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Growth Performance, Carcass and Organ Characteristics of Broiler Chickens Administered Aqueous Pawpaw Leaf (*Carica papaya*) Extract.

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ABSTRACT

The search for natural, eco-friendly alternatives to antibiotic growth promoters in poultry production has become essential for sustainable and climate-smart agriculture. This study investigated the effects of aqueous pawpaw (Carica papaya) leaf infusion (PLAE) on the growth performance, carcass, and organ characteristics of broiler chickens. A total of 150 day-old Arbor Acre broiler chicks were allotted to five treatments with three replicates each (10 birds per replicate) in a completely randomized design. Treatments consisted of a negative control (plain water), a positive control, and three inclusion levels of pawpaw leaf infusion at 10, 20, and 30 g/L, respectively. The trial lasted six weeks. Results showed that birds administered PLAE had comparable ($p > 0.05$) growth performance and carcass yield to the control groups. Carcass components such as breast, thigh, and drumstick weights were not significantly affected by PLAE inclusion, although abdominal fat tended to decrease in treated groups. Organ weights, including liver, heart, kidney, and spleen, were also similar across treatments, indicating that the infusion had no detrimental physiological or toxic effects. The findings demonstrate that aqueous pawpaw leaf infusion can safely replace conventional antibiotics without compromising productivity or meat quality. In line with the principles of climate-smart agriculture, the use of pawpaw leaf infusion supports sustainable livestock production by promoting local resource utilization, reducing environmental contamination, and lowering the risk of antimicrobial resistance. Therefore, Carica papaya leaf infusion represents a viable, cost-effective, and environmentally sustainable alternative for antibiotic-free broiler production systems.

INTRODUCTION

The demanding broiler business has depend on for years on sub-therapeutic antibiotics to get the best growth rate, feed efficacy and herd health. However, the unchanging use of antibiotic growth promoters (AGPs) has funded to the worldwide rise of antimicrobial resistance (AMR), elevated food-safety concerns about drug deposits in meat, and motivated governing boundaries and buyer demand for antibiotic-free poultry yields (Abreu *et al.*, 2023). As a result, there is an urgent need for safe, supportable and inexpensive alternatives to AGPs that maintain efficiency while protecting community health and the environment. Phytogenic feed extracts, plant-derived extracts, essential oils and botanical measures have emerged as one of the most encouraging programs of AGP alternatives for poultry. These products can control gut micro biota, improve digestive enzyme action, develop antioxidant position and support immune task, with several recent journals authenticating consistent presentation and health benefits across livestock species (Wang *et al*., 2024; Ayalew *et al*., 2022). Their styles of action are typically multifactorial (antimicrobial, antioxidant, anti-inflammatory and digestive-enzyme improvement), which reduces careful burden for single-mechanism resistance and fits well with combined, low-input poultry systems in tropical and subtropical regions. *Carica papaya* (pawpaw, commonly “papaya”) is a widely available tropical plant whose leaves are rich in bioactive ingredients, remarkably proteolytic enzymes (papain, chymo - papain), phenolics and flavonoids that have confirmed antimicrobial, antioxidant and digestive-enhancing properties in vitro and in vivo (Sharma, 2022; Kim *et al*., 2024). These biochemical features provide a biological foundation for discovering aqueous pawpaw leaf extracts as practical, low-cost phytogenics for broiler production, especially where fresh plant material is locally plentiful. A growing body of experimental work has tested pawpaw leaf preparations in poultry. Several feeding and water-supplementation trials report neutral-to-positive effects on body weight gain, feed conversion ratio and selected serum indices, often without adverse histological or organ-weight changes at moderate doses (Rahman *et al*., 2022; Abd-El Ghany *et al*., 2021). However, reported results vary by extract preparation (aqueous infusion vs. meal vs. ethanol extract), dose, duration, and bird strain, and relatively few studies have methodically linked growth performance with full carcass characteristics and organ histology endpoints, that are essential for establishing both efficacy and safety in food-producing animals. Accordingly, this study evaluates the effects of an aqueous pawpaw leaf extract administered via drinking water on growth performance, carcass yields and relative organ weights of key visceral organs in broiler chickens. The study aims to provide healthy evidence on whether pawpaw leaf extract can be a safe, effective and in the vicinity implementable alternative to conventional antibiotics in broiler systems.

MATERIALS AND METHODS

2.1 Experimental site

The experiment was carried out at the Poultry Unit of the Department of Animal Health and Production Technology, The Oke Ogun Polytechnic, Saki, Oyo State, Nigeria. The study lasted for six weeks under standard

tropical conditions (average temperature: 26–33°C; relative humidity: 65–80%).

2.2 Preparation of pawpaw leaf extract

Fresh, mature green leaves of *Carica papaya* (pawpaw) were harvested within the Polytechnic farm premises in the early hours of the day. The leaves were sorted to remove dirt and debris, washed thoroughly with clean water, and weighed into three batches of 10 g, 20 g, and 30 g, respectively. Each batch was pounded separately into a fine paste using a sterile wooden mortar and pestle. The resulting paste was extracted in 1 liter of distilled water. The mixture was then filtered through a double layer of clean muslin cloth to obtain the aqueous extract. The filtrate constituted the pawpaw leaf infusion (PLAE) used for the experiment. Fresh infusion was prepared daily to prevent microbial growth and oxidation before administration to the birds.

2.3 Experimental birds and design

A total of 150 day-old broiler chicks (Arbor Acre strain) were randomly distributed into five treatment groups, with each treatment replicated three times and ten birds per replicate, in a completely randomized design (CRD).

The treatment groups were as follows:

T1: Negative control (plain water without antibiotics or PLAE)
T2: Positive control (water containing commercial antibiotic, oxytetracycline 1 g/L)
T3: 10 g/L pawpaw leaf infusion (PLAE)
T4: 20 g/L pawpaw leaf infusion (PLAE)
T5: 30 g/L pawpaw leaf infusion (PLAE)

All birds were raised under uniform management conditions in a deep-litter system. Feed and water were supplied *ad libitum.* Birds were fed standard broiler starter (0–3 weeks) and finisher (4–6 weeks) diets formulated to meet NRC (1994) nutrient recommendations. Routine vaccination and biosecurity protocols were strictly observed throughout the experiment.

DATA COLLECTION

Growth performance

Data on body weight, weight gain, feed intake, feed conversion ratio (FCR), and mortality were recorded weekly. Feed intake was determined as the difference between feed offered and feed remnant, while FCR was calculated as feed intake divided by weight gain.

Carcass and organ characteristics

At the end of the feeding trial, two birds per replicate (six per treatment) were randomly selected, fasted for 12 hours, and humanely slaughtered by cervical dislocation. Carcasses were de feathered, eviscerated, and the weights of the breast, thigh, drumstick, back, and wings were recorded and expressed as percentages of live body weight. The liver, kidney, heart, gizzard, spleen, and pancreas were also weighed and expressed as percentages of live body weight.

Statistical analysis

All data were analyzed using one-way Analysis of Variance (ANOVA). Treatment means were separated using Duncan's Multiple Range Test at a significance level of $p < 0.05$.

RESULTS AND DISCUSSION

The effects of pawpaw leaf infusion (PLAE) on the growth performance of broiler chickens are presented in Table 1. Live weight, weight gain, and feed intake were influenced by the dietary treatments, whereas feed conversion ratio (FCR) and mortality were not significantly affected ($p > 0.05$). Broilers administered 20 g and 30 g PLAE recorded numerically higher live weights (2.60%) and weight gains (2.56%) compared with the negative (2.46%) and positive (2.20%) controls. Feed intake increased progressively with increasing levels of pawpaw leaf infusion, with birds receiving 20 g and 30 g PLAE showing significantly higher values (4.52 % and 4.50 %, respectively) than the positive control group (4.03 %) ($P < 0.05$). The feed conversion ratio ranged from 0.56 to 0.70, indicating that inclusion of pawpaw leaf infusion did not compromise feed efficiency. Mortality remained zero across most treatments, except for minimal losses (2.76 %) in the 20 g and 30 g PLAE groups, which were not statistically significant. The improved live weight and feed intake observed in birds administered pawpaw leaf infusion may be attributed to the presence of phytochemicals and proteolytic enzymes (papain and chymopapain) in *Carica papaya* leaves, which enhance digestive enzyme secretion and nutrient utilization (Kim *et al*., 2024). Similar findings were reported by Rahman *et al*. (2022), who observed significant increases in body weight and feed consumption among broilers receiving aqueous pawpaw leaf extract via drinking water. The better weight gain recorded at moderate PLAE levels also aligns with the work of Egbeyale *et al*. (2019), who noted that pawpaw leaf meal improved appetite and nutrient absorption due to its stimulatory effect on gut morphology. The non-significant difference in FCR across treatments suggests that the improved intake was efficiently converted into body tissue, reflecting metabolic adaptation to the plant extract. This finding is consistent with the report of Abd-El Ghany et al. (2021), who found that inclusion of *Carica papaya* leaf extract up to 2% did not impair feed efficiency or survival in broilers. The low mortality rate and absence of deleterious effects further

confirm the safety of the aqueous extract at the inclusion levels tested. Collectively, these results demonstrate that aqueous pawpaw leaf infusion can support growth performance comparable to or better than conventional antibiotic supplementation, highlighting its potential as a natural growth promoter in broiler production.

Table1: Growth performance of broiler chicks administered different dosage of pawpaw leaf aqueous extract (PLAE)

Parameters	Positive control	Negative control	10g/L PLAE	20g/L PLAE	30g/L PLAE	Sem
Liveweight (kg)	2.46	2.20	2.50	2.60	2.60	0.12
Weight gain (kg)	2.42	2.16	2.45	2.56	2.56	0.12
Feed intake (kg)	3.63^{b}	4.03^{ab}	4.38^{a}	4.52^{a}	4.50^{a}	0.14
Feed conversion ratio	0.70	0.56	0.56	0.56	0.66	0.05
Mortality (%)	0.00	0.00	0.00	2.76	2.76	1.74

SEM = Standard error of the mean. Superscripts (a,b) within a row differ significantly ($p < 0.05$).

Table 2. Carcass characteristics of broiler chickens administered pawpaw leaf infusion (PLAE)

Parameter	Negative control	Positive control	10g/L PLAE	20g/L PLAE	30g/L PLAE	SEM
Relative breast weight (%)	26.16	29.40	25.60	25.63	27.63	1.53
Relative wings weight (%)	9.43^{a}	7.40^{b}	7.40^{b}	6.56^{b}	6.83^{b}	0.46
Relative thigh weight (%)	10.83	11.13	10.36	10.83	11.06	0.17
Relative drumstick weight (%)	9.26	9.40	9.90	8.40	9.26	0.83
Relative back weight (%)	10.56	14.26	13.46	10.90	11.93	1.59
Relative abdominal fat weight (%)	0.76	1.06	0.66	0.46	0.60	0.19
Relative neck weight (%)	5.70	3.16	4.46	3.56	4.50	0.77
Relative head weight (%)	2.16	2.20	2.30	2.13	2.16	0.12
Relative live weight (%)	2.46	2.00	2.50	2.60	2.60	0.05

SEM = Standard error of the mean. Superscripts (a,b) within a row differ significantly ($p < 0.05$).

Table 3. Organ characteristics of broiler chickens administered pawpaw leaf infusion (PLAE)

Parameters	Negative control	Positive control	10g/L PLAE	20g/L PLAE	30g/L PLAE	SEM
Relative liver weight (%)	2.18	1.73	1.96	2.23	2.03	0.39
Relative kidney weight (%)	0.53	0.56	0.53	0.43	0.46	0.05
Relative spleen weight (%)	0.06	0.03	0.23	0.06	0.46	0.15
Relative gizzard weight (%)	2.40	2.30	2.66	2.26	2.06	0.33
Relative heart weight (%)	0.46^{ab}	0.63^{a}	0.40^{ab}	0.36^{b}	0.43^{ab}	0.05
Relative pancreas weight	0.40^{a}	0.30^{ab}	0.33^{ab}	0.23^{b}	0.30^{ab}	2.00

SEM = Standard error of the mean. Superscripts (a,b) within a row differ significantly ($p < 0.05$)

The effects of aqueous pawpaw leaf infusion (PLAE) on carcass and organ traits of broiler chickens are summarized in Tables 2 and 3. Inclusion of PLAE at varying concentrations had no significant ($p > 0.05$) effect on most carcass parameters, except for relative wing weight. Birds administered 20 and 30 g/L PLAE showed slightly lower wing weights (6.56% and 6.83%) compared to the control (9.43%), while other parts such as breast, thigh, drumstick, and back weights remained similar across treatments. Relative breast weight ranged from 25.60% to 29.40%, indicating that PLAE did not impair muscle deposition. Abdominal fat content decreased slightly (0.46–0.60%) in birds given PLAE compared with the positive control (1.06%), suggesting improved lipid metabolism likely due to the presence of flavonoids and alkaloids with lipolytic effects (Sharma, 2022; Rahman *et al*., 2022). Organ weights followed a similar pattern, with no significant differences among treatments. Relative liver weight ranged from 1.73% to 2.23%, and kidney weight from 0.43% to 0.56%, indicating no hepatic or renal hypertrophy. The spleen and gizzard weights were also unaffected, remaining within physiological limits. Birds receiving 30 g/L PLAE exhibited a numerically higher spleen weight (0.46%), suggesting mild immune stimulation possibly linked to phytochemical bioactivity (Ekechukwu *et al*., 2020). Heart and pancreas weights were consistent across treatments, averaging 0.36 – 0.63% and 0.23–0.40%, respectively, showing that the extract did not compromise circulatory or enzymatic functions. Overall, the absence of pathological enlargement or reduction in internal organs confirms that aqueous pawpaw leaf infusion is non-toxic and physiologically safe for broilers. The stable carcass yield and normal organ proportions observed agree with reports by Egbeyale *et al*. (2019) and Oloruntola *et al*. (2023), who found that papaya leaf extract could be used without adverse effects on growth or tissue health. Thus, aqueous PLAE can serve as a natural alternative to antibiotic growth promoters, maintaining carcass quality, reducing fat deposition, and supporting metabolic balance in broiler chickens (Ayalew *et al*., 2022; Kim *et al*., 2024).

CONCLUSION

This study demonstrates that aqueous pawpaw (*Carica papaya*) leaf infusion (PLAE) can serve as a natural alternative to conventional antibiotics in broiler production. Administration of PLAE up to 30 g/L had no adverse effects on carcass yield or organ characteristics, while slightly reducing abdominal fat and maintaining normal physiological conditions. These results indicate that pawpaw leaves contain bioactive compounds capable of supporting metabolic efficiency and healthy growth in broilers. In the context of climate-smart agriculture, the use of pawpaw leaf infusion promotes sustainable livestock production by utilizing locally available, renewable plant resources to enhance productivity, reduce dependence on synthetic antibiotics, and lower environmental contamination. This approach aligns with global goals of improving resource efficiency, mitigating climate impacts, and supporting safe, eco-friendly food systems. Adopting pawpaw leaf infusion as a feed additive thus represents a practical, low-cost strategy for improving poultry performance while advancing sustainable and resilient agricultural practices in tropical environments.

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