering two broilers per treatment at the end of the feeding trial. The broilers to be slaughtered were fasted for few hours to empty the digestive tract but water was supplied *ad libitum*. Slaughtering was done by making a clean cut across the jugular vein and the broilers were allowed to bleed for at least two

minutes. All the internal organs were weighed and expressed as percentage live weight.

Hematological analysis

At the end of the feeding trial, six millilitres (6 ml) of blood was collected from the jugular vein of the broiler using hypodermic needles and sterile syringes. Then 3 ml was immediately transferred to sample bottles containing Ethylene diamine tetra acetic acid (EDTA), an anti-coagulant to prevent blood clotting and used for hematological analyses. The remaining 3 ml was immediately transferred to EDTA-free sample bottles and used for biochemical analyses.

The blood samples collected were analyzed within 2 hours of collection for packed cell volume (PCV) using microhaematocrit method and haemoglobin using the Sahli method. Haemoglobin (Hb), White blood cell counts (WBC) and Red blood cell counts (RBC) was determined using improved Neubauer Haemocytometer method as described by Feldman *et al.*, (2000). The various Red cell indices; Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH) and Mean Corpuscular Haemoglobin Concentration were calculated from RBC, Hb and (PCV) as described by Feldman *et al.*, (2000).

The MCV, MCHC and MCH were calculated thus:

$$\text{Mean Corpuscular Haemoglobin (MCH)} = \frac{Hb \times 10}{RBC}$$

$$\text{Mean Corpuscular Volume (MCV)} = \frac{PCV \times 100}{RBC}$$

$$\text{Mean Corpuscular Haemoglobin Conc. (MCHC)} = \frac{Hb \times 100}{PCV}$$

Serum biochemistry

The bottles of the coagulated blood were subjected to standard methods of serum separation and the

the albumin, globulin, urea, glucose, creatinin and cholesterol.

Experimental Design

The design of this study is a Completely Randomized Design (CRD) using five treatments. The statistical model for the analysis is as follows:

$$Y_{ij} = \mu + T_i + e_{ij}$$

Where,

Y_{ij} = individual observation.

μ = population mean

T_i = treatment effect

e_{ij} = random error, (i.i.d 0, σ^2) assumed to be independently, identically and normal distributed with zero means and constant variance.

Statistical Analysis

All data analyses were done using IBM® SPSS version 20.0, and were subjected to analysis of variance (ANOVA) (Steel and Torrie, 1980). Significant differences between treatment means were separated using Duncan Multiple Range Test (Duncan, 1955).

Results and Discussion

Effect of *Terminalia mantaly* Leaf Meal Based Diet on the Organ Weights of Broiler Birds

The effect of the varying levels of *Terminalia mantaly* leaf meal based diet on the organ weights of the experimental broiler chickens is shown in Table 2.

Table 2: Effect of *Terminalia mantaly* leaf meal-based diet on the organ weights of broiler chickens

Parameters (%)	T ₁ (0.0%)	T ₂ (1.5%)	T ₃ (3.0%)	T ₄ (4.5%)	T ₅ (6.0%)	SEM
Heart	0.4633 ^{ab}	0.4433 ^b	0.5000 ^{ab}	0.4733 ^{ab}	0.5867 ^a	0.2009
Lungs	0.7700	0.6466	0.6367	0.6333	0.6300	0.0280
Liver	2.7310	2.3917	2.9027	2.8847	2.8380	0.0892
Intestine	7.7847	6.2850	7.8750	7.5086	5.7443	0.3709
Gizzard	2.2653	2.0323	2.3603	2.0407	2.1340	0.5272
Proventriculus	0.6223	0.6037	0.6447	0.6733	0.6060	0.0145
Spleen	0.1190	0.0977	0.0970	0.1150	0.1363	0.0084
Kidney	0.6500 ^a	0.4797 ^b	0.6250 ^{ab}	0.6113 ^{ab}	0.5823 ^{ab}	0.0243
Bile	0.1327	0.1003	0.1250	0.14767	0.1020	0.0112

Means within the same row with different superscripts (a-b) are significantly different SEM– Standard Error of Mean

The results showed that the heart weights recorded significant ($p < 0.05$) differences across the treatments from 0.4433% in Treatment 2 (1.5%) to 0.5867% in Treatment 5 (6%). This result is indicative that treatment 5 had the highest effect on the heart weight and could mean that broilers fed with this treatment may have enhanced cardiovascular activity (Lin *et al.*, 2019), which is crucial for broiler vitality and endurance. Similar to this result, the findings of Urom *et al.* (2021) indicated significant ($p < 0.05$) difference in heart weight among treatment groups fed cassava leaf meal. In contrast, the study by Ukorebi and Akpet (2019) showed no significant ($p > 0.05$) difference in heart weights of broilers fed a similar leaf meal-based diet. Kidney weight values, although slightly lower than other organs, showed significant ($p < 0.05$) variations across treatment groups. Values ranged from 0.4797% in Treatment 2 (1.5%) to 0.6500% in Treatment 1 (0.0%). This result also aligns with the results of Urom *et al.* (2021). This kidney results also agrees with the study findings of Borin *et al.* (2006) which showed significant increase in kidney weights of broilers fed cassava leaf meal. In contrast to this, Durunna *et al.* (2011) found no

significant ($p > 0.05$) difference in organ weights of broilers fed bitter leaf meal diet. The values fluctuated across the treatment groups increasing at Treatment 3 (3.0%) and slowly dropping in Treatments 4 (4.5%) and 5 (6%). However, the Treatment 2 (1.5%) had the lowest value. Heavier kidneys in Treatment 1 and Treatment 3 suggest that better filtration and waste elimination had occurred in these groups, indicating enhanced overall health.

Effect of *Terminalia mantaly* Leaf Meal Based Diet on the Haematological Parameters of Broiler Birds

The effect of the varying levels of *Terminalia mantaly* leaf meal-based diet on the haematological parameters of experimental birds is shown in Table 3. From the results, it was observed that Haemoglobin levels varied significantly ($p < 0.05$) with the lowest value of 10.6667g/dl observed in Treatment 5 (6.0%) and the highest level of 13.0000g/dl observed in Treatment 3 (3.0%). This result aligns with that of Nworgu *et al.* (2015) on effect of water leaf meal on haematological parameters of broilers and contrasts with the findings of Adejuyigbe *et al.* (2023). Higher haemoglobin in Treatment 3 (3.0%) may be

indicative of improved oxygen-carrying capacity, vital for broiler bird energy and growth. Lower levels in Treatment 5 (6.0%) could suggest anemia. This could mean that higher concentration of *Terminalia mantaly* leaf meal could negatively affect haemoglobin

levels. Red Blood Cell Count also differed significantly ($p < 0.05$) from 2.5467 to 3.4400 in Treatments 5 (6%) and 3 (3.0%), respectively. The study is in line with the findings of

Table 3: Effect of *Terminalia mantaly* Leaf Meal Based Diet on the Haematological Parameters of Broiler Birds

Parameters	T ₁ (0.0%)	T ₂ (1.5%)	T ₃ (3.0%)	T ₄ (4.5%)	T ₅ (6.0%)	SEM
Haemoglobin (g/dl)	12.0667 ^{ab}	12.1333 ^{ab}	13.0000 ^a	11.4000 ^{bc}	10.6667 ^c	0.2548
Packed cell volume (%)	26.6667	27.3333	27.0000	25.3333	22.6667	0.8575
Red blood cell ($\times 10^6/\text{mm}^3$)	3.0033 ^b	3.1033 ^{ab}	3.4400 ^a	2.8833 ^{bc}	2.5467 ^c	0.0903
Total White blood cell ($\times 10^3/\text{mm}^3$)	23.2500	19.7000	20.6833	19.0167	19.8500	0.8423
Mean Corpuscular Volume (MCV) (fl)	91.8467	91.0300	92.6533	91.0467	92.6300	0.4647
Mean Corpuscular Haemoglobin (MCH) (pg)	40.1900 ^{ab}	39.1467 ^{bc}	37.8067 ^c	39.5700 ^{ab}	41.9233 ^a	0.4230
Mean Corpuscular Haemoglobin Concentration (MCHC) (%)	45.2600 ^{ab}	44.4467 ^{bc}	42.8967 ^c	45.0300 ^{bc}	47.1667 ^a	0.4498

Means within the same row with different superscripts (a-c) are significantly different SEM– Standard Error of Mean

Maxwell *et al.* (1990) who also indicated significant ($p < 0.05$) variations in RBC count of broilers fed a similar leaf meal. Higher RBC count indicates effective oxygen transport, while lower counts indicate poor oxygenation suggesting that as the treatment concentration increased, it adversely affected the RBC count of experimental birds (Wang *et al.*, 2021). In Mean Cell Haemoglobin (MCH) levels, significant ($p < 0.05$) variations were observed, ranging from 37.8067pg (Treatment 3) to 41.9233pg (Treatment 5). Treatment 2 and 4 showed very similar values which could indicate that either a slight increment or reduction from the 3% level used in Treatment 3 could affect MCH levels of experimental birds. MCH levels in similar studies of Muhammad and Oloyede (2009) and

Okonkwo and Uba (2017) showed results that align with the results of this study. Samar (1990) noted that elevated MCH levels indicates larger and more oxygen-rich haemoglobin which is sort after in broiler production and management. Mean Cell Haemoglobin Concentration (MCHC) also showed significant ($p < 0.05$) differences with values ranging from 42.8967g/dl in Treatment 3 (3.0%) to 47.1667g/dl in Treatment 5(6.0%). Similar results were also shown in the study findings of Muhammad and Oloyede (2009) and Okonkwo and Uba (2017). Higher MCHC indicates a denser and more concentrated haemoglobin, enhancing oxygen transport efficiency as highlighted by Onunkwo *et al.* (2022). This variations in haematological parameters may suggest that leaf meal

concentrations led to diverse nutrient intake, impacting blood parameters. Other haematological parameters, although numerically varying slightly across treatment groups, showed no significant difference.

Effect of *Terminalia mantaly* Leaf Meal Based Diet on the Serum Biochemical Parameters of Broiler Birds

Table 4 shows the effect of *Terminalia mantaly* leaf meal based diet on the Serum Biochemical Parameters of experimental broilers. Globulin, urea, creatinine, and glucose levels showed no significant ($p > 0.05$) difference across the treatment groups. However, total protein values varied significantly ($p < 0.05$) from 2.3733g/dl in Treatment 1 (0.0%) to 3.3633g/dl in Treatment 3 (3.0%). Total protein levels peaked at Treatment 3 and began to reduce drastically till Treatment 5. The control group had the lowest Total protein levels indicating that an addition of *Terminalia mantaly* leaf meal in broiler diet can positively impact protein levels. Similar results can be seen in the study of Onunkwo *et al.* (2022). According to Beski *et al.* (2015), high protein levels in broilers are attributed to improved growth, immunity, and enzyme function. There were observed significant ($p < 0.05$) differences in Albumin levels with a range of 1.1500 to 1.8300 in Treatment 1 (0.0%) and 3 (3.0%) respectively. A note-

worthy fact in the results of this parameter is the sharp increment from 1.1600g/dl in Treatment 2 (1.5%) to 1.8300g/dl (3%) in Treatment 3. This is indicative that even a little increase in *Terminalia mantaly* leaf meal concentration can have significant effect on albumin levels. A sharp decrease was also observed after Treatment 3 which is suggestive that any further increase in treatment concentration after 3% will lead to a notable decrease in albumin levels. The findings of Igwe *et al.* (2020) and Akintunde *et al.* (2021) contrasts with this result as their studies showed no significant ($p > 0.05$) difference in albumin levels of broiler chickens fed Siam weed leaf extract. Elevated albumin levels indicates good liver function and proper nutrient absorption as highlighted by Ge *et al.* (2016) so, it is advised that broiler producers should stay within the 3% concentration level when administering feed with *Terminalia mantaly* leaf. Total Cholesterol levels varied significantly ($p < 0.05$) from 103.1833mg/dl in Treatment 4 (4.5%) to 114.7567mg/dl in the control treatment (0.0%). Total cholesterol levels reduced as the concentration increased suggesting that the effect of *Terminalia mantaly* leaf meal in broiler diet is positive especially in a concentration of 4.5%. This aligns with the results of Daramola *et al.* (2019) which showed a reduction in cholesterol levels of broilers fed bitter leaf

Table 4: Effect of *Terminalia mantaly* leaf meal based diet on the serum biochemistry of broiler birds

Parameters	T ₁ (0.0%)	T ₂ (1.5%)	T ₃ (3.0%)	T ₄ (4.5%)	T ₅ (6.0%)	SEM
Total protein(g/dl)	2.3733 ^b	2.4867 ^{ab}	3.3633 ^a	2.9067 ^{ab}	2.5567 ^{ab}	0.1420
Albumin(g/dl)	1.1500 ^b	1.1600 ^b	1.8300 ^a	1.5233 ^{ab}	1.2767 ^b	0.1008
Globulin(g/dl)	1.2233	1.3433	1.5333	1.3833	1.2800	0.0512
Urea(mg/dl)	10.7667	9.7700	11.1800	10.3667	10.5933	0.2969
Creatinine(mg/dl)	1.0467	0.9555	1.0333	0.9433	1.0500	0.0241
Glucose(mg/dl)	199.6667	206.3333	192.3333	188.3333	202.0000	2.8443
Total cholesterol(mg/dl)	114.7567 ^a	114.4267 ^a	110.3533 ^a	103.1833 ^b	108.5100 ^{ab}	1.3921

Means within the same row with different superscripts (a-b) are significantly different SEM– Standard Error of Mean

meal and *Moringa oleifera* leaf meal. A similar study by Onunkwo *et al.* (2022) also aligns with the significant variations in total cholesterol levels. Broiler producers can incorporate this treatment in feed formulation as low cholesterol levels are associated with cardiovascular health benefits (Shen *et al.*, 2019).

Conclusion and Recommendation

From this study, the following conclusions were drawn:

1. The heart weights recorded significant ($p < 0.05$) differences across the treatments from 0.4433% in Treatment 2 to 0.5867% in Treatment 5.
2. Kidney weight values, although slightly lower than other organs, showed significant ($p < 0.05$) variations across treatment groups. Values ranged from 0.4797% in Treatment 2 (1.5%) to 0.6500% in Treatment 1 (0%).
3. Haemoglobin levels displayed significant ($p < 0.05$) differences, ranging from 10.6667g/dl in treatment 5 to 13.0000g/dl in treatment. RBC count had significant ($p < 0.05$) variations across all treatments but notably in treatment 3 and 5.
4. In Mean Cell Haemoglobin (MCH) levels, significant ($p < 0.05$) variations were observed, ranging from 37.8067pg (Treatment 3) to 41.9233pg (Treatment 5). While, Mean Cell Haemoglobin Concentration (MCHC) also showed significant ($p < 0.05$) differences with values ranging from 42.8967g/dl in Treatment 3 (3.0%) to 47.1667g/dl in Treatment 5 (6.0%)
5. Total protein and albumin levels exhibited significant ($p < 0.05$) differences increasing drastically from the control group (Treatment 1) to Treatment 3 (3%).

6. Total Cholesterol levels varied significantly ($p < 0.05$) reducing from 114.7567mg/dl in the control treatment (0.0%) to 103.1833mg/dl in Treatment 4 (4.5%).

Based on the results of this study, the administration of *Terminalia mantaly* leaf meal in broiler chicken diets at a concentration of 3.0% (T3) is recommended.

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