Growth performance, carcass characteristics and lipid profile of broiler chickens fed with graded levels of roselle calyx (*Hibiscus sabdariffa* L.)

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Abstract

The study evaluated the effect of graded levels of roselle calyx (*Hibiscus sabdariffa* L.) on growth performance, carcass characteristics and lipid profile of broiler chickens. A total of 150 Arbor acre broiler birds were used for the six (6) weeks study and were randomly assigned to five treatments of thirty birds each, (T_1 , T_2 , T_3 , T_4 and T_5) which had broiler chicks fed with feed incorporated with roselle calyx as feed additive at 0%, 0.5%, 1%, 1.5%, and 2% respectively. The birds were further randomly sub-divided into three replicates of ten birds each using a completely randomized design. Data were collected on feed intake, weight gain and feed conversion ratio was computed. At the end of the study, two birds were randomly selected from each replicate for the carcass characteristics and lipid profile evaluation. Data obtained were subjected to ANOVA and means were separated using the Duncan Multiple Range Test. The result obtained showed that the initial weight, average daily feed intake, total feed intake and carcass characteristics were not significantly different across the treatment means while the final weight, total weight gain and total feed intake value were significantly differed with the highest value of final weight at T_1 (1266.67g/b) and lowest value at T_4 (1133.33g/b). Also, result for lipid profile of the broiler chicken meat showed there was significant difference ($P < 0.05$) in the values obtained for low density lipoprotein, such that birds in control (that were not fed roselle calyx) had the highest value (15.67g/L) low density lipoprotein. It was therefore concluded that the inclusion level of roselle calyx up to 2% in broiler chicken diet improved carcass characteristics and lipid profile.

Keywords: Roselle calyx, growth performance, carcass characteristics, lipid profile, broiler chickens

Introduction

Poultry is used to describe any type of domesticated bird kept for meat and egg production such as domestic fowl and turkey (Akinsanmi, 1994). Broilers are good converters of feed, with average feed consumption of 5-6kg in eight weeks in which 2kg feed will produce 1kg of body weight at ratio 2:1 (Babatunde and Fetuga, 1976). The production of high quality animal protein has been one of the major problem facing developing countries in which Nigeria is inclusive. This has led to serious malnutrition in people (Solanke, 1989).

Roselle (*Hibiscus sabdariffa* L.) belongs to

the family Malvaceae, it is an important annual crop grown successfully in tropical and sub-tropical climates (Copley, 2000). Roselle is a multi-purpose plant, whose outer leaves (calyx), also known as natal sorrel is frequently used in the production of jelly, jam, juice, wine, syrup, gelatin, pudding, cake, ice cream and flavoring. Its brilliant red color and unique flavor make it a valuable food product (Tsai and Ou, 1996). Roselle is an annual crop used in food, animal feed, nutraceuticals, cosmeceuticals and pharmaceuticals. The juice from the calyces is claimed to be a health-enhancing drink due to its high content of vitamin C, anthocyanins and

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other antioxidants (Mohamad *et al.*, 2002). Duke and Atchley (1984) reported that every 100 g of fresh calyx contains 2.85 µg vitamin D, 0.04 mg vitamin B1, 0.06 mg vitamin B2 and 0.5 mg Vitamin B complex. More so, the calyx contains 84.5% water, 1.9% protein, 0.1% fat, 12.3% fibre, 0.12% ash in addition to high amounts of citric acid and anthocyanin. Numerous scientific studies have been done on the benefit of antioxidants in *Hibiscus sabdariffa*. The high level of anthocyanins and protocatechuic acid in *Hibiscus sabdariffa* were shown to have strong antioxidant effects (Lee *et al.*, 2002; Blunden *et al.*, 2005). Previous studies demonstrated an additional cardio protective effect of *H. Sabdariffa* via antioxidants mechanisms (Tangirala *et al.*, 1995; Crawford *et al.*, 1998; Rimm and Stamfer, 2000). *Hibiscus sabdariffa* extract also was reported to have inhibited Low-density lipoprotein (LDL) oxidation in vitro and decreased serum cholesterol levels in cholesterol-fed animals (Chen *et al.*, 2003). Therefore, dietary roselle extract may reduce the incidence of atherosclerosis through their antioxidant activity (Lin *et al.*, 2007). The plant is of increasing interest because of its application in health and medicine; therefore it is important to investigate the effect of roselle calyx on growth performance, carcass characteristics and lipid profile of broiler birds.

Materials and methods

Experimental site

The experiment was conducted at Student Research Unit of Federal College of Animal Health and Production Technology Bora, Moor plantation, Ibadan.

Experimental birds and management

A total of 150, 1-day old Arbor acre broiler birds were obtained from Federal College of Animal Health and Production

Technology Hatchery Moor plantation. The chicks were brooded for seven days on a deep litter system and were randomly assigned to five treatments (30 birds per treatment), three replicate of 10 birds each. Necessary vaccination programmes were carried out at appropriate times. Anti-stress was also administered to the birds on arrival and after each weighing.

Experimental diet

The birds were fed with commercial feed with roselle calyx included at graded levels. The birds were fed starter diet (22.00% Crude protein, 2900 kcal/kg Metabolizable energy) from 1-21 days and finisher diet (18.00% Crude protein and 2900kcal/kg Metabolizable energy) from 22 to 42 days. Table 1 and 2 show the nutrient composition of the experimental diets (starter and finisher phase). Dried Roselle calyx was purchased at Bodija market also in Ibadan. The calyces were milled and stored in dried polythene bag until needed.

Experimental treatment:

Treatment 1: broiler chickens fed without inclusion of roselle calyx in their feed (control); Treatment 2: broiler chickens fed feed containing 0.5% inclusion of roselle calyx in their feed; Treatment 3: broiler chickens fed feed containing 1% inclusion of roselle calyx in their feed; Treatment 4: broiler chickens fed feed containing 1.5% inclusion of roselle calyx in their feed and Treatment 5: broiler chickens fed feed containing 2% inclusion of roselle calyx in their feed

Data collection

Data was collected on feed intake, weight gain and feed conversion ratio for the performance characteristics.

Carcass characteristics

Six birds were randomly selected from each treatment, two birds per replicate for slaughter. The slaughtered birds were plucked and eviscerated manually. Dressed

carcass and internal organ such as thigh, drumstick, breast, heart, gizzard, liver and lungs weight were recorded as the percentage of the live weight.

Lipid profile of meat

50g of the breast meat from each replicate were taken to the laboratory for analysis of the lipid profile of the meat.

Lipid profile of blood serum

Two birds were selected at random from each replicate. The birds were bled using a

sterilized disposable needle to aspirate 5mL of blood sample from each bird for laboratory analysis of the lipid profile of the blood using the spectrophotometric method to examine the parameters which include: cholesterol, triglyceride, high density lipoprotein, low density lipoprotein

Data collected were subjected to analysis of variance using SAS (2011) package and means were further separated using Duncan Multiple Range Test of the same software.

Table 1: Nutrient composition of experimental diet for starter broiler chicken

INGREDIENTS	T ₁ (0%) RC	T ₂ (0.5%) RC	T ₃ (1%) RC	T ₄ (1.5%) RC	T ₅ (2%) RC
Crude protein (%)	22.00	22.00	22.00	22.00	22.00
Fats and oil (%)	6.00	6.00	6.00	6.00	6.00
Crude fibre (%)	5.00	5.00	5.00	5.00	5.00
Calcium (%)	1.00	1.00	1.00	1.00	1.00
Phosphorus (%)	0.40	0.40	0.40	0.40	0.40
Lysine (%)	1.20	1.20	1.20	1.20	1.20
Methionine (%)	0.50	0.50	0.50	0.50	0.50
Salt (%)	0.30	0.30	0.30	0.30	0.30
Metabolizable	2900	2900	2900	2900	2900
Energy (Kcal/kg)					

RC: Roselle calyx, T: Treatment

Table 2: Nutrient composition of experimental diet for finisher broiler chicken

INGREDIENTS	T ₁ (0%) RC	T ₂ (0.5%) RC	T ₃ (1%) RC	T ₄ (1.5%) RC	T ₅ (2%) RC
Crude protein (%)	18.00	18.00	18.00	18.00	18.00
Fats and oil (%)	6.00	6.00	6.00	6.00	6.00
Crude fibre (%)	5.00	5.00	5.00	5.00	5.00
Calcium (%)	1.00	1.00	1.00	1.00	1.00
Phosphorus (%)	0.40	0.40	0.40	0.40	0.40
Lysine (%)	0.85	0.85	0.85	0.85	0.85
Methionine (%)	0.34	0.34	0.34	0.34	0.34
Salt (%)	0.30	0.30	0.30	0.30	0.30
Metabolizable	2900	2900	2900	2900	2900
Energy (Kcal/kg)					

RC: Roselle calyx, T: Treatment

Results

The effects of Roselle calyx on growth performance of broiler chickens is shown in Table 3, the parameters observed; initial weight, average daily feed intake and total feed intake were not significantly different across the treatments while the final weight,

total weight gain and total feed intake value were significantly different. Total weight of birds in T₁ was similar to those of birds in T₂ and T₃ but different from total weight of birds on T₄ and T₅, though T₂, T₃, T₄ and T₅ were not significantly different from each other.

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Table 3: Effect of roselle calyx on growth performance of broiler chickens

Parameters	T ₁ (0%Rc)	T ₂ (0.5%Rc)	T ₃ (1%Rc)	T ₄ (1.5%Rc)	T ₅ (2%Rc)	SEM
Initial weight(g/b)	172.67	182.00	165.67	168.00	166.33	3.43
Final weight gain (g/b)	1266.67	1233.34	1200.00	1133.33	1200.00	20.63
Total weight gain (g/b)	1260.67 ^a	1151.33 ^{ab}	1201.00 ^{ab}	1098.67 ^b	1133.67 ^b	20.70
Average daily weight gain (g/b/d)	29.91 ^a	25.32 ^b	28.26 ^{ab}	27.61 ^{ab}	27.42 ^{ab}	0.56
Total feed intake (g/d)	555.67	510.67	519.67	514.67	517.00	8.38
Average daily feed intake (g/b/d)	92.61	85.11	86.61	85.77	86.16	1.40
Feed conversion ratio	2.83 ^b	3.69 ^a	3.06 ^{ab}	3.12 ^{ab}	3.15 ^{ab}	0.11

^{a,ab,b} means of different superscripts along the same row are significantly different (p< 0.05)

Rc = Roselle calyx

g/b = gram per bird

g/b/d = gram per bird per/day

Table 4: Effect of roselle calyx on the carcass characteristics and internal organs of broiler chickens

Parameters	T ₁ (0%Rc)	T ₂ (0.5%Rc)	T ₃ (1%Rc)	T ₄ (1.5%Rc)	T ₅ (2%Rc)	SEM
Live Weight (g)	1365.67	1594.00	1297.33	1283.00	1210.67	50.46
Bled Weight (g)	97.70	98.27	97.80	97.98	97.99	0.13
Plucked Weight (g)	92.71	93.96	92.26	92.68	92.42	0.40
Eviscerated Weight (g)	84.38	77.71	77.73	78.46	77.26	1.00
Dressed Weight (g)	64.56	66.67	65.74	65.21	63.76	0.59
Thigh (%)	10.78	11.64	10.67	10.98	10.75	0.20
Drumstick (%)	11.37	11.09	11.57	11.42	11.06	0.14
Breast (%)	20.79	21.70	21.18	21.79	20.94	0.39
Heart (%)	0.54	0.53	0.49	0.47	0.44	0.03
Gizzard (%)	3.34	3.52	3.80	3.75	3.76	0.13
Empty gizzard (%)	2.39	2.52	2.63	2.61	2.59	0.07
Liver (%)	2.21	2.14	1.98	2.10	2.04	0.07
Lungs (%)	0.61	0.71	0.64	0.47	0.50	0.04

SEM: Standard Error Mean

T: Treatment

Rc: Roselle calyx

Table 5 shows the effects of graded levels of roselle calyx on the lipid profile of broiler chicken meat. The result showed that there was no significant effect of roselle calyx on the cholesterol, triglyceride and high

density lipoprotein of the broiler chicken. However there was significant effect of roselle calyx on low density lipoprotein, such that chicken that were not fed roselle calyx had the highest value for low density lipoprotein.

Table 5: Effect of graded levels of roselle calyx on the lipid profile of broiler chicken meat

Parameters	T ₁ (0%Rc)	T ₂ (0.5%Rc)	T ₃ (1%Rc)	T ₄ (1.5%Rc)	T ₅ (2%Rc)	SEM
Cholesterol (g/L)	76.87	77.63	84.37	87.77	80.00	3.11
Triglyceride (g/L)	244.70	218.63	239.70	156.35	233.53	12.01
High Density Lipoprotein (g/L)	22.23	23.40	26.17	25.97	26.77	2.41
Low Density Lipoprotein (g/L)	15.67 ^a	13.27 ^{ab}	15.50 ^{ab}	6.70 ^b	10.24 ^{ab}	3.08

^{a,b,c}: Means with different superscript along the same row are significantly different (p<0.05).

SEM: Standard Error Mean

T: Treatment

(g/L): Gram per Litre

Rc: roselle calyx

Table 6 shows the lipid profile of blood serum from birds fed graded levels of the Roselle calyx. The results indicated that

there were no significant difference ($P>0.05$) in the values across the treatment means.

Table 6: Effect of graded levels of rosellecalyx on the lipid profile of blood serum from broiler chickens

Parameters	T ₁ (0%Rc)	T ₂ (0.5%Rc)	T ₃ (1%Rc)	T ₄ (1.5%Rc)	T ₅ (2%Rc)	SEM
Cholesterol(g/L)	148.43	141.57	108.76	115.66	134.63	9.20
Triglyceride(g/L)	302.33	299.21	339.52	246.50	334.87	16.21
High Density Lipoprotein (g/L)	70.44	71.07	71.07	62.63	67.18	1.58
Low Density Lipoprotein(g/L)	26.12	27.07	24.80	24.37	22.58	1.33
SEM: Standard Error Mean	T: Treatment		(g/L): Gram per Litre		Rc: roselle calyx	

Discussion

The growth performance as shown in Table 4 revealed significant ($P>0.05$) difference on average daily weight gain of the chickens. Chickens that were not fed Roselle calyx T₁ (Control) had the highest daily weight gain and average daily weight gain. However, there was no significant effect of Roselle calyx on initial weight, final weight gain, total daily feed intake and average daily feed intake of the chicken. This observation was similar to the report of Unigwe (2011) who reported highest average daily weight gain of chicken when graded level of *Hibiscus sabdariffa* L. extract were administered to broiler chicken.

Feed conversion ratio is a measure of feed utilization or the efficiency of converting unit feed into unit gain. Feed conversion ratio showed that T₁ has the least value than any other treatment. Table 5 indicated that there was no significant ($P>0.05$) difference in the values obtained for all the carcass characteristics parameters examined across the treatments. The observed similarities in carcass characteristics were as a result of nutrient balance in the experimental feeds which were within recommended range for broilers NRC (1994) and the nutrient constituents (Shaheen *et al.*, 2012). Organ weights in the different dietary treatment group were similar to those earlier reported by Zhou *et al.* (2009). Though the results

indicated that there was no significant difference in the values obtained for all the lipid profile of blood serum examined across the treatments, there were numerical differences in the values such that the treatments fed with graded level of Roselle had low cholesterol value when compared to the control (T₁). The blood serum values for all the dietary treatment groups confirm the nutritional adequacy of the experimental diets.

Though, there was no significant difference in the lipid profile parameters of the meat measured (cholesterol, triglyceride and high density lipoprotein) except for low density protein (LDL). There were significant differences in the values of low density lipoprotein such that control (T₁) had a higher significant value (15.67 g/L) of low density lipoprotein than the other treatments (T₂; 13.27 g/L, T₃; 15.50 g/L, T₄; 6.70 g/L, T₅; 10.24 g/L) fed with inclusion of roselle calyx. The values obtained were comparable to those reported by Kwari *et al.* (2011) who fed fermented roselle to broiler chickens.

Conclusion

It was concluded from this study that inclusion level of Roselle calyx up to 2% compared favorably than the control. Based on the result obtained for the lipid profile of the meat, it was observed that the inclusion of roselle calyx at the graded levels

increased the High Density Lipoprotein (HDL) and reduced the Low Density Lipoprotein (LDL) except for the control. This showed that the inclusion of roselle calyx in the diet has the potential to reduce the risk of hyperlipidemia and its associated diseases

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