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Haematological Response of Broiler Birds to Pawpaw (*Carica papaya*) Leaf Infusion as an Alternative to Conventional Antibiotics

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ABSTRACT
Uncontrolled usage of conventional antibiotics has led to several consequences ranging from residual contents in meat and eggs to antibiotic resistance in both animals and man, from hypersensitivity reactions, toxicity to teratogenicity and carcinogenicity. Effects of pawpaw leaf infusion (PLI) was evaluated on the hematological response of broiler chickens as alternative to conventional antibiotics. A total of 150 broilers chickens was randomly distributed into five treatment groups with three replicates each in a Completely Randomized Design. The birds were administered varying concentrations of pawpaw leaf infusion: conventional antibiotics, no antibiotics, 10g/L, 20 g/L and 30 g/L PLI from day old for three consecutive days after which PLI was withdrawn for a week before another three consecutive days of PLI. After six weeks of the experiment, 5ml of blood was collected into EDTA bottles for haematological assay, from three birds/replicate/treatment. Data were collected and analyzed on Packed Cell Volume, Haemoglobin, Red Blood Cell, White Blood Cell, Heterophils and Monocytes were evaluated. Packed Cell Volume showed significant difference ($P<0.05$) with value ranging from 26.00% (30 g/L PLI) to 38.33% (20 g/L PLI). Haemoglobin showed significant difference ($P<0.05$) with value ranging from 8.46g/dL (30 g/L PLI) to 11.73g/dL (20 g/L PLI). Red Blood Cell showed significant difference ($P<0.05$) with value ranging from $2.70x10^6$ (30 g/L PLI) to $3.82x10^6$(20 g/L PLI). White Blood Cell showed no significant difference ($P>0.05$). Heterophils showed significant difference ($P<0.05$) with value ranging from 25.66% (20 g/L PLI) to 37.00% (30 g/L PLI). Monocytes showed significant difference ($P<0.05$) with value ranging from 1.33% (10 g/L PLI) to 4.00% (30 g/L PLI). Pawpaw leaf infusion up to 20 g/L can serve as an effective alternative to antibiotics without adverse effects on the hematology of broiler.

Keywords: pawpaw leaf infusion, RBC, PCV, monocytes, conventional antibiotics

DESCRIPTION OF PROBLEM

The poultry industry is one of the fastest-growing livestock sectors globally. It plays a pivotal role in meeting the rising demand for animal protein. However, the success of broiler chicken production is often constrained by health challenges that compromise growth and productivity. Conventionally, antibiotics have been employed to promote growth and prevent diseases, but their prolonged use has raised serious concerns about antibiotic resistance, drug residues in poultry products, and consumer health risks [1] This has created an urgent need for safe, natural, and effective alternatives to conventional antibiotics in poultry production. Phytogenic feed additives derived from medicinal plants are increasingly being explored as sustainable alternatives due to their rich bioactive compounds with antimicrobial, antioxidant, and immunomodulatory properties [2]. Among these plants, pawpaw (*Carica papaya*) stands out as an underutilized resource with promising potential. The leaves of *C. papaya* contain diverse phytochemicals including alkaloids, flavonoids, saponins, tannins, and glycosides, in addition to enzymes such as papain and chymopapain, which collectively contribute to their reported antimicrobial, hematopoietic, and hepatoprotective effects [3]. Studies in poultry nutrition have highlighted the potential of pawpaw leaf meal as a feed additive. Dietary inclusion of pawpaw leaf meal improved haemoglobin concentration and packed cell volume in broiler chickens [4], while [5] observed positive effects on white blood cell

counts and serum lipid profile. These findings suggest that pawpaw leaves can modulate hematological and biochemical parameters, which are vital indicators of the physiological and health status of birds. However, most investigations have relied on leaf meal or composite feed formulations, which may limit ease of application and consistency of dosing. An alternative approach is the use of pawpaw leaf infusion administered through drinking water. Infusions may offer better extractability of bioactive constituents and easier integration into routine poultry management systems compared to meal-based supplementation. Preliminary evidence from extract-based studies suggests modest reductions in serum triglycerides and liver enzymes, although the effects vary with dosage and method of preparation [6]. Despite this, limited scientific data exist on the direct use of pawpaw leaf infusion in broiler chicken nutrition, particularly regarding its effects on haematological and serum biochemical profiles. Therefore, this study was designed to evaluate the effect of pawpaw leaf infusion on haematological and serum biochemical parameters of broiler chickens.

MATERIALS AND METHODS

Site of the Experiment

The experiment was carried out at the poultry unit of the Oke-Ogun Polytechnic, Saki, Oyo State. Saki is located in Oyo north, Oyo state within latitude 840 north and latitude 333, and an altitude about 750m above sea level. It is within the Savannah zone of Nigeria with annual mean maximum temperature of 20-40°C maximal temperature of 28.8°C and mean annual total rainfall of 1140mm. The dry season of this area is for six months from mid-October to end mid-April with very little or no rainfall during the period.

Experimental Birds Management and Design

A total of 150 day old broiler chicks were obtained from a reputable hatchery in Ibadan, Oyo State. They were brooded for 2 weeks using commercial feed (starter diet, Crude protein 20.0% and Metabolized Energy 3000 kcal/kg while finisher diet containing Crude protein 18.0% and Metabolized Energy 3050 kcal/kg). Completely Randomized Design (CRD) was employed. Birds were allotted into five treatments (negative control, positive control, 10g/L of pawpaw leaf infusion, 20g/L of pawpaw leaf infusion, 30g/L PLI) with three replicates.

Data Collection and Analysis

After six weeks of the experiment, 5ml of blood were collected into EDTA bottle for hematological study from three birds in each treatment. Data collected were subjected to analysis of variance using [7] package. Duncan multiple range test of the same software was used to separate significantly different means.

Results and Discussion

The effect of pawpaw leaf infusion (PLI) on the haematological profile of broilers is presented in Table 1. Significant differences ($p < 0.05$) were observed in packed cell volume (PCV), haemoglobin concentration (Hb), red blood cell (RBC), heterophils, monocytes, eosinophils, mean corpuscular volume (MCV), and mean corpuscular haemoglobin concentration (MCHC). Broilers administered 20 g/L PLI had the highest PCV (38.33%) compared to the negative control (31.33%) and 30 g/L PLI (26.00%). Haemoglobin concentration followed a similar trend, with 20 g/L PLI (11.73 g/dL) being superior to the negative control (10.13 g/dL) and 30 g/L PLI (8.46 g/dL). RBC counts were also higher in 20 g/L PLI ($3.82 \times 10^6/\mu L$) relative to 30 g/L PLI ($2.70 \times 10^6/\mu L$). This suggests that moderate inclusion of PLI enhanced erythropoiesis and haemoglobin synthesis, thereby improving oxygen transport capacity. Similar improvements in blood indices with phytogenic feed additives have been reported, attributing these effects to bioactive compounds such as flavonoids and alkaloids which stimulate bone marrow activity and protect red blood cells from oxidative damage [8]. The depressed PCV, Hb, and RBC values at 30 g/L PLI, however, suggest that high levels may exert anti-nutritional or toxic effects, in line with reports that excessive

phytochemicals may impair haematopoiesis [9]. White blood cell counts did not differ significantly ($p > 0.05$) across treatments, though the 20 g/L PLI group recorded numerically higher values (22,000 $\times 10^3/\mu L$). Lymphocyte percentages showed no statistical differences, although higher values were seen in treated groups compared to the negative control. Heterophil counts were lowest in the 20 g/L PLI group (25.66%) and highest in the 30 g/L PLI group (37.00%). Monocyte and eosinophil percentages varied significantly, with the 10 g/L and 20 g/L groups showing reduced counts relative to the negative control and 30 g/L PLI. Basophil counts were unaffected. White blood cell counts were not significantly different across treatments, though birds in the 20 g/L PLI group showed numerically higher WBC values compared to other groups. This, coupled with a higher lymphocyte count and lower heterophil percentage at 20 g/L PLI, indicates an immunostimulatory effect and reduced stress response. The heterophil-to-lymphocyte ratio is a widely recognized biomarker of stress in poultry (Gross and Siegel, 1983), and the reduction observed at 20 g/L PLI suggests improved welfare and immune competence. Conversely, the elevated heterophil counts in the 30 g/L PLI group point to a physiological stress response, supporting the view that excessive supplementation may become detrimental. Monocyte and eosinophil counts varied significantly across treatments. The reduction in monocytes and eosinophils at 10–20 g/L PLI suggests lower antigenic stimulation and a more balanced immune state, whereas their elevation in the negative control and 30 g/L groups may reflect immune activation or inflammatory responses. Basophil counts remained unaffected, indicating that PLI did not alter all leukocyte populations uniformly. Erythrocyte indices revealed significant effects on MCV and MCHC. The positive control had the highest MCV (105.41 fL), while the 30 g/L PLI group had the lowest (97.67 fL). MCHC was lowest in the positive control (31.13 g/dL) and highest in the 30 g/L PLI group (32.58 g/dL). MCH did not differ significantly among treatments. Erythrocyte indices (MCV and MCHC) also reflected dose-related responses. The higher MCV values in the positive control and the lowest values in 30 g/L PLI indicate that high supplementation levels may reduce red blood cell size. On the other hand, MCHC was highest in 30 g/L PLI and lowest in the positive control, suggesting increased haemoglobin concentration per cell in the former. However, as Hb values were depressed in the same group, this may indicate red cell dehydration or altered morphology rather than a beneficial adaptation. The stability of MCH across treatments suggests that haemoglobinization per cell was not markedly affected by PLI.

Table 1: Haematological profile of broiler birds administered varying levels of pawpaw leaf infusion

Parameters	Positive control(+ve)	Negative control (-ve)	10g/L PLI	20g/L PLI	30g/L PLI	SEM
PCV (%)	37.33^{ab}	31.33^{bc}	35.00^{ab}	38.33^{a}	26.00^{c}	2.00
HB(g/dL)	10.46^{a}	10.13^{ab}	11.23^{a}	11.73^{a}	8.46^{b}	0.17
RBC (10^6 µL)	3.54^{ab}	3.16^{bc}	3.44^{ab}	3.82^{a}	2.70^{c}	0.17
WBC (10^3µL)	18083.00	19483.00	17933.00	22000.00	15433.00	2313.84
Lymphocyte (%)	185333.00	107100.00	136000.00	163333.00	93333.00	4.41
Heterophils (%)	26.33^{b}	32.66^{ab}	30.33^{ab}	25.66^{b}	37.00^{a}	2.46
Monocytes (%)	3.66^{a}	2.33^{ab}	1.33^{b}	2.66^{ab}	4.00^{a}	0.64
Eosinophils (%)	3.00^{b}	5.33^{a}	2.66^{b}	4.66^{a}	3.33^{b}	0.38
Basophils (%)	0.64	0.66	0.33	0.66	0.66	0.24
MCV(Fl)	105.41^{a}	103.44^{ab}	98.63^{bc}	98.14^{bc}	97.67^{c}	1.70
MCHC(g/dL)	31.13^{c}	32.34^{ab}	32.26^{ab}	32.00^{b}	32.58^{a}	0.15
MCH(pg)	32.60^{a}	33.46^{a}	32.16^{a}	32.02^{a}	31.73^{a}	0.52

Values with different superscripts (a, b, c) in the same row differ significantly ($p < 0.05$).

Conclusion and Application

The results demonstrate that pawpaw leaf infusion at 20 g/L positively influences haematological health by improving erythropoiesis, enhancing immune response, and reducing stress biomarkers. However, higher inclusion levels (30 g/L) negatively impacted several blood indices, highlighting the need for dosage optimization. These findings corroborate the potential of pawpaw leaf infusion as a phytogenic alternative to synthetic antibiotics in broiler production, provided that inclusion levels are carefully regulated.

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