

## Performance, Carcass Characteristics and Meat Quality Attributes of Broiler Chickens Administered Roselle (*Hibiscus sabdariffa* LINN) Calyx Extract

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### Abstract

A study was conducted to evaluate the effects of roselle (*Hibiscus sabdariffa* LINN) calyx extract on growth performance, carcass characteristics and meat quality attributes of broiler chickens. Five hundred and seventy-six Abor acre plus day-old broiler chickens were randomly assigned into six treatments with eight replicates of twelve birds each. The birds were fed daily with a basal diet and Roselle calyx extract was administered orally to the birds through drinking water for six weeks except for the controls. Treatment 1 had birds administered water only (negative control), treatments 2, 3, 4 and 5 were administered roselle calyx extract at 2000, 4000, 6000 and 8000 mg/L of drinking water and treatment 6 were on antibiotic growth promoter containing antioxidant which was administered at 2000mg/L of drinking water (positive control). Data were collected on growth performance, carcass characteristics, ileum histomorphometry, pH and microbial load count of the meat at days 0, 7 and 14. Results showed that fluid intake was not influenced by increasing roselle calyx extract levels at both the starter and finisher phases, however, feed conversion ratio (1.99) was improved at 8000mg/L roselle calyx extract inclusion. Optimal villus height:crypt depth (8.16) was obtained at 6000 mg/L. Percent crude protein of meat from broiler chickens administered 4000mg/L roselle calyx extract were significantly ( $P<0.05$ ) higher (19.98%) than other treatments means. pH values on days 0 and 7 were not significantly affected by the oral administration of roselle calyx extract, however, the pH value at day 14 of broiler chickens administered roselle calyx extract were significantly increased compared to those administered water only. It was therefore concluded that oral administration of roselle calyx extract up to 8000mg/L in drinking water of broiler chickens, improved feed utilisation and did not show any negative effects in carcass characteristics and quality in terms of pH and microbial load count of the product.

**Keywords:** Weight gain; Roselle calyx extract; Carcass quality; Broiler chickens

### Introduction

Modern poultry production has attained great heights in efficiently churning out products that are safe and of high quality. To improve the overall performance of poultry, nutrient utilisation, fertility, health status and

efficiency of production needs to be considered (Singh 2015). Recent poultry production has continuously adopted technology in the area of genetic advancement, management, health control and nutrition; this ensures competition in the

world meat market. Since the mid-1900, antimicrobials feed additives/supplements (antibiotics and therapeutic medicines) were increasingly used as growth promoting agents in animal production, in other to increase the animals' productivity especially those raised under intensive systems (Menten, 2001). It was however noted that despite the boost in the performance of broiler chickens, usage of antibiotic growth promoters has been reproved as a result of its likely role in antimicrobial resistivity in humans as a result of consumption of the products. Therefore, researches on the use of plant extract as substitutes to antibiotics as growth promoting agents have increased significantly (Seal *et al.*, 2013).

Roselle is an edible plant that is grown principally in subtropical and tropical regions. It is found nearly in all countries with warm climate including; Egypt, India, Malaysia, Saudi Arabia, Thailand, Sudan, Indonesia, Vietnam, Mexico and Philippines. Roselle has different nomenclature like 'bissap' or 'Guinea sorrel' in Senegal, 'sorrel' in Asia, 'Karkade' in North Africa, 'Jamaican flora' in Central America, and 'Zoborodo' in Nigeria (Cisse *et al.*, 2009). In Nigeria, the cultivation of roselle among farmers had gained acceptability due to its importance in medicine and the food industry (Olaniran *et al.*, 2013). Roselle is planted in various agro-ecological zones in Nigeria but highly concentrated in the North-Eastern, North-Western and Middle-Belt regions (Oboh and Elusiyan, 2004). The calyces are the most used part of the plant and is derived by separating the sepals of the flower from the capsules carrying the seeds. Calyces are used in the making of herbal drinks, beverages and other products such as jams, and jellies. The bright red color and distinct flavor make these food products valuable (Tseng *et al.*, 2000). Akindahunsi and Olaleye (2003) reported that calyces from roselle flowers are very high in Vitamin C

and are good in reducing hypertension, fever, diuretic, digestive and hepatic disorders, limit growth of microorganisms and has sedative effects. Reports of Usman *et al.* (2016) also noted that protocatechuic acid in roselle calyx helps prevent diseases and consequently boosts the immune system thereby improving feed conversion and weight gain in broiler chicken. Roselle calyx extract was also reported to mitigate oxidation of lipid in the tissues of ground beef in a study carried out by Sahil and Souravh (2014). The inclusion of roselle calyx extracts had no effect on cooking loss, fat, sensory attributes, pH value, percent protein and dry matter of beef sample at cold storage (4°C) for 15 days. It was observed that the existence of protocatechuic acid in roselle calyx extract prevented campylobacter and other aerobes contamination, slowed down lipid oxidation and thereby served the purpose of food preservation. This study therefore investigates the effects of oral administration of roselle calyx extract on growth performance of broiler chickens, its carcass characteristics, proximate composition, pH and microbial load count of the meat.

## Materials and methods

### *Experimental site*

The experiment was carried out at the Poultry unit of the Teaching and Research Farm, Federal College of Animal Health and Production Technology, Moor Plantation, Ibadan, Oyo State, Nigeria.

### *Sourcing and preparation of test ingredient*

Roselle calyx was purchased from the local market in Ibadan, Oyo state Nigeria. It was authenticated at the Pharmacognosy laboratory, Department of Pharmacognosy, Faculty of Pharmacy, University of Ibadan where the extraction was conducted. Roselle calyx extract was prepared using water and

ethanol at concentration ratio of 70:30. The extraction was carried out according to the methods of Morales-Cabrera *et al.* (2013) as followed: 100 grams of dried roselle calyces a sterile glass flask and labeled (roselle calyx to solvent ratio was 1g to 10ml of solvent). The solvents were added and the flask secured tightly and kept at room temperature (25°C) for 72 hours with manually agitated once a day; after which the solution was filtered using Whatman No. 4 filter paper. Solvents were eliminated from the concentrates using the rotary evaporator in low pressures and temperature below 50°C and freeze-dried till used.

#### *Experimental birds and their management*

Five hundred and seventy-six (576) Abor Acre Plus day-old broiler chicks acquired from Fidan Farms Ibadan, Oyo State, were brooded on a deep litter system for 7 days with artificial heating. After brooding, they were randomly assigned into six treatments (96 birds/ treatment) and replicated eight times with twelve (12) birds per replicate. The study lasted for a period of 6 weeks. Requisite vaccination programme against Newcastle disease (at day 1 and 14) and Gumboro (Infectious Bursal Disease at day 10) were carried out.

#### *Experimental diets*

Feed ingredients used were purchased from feed mills within Ibadan, the experimental diet was compounded to meet the physiological requirement of broiler chickens at the starter and phase (crude protein was 22.60% and metabolisable energy was 3220 kcal/kg at the starter phase and 20.21% and 3101 kcal/kg metabolisable energy at the finisher phase). Table 1 shows the gross composition of basal diets for broiler chickens at the starter and finisher phases.

#### *Experimental design and treatments*

The birds were randomly assigned to six treatments as presented below using a Completely Randomised Design. Broiler chickens in treatment 1 were administered water only (this served as the negative control) while birds in treatments 2, 3, 4 and 5 were administered 2000, 4000, 6000 and 8000 mg/L roselle calyx extract in a litre of drinking water respectively and birds on treatment 6 (positive control) were administered antibiotic growth promoter containing antioxidants (Oxytetracycline-5000mg with antioxidants vitamin C-2000mg and vitamin E-200mg) at 2000 mg per litre in drinking water.

#### *Collection of data*

##### *Growth performance characteristics*

**Average Daily Feed Intake:** Feed served to the birds in all treatments and their replications were weighed daily. The leftovers were collected and weighed every morning before feeding. From the division of total feed consumed by the number of live birds, feed consumed per bird was derived.

**Average Daily Weight Gain:** Weekly weights of the birds were taken with a weighing scale; which was recorded. The weight gain was derived by simply removing the value of the initial weight of the birds from the final weight.

**Average Daily fluid Intake:** The graded levels as described above were incorporated into drinking water and was served to the chickens except the negative control, served with water only and positive control, served with antibiotic growth promoter containing antioxidant in drinking water for the duration of the experiment. Daily fluid consumed by the birds was determined by measuring the leftover every morning and subtracting from fluid served.

Table 1. Gross composition of basal diets for broiler chickens at the starter and finisher phases

Ingredients (%)	Starter	Finisher
Maize	57.00	55.00
Soyabean meal	26.70	22.00
Wheat offal	0.00	9.00
Full fat soyabean	10.00	9.20
Fishmeal	2.50	1.00
DiCalcium phosphate	2.00	2.00
Limestone	1.00	1.00
Table Salt	0.25	0.25
*Premix	0.25	0.25
Methionine	0.20	0.20
Lysine	0.10	0.10
Total	100.00	100.00
<i>Calculated analysis (%)</i>		
Crude protein	22.60	20.21
Metabolisable Energy	3219.60	3101.20
Calorie: Protein ratio	142.24	153.45
Calcium	1.06	0.97
Available phosphorus	0.51	0.50
Lysine	1.30	1.33
Methionine	0.58	0.53
Crude fibre	3.84	4.06

\*Vitamins/1.25kg: A-12,000IU, D3-3000,000IU, E-30g, K3 - 2.5g, B1- 2g, B2- 2.5g, Niacin – 40g, Calpan -10g, B6- 3.5g, B12- 0.02g, Folic acid-1g, Biotin- 0.08g, Antioxidant – 125g. Minerals/kg: Sodium chloride- 8g, Potassium chloride- 50g, Sodium bicarbonate – 30g, Sodium acid phosphate- 8g, Sodium citrate – 65g, Calcium lactate- 17g, Lactose-250g

Feed Conversion Ratio (FCR): This was derived by dividing average feed intake by average weight gain.

At the end of the experiment (week 6), feed was withdrawn 8 hours prior to slaughter to ensure clean gut, two birds were randomly selected from the replicates, slaughtered by sticking the jugular vein, bled, defeathered (using the cold method) and eviscerated. The following were determined;

- Ileal morphometry: the ilea from slaughtered birds were collected. The tissue samples were opened using a sterilized scissors. The samples were fixated in formalin solution (10% vol), immersed in paraffin, sectioned, and haematoxylin-eosin was used for the staining and examined microscopically.
- Carcass characteristics and quality: Relative weights of the carcass, primal cuts and internal organs: These were obtained by dividing the weights of the part by live weight and multiplying by 100.

Meat samples from the breast, thigh and drumstick of the birds were collected, homogenized and used for proximate analysis, microbial count and pH. The proximate analysis was carried out according to the AOAC (1990) methods. The pH of the meat samples was measure on days 0, 7 and 14, using pH meter. The microbial assay of the meat samples was carried out on each sample as elucidated by Evans *et al.* (2004) at day 0, 7 and 14 days to determine the total bacterial count.

### Statistical analysis

Data were analysed with SPSS software (version 17). Linear and quadratic effects were assessed to compare treatment means using regression analysis. All the data were expressed as mean and pooled standard error of mean assuming the regression model;  $Y_{ik} = \alpha + \beta_i X_i + E_{ik}$  (linear regression) and  $Y_{ik} = \alpha + \beta_i X_i + \beta_{ii} X_{ii} + E_{ik}$  (quadratic regression). Significance differences were considered at  $p < 0.05$ .

## Results and discussion

### Growth performance

The growth performance of the birds at the starter phase (1-3 weeks) orally

administered roselle calyx extract is presented in Table 2. It was observed that administration of roselle calyx extract linearly decreased feed conversion ratio ( $P = 0.03$ ) among treatment means. Birds on 8000mg/L had the least value (1.99) for feed

conversion ratio and had the best value for weight gain (29.84 g/b/d). Significant variations ( $P < 0.05$ ) were also observed in the average daily weight gain, and average daily fluid intake.

Table 2. Performance of broiler chickens (1-3 weeks) administered roselle calyx extract

Treatment	ADWG (g/b/d)	ADFI (g/b/d)	FCR	ADFI.I (mL/b/d)
-ve control	27.61 <sup>b</sup>	58.96	2.15 <sup>a</sup>	68.28 <sup>ab</sup>
2000mg/L	28.75 <sup>ab</sup>	59.13	2.06 <sup>ab</sup>	66.88 <sup>abc</sup>
4000mg/L	28.32 <sup>ab</sup>	58.32	2.06 <sup>ab</sup>	65.32 <sup>bc</sup>
6000mg/L	28.57 <sup>ab</sup>	59.55	2.08 <sup>ab</sup>	64.53 <sup>c</sup>
8000mg/L	29.84 <sup>a</sup>	59.11	1.99 <sup>b</sup>	66.39 <sup>abc</sup>
+ve control	28.62 <sup>ab</sup>	58.68	2.06 <sup>ab</sup>	68.99 <sup>a</sup>
SEM	3.01	1.24	0.02	10.23
P value				
<i>Lin.</i>	0.03	0.25	0.03	0.04
<i>Quad.</i>	0.52	0.30	0.78	0.86

<sup>a,b,c</sup>: means with superscripts that are different along a column significantly differ at  $P < 0.05$

-ve control; negative control; (water only), +ve control; positive control; (antibiotic growth promoter containing antioxidant), ADWG: average daily weight gain in gram/bird/day, ADFI: average daily feed intake in gram per bird per day, FCR: Feed conversion ratio, ADFI.I: average daily fluid intake in milliliter per bird per day, SEM: standard error of mean, *Lin.*: Linear effect of RCE evaluated using regression analysis, *Quad.*: Quadratic effect of RCE evaluated using regression analysis

Table 3. Growth performance of broiler chickens (4-6 weeks) administered roselle calyx extract

Treatment	ADWG (g/b/d)	ADFI (g/b/d)	FCR	ADFI.I (ml/b/d)
-ve control	31.62	107.78	3.65 <sup>a</sup>	381.80
2000 mg/L	32.92	110.78	3.39 <sup>ab</sup>	396.80
4000 mg/L	32.18	104.99	3.31 <sup>ab</sup>	372.62
6000 mg/L	33.95	108.05	3.21 <sup>b</sup>	382.10
8000 mg/L	33.65	114.83	3.22 <sup>b</sup>	392.68
+ve control	31.95	108.75	3.43 <sup>ab</sup>	385.50
SEM	0.58	1.27	0.05	4.76
P value				
<i>Lin.</i>	0.85	0.44	0.02	0.88
<i>Quad.</i>	0.93	0.86	0.80	0.80

<sup>a,b,c</sup>: means with superscripts that are different along a column significantly differ at  $P < 0.05$ , -ve control; negative control; (water only), +ve control; positive control; (antibiotic growth promoter containing antioxidant), ADWG: average daily weight gain in gram/bird/day, ADFI: average daily feed intake in gram per bird per day, FCR: Feed conversion ratio, ADFI.I: average daily fluid intake in milliliter per bird per day, SEM: standard error of mean, *Lin.*: Linear effect of RCE evaluated using regression analysis, *Quad.*: Quadratic effect of RCE evaluated using regression analysis

However, average daily feed intake did not show linear or quadratic effects of roselle calyx extract. The result obtained for the growth performance of the birds at the finisher phase (weeks 4 – 6) is presented in Table 3 and it showed no significant difference in all parameters measured except in feed conversion ratio. Birds on 6000 mg/L and 8000 mg/L roselle calyx extract had better feed conversion ratio (3.21) and (3.22) than those on water only with the highest feed conversion ratio (3.65).

This could imply that the roselle calyx extract has significant effect on feed conversion ratio of the birds.

Comparable results were obtained by Awad *et al.* (2009) when different feed modulators were administered to broiler chickens. An increase in the weight observed in chicken administered roselle calyx extract suggests that the extract increased feed utilization and contains substances that enhanced the growth of the birds. One such substance is ascorbic acid which was reported by Al-Obeidy (2008) to be relevant in gut microflora and absorption of nutrient. It was reported that ascorbic acid increases

metabolism of tyrosine and phenylalanine—the main amino acids in thyroid hormone synthesis and also increases basal metabolism by maintaining growth hormone secretion. Ascorbic acid in roselle calyx extract has a positive effect on cellular activity and increase of oxygen levels in the body system. Al-Nasrawi, (2013) also corroborates this report by stating that the presence of antioxidants such as protocatechuic acid and anthocyanins in roselle calyx increases oxygen consumption thereby stimulating the thyroid gland which is essential in metabolism.

#### *Ileal histomorphometry*

The ileal histomorphometry of the birds administered roselle calyx extract is presented in Table 4. The result showed variations in the mucosal architecture in terms of linear increase ( $P = 0.01$ ) in the villus height of birds on 6000 mg/L (563.70 $\mu$ m) roselle calyx extract and showed both linear and quadratic effects ( $P < 0.05$ ) on villus height to crypt depth ratio.

Table 4. Ileal histomorphometry of broiler chickens (1-3weeks) administered roselle calyx extract

Treatments	VH ( $\mu$ m)	CD ( $\mu$ m)	VH: CD
-ve control	363.91 <sup>ab</sup>	101.90	3.47 <sup>b</sup>
2000 mg/L	315.05 <sup>b</sup>	116.90	2.90 <sup>b</sup>
4000 mg/L	367.70 <sup>ab</sup>	121.23	3.14 <sup>b</sup>
6000 mg/L	563.70 <sup>a</sup>	69.84	8.16 <sup>a</sup>
8000 mg/L	481.90 <sup>ab</sup>	108.51	4.41 <sup>b</sup>
+ve control	342.80 <sup>ab</sup>	105.39	3.31 <sup>b</sup>
SEM	33.29	7.44	0.59
P value			
<i>Lin.</i>	0.01	0.71	0.02
<i>Quad.</i>	0.16	0.79	0.04

<sup>a,b</sup>: means with different superscripts along a column significantly differ at  $P < 0.05$ , -ve control; negative control; (water only), +ve control; positive control; (antibiotic growth promoter containing antioxidant), VH: villus height

CD: crypt depth, SEM; standard error of mean, *Lin.*: Linear effect of RCE evaluated using regression analysis *Quad.*: Quadratic effect of RCE evaluated using regression analysis

Crypt depth showed no significant ( $P>0.05$ ) effects among the treatment means and the values ranged between 69.84 $\mu$ m to 121.23 $\mu$ m. Sterling *et al.* (2005) reported that advancement of intestinal villi enhances the efficiency of feed digestion and absorption. Baurhoo *et al.* (2007) also remarked that long villi and higher villi height to crypt depth ratio are correlated with enhanced gut height.

#### Carcass characteristics

Presented in Table 5 is the carcass characteristics of broiler chickens administered roselle calyx extract. It was

observed that there were no statistical differences in the live weight, and relative carcass, breast, drumstick, wings, and shank weights of the birds across the treatment means. Linear effects ( $P<0.05$ ) were observed in the relative weights of the back, thigh, head, liver, gizzard and neck. Data obtained for the relative weights of the liver showed that birds on 8000mg/L roselle calyx extract had significantly ( $P<0.05$ ) lower weight (1.99%) than other treatments. Birds on 2000 mg/L roselle calyx had the heaviest liver weight (2.51%).

Table 5. Carcass characteristics of broiler chickens administered roselle calyx extract

Parameters	Treatment (mg/L)						SEM	<i>P</i> value	
	-ve	2000	4000	6000	8000	+ve		<i>Lin.</i>	<i>Quad.</i>
LW(g)	1580	1550	1440	1430	1480	1450	32.06	0.26	0.37
<i>Relative weights of carcass, primal cuts and visceral organs (%)</i>									
Carcass	61.26	64.76	65.02	65.09	63.68	66.01	0.76	0.13	0.48
Breast	20.65	20.34	20.50	21.49	20.53	22.76	0.40	0.14	0.34
Back	10.81 <sup>b</sup>	13.40 <sup>a</sup>	13.74 <sup>a</sup>	12.77 <sup>ab</sup>	12.27 <sup>ab</sup>	12.89 <sup>ab</sup>	0.34	0.03	0.08
Drumstick	10.60	11.50	11.61	11.55	11.54	11.28	0.17	0.14	0.11
Thigh	10.01 <sup>b</sup>	10.88 <sup>ab</sup>	11.30 <sup>a</sup>	11.61 <sup>a</sup>	10.82 <sup>ab</sup>	11.45 <sup>a</sup>	0.16	0.02	0.07
Wings	7.85	8.51	8.73	8.39	8.46	8.68	0.12	0.08	0.19
Head	3.38 <sup>a</sup>	3.36 <sup>a</sup>	3.60 <sup>a</sup>	3.36 <sup>a</sup>	2.87 <sup>b</sup>	2.85 <sup>b</sup>	0.07	0.001	0.01
Shank	5.19	5.47	5.40	5.53	5.26	5.17	0.10	0.40	0.28
Neck	4.70 <sup>ab</sup>	4.59 <sup>b</sup>	4.75 <sup>ab</sup>	5.23 <sup>ab</sup>	4.77 <sup>ab</sup>	5.63 <sup>a</sup>	0.13	0.01	0.38
Heart	0.52	0.51	0.54	0.54	0.48	0.48	0.004	0.17	0.31
Liver	2.38 <sup>ab</sup>	2.51 <sup>a</sup>	2.12 <sup>ab</sup>	2.33 <sup>ab</sup>	1.99 <sup>b</sup>	2.29 <sup>ab</sup>	0.07	0.01	0.21
Gizzard	3.47 <sup>bc</sup>	3.86 <sup>ab</sup>	4.43 <sup>a</sup>	3.84 <sup>ab</sup>	2.92 <sup>c</sup>	3.26 <sup>bc</sup>	0.13	0.04	0.03

<sup>a,b,c</sup> : means of superscripts that are different on a row significantly differ at  $P<0.05$ , -ve control; negative control (water only), +ve control; positive control (antibiotic growth promoter containing antioxidant), LW (g): Live weight in grams, *Lin.*: Linear effect of RCE evaluated using regression analysis, *Quad.*: Quadratic effect of RCE evaluated using regression analysis.

Earlier studies by Awodola-Peters *et al.* (2015) showed that roselle calyx extract prepared by boiling 6g of the calyx in 1L of water for 30 minutes significantly increased the weights of liver, heart and gizzard of broiler chickens. Mahata *et al.* (2016) stated

that the carcass weight, carcass percentage and percentages of the abdominal fat and liver were unaffected by the treatments of unboiled tomatoes and boiled tomatoes. Weights of gizzard significantly increased in birds administered 4000 mg/L roselle calyx,

this correlates with the reports of Truong *et al.* (2016). In their research, it was concluded that pre-pelleting additions significantly increased gizzard weights by up to 37.5%. Mushtaq *et al.* (2014) deduced that elevations in gizzard weights reflect heightened digestive or metabolic capacity of the birds; hence, the size of the gizzard size is directly linked to the development and function of the gizzard. Therefore, the higher gizzard weights recorded in birds administered roselle calyx extracts may indicate that it contains components that strengthen broiler gizzard functions.

#### Proximate composition

The proximate composition of the meat from broiler chickens administered roselle calyx extract is presented in Table 6. The percent crude protein and ether extract were significantly different among the treatment means. Birds on 4000 mg/L roselle calyx extract had the highest percent crude protein

(19.98%) while those on 2000 mg/L had the least crude protein of 16.84%. Poultry meat is approximately 60-80% water, 15-25% protein, and 1.5 – 5.3% lipids (Castellini *et al.*, 2002). In this study, values obtained for percent moisture and ash were not statistically different, while significant variations were observed in the values obtained for crude protein and ether extract. Birds on 4000 mg/L roselle calyx extract had significantly higher (19.98 %) percent crude protein than birds on 2000 mg/L (16.84 %). This agrees with reports of Wu *et al.* (2014) that diet is known to have an effect on protein profile of meat of broiler chickens. The values obtained for other treatment ranged between 18.91-17.69 %. For percent ether extract, the values obtained in the meat of birds on positive control were significantly higher (26.16 %) than those obtained from the birds on roselle calyx extract and water only (15.32-17.86 %).

Table 6. Proximate composition of the meat of broiler chickens administered roselle calyx extract

Treatments	Moisture (%)	Crude protein (%)	Ether extract (%)	Ash (%)
-ve control	76.53	18.91 <sup>ab</sup>	17.86 <sup>b</sup>	2.48
2000 mg/L	78.46	16.84 <sup>b</sup>	15.38 <sup>b</sup>	1.40
4000 mg/L	74.89	19.98 <sup>a</sup>	17.72 <sup>b</sup>	2.44
6000 mg/L	76.32	18.90 <sup>ab</sup>	16.16 <sup>b</sup>	1.68
8000 mg/L	77.24	17.69 <sup>ab</sup>	15.32 <sup>b</sup>	2.18
+ve control	75.84	18.89 <sup>ab</sup>	26.16 <sup>a</sup>	2.50
SEM	0.46	0.40	1.17	0.15
P value	0.05	0.03	0.03	0.06

<sup>a, b</sup> : means of superscripts that are different along a column significantly differ at  $P < 0.05$ , -ve control; negative control; treatment on water only, +ve control; positive control; treatment on antibiotic growth promoter containing antioxidant

#### pH and microbial count

Presented in Table 7 are the pH and microbial load count at days 0, 7 and 14 of the meat of broiler chickens administered roselle calyx extract. Significance ( $P < 0.05$ ) was observed in the pH of the meat at day 14.

Birds on water only (negative control) had the lowest pH value (4.84) while birds on 2000 mg/L had the highest pH value of 5.48 while at day 0 and 7, no statistical variations ( $P > 0.05$ ) were observed.

Table 7. The pH, microbial count and lipid peroxidation of the meat of broiler chickens administered roselle calyx extract

Parameters	Day	Treatments (mg/L)					SEM	P value	
		-ve	2000	4000	6000	8000			+ve
pH	0	5.86	5.87	5.86	5.89	5.88	5.79	0.02	0.21
	7	5.37	5.57	5.40	5.25	5.60	5.38	0.06	0.15
	14	4.84 <sup>b</sup>	5.48 <sup>a</sup>	4.97 <sup>ab</sup>	5.03 <sup>ab</sup>	5.21 <sup>ab</sup>	4.98 <sup>ab</sup>	0.08	0.01
<u>Microbial count x10<sup>6</sup> cfu/g</u>									
	0	18.40	18.44	17.48	13.92	10.44	15.04	1.22	0.37
	7	3.76	1.60	1.44	0.58	0.28	0.82	0.54	0.51
	14	9.12	6.50	4.10	0.88	0.64	2.96	1.40	0.49

<sup>a,b,c</sup> : means of superscripts that are different along a column significantly differ at P<0.05, -ve control; negative control; treatment on water only, +ve control; positive control; treatment on antibiotic growth promoter containing antioxidant, MDA: malondialdehyde

For the microbial load count, although there was decline in the microbial count in the meat as the levels of roselle calyx extract increased, there were no significant (P>0.05) differences observed among the treatment means on the days (0, 7 and 14) the counts were made. Husak *et al.* (2008) contend that the meat quality characteristics are influenced by the extent and rate of pH decline which also influences the abilities of the meat to retain water. The decline in pH is explained by the fact that energy metabolism post mortem proceeds anaerobically (mainly glycolysis) producing lactic acid as an end product and this is responsible for pH decline post mortem. Meat and meat products spoilage or deterioration occurs at contrasting rates which depends on the storage condition. Poultry meat in similarity with red meat is prone to spoilage because of high levels of unstable unsaturated fatty acids (Sabow *et al.*, 2015).

## Conclusion

Oral administration of roselle calyx extract at 8000mg/L in drinking water of broiler chickens improved feed utilization

and did not show any negative effects in carcass characteristics and quality in terms of pH and microbial load count of the product.

## References

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