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Hematological and carcass characteristics of finisher broilers fed varying levels of dietary pawpaw leaf meal

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Abstract

This study was designed to investigate the effect of varying levels of pawpaw leaf meal (PLM) on haematological and carcass characteristics of broiler birds. Sixty broilers of five weeks old were used for the study which lasted for five weeks. The birds were assigned to four treatment diets with three replicates. The finisher rations were formulated in which PLM was incorporated at 0.5%, 1.5% and 2.0% in T_2, T_3 and T_4 respectively. T_1 had no PLM and served as the control diet. The diets were isocaloric and isonitrogenous containing 2,850kcal ME/kg and 20% crude protein. At the end of the experiment, data collected on haematological and carcass characteristics were subjected to analysis of variance (ANOVA) in a completely Randomized Design (CRD). Results showed that there were significant ($p < 0.05$) improvements on the haematological and carcass characteristics of birds fed the treatment diets. Birds on T_4 diets had ($p < 0.05$) better haemoglobin concentration (Hb) of 10.17 and packed cell volume (PCV) of (31%) as against the control diet of Hb (8.09%) and PCV (25.97%). The carcass characteristics of the birds followed similar trend in which T_4 had significant higher values of 2,168g and 73.90% for dressed weight and dressed % respectively while T_1 (control) had the lowest values of 1,786g and 68.96% for dressed weight and dressed% respectively. It is concluded that incorporating 2.0% PLM (T_4) into the diets of broilers helped to improve the hematopoietic tissue resulting in an enhanced haematological indices and carcass yield of the broiler birds.

Keywords: Haematology; Carcass; Pawpaw Leaf meal; Broiler

1. Introduction

High cost of feed arising from the general unavailability of feedstuff or high cost of feed ingredients especially protein sources have resulted in drastic decline in productivity and profitability for intensive broiler production system. This scenario has resulted in supply bottlenecks forcing an upsurge in the price of broiler products in Nigeria. It is in realization of the above that farmers and feed manufacturers are now adjusting their operations towards exploring locally available and cheap feedstuff such as plant leaf meal (Bratte *et al*., 2011) that are not readily utilized by man and the industries and stand as the only viable alternative to conventional feed ingredients (Mohammad, 2021).

The proteins from plant leaves may be recovered and fed to farm animals in form of leaf meal protein concentrates. Examples of the leaf meals which have been widely used in feeding non-ruminant animals include *Leucaena leucocephala, Azadirachyta indica, Gliricidia sepium, Carica papaya* and *Manihot esculenta* (Gadzirayi *et al*., 2012; Onyimonyi and Onu, 2009) they also provides some essential minerals, vitamins and oxycarotenoids which cause yellow colour of broiler skin, shank and egg yolk (Onyimonyi and Onu, 2009; Esonu *et al.,* 2006). Pawpaw leaves are

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characterized by high crude protein content, making them a valuable resource that can be harvested and utilized as pawpaw leaf meal (PLM) in feeding livestock animals.

Pawpaw plant originated from Tropical America and is referred to as "Okwuru bekee" in Igboland, "Gonda" in Hausa, and "Ibepe" in Yoruba-speaking regions of Nigeria (Onyimonyi and Onu, 2009). Widely recognized in the tropics and subtropics, it is valued for its ease of cultivation, rapid growth, swift economic returns, and its ability to thrive in diverse soil and climatic conditions (Campbell, 1984). Rich in antioxidants, vitamins A, B, B2, C, and E, flavonoids, as well as minerals such as calcium, phosphorus, iron, copper, and zinc (Santana *et al*., 2019). The plant has been identified for its potential benefits in enhancing cardiovascular functions and protecting against conditions like colon cancer (Amin *et al*., 2019). Given these noteworthy attributes, research interest has been sparked in exploring the untapped potential of *C. papaya* in the nutritional aspects of livestock feed.

However, the only perceived constraints of using leaf meal are the presence of some anti-nutrient factors which could limit digestibility at certain dosage or may result in physiological disorder (Onu *et al.,* 2021). This research was therefore designed to examine the haematological and carcass characteristics of finishing broilers fed varying dietary levels of PLM and to further ascertain the safety of its use since there is paucity of information in that regard.

The objectives of the study are to;

- Evaluate the haematological profiles of finisher broilers fed varying levels of PLM
- Determine the carcass characteristics of finisher broilers fed varying inclusions of PLM

2. Methodology

2.1. Experimental Location and Animal Management

The experiment was conducted at the poultry unit of the Teaching and Research Farm of the Faculty of Agriculture, University of Nigeria, Nsukka. A total number of 60 broiler chicks of Anak strain were used for the experiment. The chicks were brooded in a deep litter system for four weeks and were transferred into individual pens measuring 4 x 5feets. Feed and water were provided *ad-libitum* with appropriate routine medications and vaccinations.

2.2. Preparation of Test Ingredients and Experimental Diets

The pawpaw leaves (*Carica papaya*) used for this experiment were harvested from the pawpaw plantation of the Department of Crop Science, University of Nigeria Nsukka. The leaves were harvested washed and dried at the greenhouse unit of the Department of Crop Science. The greenhouse has a temperature range of 30-40C in the afternoon but lower than this in the morning and evening hours. The pawpaw leaves were allowed to stay for 2-3 days at the greenhouse for it to dry to crispy while still retaining its greenish colouration the dried leaves were milled using the milling machine at the Department of Crop Science Analytical Laboratory to produce pawpaw leaf meals (PLM). The leaf meal was further subjected to proximate analysis to determine the crude protein content.

2.3. Experimental Design and Data Collection

The experimental design used was a completely randomized design (CRD). After brooding for four weeks, the birds were randomly allotted to the four (4) experimental groups with 15 birds each, replicated 3 times to give 5 birds per replicate. The treatment effect was estimated by comparing the means of the assessed parameters in the treated groups against the control.

At ten weeks old, one bird was randomly selected from each replicate, isolated, tagged and starved overnight. The blood samples were drawn for haematological tests from the jugular veins (Alcorn, 2002). The samples were taken in labeled sterile universal bottles containing ethylene diamine tetra-acetic acid (EDTA) and were used to analyze for full blood count.

2.4. Heamatological determination

In heamatological determination, the Haemoglobin concentration (Hb) was determined using the method as described by Drabkin 1932 while Red blood cell (RBC) was determined using the methods as described by Sood, 2006. White Blood Cell (WBC) and Packed Cell Volume (PCV), were determined using the method as described by Baker and Silverton (1985). Thereafter, the Mean Cellular Volume (MCV) Mean Cellular Haemoglobin Concentration (MCHC), and Mean Cellular Haemoglobin (MCH) were calculated from red blood cell.

In carcass characteristics, the following parameters were collected; Live weight (g), Dressed weight (g), % Dressed weight, % Head weight, % Neck weight, % Breast weight, % Wing weight, % Thigh weight and % Shank weight,

2.5. Statistical Analysis

The data collected were subjected to analysis of variance (ANOVA) using SPSS version 21. Means were separated using Duncan's option as found in statistical package /software (Duncan, 1955)

Table 1 Percentage Composition of the Finisher Diets

Ingredients	**T_1(Control)**	**T_2 (0.5%)**	**T (1.5%)**	**T_4 (2.0%)**
Cassava chips	40	40	40	40
Maize	7	7	7	7
Groundnut cake	25	24.5	23.5	23
Palm kernel cake	19	19	19	19
Pawpaw leaf meal	0	0.5	1.5	2.0
Fish meal	5	5	5	5
Bone meal	3	3	3	3
Salt	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25
Vitamin premise	0.25	0.25	0.25	0.25
Total	100	100	100	100
Determined Analysis				
Moisture	12.20	11.00	12.80	10.20
Crude Protein	20.66	21.37	21.42	21.16
Crude Fibre	4.90	5.12	5.27	5.38
Ether Extract	1.10	1.20	2.0	1.40
Ash	10..03	10.02	1..49	10.62
Nitrogen Free Extract	52.01	51.29	48.52	51.99

Provided the following per kg of feed: vitamin A, 10,000iμ; vitamin D2, 2000iμ; vitamin E, 6iμ; vitamin K, 2mg; riboflavin, 4.2 mg; vitamin B12, 0.01mg; pantothenic acid, 5mg; nicotinic acid, 20mg; folic acid, 0.5mg; choline, 3mg; Fe, 20mg; Mg, 56mg; Cu, 1.0mg; Zn, 5.0mg; Co, 1.25mg; Iodine, 0.8mg.

Table 2 Proximate Composition of Pawpaw Leaf Meal (PLM)

PLM	**Percentage Composition**
Moisture	10.20
Crude Protein	30.12
Crude Fibre	5.60
Ether Extract	1.20
Ash	8.45
Nitrogen Free Extract	44.43

Source: Onyimonyi and Onu , 2009

Table 3 Haematological Indices of Broilers Fed Varying Levels of PLM

Parameters	T1(Control)	T2 (0.5%)	T3 (1.5%)	T4 (2.0%)	SEM
PCV (%)	25.97[b]	26.27[b]	29.97[a]	31.00[a]	0.40
Haemoglobin (g/100ml)	8.09[b]	8.48[b]	9.46[a]	10.15[a]	0.53
Red Blood Cell (mm^3)	3.43	3.97	4.23	4.27	0.21
Total WBC x $10^6 mm^3$	5.27	5.50	5.40	5.37	1.05
TWBCDIFF					
Neutrophils (%)	14.60	12.70	13.30	12.50	0.63
Monocytes (%)	4.10	4.80	4.60	4.30	0.21
Lymphocytes (%)	81.30	82.50	82.10	83.20	1.38
MCV (fl)	101.30[c]	112.10[b]	116.40[b]	125.40[a]	1.76
MCH (g/dl)	33.80	34.70	33.60	32.60	1.13
MCHC (%)	41.60	40.90	42.40	43.30	0.82

PCV = packed cell volume; MCV=mean corpuscular volume; MCH=mean corpuscular haemoglobin; MCHC= mean corpuscular haemoglobin concentration

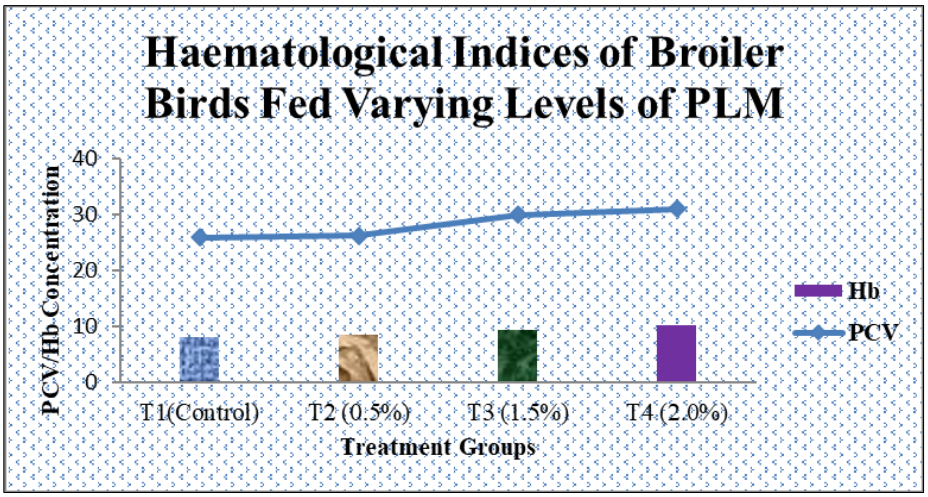

Figure 1 Haematological Indices of Broiler Birds Fed Varying Levels of PLM

Table 4 Carcass Characteristics of Broilers Fed Varying Levels of PLM

Parameters	T1(Control)	T2 (0.5%)	T3 (1.5%)	T4 (2.0%)	SEM
Live Weight (g)	2,600[c]	2,750[b]	2,800[b]	2,950[a]	1.27
Dressed weight (g)	1,786[c]	1,946[c]	1,986[b]	2,168[a]	1.72
Dressing %	68.69[c]	70.76[b]	70.93[b]	73.90[a]	0.89
Breast %	27.24	27.86	28.14	28.78	0.38
Thigh %	20.63	21.48	21.32	21.78	0.32
Wings %	7.13	7.64	7.79	7.91	0.14
Shank %	4.16	4.62	4.24	4.54	0.12
Head %	2.50	2.46	2.67	2.69	0.10

a,b,c = Row with different superscript are significantly different

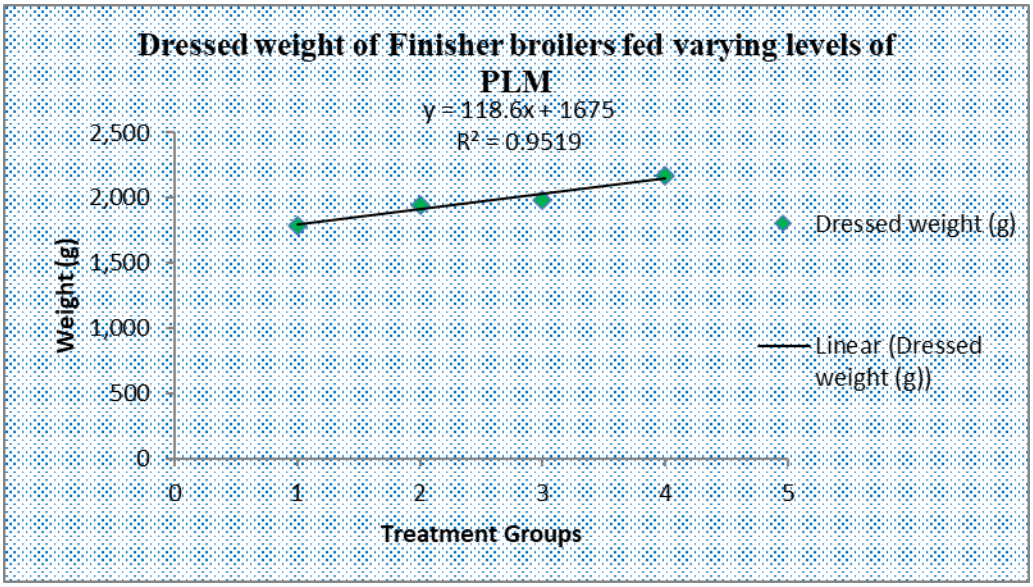

Figure 2 Dressed Weight of Broiler Birds Fed Varying Levels of PLM

3. Results and discussion

3.1. Haematological Indices

The results of the haematological indices of the finishing broiler birds were presented in table 2. Hb, PCV, and MCV were significantly ($p < 0.05$) affected by the treatment groups. Birds on T_4 and T_3 had similar ($p > 0.05$) PCV values of 31.00% and 29.97% which were themselves similar but differed significantly ($p<0.05$) from the values of 25.97% and 26.27% reported on T_1 and T_2 respectively. However, Hb followed the same trend in which T_4 and T_3 had higher significant ($p > 0.05$) values than T_1 and T_2. In MCV, T_4 had the highest value of 125.40fl which was significantly ($p<0.05$) different from T_3 (116.40fl) and T_2 (112.10fl) which were themselves similar but different ($p > 0.05$) from the value of T_1 (101.30fl).

In carcass characteristics of broiler chickens fed varying levels of PLM, significant differences exist on their live weight, dressed weight and dressing percentage. Birds on T_4 had the highest live weight of 2950g which was significantly ($p<0.05$) higher than T_2 (2750g) and T_3 (2800g) which were themselves similar but different from T_1 (Control) which had the lowest value of 2600g. The dressed weight and dressing percentage followed the same trend in which T_4 had the highest values of 2,168g and 73.90% respectively while T_1 had the lowest values of 1,786g and 68.69% for dressed weight gain and dressing percentage respectively.

Hematological indices serve as a crucial tool for assessing the physiological well-being of animals, differentiating between normal and stressed states, which can stem from nutritional, environmental, or physical factors. The PCV value above 56% is a sign of dehydration in birds, while a value below 22% indicates an anemic condition (Pendl, 2001). In this study, all PCV values fell within the normal range for birds of their size and age (25-45%) (Al-Nedawi, 2018). Despite the fact that birds in this study maintained normal PCV levels, those fed PLM exhibited a significant rise in Hb and PCV, coupled with a numerical increase in RBC counts, suggesting an enhancement in their blood's oxygen-carrying capacity (Napirah *et al.,* 2013; Revsianto, 2016). The hemoglobin range of 7.04 to 13.0g/dl reported by Putriani *et al.* (2012) aligns with the values of 8.09g/dl to 10.17g/dl obtained in this present study. However, the range of Hb values from this study were higher than the range of 6.85g/dl to 7.40g/dl reported by Sugiharto *et al.* (2015) and 5.18 to 9.30g/dl submitted by Salam *et al*. (2013).

Elevated MCV, MCH, and MCHC levels were clear indication that the birds were not under any significant stress (Huff, *et al*., 2008). Thus, it can be inferred that PLM may have slightly bolstered the birds' ability to withstand stress, aligning with the work of Esonu *et al*. (2006) who reported an improved haematological performance of broiler chicken fed graded levels of Neem leaf meal.

In carcass characteristics, the high breast percentage range of 27.24% - 28.78% corresponds with the findings of Egbunike *et al.* (2009) but surpasses the range of 21.77% - 24.90% reported by (Oladimeji *et al.*, 2020). Similarly, the

range of 27.24% - 28.78% exceeds the earlier range of 23.04% - 24.73% submitted by Ogunwole *et al.* (2016) when fed β-carotene cassava grit-based diets.

Generally, T_4 displayed superior values in all carcass parameters, suggesting that PLM may have positively influenced the carcass yield of broilers in the treatment diets. The high crude protein content and other bioactive compounds in pawpaw leaf may have facilitated digestion and the release of free amino acids, contributing to the observed improved performance.

4. Conclusion

This study has revealed that broiler finisher diets can be supplemented with PLM at 2.0% with no adverse effects on haematological and carcass characteristics. The positive influence of PLM justifies the practice of using them in broiler production to help improve the health and general wellbeing of broiler chickens. It also aided in cost reduction and increased profit margins as a protein supplement in finishing broiler diets judging from the increased carcass meat yield as observed from the birds fed the treatment diets.

Recommendation

I recommend that further study be carried out with higher inclusion levels of pawpaw leaf meal (PLM) in the finisher broilers' diet to ascertain the maximum level at which a decline in performance occurs.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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