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Utilization of Pawpaw Leaf Meal: Effect on Growth Response of Broiler Chickens

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Target Audience: Farmers, Researchers

Abstract

A study was conducted at the Teaching and Research farm of Taraba State University to investigate the utilization of dietary inclusion of Pawpaw Leaf Meal (PLM) on the Growth response of broiler chickens. A total of One Hundred and Eighty (180) day old broiler chicks were used in the study for eight weeks. The chicks were randomly allotted to five (5) treatment groups of thirty-six (36) birds per treatment and replicated three times with twelve (12) birds per replicate in a Completely Randomized Design (CRD). Five experimental diets were formulated with PLM at inclusion levels of 0%, 5%, 10%, 15% and 20% for both starter and finisher phases. The average daily weight gain, final weight gain and FCR for starter phase were statistically (P<0.05) different similarly average daily weight gain, final weight gain, FCR and average daily feed intake for the finisher phase were also statistically (P<0.05) different. The values recorded for final weight at the starter phase were 966.33g, 930.00g, 903.33g, 889.33 and 827.00g for T1, T2, T3, T4 and T5 respectively while the finisher phase showed values of 1598.06g, 1693.44g, 1826.72g 1988.00g and 1819.44g for T1, T2, T3, T4 and T5 respectively. The findings of this study showed that PLM inclusion at 15% in the diet of broiler chickens can be utilized as growth promoter that enhance growth performance without adverse effect on the health status of the birds.

Keywords: ***Broiler chickens, pawpaw leaf meal, growth response***

Description of problem

Intensive poultry production in developing countries could be further enhanced through feeding strategies that promote feed utilization in relation to bird performances [1]. Before 2003 in the United Kingdom, the inclusion of antibiotics as growth promoters in animal feeds was widely adopted following the reported growth stimulation effect [2]. Thus; according to [1], antibiotics have the ability to decrease feed usage per production unit with concomitant increase in production performance. This is in addition to the fact that antibiotics can help reduce the disease burden, inhibit pathogenic microorganisms, and reduce microbial toxic metabolites, epithelium turn over, intestinal motility and bacterial deconjugation of bile

salt [1]. However, the ban on the use of antibiotics in animal feeds has fuelled the search for alternative animal growth promoters in the form of enzyme supplementation [3] and phytogenic feed additives [4]. Enzyme supplementation has been reported to improve changes in the intestinal environment, including the viscosity of the digesta, which may promote contact among nutrients, endogenous enzymes and absorptive mucosae, thus enhancing the usage of the diet by the concerned animal.

Leaf meal is also used as growth promoters, which has been adopted for several decades in animal production to enhance the animals' growth performance, increase their prime cuts yield, and decrease intramuscular fat deposition [5]. However, due to the human and animal health risks associated with the use of synthetic feed additives as growth promoters in meat production, synthetic or antibiotic growth promoters are now being rejected in many countries [6]. The dietary supplementation with phytobiotics, phytogenic feed additives, phytochemical feed additives, and herbal supplements or ingredients are now being considered as alternatives to the synthetic growth promoters [7] [8] [9]. The phytochemicals have antimicrobial, anti-stress, antioxidant, and immunomodulatory properties which made them potential growth promoters in animal production [5].

Although, positive results have been reported when pawpaw plant parts are used as supplements or ingredients in animal feeds [8], pathological investigations on effect of the use of pawpaw leaves and seeds as dietary supplements or ingredients on broiler chickens are scanty and unsatisfactory. Therefore, this study was intended to investigate the effect of pawpaw leaf meal on Growth performance.

Materials and Methods

Experimental site

The study was conducted at the Teaching and Research Farm of Taraba State University. Taraba State is located at the North Eastern part of Nigeria and characterized by the Northern guinea savannah, and lies between latitude 6°30′ and 9°30′ N of the equator and between longitude 9°00′ and 12°00′ E of the Greenwich Meridian. Bauchi and Gombe states are located in its northern axis while Adamawa is in the east; on the south is Cameroun, and on the west are Benue, Nassarawa, and Plateau states. The area is tropical with distinct wet and dry seasons. The wet season lasts for 7 months while the dry season lasts for 5 months with a mean annual rainfall which ranges from 800 mm in the northern part of the state to over 2000 mm in the southern part [10]. Precipitation is lowest in January with an average of 0 mm while in August, the most precipitation falls with an average of 217 mm. Mean annual temperature is 34°C and varies in mean monthly values between 28.4°C in the coolest month of December and 37°C in the hottest month of March.

Processing of test ingredient (pawpaw leaf meal)

Fresh pawpaw leaves were plucked from pawpaw tree within Jalingo metropolis and its environs in Taraba State, North Eastern

Nigeria, separated from the stalk chopped into pieces with kitchen knife and was air-dried for 3-5 days. Drying was to reduce the level of anti-nutritional factors contained in pawpaw leaves, while retaining most nutrients [11] [12]. The dried leaves were blended into meal form which was supplemented across dietary treatments. The leaf meal was packed into bags.

Experimental birds and management.

A total of 180 day old chicks of Cobb 500 strain were used in this study. The birds were managed on deep litter system throughout the period of the study. Brooding of the chicks was done at the first seven days of the experiment, during which they were fed commercial broiler starter diet. Subsequently, formulated dietary treatments and clean drinking water were offered *ad libitum*. All the necessary routine and occasional management practices such as vaccinations and other biosecurity measures were strictly adhered to throughout the study period.

Duration of study, and experimental design

The study lasted 56 days from the starter to finisher phases. The experimental design was Completely Randomized Design (CRD). After one week of brooding, the chicks were weighed and randomly divided into five dietary treatments (36 birds per treatment) with three replications per treatment (12 chicks per replicate or pen).

Treatment

Each of the dietary treatments had 0, 5, 10, 15 and 20 % inclusion levels of pawpaw leaf meal representing T_1, T_2, T_3, T_4, and T_5, respectively for both starter and finisher diets. Dietary treatment (T_1) served as the control (basal) group. The composition of experimental diets is shown in Tables 1 and 2 for the starter and finisher diets respectively.

Determination of proximate compositions

Proximate composition of the experimental diets (starter and finisher) and that of pawpaw leaf meal was carried out to determine the moisture content (MC) content, crude protein (CP), crude fibre (CF), ether extract (EE) and total ash content [13]. The Nitrogen free extract (NFE) was calculated using values obtained from the proximate composition and metabolisable energy (ME) calculated according to [14] equation as:

ME (Kcal/kg DM) =37 x % CP + 81.8 x % EE + 35.5 x % NFE

Data collection

In the course of the study, the following parameters were determined; growth performance indices.

Determination of body weight gain

After the brooding phase, the experimental birds were weighed to determine their initial weight and then weekly to determine their weight changes. Weekly weight gain was obtained at the end of every week of the study by taking the weight of the birds, and the difference between the initial weight and the current weight. [15], opined that birds should be weighed on the same day of each week at approximately the same time of the day. The

Table 1: Calculated Composition of experimental diets (Starter phase)

Ingredient	T_1 (0%)	T_2 (5%)	T_3 (10%)	T_4 (15%)	T_5 (20%)
Yellow maize	50.00	47.00	46.00	46.00	46.00
Maize bran	10.75	9.75	8.25	4.75	2.75
Soybean meal	30.50	30.00	27.00	25.00	22.00
Pawpaw leaf meal	0.00	5.00	10.00	15.00	20.00
Fish meal	5.00	5.00	5.00	5.00	5.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Limestone	0.75	0.75	0.75	0.75	0.75
Premix	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Total (%)	100.00	100.00	100.00	100.00	100.00
Calculated analysis:					
Crude protein	22.60	22.82	23.02	23.03	23.00
ME (Kcal/kg)	2,847.00	2,810.74	2,830.92	2,822.92	2,828.22

Premix: Vit. A=12,000,000IU, Vit . D3=2,500,000UI, Vit. C=30,000IU, Vit. K=2,000mg, Vit.B1=2,250mg, Vit.B2=6,000mg, Vit. B6=4,500mg, Vit. B12=15mcg, Niacin=40,000mg, Pantothenic Acid=15,000mg, Folic Acid=1,500mg, Biotin=50mcg, Choline Chloride=300,000mg, Manganese=80,000mg, Zinc=50,000mg, Iron=20,000mg, Copper=5,000mg, Iodine=1,000mg, Selenium=200mg, Cobalt=500mg, Antioxidant=125,000mg.

values obtained were used to determine the average daily weight gain at the end of each phase (Starter and Finisher respectively) of the experiment which lasted for 28days in each replicate using the equation below: -

$$\text{ADWG} = \frac{\text{Final Live Weight (g/bird)}}{\text{Number of birds x 28}}$$

Determination of feed intake

A known quantity of feed offered to each group of the experimental birds twice every day between 7 (19 hours) and 8 am (20 hours) in the morning and checked in the afternoon. The quantity of feed consumed by bird/day/replicate was determined as the difference between weights of the left over feed and the quantity offered. This was done throughout the period of the experiment for both starter and finisher phase. The values obtained were used to determine the feed intake which each lasted for 28days in each replicate using the equation:

$$\text{AFI} = \frac{\text{Quantity of feed offered - left over (g/bird)}}{\text{Number of birds x 28days.}}$$

Determination of feed conversion ratio (FCR)

The feed conversion ratio of the experimental birds was measured as an index of feed utilisation for each treatment group, i.e. feed intake per unit rate of weight gain. In other words, feed conversion ratio (FCR) was

Table 2: Calculated Composition of experimental diets (Finisher phase)

Ingredient	T_1 (0%)	T_2 (5%)	T_3 (10%)	T_4 (15%)	T_5 (20%)
Yellow maize	56.00	54.00	54.00	54.00	54.00
Maize bran	13.75	12. 25	10.00	7.50	5.00
Soybean meal	22.00	21.00	18.00	15.75	13.25
Pawpaw leaf meal	0.00	5.00	10.00	15.00	20.00
Fish meal	5.00	4.50	4.50	4.50	4.50
Bone meal	2.00	2.00	2.00	2.00	2.00
Limestone	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00
Calculated analysis					
Crude protein (%)	19.95	19.51	19.59	19.75	19.81
ME (Kcal/kg)	2,941.07	2,881.43	2,857.58	2,835.63	2,807.63

Premix: Vit. A=10,000,000IU, Vit. D3=2,000,000UI, Vit. C=20,000mg, Vit. K=2,000mg, Vit.B1=3,000mg, Vit.B2=5,000mg, Vit.B6=45,000mg, Vit.B12=10,000mg, Niacin=4,000mg Pantothenic Acid=20mg, Folic Acid=300,000mg, Biotin=1,000mg, Choline Chloride=50mg, Manganese=300,000mg, Zinc=120,000mg, Iron=80,000mg, Copper=3,500mg, Iodine=1,500 mg, Selenium=300mg, Cobalt=120mg, Antioxidant=120,000mg.

calculated as the ratio of feed intake to weight gain as follows:

$$FCR = \frac{\text{Average Feed Intake (g)}}{\text{Average weight gain (g)}}$$

Determination of mortality

Mortality was recorded as it occurs during the eight weeks of the study. In each phase of the experiment, the percentage mortality was obtained as:

$$\text{Percentage motality} = \frac{\text{Number of Dead Birds}}{\text{Total number of live birds}} \times 100$$

Statistical analysis

All the data obtained in this study was subjected to one –way Analysis of Variance (ANOVA) at 5% level using the statistical package for Social Sciences (SPSS) version 20 (2011) software. Significant means were separated using the Duncan's Multiple Range Test (DMRT) of the same statistical software.

Results

Proximate composition of the test ingredient, pawpaw leaf meal (PLM).

The result of the proximate composition of PLM is presented in Table 3. The result shows that PLM had moisture content (MC) of 8.10%, crude protein (CP) 23.33, crude fibre (CF) 9.55%, Ether extract (EE) 15.84%, Ash 13.33% and Nitrogen Free Extract (NFE) 29.55% respectively. However, the

Metabolizable energy (ME) was calculated as 2704.08 using Pauzenga equation

Table 3: Proximate composition of dried pawpaw leaf meal (PLM)

Parameter	% Composition
Moisture content (MC)	8.10
Crude protein (CP)	23.33
Crude fibre (CF)	9.55
Ether extract (EE)	15.84
Ash	13.33
Nitrogen Free Extract (NFE)	29.85
ME (Kcal/kg)	2704.08

Growth performance of broiler chickens fed pawpaw leaf meal based diets

Growth performance at starter phase

The growth performance of broiler chickens at the starter phase is presented in Table 4. The final weight, daily weight gain and feed conversion ratio (FCR) of the broiler starter chickens fed pawpaw leaf meal based – diets recorded significant ($P<0.05$) between dietary treatments. The average daily feed intake values ranged 63.03-64.11g/bird for T_1 and T_5 respectively while the average daily weight gain values for T_1. T_2, T_3, T_4 and T_5 were 33.46, 32.13, 31.19, 30.70 and 28.49 g/bird respectively. The initial weight values were 29.67, 30.49, 30.12, 30.13 and 29.53 g/bird for T_1. T_2, T_3, T_4 and T_5 respectively while the final weight values obtained at the end of starter phase were 966.33, 930.00, 903.33, 889.33 and 827.00 g/bird. The values for feed conversion ratio (FCR) for T_1, T_2, T_3, T_4 and T_5 were 1.92, 1.98, 2.02, 2.06 and 2.22 respectively.

Growth performance at the finisher phase

*T*he growth performance of broiler chickens at the finisher phase is presented in Table 5.

The average daily feed intake of the finisher recorded were 92.55g, 88.10g, 96.10g, 87.99g and 88.97g for T_1. T_2, T_3, T_4 and T_5 respectively while the average daily weight gain for T_1. T_2, T_3, T_4 and T_5 was 24.77g, 28.15g, 32.86g, 38.74g and 32.66g respectively. The initial weight recorded for the finisher phase were 904.50g, 905.34g, 906.67g, 903.33 and 905.00g for T_1. T_2, T_3, T_4 and T_5 respectively while the final was obtained after the finisher phase period were 1598.60g, 1693.44g, 1826.72g, 1988.00 and 1819.44g. Furthermore, the Feed Conversion Ratio (FCR) for T_1. T_2, T_3, T_4 and T_5 were 3.74, 3.13, 2.93, 2.41 and 2.72 respectively.

Table 4: Growth performance of broiler chickens fed pawpaw leaf meal based-diets (0-4 weeks)

Parameter	T_1 (0.0%)	T_2 (5%)	T_3 (10%)	T_4 (15%)	T5 (20%)	SEM
Initial weight (g/bird)	29.67	30.49	30.12	30.13	29.53	0.14
Final weight (g/bird)	966.33^{a}	930.00^{ab}	903.33^{ab}	889.33^{bc}	827.00^{c}	14.81
Daily weight gain (g/bird)	33.46^{a}	32.13^{ab}	31.19^{ab}	30.70^{bc}	28.69^{c}	0.51
Daily feed intake (g/bird)	64.11	63.56	63.16	63.09	63.03	0.16
Feed conversion ratio (FCR)	1.92^{a}	1.98^{a}	2.02^{a}	2.06^{a}	2.22^{b}	1.88

$^{a, b, c, d}$ Means within the same row bearing different superscripts differ significantly ($P < 0.05$)
SEM = Standard Error of Mean

Table 5: Growth performance of broiler chickens fed pawpaw leaf meal based-diets (5-8 weeks)

Parameter	T_1 (0.0%)	T_2 (5%)	T_3 (10%)	T_4 (15%)	T_5 (20%)	SEM
Initial weight (g/bird)	904.50	905.34	906.67	903.33	905.00	3.46
Final weight (g/bird)	1598.06^{c}	1693.44^{c}	1826.72^{b}	1988.00^{a}	1819.44^{b}	38.31
Daily weight gain (g/bird)	24.77^{c}	28.15^{bc}	32.86^{b}	38.74^{a}	32.66^{b}	1.38
Daily feed intake (g/bird)	92.55	88.10	96.10	87.99	88.97	1.41
Feed conversion ratio (FCR)	3.74^{a}	3.13^{a}	2.93^{ab}	2.41^{c}	2.72^{bc}	0.16
Mortality (%)	10.00	0.00	10.00	0.00	3.33	

$^{a, b, c,}$ Means within the same row bearing different superscripts differ significantly ($P < 0.05$)
SEM = Standard Error of Mean

Discussion

Proximate composition of pawpaw leaf meal

The result of the proximate composition of Pawpaw leaf meal (PLM) is presented in table 3, the crude protein (CP) was 23.33%, moisture content 8.10%, EE 15.84%, crude fibre 9.55%, Ash 13.33% and NFE 29.85% with metabolizable energy of 2704.08 Kcal. The CP obtained is within the range of those reported by [16] [17], who recorded crude protein of 23.30, 23.90, 25.30 and 25.50% respectively. However, the result of CP obtained from the study of [18] [19] showed higher CP of 30.12% and 32.6% respectively compared to the result obtained from this present study. This result revealed that PLM possess relatively high crude protein that can classify it as concentrate feed ingredient. The ash content of 13.33% of the PLM compared favourably with those reported by [19] with ash content of 11.0, 11.3 and 11.3% respectively while it showed higher value compared with those reported by [18] [16] of 8.45, 8.88, 7.61 and 3.0%respectively. The Crude fibre recorded from the proximate analysis showed 9.55% which is related to those reported by [16] [19] of 11.0, 8.86 and 7.30% respectively while [18] reported CF values of 5.60 and 1.95% respectively. Ether

extract of 15.84% recorded from this study showed higher value compared with those of [16] [18] [19] who reported 7.5, 3.5, 1.20, 0.81 and 0.80% respectively. The Nitrogen free extract (NFE) obtained for this study was 29.85% and it showed lower value compared with 63.10, 58.40, 58.40, 44.43, 43.82 and 43.7% reported by [18] [16]. However, the metabolizable energy (ME) of 2704.08 Kcal recorded from this research revealed that PLM meal possess high ME compared to 3062.95 Kcal/kg reported by [16] and 1900 Kcal reported by [19].

Growth performance characteristics of Broiler chickens fed varying levels of PLM

The growth performance of broiler starter fed diet with varying levels of *C. papaya* leaf meal showed no significant ($P<0.05$) differences were observed among different treatments on the initial weight of the broiler chickens, and feed intake of the broiler chicken subjected to different inclusion levels of *C. papaya* leaf meal. The feed intake was similar across treatments. However, the final weight gain, and average daily weight gain were showing progressive decrease with increase in PLM inclusion. This study agrees with the findings of [21] who reported gradual increase in growth performance and later decreases as the inclusion levels increases; this is because at the started phase the digestive system is not fully developed. Similar trend characterised the average total body weight again of T_1 (966.33g), T_2 (930.00g), T_3 (903.33g), T_4 (889.33g) and T_5 (827.00g). This trend is in agrees with the findings of [22] [23] who found gradual decrease in average weight gains as the level of inclusion of PLM increased from 1% through 1.5% and 2%. This is in tandem with the work of [18] who found progressive increase in weight gain as the PLM was increase between 0.5% and 2%. The FCR for T4 had better conversion (2.06), followed by T5 (2.22, then T3 (2.02), T2 (1.98) and the control diet (1.92). This trend could be ascribed to the high nutritional value in terms of protein and minerals/vitamins supplied by PLM. It could also be attributed to the papain in the PLM which aid protein digestion thus enhancing the release of free amino acids necessary to enhance growth [18]. This is in agreement with the earlier work of [24] that papain is an effective natural digestive aid which breaks down protein and cleanses the digestive tract. These findings also corroborate the work of [17] who found increase weight gain associated with supplementation of PLM progressed in percentage in the diet of broiler chicks. The daily feed intake also increased as the PLM T1 (64.11g), T2 (63.56g), T3 (63.16g), T4 (63.69g), and T5. TheT1 differ significant ($P<0.05$).

Growth performance of starter broiler chickens as presented in table 6 showed that the parameters measured except initial weight and average daily feed intake were significantly ($P<0.05$) different across the experimental treatment. This result agrees with the study of [18] who fed broiler chickens with supplemented levels of SPLM on growth performance of broilers the results showed no significant difference with regards to average daily weight gain but the performance increased as the inclusion levels increased.

The finisher phase as presented in table 7 revealed that all growth parameters recorded

were significantly (P<0.05) different except the average feed intake. This is indicative that PLM serves as growth promoter by enhancing feed conversion ratio. This confirms with the work of [5] [7] [8] [9] who reported the use of PLM as growth promoter on broiler chickens, the highest value was recorded in T_4 with 38.74g for average daily weight gain. The final weight was significantly (P<0.05) different, T_4 had the highest value (1988.00g) this is consonant with [20] who reported similar value for finishing broiler chicken fed different levels of PLM. The daily feed intake decrease from T3 (96.10g), T4(87.99g) and T5 (88. 77g) this shows declined as the level of inclusion increases the intake decreases this due to increase in fibre content of the feed since broiler chicken feed to satisfy their energy.

Conclusion and Application

Base on the result from this study, it is without doubt that PLM can be used as a natural or herbal source of growth promoter devoid of side effect on both the broiler and the consumer when maximum of 15% is included in the broiler chicken fed.

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