



Performance of Finisher Broiler Chickens Fed Diets Supplemented with fresh and *In situ* dried Pawpaw (*Carica papaya*) Leaf Meals.

¹*Omogiade, C. L., ¹Onyekwere, G. E., ¹Eke, A. C., ²Gbadamosi, J. A., and ³Adaramoti, D. T.

¹Department of Animal Science and Technology, School of Agriculture and Agricultural Technology, Federal University of Technology, PMB 1526, Owerri, Imo State, Nigeria

²Department of Animal Production and Health, Faculty of Agricultural Science, Ladoke Akintola University, Ogbomosho, Nigeria

³Department of Animal Breeding and Product Quality Assessment, Poznan University of Life Sciences, Poland

*collinsomogiade500@gmail.com, +2349069028447

Abstract

*This study evaluated the growth performance of finisher broiler chickens fed diets with different forms of pawpaw (*Carica papaya*) leaf meal (PLM). Ninety-nine Ross-308 broiler chickens at 32 days of age were subjected to the dietary treatments of fresh and in situ dried PLM. The birds were subjected to three dietary treatments in groups of thirty-three birds each in a completely randomized design (CRD), with 3 replicates (11 birds). The diets were T1, the control diet (0% PLM), T2 (0.2% fresh dried PLM) and T3 (0.2% in situ dried PLM). The birds were given the experimental diets from 32 to 56 days of age. Performance indicators such as feed intake, Final Weight gain (WG), Average daily feed intake (FI), and Feed conversion ratio were determined. The results showed that birds subjected to the control diet (T1) had better performance in weight gain (1049.00 g) and final body weight (2514.33 g) than the other groups. This was followed by birds fed diets with in situ dried (T3) PLM, which had 985.30 g and 2449.77 g, respectively. T2 had the lowest final body weight of 2341.17 g. The Average daily feed intake (134.31 g) in the fresh dried PLM birds was significantly different ($p > 0.05$) than the control (156.07 g) and in situ group (155.36g). T1 had the best feed conversion ratio (3.14) compared to other treatments. The performance of the birds indicates that low levels of inclusion of PLM in the diets depressed their overall performance.*

Keywords: Pawpaw leaf meal; Broiler chickens; Growth performance; Feed intake; Weight gain

Introduction

The production of broiler chickens as a source of food is essential to meet the protein demand needed globally, especially in sub-Saharan countries, due to their rapid growth rate, efficient utilization of feed and quick returns on investment unlike other livestock production (Paswan *et al.*, 2014). Broiler chickens can enhance food security worldwide and reduce the reliance of imported meat products in African countries like Nigeria (Hatab *et al.*, 2019).

Feed cost account for 70-80% in total cost of production (Omole *et al.*, 2005; Ademola and Farinu, 2006; Olugbenga *et al.*, 2018),

which has necessitated the search for alternative measures that could mitigate this cost of expensive conventional feed ingredients and still meet optimum production. While Antibiotics have been widely used as growth promoters to enhance poultry production, concerns over residues in animal products and resistance bacteria have led to their restricted use (Osato *et al.*, 1993). Natural alternatives, such as herbs or plant additives, are now considered for their safety as natural medicinal defense against pathogens (Shirdel and Nobakhat, 2017).

Pawpaw (*Carica papaya*) seeds have anticoccidial properties which are used for

the treatment of important coccidial disease in poultry birds (Banjoko *et al.*, 2020). Research has shown that papaw seeds can reduce oocyst levels in faecal matter (Adama *et al.*, 2025) and serve as a synthetic anticoccidial drug to enhance performance of birds (Christopher *et al.* 2021). Pawpaw latex has been reported to improve immune response and carcass yield (Moshood and Adeyinka, 2018).

Pawpaw (*Carica papaya*) leaves have phytogetic feed properties which have been reported to be nutritional and have medicinal benefits, containing about 30% crude proteins (Maisarah *et al.*, 2014; Adingra *et al.*, 2017) and various bioactive compounds of enzymatic properties such as palpain, alkaloid and antifungal properties that enhance feed intake and digestion in poultry (Onyimonyi and Onu, 2009). These enzymes aid in the digestion of soluble proteins (Isa, 2010). Various inclusion of PLM in diets has shown improved nutrient digestibility and performance in poultry (Adegbeye *et al.*, 2020; Inuwa *et al.*, 2023; Unigwe *et al.*, 2024; Adelowo *et al.*, 2025) to enhance meat quality and reduce bacterial and fungal effect on meat stored under refrigeration condition (Akinduro *et al.*, 2022). The constituents of PLM which are suitable as dietary supplement in poultry feed, depends on the optimum inclusion level, processing methods and fibre contents to influence feed intake and nutrient digestibility.

Despite existing studies on PLM, limited research compares the comparative effects of fresh dried and *in situ* dried PLM at low inclusion levels of 0.2% and below. Therefore the objectives of this research were to evaluate the proximate composition of fresh dried and *in situ* dried PLM and their effects on growth performance of finisher broiler chickens. This study aims to contribute to the development of sustainable

feeding strategies using indigenous plant materials for poultry nutrition.

Materials and Methods

Experimental site

This research was carried out in the poultry unit of the Teaching and Research Farm in the School of Agriculture and Agricultural Technology, Federal University of Technology, Owerri (FUTO), Imo State, Nigeria. The region falls in the southeastern region of Nigeria and has an annual rainfall of 2000 - 2500 mm and temperature of 26°C - 28°C. The relative humidity is about 98% during the rainy season. The soil is predominantly sandy loam with pH of 5.5 and evapotranspiration of about 1450 mm (Ministry of Land and Survey, 1992).

Sources of materials, processing and chemical composition of pawpaw (*carica papaya*) leaf

Pawpaw (*Carica papaya*) leaves were purchased from cultivated farms in Eziobodo Community, Owerri West Local Government Area of Imo State, Nigeria. Two drying procedures were used. The fresh dried PLM were chopped into small pieces and sun dried for seven days. The *in situ* dried PLM were purchased directly from the plantation field. The fresh dried and *in situ* dried pawpaw leaves were separately pulverized by a milling machine. The pulverized pawpaw leaves were stored in different airtight containers and kept at room temperature for use in feed formulation. Proximate analysis was carried out on the fresh dried and *in situ* dried pulverized materials to determine the content of crude protein, crude fibre, moisture, ash, fat and nitrogen- free extract (Table 1) according to the procedure of the Association of Official Analytical Chemists (AOAC, 1990), before inclusion into the experimental diet. The finisher birds were purchased from FUTO farms for the experiment.

Housing and management

The pen was cleaned and fumigated two days before the arrival of the finisher broiler birds.

The birds were housed in a deep litter system lined with a mixture of sawdust and wood shavings and reared under standard management practices of FUTO. Light was provided for feeding at night. Clean water and the experimental diets were supplied *ad libitum*. Routine vaccination, multivitamins, and necessary medications were administered throughout the trial period.

Experimental birds and design

Ninety-nine Ross-308 broiler finisher chickens of 32 days old were used. The birds were randomly selected and assigned into three dietary treatment groups in a completely randomized design. The treatment groups had 11 birds each and was further divided into 3 replicates of 11 birds each.

Dietary treatments

Three experimental diets were formulated:

T1 (control diet): Basal diet without PLM (0% inclusion level).

T2: Basal diet with 0.2% fresh dried PLM inclusion level.

T3: Basal diet with 0.2% *in situ* dried PLM inclusion level.

The birds were fed the experimental diets from 32 - 56 days of age. The nutrient composition and calculated nutrient levels are shown in Table 1. The diets were formulated to meet the nutrient requirement of the broiler finishers. The diets were isocaloric and isonitrogenous with crude protein content of approximately 20.06% and metabolizable energy of 2872.75 kcal/kg.

Data collection

The birds were individually weighed at the beginning of the experiment to determine

the initial live weights. The final weight was recorded on day 56. To calculate:

Average daily weight gain (DWG) = the difference between the final and initial weight divided by the number of experimental days. i.e $DWG = (Final\ Weight - Initial\ Weight) / Number\ of\ Days$

The Average total weight gain (ATWG) is calculated as the difference between the Final weight and Initial weight. i.e

$ATWG = (Final\ weight - Initial\ weight)$

Feed given and Feed remnants were recorded daily to determine the average daily feed intake (FI). The Feed conversion ratio (FCR) is calculated as the ratio of average daily feed intake to average daily weight gain i.e

$FCR = AVDFI / AVDWG$

Statistical Analysis

The data collected were analyzed using one-way analysis of variance (ANOVA) using R Statistical software (R. 2.6.0, 2008). Statistical differences were compared using Least Significant Difference (LSD) at a significant level of $p < 0.05$.

Results

Proximate composition of fresh dried and *in situ* dried PLM

The proximate composition is presented in Table 2. Crude protein, ether extract, ash and moisture content in the fresh dried PLM were higher than the *in situ* dried PLM. The nitrogen-free extract (NFE) and crude fibre in fresh dried PLM were lower compared to the *in situ* dried PLM.

Weight Gain

The growth performance of finisher broiler chickens is presented in Table 3. At the beginning of the feeding trials, the average initial live weight (LW) was comparable for each group: 1465.33g, 1518.13g and 1464.47g for the control, fresh dried PLM and *in situ* dried PLM respectively (Table

3). The control group weighed the most (2514.33g) at the end of the study, followed by the *in situ* dried PLM group (2449.77g), and then fresh dried PLM (2341.17g). This finding implies that the control performance was better, and the PLM inclusion on the dietary treatments depressed growth.

The average daily weight gain (ADWG) was highest in the control group (49.92 g/day), with the *in situ* group (46.92 g/day) performing better than the fresh dried PLM group (39.19 g/day). This trend suggests that PLM inclusion, especially in its fresh dried form, may limit growth, likely due to the bitter taste or anti-nutritional compounds such as carpaine that reduce feed palatability and nutrient utilization (Sari *et al.*, 2020).

Feed intake and Feed Conversion ratio

The control had the highest average daily feed intake (FI) at 156.07g, while the *in situ* dried PLM was somewhat lower at 155.36g. With the lowest FI of 134.31g, the birds given fresh dried PLM showed a statistically significant difference ($P < 0.05$) between the *in situ* dried PLM and fresh dried PLM. This could be linked to the unpalatable taste or higher moisture retention of the leaves, which may have affected the texture of the feed materials. Feed conversion ratio (FCR), which is a critical measure of feed efficiency for growth performance, was best in the control group (3.14), and followed by *in situ* PLM (3.39) while the worst value of 3.56 was recorded in the group on fresh dried. This further supports the superior performance of the control and *in situ* treatments in utilizing feed for body weight gain.

Discussion

The proximate composition of the PLM is presented in Table 2. The crude protein (CP) content of the fresh dried leaf (23.63%) was significantly higher than the *in situ* dried leaf (17.50%). This variability

of crude protein may suggest degradation of protein due to prolonged exposure to sunlight, microbial activity, drying method or enzymatic breakdown in the field. The CP value of this study is lower compared to the 31.12% recorded in the study by Onyimonyi and Onu (2009) and Ekwe *et al.* (2004) recorded higher crude protein content of 28.20% and 25.30% in their studies respectively and this can be attributed to differences in plant maturity, soil fertility, climate and drying process. The crude fibre content was high in both samples (16.42%) in fresh dried and 18.94% in *in situ* dried PLM, which could negatively influence digestibility in monogastric animals like poultry. The structural hardening during the long period of drying may also have contributed to the increased fibre level (Miranda *et al.* 2010; Sule and Omologbe, 2017).

The ash content of fresh dried PLM (14.47%) was also higher than that of the *in situ* dried sample (10.90%), and both were higher than the 8.45% previously reported (Onyimonyi and Onu, 2009) and 8.8% reported by Ekwe *et al.* (2004). High ash content may suggest a richer mineral profile, but could also influence palatability and feed intake. The nitrogen-free extract (NFE), which reflects carbohydrate content, was higher in *in situ* dried PLM (36.34%) compared to fresh dried (25.76%), possibly indicating greater energy content.

The total WG and DWG of the fresh PLM were the worst, weighing 823.04 g and 39.19 g daily, respectively. This study aligns with Iheukwumere *et al.* (2008) who reported a depressed growth in broiler performance with increasing levels of PLM inclusion between 0.5 and 2%. However, the performance in this trial, particularly for the *in situ* PLM group, was closer to the control, indicating improved growth potential for PLM utilization if processed optimally. According to Kassali *et al.*

(2022), the backyard and medium scale production system of birds at 6-7 weeks is 2500 g and 8-9 weeks of age is 3000 g respectively. The average final weight gain of the fresh dried PLM and *in situ* dried PLM is closer to the average standard market weight (2500 g) at 6 weeks of age but lower compared to 3000 g at 8 weeks of age.

Ekwe *et al.* (2024) investigated the effects of sun-dried pawpaw leaf meal (PLM) inclusion at 0, 5, 10, and 15% levels in broiler diets, reporting no significant differences ($P>0.05$) in most growth performance indicators, apart from feed intake which aligns with this study. Although earlier studies by Onyimonyi and Onu (2009) and Ekwe *et al.* (2024) noted improved bird performance with PLM supplementation, the present research observed superior performance in the control group compared to diets containing both fresh-dried and *in situ*-dried PLM. This variation could be attributed to the relatively low inclusion rate (0.2%) used in this study, which contrasts with the higher levels (5–15%) reported in their research. Additionally, the high crude fibre content of the PLM samples used in this research may have negatively influenced nutrient digestibility and, consequently, growth performance. While PLM is recognized for its potential health-promoting properties, the findings from this study suggest that at a 0.2% inclusion rate, both drying methods resulted in poorer performance than the control. This indicates the need for further research into optimal inclusion levels, potential processing improvements, and the use of complementary feed additives to enhance broiler productivity.

Conclusion

The results from this study indicates that at low inclusion level (0.2%) of PLM, the control diet performed better than the fresh dried and *in situ* dried in overall growth

performance. Therefore, despite the promising effect of PLM to influence growth positively, further research is required to investigate broader inclusion levels (e.g. 1%–7%) to ascertain the optimal dosage of PLM that will enhance growth performance and feed efficiency in broiler chickens. Advanced processing methodology such as fermentation, ensiling, or enzymatic hydrolysis is needed in order to reduce the fibre content and anti-nutritional factors inherent in PLM.

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Conflicts of Interest

The authors declared that there are no conflicts of interest.

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Table 1: Ingredient and calculated nutrients composition of experimental broiler finisher diets

Ingredients	Control T1 (0.0% PLM)	Fresh dried leaves T2 (0.2% PLM)	<i>In situ</i> -dried leaves T3 (0.2% PLM)
PLM	-	0.2	0.2
Maize	55.0	55.0	55.0
Palm Kernel Cake	9.5	9.5	9.5
Soya Bean Meal	17.0	17.0	17.0
Fish Meal	6.5	6.3	6.3
Spent Grain	5.0	5.0	5.0
Bone Meal	5.0	5.0	5.0
Vitamin/Mineral premix*	0.25	0.25	0.25
Salt (NaCl)	0.25	0.25	0.25
Lysine	0.25	0.25	0.25
Methionine	0.25	0.25	0.25
Total	100.00	100.00	100.00
Calculated nutrient composition			
Crude protein (%)	20.06	20.06	20.06
Calcium (%)	2.08	2.08	2.08
Phosphorus (%)	1.35	1.35	1.35
Crude fibre (%)	4.31	4.31	4.31
Metabolizable Energy (Kcal/kg)	2872.75	2872.75	2872.75

Agro bar Magen starter/finisher premix: To provide per ton of feed: Vitamin A: 8,500,000 IU; Vitamin D₂ 1,500,000 IU; Vitamin E 10,000mg Vitamin K₃ 1,500mg; Vitamin B₁ 1,600mg Vitamin B₂ 4,000mg; Niacin 20,000mg; Pantothenic Acid 5,000mg; Vitamin B₆ 1,500mg; Vitamin B₁₂ 10.0 mg; Folic Acid 500mg; Biotin 112 750mg; Choline Chloride 175,000mg; Cobalt 200mg; Copper 3,000mg; Iodine 1,000mg; Iron 20,000mg; Manganese 40,000mg; Selenium 200mg; Zinc 30,000mg; Antioxidant 1.250mg at inclusion rate 2.5kg per ton of feed. PLM= Pawpaw Leaf Meal

Table 2: Proximate composition of fresh dried and *In situ*-dried PLM

Parameters	Fresh dried (%)	<i>in situ</i> dried(%)
Moisture content	12.94	10.62
Crude protein	23.63	17.50
Crude fibre	16.442	18.94
Ether extract (fat)	6.78	5.70
Ash content	14.47	10.90
Nitrogen-free extract (NFE)	25.76	36.34

Table 3: Performance of finisher broiler chickens fed pawpaw leaf meal from 32 to 53 days of age.

Parameters	Control (0.0%)PLM	Fresh dried (0.2%) PLM	<i>In situ</i> -dried (0.2%) PLM	SEM
Average Initial Weight (g/ per bird)	1465.33	1518.13	1464.47	49.49
Average final Weight (g/ per bird)	2514.33	2341.17	2449.77	76.57
Average Total Weight (g/ per bird)	1049.00	823.04	985.30	88.59
Average Daily Weight (g/ per bird per day)	49.92	39.19	46.92	4.55
Average Daily feed intake (g/ per bird per day)	156.07 ^a	134.31 ^b	155.36 ^a	4.87
Feed conversion ratio (feed/gain)	3.14	3.56	3.39	0.38

^{ab} means in the same row with different superscripts are significantly different (P<0.05)

PLM = pawpaw leaf meal

SEM = Standard error of mean