Asian Journal of Research in Animal and Veterinary Sciences

4(4): 1-11, 2019; Article no.AJRAVS.50626

Effect of *Lawsonia inermis* Leaf Meal on Performance and Blood Profile of Broiler Chicken at Starter and Finisher Phase

O. S. Adedeji[1], P. O. Adeniran[2*], S. A. Jimoh[1], N. B. Olajire[1], O. O. Ogunfuwa[1] and A. Afosi[1]

[1]Department of Animal Nutrition and Biotechnology, Ladoke Akintola University of Technology, Ogbomoso, Nigeria.
[2]Department of Animal Production and Health, Ladoke Akintola University of Technology, Ogbomoso, Nigeria.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

Editor(s):
(1) Dr. Hazem Mohammed Ebraheem Shaheen ,Professor, Department of Pharmacology, Faculty of Veterinary Medicine,Damanhour University, Egypt.
Reviewers:
(1) Wafaa Abd El-Ghany Abd El-Ghany, Cairo University, Egypt.
(2) Juliana Nneka, Akanu Ibiam Federal Polytechnic, Nigeria.
Complete Peer review History: http://www.sdiarticle4.com/review-history/50626

Original Research Article

Received 07 June 2019
Accepted 12 August 2019
Published 23 November 2019

ABSTRACT

This study was conducted to determine the effect of *Lawsonia inermis* leaf meal on growth performance and blood profile of broiler chicks for fifty-six days. A total of 150 day old broiler chicks were used. They were divided into five treatment groups of three replicates each (T_1, T_2, T_3, T_4, and T_5 fed 0, 10, 20, 30 and 40 g/kg *Lawsonia inermis* leaf meal respectively). Each replicates contained 10 birds. The experimental design used for this study was complete randomized design. The responses of the broiler to the dietary treatments were measured by feed intake (g/bird), final weight (g/bird), feed conversion ratio (FCR), haematology parameters and serum biochemistry parameters. Result obtained from this experiment indicated that *Lawsonia inermis* leaf meal had significant ($P<0.05$) effect on blood profile and growth performance of the broiler chicken at both starter and finisher phase. At the starter phase, the Average weight, Daily weight gain and Final weight had

**Corresponding author: E-mail: adeniranpaul@gmail.com, adepojupaul17@gmail.com;*

their highest values from broiler birds on T_4 fed (30 g/kg *Lawsonia inermis* leaf meal) while their highest values were observed from broiler birds on T_5 fed (40 g/kg *Lawsonia inermis* leaf meal) at finisher phase. Meanwhile, the feed conversion ratio had its lowest value in T_4 at starter phase and T_5 at finisher phase. At both starter and finisher phase, *Lawsonia inermis* leaf meal had Significant ($P<0.05$) effect on white blood cells (WBC), red blood cells (RBC), haemoglobin (Hb) and Pack cell volume (PCV) which could indicate a boost in the body's ability to fight of disease. Also, all the serum parameters were significantly affected by dietary treatment of *Lawsonia inermis* leaf meal at the starter phase while only total protein, albumin, globumin and AST were significantly affected at finisher phase. However, total cholesterol was observed to be reduced among broiler chicks on T_4 and T_5 (fed 30 g/kg and 40 g/kg of *Lawsonia inermis* leaf meal respectively) at starter phase. The study therefore concluded that, *Lawsonia inermis* leaf meal could be included to the diet of broiler chicks up to 40 g/kg without any deleterious effect.

Keywords: Broiler; growth performance; haematology; Lawsonia inermis ; serum biochemistry.

1. INTRODUCTION

Studies have shown that demand for poultry meat is higher because of its superiority in health aspects when compared to red meat, comparably low contents of fat and cholesterol, relatively low price, high rate of meat production and lack of religious restriction (Jaturashita, 2004). Large scale commercial poultry production has been identified as a quick and effective way of correcting the problem of animal protein intake deficiency [1] as broiler birds are usually the most universal and important producers of meat for human consumption [2]. There is need to encourage the production of broiler birds in the third world countries because broiler are breeds of poultry birds that are genetically bred for meat production [3].

Lawsonia inermis (Henna) is a shrub or small tree cultivated in many regions as an ornamental and commercial dye crop [4]. It is mostly found in the tropic, sub-tropic, and semi-arid zones of Africa (tropical Savannah and tropical arid zones), south Asia, and north Australia [5]. The henna plant *Lawsonia inermis* is one such plant known for its healing attributes and it is now the subject of intense scientific study [6,7]. The plants belong to the family Lythraceae. As reported by Varghese et al. [8], wide range of chemical constituents have been isolated from Henna which includes naphthoquinone derivatives (lawsone which is the chief ingredient and the coloring matter in the leaves), phenolic derivatives, coumarins, xanthones, tannins, flavonoids, aliphatic components, triterpenes, sterols and other chemical constituents such as glucose, gallic acid, amino acids, mannitol, trace elements and minerals. As a medicinal plant, Henna has been used as astringent, hypotensive, sedative, and against headache, jaundice, and leprosy [9]. It is desirable to know the effect of L*awsomia inermis* plants on the growth performance and blood profile of broiler chickens. Because, it has been reported to provide valuable information for the growth performance purpose and blood profile of animals.

1.1 General Objective of the Study

To study the effect of *Lawsonia inermis* leaf meal on growth performance and blood profile of broiler chicken at starter phase (0-4 weeks) and finisher phase (5-8 weeks).

1.2 Specific Objectives

i. To determine the effects of inclusion levels of *Lawsonia inermis* leave on growth performance.
ii. To determine the effect of *Lawsonia inermis* leave on haematology.
iii. To determine the effect of *Lawsonia inermis* leave on serum biochemistry.

2. MATERIALS AND METHODS

2.1 Experimental Site

The research was carried out at the Poultry unit of Teaching and Research Farm of the Ladoke Akintola University of Technology, Ogbomoso, Oyo State, Nigeria.

2.2 Procurement and Processing of Test Ingredients

Lawsonia inemis used for the experiment was purchased from a local market **(**Oja-otte), along Ilorin road, kwara state, Nigeria. The stalks purchased were air-dried for 3-4 days. The air-

dried leaves were detached from the stalk, ground to powder and added to the diet. in 0, 10, 20 g/kg of feed.

2.3 Experimental Birds and Management

A total number of ninety (90) day old broiler chicks of Arbor Acre strain were sourced from a reputable hatchery. Prior to the arrival of the chicks, the pen was cleaned and disinfected. The birds were randomly divided into five (5) treatments groups, each treatment consist of three (3) replicate consisting of 10 birds each. The birds were brooded and raised on deep litter for fifty-six (56) days. Feed and fresh water were given *ad-libtum* to the birds throughout the experimental period. The feed offered were weighed on daily basis while the birds were weighed on weekly basis throughout the weeks of experiment. Drugs and vaccinations were done in accordance with the prevailing vaccination and medication schedules for broiler in the experimental area.

2.4 Experimental Diet

Conventional broiler starter (CP 22.01%, ME 3017.03 kcal/kg) and boiler finisher (CP 20.39%, ME 2881.96 kcal/kg) were given to the broilers and the processed *Lawsonia inermis leave*s were added to broiler diets both at starter and finisher phase. *Lawsonia inermis* were added to broiler diet in 0 gram, 10 grams, 20 grams, 30 grams and 40 grams per *kilogram* of feed. The broiler birds were fed *ad-ilbitum. Lawsonia Innamis* was added as an additive. The experimental diets were designed as:

T_1: control + 0 g/kg of diet;
T_2: control + 10 g/kg of diet;
T_3: control + 20 g/kg of diet;
T_4: control + 30 g/kg of diet;
T_5: control + 40 g/kg of diet;

2.5 Data Collection

2.5.1 Growth performance

Data were collected on feed intake and weight gain was calculated from weekly weight changes while feed to gain ratio was calculated as average feed intake divided by average weight gain.

$$\text{Feed intake} = \frac{\text{Quantity given- leftover}}{\text{Total number of broilers}}$$

$$\text{Feed conversion ratio} = \frac{\text{Feed Intake}}{\text{Weight gain}}$$

Total weight gain = Final weight – Initial weight

2.5.2 Collection of blood samples

At 4th and 8th week, two chicks from each replicate were selected and starved for 12 hours to avoid temporal elevation of blood metabolites by feeding and then slaughter by cervical dislocation. During this period water was supplied *ad libitum*. Blood samples for biochemical analysis were collected into EDTA-free tubes and allowed to clot for the separation of the serum from the coagulum/clot by decantation. Another set of blood samples were collected into sterilized tubes with ethylene-diamine tetra-acetic acid (EDTA) solution in order to avoid coagulation for determination of haematological parameters. To preserve the freshness of the blood sample, blood sample were kept in ice cold pack prior to the laboratory analyses.

2.6 Heamatological Tests

The set with EDTA was used to determine Red Blood Cell (RBC), White blood Cell (WBC) using the improved Neubaucer haemocytometer, as described by Dacie and Lewis, [10]. Packed Cell Volume (PCV) was determined using the microhaematocrit method and haemoglobin (HB) using cyanomethaemoglobin method according to Coles (1986). Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin Concentration (MCHC) were determined as described by [11].

2.7 Mean Corpuscular Volume (MCV)

The Mean Corpuscular Volume is a measure of the average red blood cell volume that is reported as a part of standard blood count. The MCV was calculated by dividing the total volume of packed red blood cell by the total number of red blood cells. The resulting number is then multiplied by 10. The red blood cells get packed together when they are spun around at high speeds in a centrifuge [12].

To calculate the MCV expressed in femtoliters (fl, or 10-15 L)

$$\text{MCV} = \frac{PCV}{RBC} X\ 10$$

2.8 Mean Corpucular Haemoglobin

The mean corpuscular is the average mass of haemoglobin per red blood cell in a sample of

blood. It is reported as part of a standard complete blood count. It is calculated by dividing the total mass of haemoglobin by the number of red blood cells in a volume of blood. Conversion to SI-unit: 1 pg of haemoglobin = 0.06207 femtomol [13].

$$\text{MCH} = \frac{Hgb}{RBC} X\ 10$$

2.9 Serum Biochemical Tests

The set of samples bottles without EDTA were centrifuged in a micro centrifuge to generate centrifuge for serum for biochemical analysis. Total protein was determined using the Biuret method as described by Doumas [14], albumin using dye-binding technique with bromocresol green as described by Doumas and Biggs [15]. Globulin by difference (total protein minus albumin) total cholesterol by enzymatic method as described by Allain *et al.* [16]. Urea by di-methyl monoxide method as described by Varley et al. (1980). Serum glucose by enzymatic method of Kaplan and Szabo [17].

2.10 Average Daily Feed Intake (ADFI)

This was obtained by subtracting the weight of feed leftover at the end of 7 days (a week) from the weight of the feed offered to the birds divided by number of days.

2.11 Body Weight Grain

Birds were weighed on weekly basis and the weight gained was calculated by subtracting the weight in the preceding week from that of the current week.'

2.12 Mortality

This was taken as the number of dead birds per week within each treatment.

2.13 Experimental Design

The experimental design follows a completely randomized design (CRD).

2.14 Statistical Analysis

All data obtained were subjected to one way analysis of variance (ANOVA) at a significant level of 5% using Statistical Analysis System 2003, version 10. The means were compared using Duncan multiple range test of the same packages. The statistical model used in this research is as follows:

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

Where

Y_{ij} = Individual observation on the experimental unit
μ = Overall/Population mean
T_i = effect of *Lawsomia inermis*
e_{ij} = Random error associated with Y_{ij}

3. RESULTS

Table 1 showed the effect of *Lawsonnia innermis* leaf meal on Growth Performance of the Broiler Chicken at starter phase. Final weight, Daily weight, and Average weight had their highest values for broiler chicken on T_4 feed (30 g/kg *Lawsonnia innermis* leaf meal). Total feed intake however had its lowest value for broiler chicken on T_3 feed (20 g/kg *Lawsonnia innermis* leaf meal). Feed conversion ratio had its lowest value for broiler birds in T_4 while the highest was observed among broiler birds feed control T_1 (0 g/kg) of *Lawsonnia innermis*.

Table 4 showed the effect of *Lawsonia inermis* leaf meal on growth performance of broiler at finisher phase. Daily weight gain and final weight had significant difference ($P<0.05$) in the values observed. T5 recorded the highest values of 43.00 g and 2143.73 g for daily weight gain and final weight respectively. The values for total feed intake ranged from 31113.33 g to 35856.67 g, while the values for daily feed intake ranged from 111.12 g to 128.06 g. The highest values for both parameters were observed in T_3, and significant difference was also observed. The feed conversion ratio also had significant difference ($p<0.05$). Best feed conversion was observed in T_5 with a value of 2.81 while T_2 had the poorest conversion ratio of 3.28.

Table 5 showed the haematological parameters of broiler chicken fed varying level of *Lawsomia Inermis* leaf meal at Starter Phase (0-4 Weeks). *Lawsonia inermis* leaf meal had Significant ($P<0.05$) effect on white blood cells (WBC), red blood cells(RBC), haemoglobin (Hb),Pack cell volume (PCV), and Eosinophils. Although, MCV and Platelet increased significantly ($P>0.05$) with increasing inclusion level of *Lawsonia inermis* leaf meal to T_3 but neutrophils decreased ($P<0.05$) *as Lawsonia inermis* leaf meal inclusion level increases.

Table 1. Gross composition of experimental diet at starter phase

Ingredient	T_1 0 g/kg	T_2 10 g/kg	T_3 20 g/kg	$T_4$30 g/kg	$T_5$40 g/kg
Maize	59.00	59.00	59.00	59.00	59.00
Soya Bean Meal	31.00	31.00	31.00	31.00	31.00
Corn Bran	1.63	1.63	1.63	1.63	1.63
Fish Meal	4.00	4.00	4.00	4.00	4.00
Bone Meal	2.00	2.00	2.00	2.00	2.00
Limestone	1.50	1.50	1.50	1.50	1.50
Vitamin (Premix)	0.25	0.25	0.25	0.25	0.25
Lysine	0.12	0.12	0.12	0.12	0.12
Methionine	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Lawsonia inermis	0.00	0.10	0.20	0.20	0.20
Total	100.00	100.10	100.20	100.30	100.40
Calculated analysis					
Metabolizable Energy(kcal/kg)	3017.03				
Crude Protein (%)	22.01				
Fruit Fibre (%)	3.42				
Ether Extract	3.76				
Calcium	1.38				
Available Phosphorus	0.55				
Lysine	1.31				

$T_1$0 g/kg= diet without Lawsonia inermis leaf meal, $T_2$10 g/kg= diet with Lawsonia inermis leaf meal, $T_3$20 g/kg= diet with Lawsonia inermis leaf meal

Table 2. Gross composition of experimental diet at finisher phase

Ingredient	T_1	T_2	T_3	T_4	T_5
Maize	45.13	45.13	45.13	45.13	45.13
Soya bean meal	29.00	29.00	29.00	29.00	29.00
Corn bran	18.00	18.00	18.00	18.00	18.00
Fish meal	3.50	3.50	3.50	3.50	3.50
Bone meal	2.00	2.00	2.00	2.00	2.00
Lime stone	1.50	1.50	1.50	1.50	1.50
Premix	0.25	0.25	0.25	0.25	0.25
Lysine	0.12	0.12	0.12	0.12	0.12
Methionine	0.25	0.25	0.25	0.25	0.25
Lawsonia inermis (Henna)	-	0.10	0.20	0.30	0.40
Salts	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.10	100.20	100.30	100.40
Calculated nutrient analysis					
Energy (kcal/kg)	2881.96				
Crude Protein (%)	20.39				
Crude Fibre (%)	8.10				
Ether Extract	4.12				
Calcium	1.37				
Available Phosphorus	0.51				
Lysine	1.20				

Table 6 showed the effect of *Lawsonia inermis* on haematological parameters of broiler chickens at finisher phase. Haemoglobin (HB), white blood cell(WBC), red blood cell (RBC), packed cell volume (PCV), mean corpuscular haemoglobin (MCH), platelets and mean corpuscular haemoglobin concentration (MCHC) were significantly ($P<0.05$) affected by dietary inclusion of *Lawsonia inermis* leaf meal. Haemoglobin (HB), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) had their highest values form broiler birds fed T_1 (0 g/kg) feed. HB, RBC, WBC and PCV had their lowest

values from broiler fed T_2 (10 g/kg) of *Lawsonia inermis* leaf meal. The highest value of white blood cell (WBC) was observed from broiler birds fed T_3 (20 g/kg) of *Lawsonia inermis* leaf meal, while its lowest value was observed from broiler birds fed T_2 (10 g/kg) of *Lawsonia inermis* leaf meal.

Table 7 showed that varying inclusion level of *Lawsonia inermis* leaf meal had significant (P< 0.05) effects on all the serum biochemical indices of the broiler starter chicken. Aspartate amino-transaminase (AST) and Alkaline phosphate (ALP) significantly (P< 0.05) decreased with increasing inclusion level of *Lawsonia inermis* and was highest among birds fed control diet (T_1). Alanine amino-transaminase (ALT) significantly (P< 0.05) increased with increasing level of inclusion level of *Lawsonia inermis* leaf meal and was highest at 40 g/kg *Lawsonia inermis* leaf meal inclusion. Total protein (TP), Albumin, and Globulin significantly (P< 0.05) had their lowest values at broilers fed 40 g/kg *Lawsonia inermis*. However, TP and Globulin were highest at 30 g/kg than other inclusion levels.

The results for the serum biochemistry of the broiler chickens fed *Lawsonia inermis* leaf meal at finisher phase is represented in Table 8. All parameters differed significantly (P<0.05) with the exception of cholesterol, ALP and ALT**.** Total protein, globumin and AST had their highest value (5.13, 4.24 and 37.11 g/dl respectively) in T_4 while the lowest value of Total Protein and Globumin were observed from birds in T_2. Albumin was highest (1.04 g/dl) in birds on T_5 and lowest (0.71 g/dl) in birds in T_3 groups.

4. DISCUSSION

Table 3 shows the effect of *Lawsonnia innermis* leaf meal on Growth Performance of the Broiler Chicken at starter phase. The growth performance parameters (daily weight gain, total weight gain, final weight, daily feed intake) of broiler birds are significantly (P>0.05) affected by the varying Inclusion of *Lawsonia inermis* in their feed and this does not go in line with the findings of Okerie et al., [18] which stated that there was no significant effect of scent leaf on growth performance of broiler chicken. The highest final weight and total feed intake were at T_4 which corresponds with the findings of Sharifi et al. [19] who reported that increased supplementation of flavomycin and peppermint did not reduce feed intake and body weight gain. Feed conversion ratio values decreases with increases in

Table 3. Effect of *Lawsomia Inermis* on growth performance parameters of broiler chicken at starter phase

Parameters	T_1(0 g/kg)	T_2(10 g/kg)	T_3(20 g/kg)	T_4(30 g/kg)	T_5(40 g/kg)	SEM
Initial weight(g)	41.03	41.03	41.70	40.20	39.47	2.02
Final weight(g)	633.90^{b}	693.10^{b}	635.60^{b}	753.67^{a}	733.80^{a}	25.26
Average weight gain(g)	592.87^{c}	652.07^{b}	593.90^{c}	713.47^{a}	694.33^{ab}	25.29
Daily weight gain(g)	21.17^{c}	23.29^{b}	21.21^{c}	25.48^{a}	24.80^{b}	0.9
Daily feed intake(g)	48.80^{ab}	49.95^{a}	47.78^{c}	49.76^{a}	48.16^{b}	0.02
Feed conversion ratio(g)	2.56^{a}	2.21^{b}	2.41^{b}	1.98^{c}	1.99^{c}	0.75
Total feed intake(g)	41004.40	41960.00	40134.00	41964.00	40452.00	0.24

Table 4. Effect of *Lawsomia Inermis* on growth performance parameters of broiler chicken at finisher phase (5-8 Weeks)

Parameters	T_1(0 g/kg)	T_2(10 g/kg)	T_3(20 g/kg)	T_4(30 g/kg)	T_5(40 g/kg)	SEM
Initial weight(g)	889.50	960.30	911.37	961.30	940.03	16.73
Final weight(g)	2012.33^{c}	2024.73^{b}	2107.50^{ab}	2036.63^{b}	2143.73^{a}	18.89
Total weight gain(g)	1122.83	1063.93	1196.13	1075.33	1203.70	20.36
Daily weight gain(g)	40.10^{b}	38.00^{c}	42.72^{ab}	38.40^{c}	43.00^{a}	0.73
Daily feed intake(g)	123.17^{ab}	122.05^{b}	128.06^{a}	111.12^{c}	113.58^{c}	1.01
Feed conversion ratio(g)	3.18^{ab}	3.28^{a}	3.08^{b}	3.01^{b}	2.81^{c}	0.05
Total feed intake(g)	34487.33^{ab}	34173.00^{b}	35856.67^{a}	31113.33^{c}	31802.33^{c}	283.35

Table 5. Effect of *Lawsonia Innermis* leaf meal on haematology parameters of broiler chicken at 4 weeks at starter phase

Parameters	T_1 0 g/kg	T_2 10 g/kg	T_3 20 g/kg	T_4 30 g/kg	T_5 40 g/kg	SEM
WBC (X 10^3/µl)	237.45^{c}	247.00^{b}	253.45^{a}	241.35	238.50^{c}	1.53
RBC (X 10^6/µl)	2.40^{b}	2.57^{a}	2.59^{a}	2.16^{c}	2.39^{b}	0.45
Hb (g/dl)	9.00^{b}	9.90^{ab}	10.05^{a}	8.15^{c}	9.15^{b}	0.37
PCV (%)	31.10^{c}	33.75^{b}	34.55^{a}	27.90^{c}	31.75^{c}	0.61
MCV (fl)	129.6	131.45	133.35	129.50	133.63	0.64
Platelets ($X10^3$/µl)	44.00	44.50	45.00	41.50	38.50	2.40
Neutrophils	15.00	12.50	12.00	12.50	10.00	1.82
Eosinophils	0.00^{b}	1.00^{b}	3.00^{a}	0.00^{b}	3.00^{a}	0.38

^{abc} *Means along the same column with different superscripts are significantly (P < 0.05) different PCV – Packed Cell Volume, Hb – Haemoglobin, RBC – Red Blood Cell, MCV – Mean Corpuscular Volume, MCHC – Mean Corpuscular Haemoglobin Concentration, WBC – White Blood Cells*

Table 6. Effect of *Lawsonia Innermis* Leaf Meal on haematology parameters of broiler chicken at finisher phase (5-8 Weeks)

Parameters	T_1 0 g/kg	T_2 10 g/kg	T_3 20 g/kg	T_4 30 g/kg	T_5 40 g/kg	SEM
WBC (X 10^3/µl)	229.35^{b}	214.85^{c}	255.00^{a}	242.70^{ab}	238.50^{b}	5.66
RBC (X 10^6/µl)	2.37^{ab}	1.50^{c}	2.36^{ab}	2.08^{b}	2.41^{a}	0.08
Hb (g/dl)	9.00^{a}	5.75^{c}	8.55^{ab}	7.65^{b}	8.70^{ab}	0.31
PCV (%)	31.15^{ab}	21.65^{c}	31.10^{ab}	29.05^{b}	32.70^{a}	1.06
MCV (fl)	135.65	131.25	131.95	139.65	135.50	1.19
MCHC (%)	28.05^{a}	26.45^{b}	27.50^{ab}	26.35^{c}	26.55^{b}	0.21
MCH (%)	37.95^{a}	36.30^{b}	36.25^{b}	36.75^{ab}	36.15^{c}	0.25
Platelets ($X10^3$/µl)	75.50^{b}	76.00^{b}	71.00^{c}	87.50^{a}	79.50^{ab}	1.69
Neutrophils (%)	12.50	17.80	10.00	12.50	13.00	1.16
Lymphocytes (%)	85.50	80.00	89.00	83.50	86.00	1.35
Eosinophils (%)	2.00	2.50	1.01	4.00	1.01	0.45

^{abc} *Means along the same column with different superscripts are significantly (P < 0.05) different PCV – Packed Cell Volume, Hb – Haemoglobin, RBC – Red Blood Cell, MCV – Mean Corpuscular Volume, MCHC – Mean Corpuscular Haemoglobin Concentration, WBC – White Blood Cells*

Lawsonia inermis across dietary treatment and this is similar to the findings of Nihad et al., [20]. This study reveals that T_4 (30 g of *Lawsonia inermis* leaf meal) at week 4 utilized the nutrition in the feed taken efficiently to produce increased final weight compared to other treatments.

Table 4 shows the effect of *Lawsonnia innermis* leaf meal on Growth Performance of the Broiler Chicken at finisher phase. Significant difference was observed in the body weight gain, with the control group recording the lowest value for final weight. The findings of this study are in close agreement with the observations of Shinde [21]; Kabir et al. [22]; Dhekane [23] and Ogunwole et al. [24] who reported that supplementation of feed additive had significant effect on body weight in broiler. The increase in the body weight due to addition of feed additive in the feed might be due to the direct action of *Lawsonnia innermis* leading to meet the deficiencies of minerals and vitamins and protecting the birds against all sorts of harmful environmental stresses. With respect to feed conversion and total weight gain, T_5 recorded the best value for FCR and subsequently, had the highest total weight gain. In line with the report of Denil et al. [25] who reported that the supplementation of additives in broiler diets enhanced nutrient utilization, growth and feed conversion efficiency (FCE) of broilers. Garlic as a natural feed additive alsoimproved the growth, FCR and decreased mortality [26].

Table 5 shows the varying inclusion level of *Lawsonia inermis* on haematology parameters of broiler chicken at starter phase. It has been established that heamatological parameters; packed cell volume (PCV), heamoglobin(Hb), red blood cell (RBC), mean corpuscular volume(MCV) and platelet count are important indicators used in analyzing the health status of animals. Platelet and Neutrophils decrease as the inclusion level increases and it disagrees with the findings of Okorie et al. [17] which says

platelet improves at increasing level of inclusion of scent leaf. Red blood cell value was high in T_5 (40 g/kg) of LILM while the WBC decreases which is similar to the findings of Nikola et al. [27]. The study reveal that the animal is susceptible to disease at increased level of *Lawsonia inermis* inclusion in diet because of its reduced white blood cell. The PCV values obtained (27.90-34.55%) fell within the range of normal values for healthy birds (25-45%) reported by Mitruka and Rawnsley [28]. The Hb values obtained (8.15-10.05 g/dl) fell within the range of normal value for healthy birds (7-13 g/dl) reported by Jain [11].

Table 6 shows the varying inclusion level of *Lawsonia inermis* on haematology parameters of broiler chicken at finisher phase. Haemotological responses of broiler finishers as shown in Table 4.2b revealed that the birds were in good health state since all blood parameters were within normal range reported by several other authors [28,29]. The PCV values obtained from this study were within the standard range of 22-35% reported by Schalm et al. [30] for healthy chickens. The red pigment of the erythrocytes function in the transportation of oxygen and carbon (iv) oxide in animal body. Results for Haemoglobin was therefore an indication of variation in oxygen and carbon (iv) oxide carrying capacity of birds fed graded levels of *Lawsonia inermis* based diets. The values obtained were within standard range of 7-13 g/dl [28]. WBC counts for the treatment groups showed significant difference. Since WBC are known to fight against diseases, the result of the study indicated that birds on *Lawsonia inermis* based diets have similar immunity status. Thus, animals with low WBC count are exposed to high risk of disease infection, while those with high counts are capable of generating antibodies in the process of phagocytosis and have higher degree of resistance to diseases [31].

Table 7 shows the varying inclusion level of *Lawsonia inermis* leaf meal (LILM) on the serum biochemical parameters of broiler chicken at starter phase. The varying inclusion level of LILM in the feed of the birds have significant (P>0.05) effect on the serum biochemistry Parameters which is in line with the findings of Tijani et al. [32]. Total protein value increased across the dietary treatment from T_2 to T_4 meaning that this was in accordance to the findings of Kwiterovich [33] who reported on the capability of inclusion of *Sesamum indicum* to increase serum protein.

Table 7. Effect of *Lawsonia inermis* leaf meal on serum parameters of broiler chicken at starter phase

Parameters	T_1 0g/kg	T_2 10g/kg	T_3 20g/kg	T_4 30g/kg	T_5 40g/kg	SEM
ALT IU/L	53.83^{c}	67.25^{ab}	65.17^{b}	57.82^{c}	68.19^{a}	1.45
AST IU/L	70.27^{a}	47.11^{b}	58.16^{ab}	45.79^{c}	55.53^{b}	1.77
ALP IU.L	217.37^{a}	182.63^{b}	88.17^{c}	32.63^{c}	53.63^{c}	9.69
T.PROTEIN g/L	4.44^{b}	4.18^{b}	4.51^{b}	8.28^{a}	3.60^{c}	0.13
ALBUMIN g/L	1.34^{ab}	1.30^{b}	1.56^{a}	1.33^{ab}	1.07^{c}	0.27
GLB g/L	3.10^{b}	2.88^{c}	2.95^{bc}	6.95^{a}	2.63^{c}	0.52
T.CHOL mg/dl	89.08^{ab}	107.74^{a}	86.04^{b}	83.16^{b}	81.79^{c}	5.45

^{abc} means with different superscript along the same row are significantly (P<0.05) different ALT-Alanine Aminotransferase, AST-Aspartate Transferase, ALP-Alkaline Phosphate, TP-Total Protein, T.CHOL-Total cholesterol

Table 8. Effect of *Lawsonia inermis* leaf meal on serum parameters of broiler chicken at finisher phase

Parameters	T_1 0g/kg	T_2 10g/kg	T_3 20g/kg	T_4 30g/kg	T_5 40g/kg	SEM
ALT IU/L	34.04	37.34	38.66	29.42	39.32	1.51
AST IU/L	33.42^{b}	26.84^{c}	29.47^{bc}	37.11^{a}	19.74^{c}	1.89
ALP IU.L	46.66	44.98	42.89	24.07	32.11	4.60
T.PROTEIN g/dL	4.17^{b}	3.72^{c}	4.68^{ab}	5.13^{a}	4.01^{c}	0.18
ALBUMIN g/dL	0.95^{ab}	0.88^{b}	0.71^{c}	0.89^{b}	1.04^{a}	0.04
GLB g/dL	3.22^{b}	2.85^{c}	3.97^{ab}	4.24^{a}	2.97^{c}	0.17
T.CHOL mg/dl	83.50	101.17	116.12	108.35	103.50	5.45

^{abc} means with different superscript along the same row are significantly (P<0.05) different ALT-Alanine Aminotransferase, AST-Aspartate Transferase, ALP-Alkaline Phosphate, TP-Total Protein, T.CHOL-Total cholesterol

Table 8 shows the varying inclusion level of *Lawsonia inermis* leaf meal (LILM) on the serum biochemical parameters of broiler chicken at finisher phase. Serum protein is the total amount of protein in the blood in which albumin is the most abundant. Albumin helps keep the blood from leaking out of blood vessels as well as to carry some medicines and other substances through the blood that is important for tissue growth and healing. Low total protein levels can suggest a liver disorder, a kidney disorder, or a disorder in which protein is not digested or absorbed properly. The increased level of total protein concentrations observed at T_4 is an indication that the diet is rich in amino acid that led to increased total protein levels which invariably led to increase in serum globulin [34]. AST is well distributed in several organs such as skeletal muscles, the heart, liver whereas primary source of ALT is mainly liver. Any exaggerated increase in levels of serum enzyme AST could be an indication of liver damage and necrosis. The decrease in the values of AST in the diet containing *Lawsonia inermis* seed meal showed that *Lawsonia inermis* seed meal can be fed to broilers without deleterious effect, higher levels of AST indicates presence of toxins or poisons in the heart and liver.

5. CONCLUSION

From the result of this experiment, it can be concluded that *Lawsonia inermis* can be fed to broilers chickens upto 40 g/kg without deleterious effects on growth performance, hematology and serum biochemical parameters.

The values recorded for feed conversion ratio and final weight at finisher phase showed that *Lawsonia inermis* can be used in commercial broilers production to achieve optimum productivity and performance at rate of 40 g.

CONSENT

It is not applicable.

ETHICAL APPROVAL

As per international standard informed written ethical approval has been collected and preserved by the author(s).

ACKNOWLEDGEMENTS

Authors wish to acknowledge the staff of the Department of animal production and health and animal nutrition and biochemistry, faculty of agricultural sciences, Ladoke Akintola University of Technology for their technical supports towards the completion of this research work.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCE

1. Amao SR. Comparative studies of growth performance and blood parameters of four strains of broilers chickens under deep litter and cage systems. M. Tech dissertation submitted to the department of Animal Production and Health- Lautech. Ogbomoso; 2019.
2. Oluremi OIA, Wuanor GJ, Orayaga KT. Effect of fermentation on some chemical constituents in sweet orange (Citrus sinensis) peal meal and nutrient digestibility in broiler chickens. Proceeding of 14th Annual Conference of Association of Animal Science of Nigeria.-Lautech. 2009;118-120.
3. Nkwocha GA, Anukam KU, Nkwocha UI. Growth response and carcass characteristics of broiler finisher chickens fed varying dietary levels of sun-dried animal plasma. Proceeding of 14th of Animal Science Association of Nigeria (ASAN)-Lautech. 2009;375-378.
4. Muthumani P, Meera R, Sundaraganapathy DP, Mohamed ASA, Cholarja K. Biological evaluation of dried fruits of Lawsonia inermis. J Pharm Biomed Sci. 2010;1:1-5.
5. Donkor SC, Quainoo AK, Gustav M. Propagation of Henna (*Lawsonia inermis*) cuttings using nathelene acetic acid, indole-3- butyric acid and wood ash. JPBAS. 2013;1:115-23.
6. Singh A, Singh DK 2001. Molluscicidal activity of *Lawsonia inermis* and it binary and tertiary combinations with plant derived molluscicides. Indian Journal Experimental Biology. 2001;263-268.
7. Azaizeh H, Fuider S, Said K, Khalil O. Ethno-botanical knowledge of local Arab practitioners JV, Lewis SM in the Middle Eastern region. Journal of Filoterapia. 2003;74:98-108.
8. Varghese JK, Silvipriya K, Resmi S, Jolly C. *Lawsonia inermis* (Henna): A natural

dye of various therapeutic uses - A review. *Inventi Rapid:* Cosmeceuticals. 2010;1:1-5.
9. Abdulmoneim MA. Evaluation of *Lawsonia inermis* Linn. (Sudanese Henna) leaf extract as an antimicrobial agent. Research Journal of Biological Sciences. 2007;2:417-423.
10. Dacie. Practical haematology 7th (ED). ELBS with Churchill Livingstone. England. 1991;37-85.
11. Jain NC. Schalm's veterinary hematology. 8th edition lea and febiger, Philadephia; 2000.
12. Cholada VC. Mean corpuscular volume (MCV); 2012.
Available:Medicine.Medscape.com/article 2085
Retrieved: December 14, 2017
13. Gernsten T. Medline plus Medical Encyclopedia; RBC indices; 2009.
Available at;en.wikipedia.org/wiki/red blood cell indices
Retrieved: December 12, 2017
14. Doumas BT. Standards for total serum protein assay. Clinical Chemistry. 1975; 21:1159.
15. Doumas BT, Biggs HG. Determination of serum albumin. In G.R. Cooper (Ed.), Standard Methods of Clinical Chemistry. New York: Academic Press. 1972;175.
16. Allain CC, Poon LS, Chon CGS, Richmond W, Fu PC. Enzymatic determination of total serum cholesterol. Clinical Chemistry. 1974;20:470.
17. Kaplan A, Szabo LL. Clinical Chemistry: Interpretation and Techniques, 2nd (Ed). Philadelphia: Lea and Ferbiger. 1983;313-314.
18. Okorie SU, Ekwe CC. The comparative analysis of sprouted legume and Cereal based composite diet. Journal of Applied Biotechnology & Bioengineering. 2017;4 (2):554–561.
19. Sharifi SD, Khorsandi SH, Khadem AA, Salehi A, Moslehi H. The effect of four medicinal plants on the performance, blood biochemical traits and ileal microflora of broiler chicks. Journal of Veterinary. 2013;83(1):69-80.
20. Nihad AA, Fadel RA, AL-Kafagy AK (2006). Effect of adding different levels of the nutrient powder to the ration in some physiological characteristics of the blood of broiler chickens. International Journal of Current Research and Academic Review. 2006;4:34-39.ISSN: 2347-3215
21. Shinde NS, Barmase BS, Ambulkar DR, Rekhate DH. Effect of probiotic and enzyme supplement on the performance of broilers. Indian Poultry Science Association XXIII Conference & National Symposium. Hydrabad. 2005;2:83-84.
22. Kabir SML, Rahman MM, Rahman MB, Ahmed SV. The dynamics of probiotics on growth performance and immune response in broilers. International Journal of Poultry Science. 2004;3(5):361-364.
23. Dhekane VS. Effect of supplementation of probiotic on performance of broilers. M.V.Sc. Thesis Submitted to MAFSU, Nagpur; 2005.
24. Ogunwole OA, Kolade EO, Taiwo BA. Performance and carcass characteristics of broilers fed five different commercial vitamin-mineral premixes in Ibadan, Nigeria. International Journal of Poultry Science. 2012;11(2):120-124.
25. Denil M, Okan F, Celik K. Effect of dietary probiotic, organic acid and antibiotic supplementation to diets on broiler performance and carcass yield. Pakistan Journal of Nutrition. 2003;2:89-91.
26. Tollba AAH, Hassan MSH. Using some natural additive to improve physiological and productive performance of broiler chicks under high temperature condition. Black cumin (*Nigella sativa*) or garlic (*Allium sativum*). Poultry Science. 2003; 23:327-40.
27. Nikola P, Dragomir L, Vidica S, Ljiljana K, Milos B, Dragana L, Sladana Z. Effect of spice herbs in broiler chicken nutrition on productive performance. Journal of Veterinary Medicine. 2014;78(2):171-177.
28. Mitruka BJ, Rawnley HM. Clinical biochemical and hematological reference values in normal experimental animal 2nd edition Masson Publishing USA. Inc.1961; 1977.
29. Anon. Guide to the care and use of experimental animals (Canadian council on animal care, Ottawa, Ontario, Canada. 1980;1:85–90.
30. Schalm OW, Jain NC, Carol EJ. Veterinary Haematology. 3rd Edition. Publisher; Lea and Febiger Philadelphia; 1975.
31. Soetan KO, Akinrinde AS, Ajibade TO. Preliminary studies on the hematological parameters of cockerels fed raw and processed guinea corn (*Sorghum bicolor*), Proceedings of 38th Annual Conference of

Nigerian Society for Animal Production. 2013;49-52.

32. Tijani LA, Akanji AM, Agbalaya K, Onigemo M. (Haematological and serum biochemical profiles of broiler chickens fed diets containing moringa leaf meals. Journal of Tropical Agriculture, Food, Enviroment and Extension. 2015;14(3):7-11

33. Kwiterovich PO. The metabolic pathways of high-density lipoprotein, low-density Lipoprotein, and triglycerides: a current review. The American journal of cardiology. 2000;86(12A):5L–10L. PMID: 11374859.

34. Thrall MA, Veiser G, Allison R, Campbel TW. Veterinary Hematology and Clinical Chemistry. 2nd Edition. 2012;60-90.

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/50626