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Growth performance, Haematological and Serum biochemistry of broilers fed diets containing *Vitex doniana* leaf meal

Desempenho de crescimento, bioquímica hematológica e sérica de frangos de *corte alimentados com dietas contendo farinha de folhas de Vitex doniana*

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ABSTRACT

This experiment was conducted to investigate the growth performance, haematological and serum biochemistry indices of broilers fed diets containing *Vitex doniana* leaf meal (VDLM). A total of 120 unsexed broilers were allocated to four treatments of T1, T2, T3 and T4 and replicated three times with ten birds per replicate in a Completely Randomized Design. The birds in each treatment were fed with diets containing 0.0, 2.5, 5.0 and 7.5% VDLM respectively. Growth performances, packed cell volume, red blood cell count, haemoglobin, white blood cell count, lymphocytes, neutrophils, mean corpuscular volume, mean corpuscular haemoglobin concentration, platelet count, aspartate amino transaminase, alanine amino transaminase, alkaline phosphate, high density lipoprotein, low density lipoprotein, cholesterol, albumin, globulin, urea, glucose, total protein and creatinine were evaluated. Growth performance results showed that there were significant differences (P<0.05) in all the measured parameters except feed cost. The result of the experiment showed that there were significant differences (P<0.05) in all the heamatological and serum biochemistry parameters at starter and finisher phases, except for haemoglobin and mean corpuscular haemoglobin concentration which were not significantly different (P>0.05) at the starter phase. Growth performances of broilers fed control diets were better than the other treatment diets. Mean corpuscular haemoglobin, platelet count and low density lipoprotein decreased progressively while mean corpuscular volume, neutrophils, alanine amino transaminase, aspartate amino transaminase and creatinine increased progressively with increase in the inclusion of VDLM at the finisher phase. At the finisher phase, haemoglobin, packed cell volume and glucose decreased progressively while high density lipoprotein increased progressively with increase in VDLM. The results show that VDLM reduced the growth performance but improved the heamatological and serum biochemistry of broiler at lower levels of inclusion.

KEYWORDS: broiler; leaf meal; *vitex doniana*; serum biochemistry.

RESUMO

Investigou-se o desempenho de crescimento, índices hematológicos e bioquímicos séricos de frangos de corte alimentados com dietas contendo farinha de folhas de *Vitex doniana* (VDLM). Um total de 120 frangos de corte não sexados foram alocados em quatro tratamentos e replicados três vezes com dez aves por repetição em um delineamento inteiramente casualizado. As aves de cada tratamento foram alimentadas com dietas contendo 0,0, 2,5, 5,0 e 7,5% de VDLM respectivamente. Foram avaliados o desempenho de crescimento, hematócrito, contagem de glóbulos vermelhos, hemoglobina, contagem de glóbulos brancos, linfócitos, neutrófilos, volume corpuscular médio, concentração média de hemoglobina corpuscular, contagem de plaquetas, aspartato amino transaminase, alanina amino transaminase, fosfato alcalino, lipoproteína de alta densidade, lipoproteína de baixa densidade, colesterol, albumina, globulina, ureia, glicose, proteína total e creatinina. Os resultados do desempenho de crescimento mostraram que houveram diferenças significativas (P<0,05) em todos os parâmetros medidos, exceto no custo da alimentação. Observou-se diferenças significativas (P<0,05) em todos os parâmetros hematológicos e bioquímicos séricos nas fases inicial e final, exceto para hemoglobina e concentração média de hemoglobina corpuscular que não foram significativamente diferentes (P>0,05) nas fases inicial e final. O desempenho de crescimento dos frangos alimentados com dietas controle foi melhor do que as outras

dietas de tratamento. A hemoglobina corpuscular média, a contagem de plaquetas e a lipoproteína de baixa densidade diminuíram progressivamente, enquanto que, o volume corpuscular médio, neutrófilos, alanina amino transaminase, aspartato amino transaminase e creatinina aumentaram progressivamente com aumento na inclusão de VDLM na fase final. Na fase final, a hemoglobina, o hematócrito e a glicose diminuíram progressivamente enquanto a lipoproteína de alta densidade aumentou progressivamente com o aumento do VDLM. Os resultados mostram que o VDLM reduziu o desempenho de crescimento, mas melhorou a bioquímica hematológica e sérica dos frangos de corte em níveis mais baixos de inclusão.

PALAVRAS-CHAVE: frango; farinha de folhas; *Vitex doniana*; bioquímica sérica.

INTRODUCTION

Broiler production is one of the fastest ways to achieve appreciable improvement in the nutritional standard of the population because it has a short production cycle, quick turnover rate and relatively low capital investment (SMITH 2001, ANI & OKEKE 2011). The cost of production has skyrocketed in recent times due to high feed cost. Nutrition is the most important consideration in any livestock enterprise. Its survival is dependent on the availability of feedstuffs which are mainly components of human food.

The growing competition between the human populace that have been increasing and the feed used for livestock for feed and other various uses caused by increasing human population has led to an increase in prices of feed materials such as maize etc. According to DIARRA & DEVI (2015), many conventional ingredients used in poultry diets are always in short supply mainly as a result of the increase in human population and climatic changes. The high cost of feed ingredients due to competition between animal and man have made the prices of commercial animal feed to increase to over 300%. These problems remain the most important constraints to the expansion of commercial poultry production.

The high cost of conventional feedstuff has already sent a lot of livestock farmers out of business and this leads to a reduction in the overall animal protein production and availability for human dietary need. Feed cost is about 60-80% of the total cost of production in developing countries (IGBOELI 2000, ESONU et al. 2006). One way to mitigate this effect of competition is to look for alternative sources of feed supplemenst that is not only cheaper and could boost the growth of poultry birds but also readily available and not in competition with human. This has led to an increased interest by poultry farmers on the search forl feed ingredients that could be cheaper such as leaf of medicinal plants (OKOLI et al. 2001, 2003).

Plants are primary sources of food, medicine, shelters and other items used by both man and animals since plant leaves are commonly processed into leaf meals for used as poultry feedstuffs. The leaves of some shrubs and trees not only provide food for human and animals but are also medicinal and are known to cure some diseases or the other such as the plant *Vitex doniana* commonly known as Black Plum. As blood act as a pathological reflector and its component changes in relation to the physiological conditions of health (TOGUN et al. 2007), animals with normal blood composition are likely to show good performance.

The examination of blood gives the opportunity to investigate the presence of several metabolites and other constituents in the body of animals and it plays a vital role on the physiological, nutritional and pathological status of an organism (ADEREMI 2004, DOYLE 2006). Therefore, this experiment is to determine the effects of including *Vitex doniana* leaf meal on the growth, haematology and serum biochemistry of broiler birds.

MATERIAL AND METHODS

Experimental Site

This study was conducted at the experimental farm of Nnamdi Azikiwe University, Awka, Anambra state in Nigeria. Awka is located at the tropical rain forest zone at Latitude 6.24^{0}N and Longitude 7.00^{0}E and 7.08^{0}E on the South Eastern part of Nigeria. The mean average annual temperature is 27^{o}c while average annual rainfall is 1600mm with a bimodal rainfall pattern and a relative humidity of about 80% at dawn (EZENWAJI et al. 2013).

Collection and Preparation of Experimental Material

Fresh leaves of *Vitex doniana* were harvested within the premises of the Nnamdi Azikiwe University, Awka. The harvested leaves were dried under shade for about 3-4 days and milled in a hammer mill to create *Vitex doniana* leaf meal (VDLM).

Experimental Diets

The proximate analysis of *Vitex doniana* leaf meal was carried out using standard methods and all reagents used were analytical standard (AOAC 2001). The *Vitex doniana* leaf meal was used to formulate four diets for both starter and finisher. The diets contained different levels of *Vitex doniana* leaf meal (0.0, 2.5, 5.0 and 7.5) and were adjusted to make the diet isonitrogeneous and isocaloric. The diets designated T1 (0.0%VDLM), T2 (2.5%VDLM), T3 (5.0%VDLM) and T4 (7.5%VDLM).

Table 1 shows the percentage feed stuff at various levels of inclusion of *Vitex doniana* leaf meal in the formulated broiler starter diet.

Table 1. Percentage feedstuff composition in the broiler starter diet.

Ingredients	Varying Levels of Replacement			
	T1(KG)	T2(KG)	T3(KG)	T4(KG)
Corn meal	51.00	51.00	50.00	54.95
Soyabean meal	26.00	24.00	23.00	20.00
Wheat offal	14.45	14.45	14.45	10.00
VDLM	0.00	2.50	5.00	7.50
Fish meal	4.00	3.50	3.00	3.00
Bone meal	2.50	2.50	2.50	2.50
Premix	0.25	0.25	0.25	0.25
Lysine	0.20	0.20	0.20	0.20
Methionine	0.30	0.30	0.30	0.30
Salt	0.30	0.30	0.30	0.30
Toxin binder	1.00	1.00	1.00	1.00
TOTAL	100	100	100	100
Calculated C.P(%)	21.68	22.00	21.97	21.70
Metabolizable energy (kcal)	3676.26	3677.47	3672.30	3674.97
Crude fiber (%)	4.81	5.64	6.53	6.56

Table 2 shows the percentage feed stuff at various levels of inclusion of *Vitex doniana* leaf meal of broiler finisher diet.

Table 2. Percentage feed stuff in the broiler finisher diet.

Ingredients	Varying levels of replacement			
	T1(Kg)	T2(Kg)	T3(Kg)	T4(Kg)
Corn meal	50	47.5	46.0	44
Full fat soya	5	5	5	5
Soyabean meal	16	16	16	15.5
Palm kernel cake	10	10	9	9
Groundnut cake	7	7	7	7
Fish meal	3	3	3	3
VDLM	0	2.5	5.0	7.5
Bone meal	3	3	3	3
Limestone	3	3	3	3
Premix	0.5	0.5	0.5	0.5
Lysine	0.5	0.5	0.5	0.5
Methionine	0.5	0.5	0.5	0.5
Salt	0.5	0.5	0.5	0.5
Toxin binder	1	1	1	1
Total	100	100	100	100
Crude protein (%)	19.93	19.83	19.88	19.86
Metabolizable energy	3797.27	3786.02	3793.60	3786.54
Crude fiber (%)	4.64	5.62	6.05	6.87

Experimental Design

One hundred and twenty broiler chicks were randomly assigned to the four dietary treatments. Each treatment was replicated thrice with 10 birds per replicate in a completely randomized design (CRD).

Management of the experimental birds

Brooding and housing of the birds

The poultry pen was washed and disinfected with Izal. It was left for seven days to dry before wood shavings were spread on the floor pen in preparation for the arrival of the birds. A total of one hundred and twenty (120) unsexed broiler chicks of Agrited breed were used for the experiment. The broiler chicks were brooded and reared from 1 day old to 8 weeks on deep litter system using wood shavings. Each compartment was equipped with feeding trough, drinkers and kerosene lanterns as sources of brooding heat and light. Management practices for optimal growth and development such as timely vaccination, feeding, sanitation as well as pest and disease control were carried out.

Feeding of the Birds

From 1 day old to the 28th day, the birds were fed with experimental starter feed after which they were introduced to the experimental finisher feed from 29th day to the 56th day. The feeds were isocaloric and isonitrogenous. The birds were fed *ad libitum* with the experimental diet.

Sanitation and Hygiene

The wood shaving was changed regularly once every week from week 2 to week 4 and from the 5^{th} week to the 8^{th} week. This was done to prevent the accumulation of manure which can be a source of disease infection to the birds. The drinkers were washed thoroughly everyday with detergent and clean water. Foot deep was provided at the entrance of each pen to prevent infection from one pen to the other. For the purpose of convenience, the chicks were fed with shallow feeders and drinkers in their first four weeks. The feeders were later suspended using a rope after their fourth week.

Data Collection

Data were collected on body weight, feed intake and feed cost from the feed consumed by the broilers. Blood samples were taken from three birds per replicate making a total of 9 birds per treatment at both fourth and eight week by inserting a sterile needle into the wing vein of the birds and extracting 5mls of blood each. The blood samples were placed in labeled and sterilized sample tubes containing EDTA for hematology and plain sample bottles were used for serum biochemistry.

Hematological Technique

Differential WBC counts were made on monolayer blood films, fixed and stained with Giemsa-Wright's stain. Total red blood cell (TRBC) and total white blood cell were count (TWBC) and determined by a manual method using hemacytometer. Packed cell volume (PCV) was measured by a standard manual technique using microhematocrit capillary tubes and centrifuged at 2500 rpm for 5 min. Hemoglobin concentration (Hb) was measured by Cyanmeth- Hemoglobin method. Erythrocyte indices (mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentrations (MCHC)) were calculated from TRBC, PCV and Hb, respectively.

Serum biochemistry technique

Serum biochemical indices were determined by an automatic analyzer.

Data Analysis

All the data collected was subjected to analysis of variance (ANOVA) using the Statistical Package for Social Sciences (SPSS). Significant difference among treatment means were separated using Duncan's multiple range test (DUNCAN 1955) at 5% significance level.

RESULTS

Proximate and Phytochemical Composition of *Vitex doniana* Leaf Meal

Table 3 shows the proximate composition of the *Vitex doniana* leaf meal. The *Vitex doniana* leaf meal used in formulating the broilers starter and finisher diets contained moisture content of (7.30%), ash (6.55%), fat (0.10%), fiber (41.90%), protein (14.45%) and carbohydrate (29.70%).

Table 3. Proximate composition of *Vitex doniana* leaf meal (VDLM).

Moisture	7.30%
Ash	6.55%
Fat	0.10%
Fibre	41.90%
Protein	14.45%
Carbohydrate	29.70%

Table 4 shows that the *Vitex doniana* leaf meal contained some anti-nutritional factors such as alkaloids, saponin, tannin, cardiac glycosides, anthraquinones, terpenes and steroids.

Growth performance of broilers fed diets containing *Vitex doniana* leaf meal

The growth performance of broilers fed diets containing *Vitex doniana* leaf meal is shown in table 5. The table shows that final body weight of broilers, total weight gain, average daily weight gain, total feed intake, average daily feed intake and feed conversion ratio were significantly different between treatment means ($P<0.05$).

Table 4. Phytochemical composition of VDLM.

Alkaloid	+
Flavonoid	+
Saponin	+
Tannin	+
Cardiac glycosides	+
Terpenes and steroids	+
Anthraquinones	+

Table 5. Growth performance of broilers fed diets containing (VDLM) at finisher phase.

Parameters	T1	T2	T3	T4	SEM	Pvalue
Final weight (g)	2895.73^{b}	1594.67^{a}	2369.60^{b}	2086.93^{ab}	117.99	0.02
Total weight gain (g)	1815.80^{c}	1188.03^{a}	1188.03^{a}	1560.43^{b}	85.17	0.00
Average daily weight gain(g)	64.87^{c}	42.40^{a}	42.40^{a}	55.77^{b}	3.05	0.00
Total feed intake (g)	5058.17^{c}	2817.40^{a}	4965.40^{bc}	4826.63^{b}	280.61	0.00
Average daily feed intake (g)	180.63^{c}	100.57^{a}	100.57^{a}	173.17^{b}	11.56	0.00
Feed conversion ratio	2.77^{ab}	2.40^{a}	2.40^{a}	3.10^{b}	0.11	0.02
Feed cost US Dollar	0.64	0.43	0.43	0.73	0.44	0.92
Feed cost per kg weight gain US Dollar	0.44	0.37	0.37	0.47	0.38	0.30

abc: Means on the same row with different superscripts are significantly different ($P<0.05$).

Hematological and serum biochemical parameters of broilers at starter phase fed diets containing VDLM.

Table 6 shows that there were significant differences ($P<0.05$) between the treatment means in all the hematological parameters of the broiler chicks.

Table 6. Hematological indices of broilers at starter phase fed diets containing VDLM.

Parameters	T 1	T 2	T 3	T 4	SEM	P value
HB(g/dl)	11.87^{c}	10.33^{b}	11.43^{bc}	7.00^{a}	0.60	0.000
RBC($\times10^{12}$/L)	3.67^{b}	4.67^{c}	5.23^{c}	1.57^{a}	0.44	0.000
WBC($\times10^{9}$/L)	3.85×10^{9c}	2.68×10^{9b}	1.99×10^{9a}	5.73×10^{9d}	4.28×10^{9}	0.000
PCV(%)	38.00^{d}	29.00^{b}	33.67^{c}	21.00^{a}	1.91	0.000
MCV(%)	21.10^{a}	31.17^{b}	41.40^{c}	85.20^{d}	7.38	0.000
MCH(%)	89.6667^{d}	76.3333^{c}	51.0000^{b}	41.7333^{a}	5.80	0.000
MCHC(g/dl)	296.00^{c}	193.03^{b}	170.00^{a}	190.67^{b}	14.87	0.000
LYMPH($\times10^{9}$/L)	48.33^{d}	37.00^{b}	40.00^{c}	24.67^{a}	2.57	0.000
Neutrophils($\times10^{9}$/L)	49.67^{a}	61.00^{b}	60.00^{b}	74.00^{c}	2.61	0.000
Platelet($\times10^{9}$/L)	2.88×10^{11d}	2.50×10^{11c}	1.99×10^{11b}	1.25×10^{11a}	1.84×10^{1}	0.000

abc: means on the same row with different superscripts are significantly different ($P<0.05$). HB – Hemoglobin, RBC - Red blood cell, WBC - White blood cell, PCV - Packed cell volume. MCV - Mean corpuscular volume, MCH - Mean corpuscular hemoglobin, MCHC - Mean corpuscular heamoglobin concentration, LYMPH – Lymphocytes.

Table 7 shows that all the treatment means of the various serum biochemical indices were all significantly different ($P<0.05$).

Table 7. Serum biochemical indices of broilers at starter phase fed diets containing VDLM.

Parameters	T 1	T 2	T 3	T 4	SEM	P value
Urea(mg/dl)	4.67^{a}	4.33^{a}	5.33^{a}	6.67^{b}	0.30	0.005
AST(u/l)	118.00^{b}	113.67^{a}	123.67^{c}	123.67^{c}	1.28	0.000
ALT(u/l)	33.67^{a}	35.67^{b}	41.67^{c}	53.67^{d}	2.35	0.000
ALP(u/l)	159.00^{b}	99.00^{a}	200.33^{d}	180.33^{c}	11.45	0.000
Globulin (g/l)	14.67^{a}	16.67^{b}	26.00^{c}	16.33^{b}	1.35	0.000
Glucose(mg/dl)	64.00^{a}	94.67^{d}	80.33^{c}	71.00^{b}	3.47	0.000
Total protein(g/l)	23.34^{a}	24.00^{a}	34.67^{b}	24.00^{a}	1.46	0.000
Albumin(g/l)	8.67^{b}	7.33^{a}	8.67^{b}	7.67^{ab}	0.23	0.045
Creatinine(mg/dl)	1.13^{a}	1.47^{b}	1.97^{c}	3.57^{d}	0.28	0.000
Cholesterol(mg/dl)	99.67^{c}	71.67^{b}	105.00^{d}	64.00^{a}	5.31	0.000
HDL(mg/dl)	71.00^{c}	61.00^{a}	64.00^{b}	99.00^{d}	4.54	0.000
LDL(mg/dl)	29.00^{d}	12.33^{a}	18.00^{b}	12.33^{a}	2.09	0.000

abc: means on the same row with different superscripts are significantly different (P<0.05). AST - Aspartate transaminase, ALT - Alanine transaminase, ALP - Alkaline phosphatase. HDL - High density lipid, LDL - Low density lipid.

Haematological and serum biochemical parameters of finisher broilers fed diets containing VDLM.

Table 8 shows that there was no significant difference between the treatment means for the haemoglobin (P>0.05). However, other parameters were statistically significantly different (p<0.05) between their treatment means.

Table 8. Haematological indices of finisher broilers fed diets containing VDLM.

Parameters	T 1	T 2	T 3	T 4	SEM	P value
HB(g/dl)	9.67	9.30	8.97	8.27	0.21	0.076
RBC($\times10^{12}$/L)	3.67^{d}	1.47^{a}	2.47^{c}	1.63^{b}	0.26	0.000
WBC($\times10^{9}$/L)	2.85×10^{9b}	1.03×10^{9a}	2.67×10^{9b}	3.83×10^{9c}	3.05×10^{9}	0.000
PCV(%)	29.67^{c}	28.67^{bc}	27.67^{b}	25.67^{a}	0.47	0.000
MCV(fl)	81.33^{a}	192.77^{d}	122.33^{b}	152.63^{c}	12.31	0.000
MCH(pg)	27.33^{a}	63.67^{d}	36.73^{b}	51.17^{c}	4.18	0.000
MCHC(g/dl)	33.15	33.07	33.20	33.04	0.03	0.201
LYMPH($\times10^{9}$/L)	41.00^{b}	29.67^{a}	48.67^{c}	25.33^{a}	2.90	0.000
Neutrophils($\times10^{9}$/L)	60.67^{b}	71.00^{c}	50.67^{a}	78.33^{d}	3.16	0.000
Platelet($\times10^{9}$/L)	2.50×10^{11c}	2.71×10^{11d}	2.41×10^{11b}	1.38×10^{11a}	1.55×10^{11}	0.000

abc: means on the same row with different superscripts are significantly different (P<0.05). HB – Haemoglobin, RBC - Red blood cell, WBC - White blood cell, PCV - Packed cell volume. MCV - Mean corpuscular volume, MCH - Mean corpuscular heamoglobin, MCHC - Mean corpuscular heamoglobin concentration, LYMPH – Lymphocytes.

Table 9 shows that all the serum biochemical parameters were statistically different between their treatment means (P<0.05).

Table 9. Serum biochemical indices of finisher broilers fed diets containing VDLM.

Parameters	T 1	T 2	T 3	T 4	SEM	P value
Urea(mg/dl)	9.33^{a}	19.67^{c}	15.67^{b}	19.67^{c}	1.28	0.000
AST(u/l)	127.67^{b}	170.67^{d}	119.67^{a}	166.67^{c}	6.25	0.000
ALT(u/l)	35.67^{a}	65.67^{d}	40.67^{b}	49.67^{c}	3.44	0.000
ALP(u/l)	2123.67^{a}	2205.67^{c}	2150.67^{b}	2575.67^{d}	54.10	0.000
Globulin(g/l)	16.67^{b}	14.33^{a}	15.33^{a}	27.67^{c}	1.62	0.000
Glucose(mg/dl)	79.67^{d}	64.67^{b}	69.67^{c}	58.67^{a}	2.33	0.000
Total protein(g/l)	41.67^{b}	60.67^{d}	38.67^{a}	50.33^{c}	2.58	0.000
Albumin(g/l)	16.83^{b}	24.33^{d}	18.33^{c}	14.67^{a}	1.09	0.000
Creatinine(mg/dl)	0.47^{a}	0.67^{b}	0.43^{a}	0.67^{b}	0.04	0.001
Cholesterol(mg/dl)	120.33^{b}	127.67^{c}	100.67^{a}	140.67^{d}	4.37	0.000
HDL(mg/dl)	40.67^{a}	69.67^{b}	99.67^{c}	120.33^{d}	9.10	0.000
LDL(mg/dl)	24.67^{d}	8.67^{a}	14.67^{c}	11.67^{b}	1.82	0.000

abc: means on the same row with different superscripts are significantly different (P<0.05). AST - Aspartate transaminase, ALT - Alanine transaminase, ALP - Alkaline phosphatase. HDL - High density lipid, LDL - Low density lipid.

DISCUSSION

Proximate analysis and phytochemical composition of *Vitex doniana* leaf meal

The proximate analysis and phytochemical composition results appear similar with that obtained by ADEYINA et al. (2017). In this experiment to investigate the effect of *Vitex doniana* leaf meal on cockerels, the authors got a crude protein value of 11.10±0.08, crude fiber of 7.20±0.01, and dry matter of 88.99±0.05%. The slight difference in values could be attributed to the fact that he sun-dried the *Vitex doniana* leaf before grinding into a leaf meal as against shade drying method which was used in this study. The difference could equally be attributed to the difference in the geographical location from where the leaf meals were sourced.

Growth performance of broilers fed diets containing *Vitex doniana* leaf meal

There was significant difference ($P < 0.05$) among the treatment means in the final weight of broilers fed diets containing *Vitex doniana* leaf meal. Broilers fed the control diet had the highest final body weight while the broilers in treatment 2 was the lowest. However, ADEBISI et al. (2017) indicated that the inclusion level of 10% VDLM produced the highest final body weight and that treatment 2 which had about 5% inclusion level of (VDLM) performed better than the control treatment.

There was significant difference ($P < 0.05$) among treatment means in average daily weight gain of broilers fed diets containing *Vitex doniana* leaf meal. Broilers fed control diet was the highest in average daily weight gain followed by treatment 4. This is contrary to ADEBISI et al. (2017) who reported highest average daily weight gain from broilers fed diet containing 5% Vitex doniana leaf meal.

There were significant differences ($P<0.05$) in average daily feed intake and total feed intake of broilers fed diets containing VDLM. The control diet was consumed more than the other treatment diets. This implies that VDLM inclusion affected the quantity of feed consumed by these broilers. This may be due to the bitter taste of high flavoid component of the phytochemical properties of VDLM. This result is also contrary to the one obtained by ADEBISI et al. (2017) who reported that Treatment 3 which contained 10% inclusion level of *Vitex doniana* leaf meal (VDLM) had more average feed intake compared to other treatment groups.

There was significant difference ($P < 0.05$) among the treatment means in feed conversion ratio of diets containing VDLM. The control diet was better utilized and therefore had the lowest feed conversion ratio. This also implies that VDLM inclusion also affected the conversion of the other treatment diets to flesh. There was no significant difference ($P > 0.05$) among the treatment means in feed cost of diets fed to the experimental animals. Treatment 1 and 2 had the least feed cost while treatment 4 was the highest. Significance difference ($P < 0.05$) existed among the treatment means in feed cost per kg weight gain.

Treatment 2 and 3 were similar and also the lowest in feed cost per kg weight gain while treatment 4 was the highest. This result is also in line with the values obtained in feed conversion ratio of the treatment diets. According to (CLETUS et al. 2023), including BPLM into a broiler finisher diet decreases their feed intake but significantly improves growth performance.

Hematological Profile of the Experimental Broilers

Hemoglobin concentration values obtained in this study both at the starter and finisher phases were within the accepted range of 7.0-13.0(g/dl) for broiler chickens (ANON 1980; SWENSON 1999). This indicated that all the birds had higher tendency to resist respiratory stress owing to the fact that the Hb which is carried on the red blood cell is the oxygen carrying pigment as observed by MUHAMMAD & OLOYEDE (2009).

The red blood cell count in the 2.5% inclusion level of VDLM was in the normal range for avian species but it was slightly lower in the 0% VDLM inclusion level, slightly higher in the 5% and very low in the 7.5% VDLM inclusion level for the starter broiler. At the finisher phase, the RBC count was lower than the normal range for avian species at all level of inclusion. 0% VDLM was slightly lower followed by 5.0%VDLM, 2.5% VDLM inclusion level while 7.5% was the lowest.

White blood cell count was not in the normal range for avian species at all levels of inclusion both at the starter and finisher phases. In the starter broiler, TI (0% VDLM), T2 (2.5% VDLM) and T3 (5.0% VDLM) were lower than the normal reference range for avian species while T4 (7.5% VDLM) was slightly higher. But in the finisher phase, all the treatment means were lower than the normal reference range for avian species (AENGWANICH et al. 2004) with T2 (2.5% VDLM) being the lowest.

The packed cell volume concentration were in the normal range of 25-45% as reported by AENGWANICH et al. (2004), except T4 (7.5% VDLM) at the starter phase but at the finisher phase, all the treatment groups were within the normal reference range of 25-45%. This implies that irrespective of the

level of inclusion of VDLM, the diets were nutritionally adequate in providing sound nutrition. Also, none of the treatment groups were found to be prone to anemia.

For mean corpuscular volume, only T4 (7.5% VDLM) had a value in the normal range of avian species at the starter phase while at the finisher phase both T3 (5.0%VDLM) and T4 (7.5% VDLM) had values in the normal range. The T3, T4 and all the inclusion levels at the finisher phase had values in the normal ranges of MCH for avian species except for T2. MCHC showed significant difference ($p<0.05$) between the treatment means with T3 (5.0% VDLM) having the lowest concentration followed by T4 (7.5%VDLM), T2 (2.5% VDLM) and T1 (0% VDLM) at the starter phase while at the finisher phase all the treatment groups were not significantly different ($P> 0.05$).

The values obtained for lymphocytes were within the normal ranges for avian species both at the starter and also at the finisher level (MITRUKA & RAWNSLEY 1997). This indicated that all treatment groups had adequate immune response status and also none of the levels of inclusion predisposed the broilers to infection as higher count than normal may suggest that the bird immune system was combating some kind of infection as earlier reported by FRANDSON (1986), ADEYEMO & LONGE (2007). Neutrophils at the starter phase was significantly different among its treatment groups with T1 (0%VDLM) having the least concentration followed by T3 (5.0%VDLM), T2 (2.5%VDLM) with T4 (7.5%VDLM) having the highest concentration. At the finisher phase, T3 had the least concentration followed by T1, T2 and finally T4. CHAMPE et al. (2008) observed that neutrophils and monocytes are components of WBC that are involved in both oxygen-independent and oxygen-dependent mechanism for combating viral, killing and engulfing bacteria. Thus, an increase signifies an increase in the broiler ability to combat viruses and bacteria.

Serum Biochemistry Indices of the Experimental Broilers

The values obtained from the study showed that there were significant differences ($P<0.05$) in all the treatment groups for the serum biochemistry parameters of the starter and finisher broilers fed diets containing varying levels of VDLM. For urea, in the starter broiler, only the control (0% VDLM inclusion) had a value in the normal range for commercial broilers (WIKIVET, 2012). The urea concentration in 2.5% VDLM inclusion was slightly lower while 5.0% inclusion and 7.5% were significantly higher than the normal range of values. Serum urea originates from the diet and tissue deamination of proteins and it indicates the quality of dietary proteins. Therefore, an increase in its serum value indicates poor kidney functioning or low quality of dietary proteins. At the finisher phase, none of the treatment groups had value within the normal range for commercial broiler birds (WIKIVET, 2012). T1 (0%VDLM) was very low while T2 (2.5% VDLM) and T4 (7.5%VDLM) were highest and had a value higher than the normal range. This could imply poor kidney functioning in eliminating urea from the blood after deamination process.

The total proteins (TP) obtained from this study at all treatment groups and both at starter and finisher phases were significantly higher ($p<0.05$) than the normal ranges reported by (WIKIVET, 2012) and ANON (1980). However, serum total protein values indicates nutritional adequacy of the test material with respect to protein, hence, high serum proteins and albumin values are reflection of better quality and amount of protein in the diets (OMOIKHOJE et al. 2004).

The range of albumin values obtained in this study were significantly higher than the normal reference values reported by (WIKIVET, 2012), ANON (1980) and JAIN (1986), at both starter and finisher phases. Globulins are the main sites of the antibodies (immunoglobulins) (PETERS et al. 1982). However, MELUZZI et al. (1991) reported that changes in nutritional protein status are better shown in the albumin than globulin content of the blood. From this study, the globulin values observed were also significantly higher at both the starter and finisher phases.

The glucose range of 59-80 mg/dl observed in the finisher broilers and 64-94 mg/dl observed in the starter broiler was not within the range of normal values of 44.1-45.5 mg/dl as reported by WikiVet.net. The findings of BALOGUN (1982) and MELUZZI et al. 1991 showed that low blood glucose could be an indication of inadequate intake or incipient problem with ketosis but the high blood glucose observed could have resulted from the fact that the broilers were fed *ad-libitum* and fasting blood sugar was not obtainable.

The blood creatinine level was slightly lower at all levels of VDLM inclusion at both starter and finisher phases than the normal ranges reported by (WIKIVET, 2012). This could be as a result of breed or genetic differences. Higher blood creatinine values could indicate kidney malfunction (CHAMPE et al. 2008).

An alkaline phosphatase (ALP) test measures the amount of ALP in the blood. ALP is an enzyme found throughout the body, but it is mostly found in the liver, bones, kidneys, and digestive system. When the liver is damaged, ALP may leak into the bloodstream. High levels of ALP can indicate liver disease or bone

disorders. From the study, only the starter ALP value at 2.5% VDLM inclusion level fell within the normal ranges of 10-106 (u/l) according to CLINICAL DIAGNOSTIC DIVISION (1990). Others were significantly higher than the normal reference range. For the finisher phase, the ALP values were significantly higher than the normal reference ranges at all levels of VDLM inclusion.

Aspartate aminotransferase (AST) is an enzyme found in cells throughout the body but mostly in the heart and liver and, to a lesser extent, in the kidneys and muscles. In healthy animals, levels of AST in the blood are low. When liver or muscle cells are injured, they release AST into the blood. This makes AST a useful test for detecting or monitoring liver damage. At the starter phase, AST has its lowest value at 2.5% VDLM inclusion while 5.0% and 7.5% VDLM inclusion levels were highest. Therefore, there is higher possibility of liver damage at 5.0% and 7.5% VDLM inclusion levels than at 2.5% and control diet (0%). At the finisher phase, AST was lowest at 5.0% VDLM and highest at 2.5% VDLM level of inclusion.

Alanine amino transferase (ALT) is a liver enzyme having a linkage between the liver and the blood. An increase in its quantity in the blood is an indication of the possibility of liver damage due to nutrition or metabolic malfunctions. In the study, ALT in the starter broilers was lowest at the control (0%VDLM) and progressively increased to give the highest at 7.5% VDLM inclusion level. This implies that there is more tendency of liver damage at 7.5% than the control diet. At the finisher phase, the value was lowest at the control diet (T1) and highest at T2 (2.5%VDLM inclusion).

An increase in HDL indicates lower level of LDL and reduces the risk of atherosclerosis and heart attack while a general increase in the cholesterol level could lead to heart failure as well in the broiler birds. At the starter phase, total cholesterol was lowest at 7.5% VDLM inclusion and highest at 5.0% VDLM inclusion level. At the finisher phase, the total cholesterol value was lowest at 5.0% VDLM inclusion and it was highest at 7.5%VDLM inclusion. This could be attributed to breed differences and individual metabolic system in metabolizing cholesterol as well as the diet as it was highest in both phases at the highest level of VDLM inclusion.

High density lipids at the starter phase was highest at 7.5% VDLM inclusion and lowest at 2.5% VDLM inclusion level. Also, the LDL value was lowest at 2.5% and 7.5% while 0% was the highest. At the finisher phase, HDL level was lowest at the control diet and highest at the 7.5% VDLM inclusion while LDL was lowest at 2.5% VDLM inclusion and highest at the control diet (0%VDLM). This implies that the broilers had a higher tendency of developing heart problems from the 0% VDLM inclusion level and the 2.5% VDLM diet gave the best result in terms of the low density lipoprotein.

These results obtained were quite different from the results observed when *Vitex doniana* leaf meal was included in diets fed to cockerels at 0%, 5% and 10% inclusion levels of VDLM. In this study, dietary treatment did not significantly ($P>0.05$) affect or alter the hematological and serum biochemical indices except for the absolute content of granulocyte where there was significant increase with increase in VDLM. This lack of dietary effect of VDLM based diet on the cockerels could be attributed to genetic and age differences as the cockerels were 14 weeks old at the commencement of the experiment. According to ETIM et al. (2013), genetic factors and non-genetic factors including age are some of the factors that significantly affects hematological and serum parameters causing great variation and changes in animals.

CONCLUSION

The trend on the effect of *vitex doniana* leaf meal on broilers as established in this experiment shows that it has the potential of improving the hematological and serum biochemistry of broilers. Low density lipoprotein which progressively decreased as the percentage inclusion of VDLM increased but the growth performance of the broilers decreased as the inclusion levels increased. This suggests that lower inclusion levels may improve growth performance, hematological parameters and serum biochemistry of broilers.

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