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Effect of bitter leaf (*Vernonia amygdalina*) and Pawpaw (*Carica papaya*) Leaf Extract Mixtures on Growth Performance and Nutrient Digestibility of Broiler Chicken.

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Target Audience: Animal Scientists; Consumers of Chicken; Food Scientists; Poultry Farmers

Abstract

There is growing concern about the development of antimicrobial resistance in poultry and humans due to the use of in-feed antibiotics as growth promoters. A study was conducted to evaluate the effect of bitter leaf and pawpaw leaf extract mixtures as natural alternatives to in-feed antibiotics on the performance and nutrient digestibility of broiler chickens. Sixty (60) day-old broiler chickens (Cobb strain) were randomly allotted to four treatment groups of 15 birds per treatment in three replicates. Each replicate had 5 birds. The experiment lasted for 8 weeks. The experimental design is a Completely Randomized Design. Leaf extract mixtures were obtained from bitter and pawpaw leaves, and added into the bird's drinking water at: 0 mL (T1), 25 mL (T2), 50 mL (T3) and 75 mL (T4) inclusion levels per 3 litre drinker, respectively. All the data collected were subjected to analyses of variance using general linear model of SAS. The results showed that average daily feed intake and total feed intake of broiler chicken were significantly ($P<0.05$) different but the average daily weight gain, feed conversion ratio and percentage mortality were not different ($P>0.05$). Birds on 75 mL inclusion of leaf extract mixtures had the highest final weight gain and remarkable feed conversion ratio. The apparent digestibility of nutrients was significant ($P<0.05$) across the treatment groups. In conclusion, bitter leaf and pawpaw leaf extract mixtures in drinking water of broiler chickens can be a good source of natural growth promoters as it enhances digestibility of nutrients and growth performance.

Keywords: Chicken; Feed intake; Leaf extracts; Nutrient digestibility; Weight gain

Description of problem

Drug toxicity in broilers, especially due to the use of antibiotics is an issue of economic concern to the poultry industry and has negative consequences on animal and human health. Throughout the world, antibiotics are used in the poultry industry for preventive and therapeutic purposes (1). The massive use of antibiotics in poultry farming is due to their growth promotion effects and the high prevalence of self-medication (1). The use of natural alternatives has been recommended and some of those successfully used in other continents as well as African countries, include natural pro and prebiotics, and phytochemicals. Plant extracts have minor

metabolites such as terpenoids, phenolics, glycosides, and alkaloids, present as alcohols, aldehydes, ketones, esters, ethers, and lactones (2). These metabolites are important mechanisms which increase the growth performance and health of poultry (3).

Papaya (*Carica papaya*) leaves have emerged as one of the most useful parts of the papaya plant with a plethora of health-promoting compounds and activities. Some of the phytochemical compounds in pawpaw leaf are the alkaloids, flavonoids, saponin, phenols and tannin, and the active compounds are the papain, chymopapin and glycosides. In poultry, papaya seed and leaf have been used generally for medicinal action, as well as phytogenic additive in the diet of poultry instead of synthetic chemicals and reducing the unnecessary cost of medicine (4,5). Moreover, the antioxidant properties of papaya seed and leaf have been documented as they partly contribute to enhanced growth performance and improved immunity in poultry (6,7). In another study, enzymes in papaya seed and leaf were also responsible for the improved performance, digestibility and antioxidant status of the animal (8).

Findings by (9) revealed that the young leaves of *V. amydalina* contain higher cyanide (60.1mg/100g DM) and tannin content (40.6mg/100g DM) than older ones. Research has shown that *V. amygdalina* has some beneficial effects on disease management of poultry (10), such as anti-coccidiosis, anti-bacterial and anti-parasitic (11,12) as an anti-oxidant (13) and as a growth promoter by enhancing the gastrointestinal enzymes thus increasing feed conversion efficiency (14, 15). While individual studies have explored the effects of pawpaw leaf and bitter leaf extract separately on broilers, the potential of a combined pawpaw and bitter leaf extract mixture remains largely uninvestigated. The aim and broad objectives of this study are to investigate the effect of papaya leaf extract and bitter leaf extract mixtures as natural growthpromoterson the growth performance and nutrient digestibility of broiler chickens.

Materials and methods

Experimental site

The study was conducted at the Poultry Unit of the Teaching and Research Farm of the Faculty of Agriculture, Federal University of Kashere, Gombe State, whose coordinates lie on latitude (10° 30′ N) and longitude (10°52′ E), on the northern fringes of the Sudan Savanna belt of Nigeria. It is located at an elevation of 523 m above sea level. The area has a tropical climate, with distinct wet and dry seasons. It records about five months of rainfall concentrated in the months of July, August and September with an average annual rainfall of 951 mm per annum (16). The mean annual temperature ranged from 30 to 37°C, while March, April and May were observed to be the dry hot months of the year (16).

Source of Experimental Birds and Management

Sixty (60) day-old broiler chicks (COBB strain) were obtained from a reputable poultry farm. The brooding of chicks lasted for two weeks on a deep litter housing system. Chicks were fed *ad libitum* on a broiler starter diet (23% CP) for the first four weeks and later fed a broiler finisher diet (20% CP) in the last four weeks of the rearing phase. The mixtures of pawpaw and bitter

leaf extract was added into the birds' drinking water at 0 mL, 25 mL, 50 mL and 75 mL for the four treatment groups respectively, and offered *ad libitum.*

Sources and Processing of Experimental Materials

The bitter leaves and pawpaw leaves used for the experiment were collected from the K a s h e r e C o m m u n i t y, A k k o L o c a l Government Area of Gombe State. Fresh, young papaya leaves of less than 30 days old and bitter leaf were size-reduced and triturated with a minimum quantity of water in a mortar. To obtain the extract, 100g of fresh leaves were triturated with 500ml of water, stirred thoroughly, covered and allowed to stay overnight. |After steeping the mixture was filtered through cheesecloth into another container, discarding the solid. The filtered liquid was poured into a shallow container and water was evaporated through air drying until desired consistency was reached. The extract was then stored in an air tight container in a cool dark place to preserve the bioactive compounds and ensure a longer shelf life (17).

Experimental Design and Diets.

Sixty (60) day-old broiler chicks were randomly allotted to four treatments with three replicates of 5 birds each in a Completely Randomized Design. The treatments were coded as T1, T2, T3 and T4 for 0 mL, 25 mL, 50 mL, and 75 mL levels of inclusion, respectively. The ingredients composition of the diet is shown in Table 1 below.

Evaluation of Growth Performance and Nutrient Digestibility Parameters

The initial weight of the birds was recorded at the beginning of the experiment and weekly weight was taken subsequently to determine weight changes. Weight gain was computed as the difference between two consecutive weeks as;

Weight Gain = (Final Weight – Initial Weight).

A weighed quantity of feed was given every morning, and the leftover was weighed to account for daily feed intake by determining the difference between the weight of the leftover and the quantity of feed supplied;

Feed Intake = (Quantity of feed offered – Leftover).

This was also done throughout the experimental period. The feed conversion ratio was measured as an index of feed utilization and calculated by dividing the quality of feed intake by the weight gain.

A digestibility trial was carried out in the last week (week 8) of the experiment. One bird from each replicate was taken to a clean, separate and disinfected metabolic cage with a polythene bag attached beneath the cage to collect the excreta. The digestibility trial lasted for 5 days. A weighed quantity of feed was given to the birds in each pen daily during the digestibility trial. The total faecal output for each treatment was bulked and dried. Dried faecal and feed samples were taken to the Laboratory for determination of proximate composition using the methods described by (18)

The % digestibility of nutrients was calculated using the equation below:

% Digestibility of Nutrient = (Nutrient output - nutrient intake) x 100

Nutrient intake (g) = feed intake × nutrient in diet

Nutrient output (g) = faecal output × nutrient in faeces

Table 1: Ingredient Composition of Broiler Starter and Broiler Finisher Diets

Ingredients (kg)	Broiler Starter	Broiler Finisher
Maize	60.8	63.2
SBM	7.6	31
GNC	23	0
Fish meal	5.5	0
Maize offal	0	2.5
Bone Meal	2.5	2.5
Salt	0.1	0.1
Methionine	0.1	0.2
Lysine	0.1	0.1
Vitamin Premix	0.2	0.2
Limestone	0.1	0.2
Total	**100**	**100**
Calculated Analysis		
Metabolizable energy (ME/kcal)	2923.68	2901.52
Crude Protein (%)	22.53	19.68
Crude fiber (%)	3.53	3.81
Ether extract (%)	4.46	4.04
Lysine (%)	1.02	1.09
Methionine (%)	0.44	0.47
Cysteine (%)	0.26	0.28
Calcium (%)	1.21	1.08
Phosphorus (%)	0.66	0.54

Statistical analysis

All data were subjected to Analysis of Variance (ANOVA) using the General Linear Model of the Statistical Analysis System (SAS, 2008, Version 9.1). Differences between treatment means were separated using the least significant differences (LSD) SAS package.

Results and Discussion

Effect of pawpaw and bitter leaf extract mixture on growth performance of broiler chicken

Table 2 shows the effect of bitter leaf and pawpaw leaf extract mixtures on the growth performance of broiler chickens. The daily and total feed intakes of broiler chicken were significantly different ($P<0.05$) across all

treatment groups. The highest value obtained for total feed intake (6254.70g) was from birds on 50 mL of the extracts while the lowest value (5950g) was recorded in birds on 25ml of the extracts. The total feed intake and average daily feed intake for birds on 50 mL (6254g, 127.6g) and 75 mL (6156g, 125.6g) were comparable to birds in the control group. However, final weight, total weight gain, average daily weight gain and feed conversion ratio were not significantly different (P>0.05) across all treatment groups. The variations in feed intake could be attributed to the bitter taste of pawpaw as noted by (19). Higher saponin concentration at this higher level of inclusion (75 mL) could impart greater bitterness to the drinking water and therefore, reduce its intake by the birds. According to (20), the feed intake of broiler chickens at the starter level was reduced with the inclusion of fresh dried pawpaw leaf meal in the diet.

Table 2: Effect of pawpaw and bitter leaf extract mixtures on growth performance of Broiler chickens

Parameters	Extract inclusion level/3 litre of water				LSD	LOS
	0 mL	25 mL	50 mL	75 mL		
IW (g/bird)	66.60	65.20	65.20	66.60	1.72	NS
FW (g/bird)	2846.70	2906.70	2933.00	3166.70	0.26	NS
TWG (g/bird)	2780.10	2841.50	2868.10	3100.10	0.26	NS
ADWG (g/bird)	0056.79	0057.99	0058.53	0063.27	0.02	NS
TFI (g/bird)	6210.00^{ab}	5950.70^{b}	6254.70^{a}	6156.00^{ab}	0.19	*
ADFI (g/bird)	128.31^{a}	121.44^{b}	127.65^{ab}	125.63^{ab}	0.02	*
FCR	2.26	2.10	2.20	1.99	0.19	NS
Mortality (%)	6.67	6.67	0.00	6.67	11.55	NS

^{a,b} = Means with different superscripts along the same row differ significantly (p<0.05).
IW = Initial weight; FW = Final weight; TWG = Total Weight Gain; ADWG = Average Daily Weight Gain ; TFI = Total Feed Intake; ADFI = Average Daily Feed Intake; FCR = Feed Conversion Ratio; LSD = Least significant differences; LOS = level of significant.

Effect of pawpaw and bitter leaf extract mixture on nutrient digestibility of broiler chickens

The effect of pawpaw and bitter leaf extract mixtures on the nutrients digestibility of broiler chickens is presented in Table 3. Nutrient digestibility in broiler chickens offered pawpaw and bitter leaf extract mixtures was significant (P<0.05). Birds with papaya and bitter leaf extract mixture at 50 mL level of inclusion had the highest percentage digestibility of crude protein (91.63 %), dry matter (90.79 %) and carbohydrate (95.21%). The lowest values for crude protein, dry matter and carbohydrate digestibility were obtained from birds on 25ml of pawpaw and bitter leaf extract mixture which were 87.01%, 86.20% and 91.68% respectively. Birds administered 75ml of pawpaw and bitter leaf extract in their drinking water recorded the highest percentdigestibilityforash and carbohydrate. Birds in the control group (0 mL level of inclusion) recorded higher percentage digestibility of ether extract and crude fiber when compared to other treatment groups. The apparent nutrient digestibility of broilers on pawpaw and bitter leaf extract mixtures demonstrated enhanced crude protein, dry matter, ash and

carbohydrate digestibility. This agreed with the results of (21) who reported improved nutrient digestibility in chicks fed *Moringa oleifera* leaf. The lower digestibility of crude fiber (43.94 %) and ether extract (36.37 %) in birds on 25 mL and 75 mL pawpaw and bitter leaf extract mixtures respectively align with (22) who reported the presence of bitter triterpenoids in feed fed to broiler chickens, this may be due to high concentration of the bitter and pawpaw leaf extract in the water.

Table 3: Effect of pawpaw and bitter leaf extract mixture on apparent nutrient digestibility of broiler chickens

Parameter	Leaf extract inclusion level/3 Litre of water				LSD	LOS
	0 mL	25 mL	50 mL	75 mL		
Dry matter	89.66^{b}	86.21^{c}	90.80^{a}	89.66^{b}	0.16	*
Crude protein	91.35^{b}	87.02^{d}	91.63^{a}	88.83^{c}	0.14	*
Crude fibre	72.12^{a}	43.94^{d}	61.27^{c}	64.21^{b}	0.60	*
Ether extract	61.18^{a}	44.83^{b}	38.11^{c}	36.37^{d}	0.97	*
Ash	78.97^{d}	85.85^{b}	84.96^{c}	86.80^{a}	0.25	*
CHO	92.85^{b}	91.69^{c}	95.22^{a}	95.16^{a}	0.09	*

^{a,b,c,d} = Means with different superscripts along the same row differ significantly ($p<0.05$).
CHO = Carbohydrate; LSD = Least Significant Differences; LOS= Level of Significant

Conclusion and application

1. The inclusion of bitter and pawpaw leaf extract mixtures in drinking water enhanced the feed intake, weight gain, and FCR of broiler chickens.
2. Bitter and pawpaw leaf extract mixtures significantly affected the crude protein, ether extract, dry matter, ash and carbohydrate digestibility.
3. The inclusion of 75 mL bitter and pawpaw leaf extract mixtures in drinking water improved the weight gain and feed conversion ratio of broiler chickens.

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