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Effect of Graded Levels of Roselle (*Hibiscus sabdariffa* LINN.) Calyx Extract on Performance and Carcass Characteristic of Broiler Chickens

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Abstract: The study evaluated the effect of graded levels of the red variety of roselle (*Hibiscus sabdariffa* L.) calyx extract on performance and carcass characteristics of broiler chickens. A total of two hundred Arbor acres broiler birds were used for the study, these were randomly assigned to five treatments, (T_1, T_2, T_3, T_4 and T_5) which had broiler chicks on water only, 2 g of roselle calyx boiled in 1 L of water for 30 min, 4 g of roselle calyx boiled in 1 L of water for 30 min, 6 g of roselle calyx boiled in 1 L of water for 30 min and 8 g of roselle calyx boiled in 1 L of water for 30 min, respectively. The birds were further randomly sub-divided into four replicates of ten birds each. The birds were given basal diets at both the starter (0-3 weeks) and finisher phases (4-6 weeks). Data obtained were subjected to ANOVA and means separated using the Duncan's New Multiple Range Test. Result showed no significant difference in average daily fluid intake, average daily weight gain, feed intake and FCR of the birds at the starter phase. However, at the finisher phase, there was significant difference ($p<0.05$) in the values obtained for average daily feed intake, weight gain and feed conversion. Carcass evaluation showed birds in T_5 had better breast meat weight and dressing percentage. The extract was not toxic to the birds and can be administered to broiler chickens at a graded level of 8 g of Roselle calyx boiled in 1 L of water for 30 min.

Key words: Roselle calyx extract, fluid intake, weight gain, carcass characteristics

INTRODUCTION

Poultry production is one of the fastest means of correcting shortage of animal protein supply and consumption in Africa. This is because of their short generation interval, high rate of reproduction and efficiency of nutrient transformation into high quality protein (Akinpelu *et al*., 1999). However, the cost of this transformation is high (Onyimonyi and Onu, 2009), as 80% of the cost of production is spent on feed.

The poultry industry in Nigeria have continued to decline as a result of high cost of feeds as well as feeding of low quality feeds. Feed alone accounts for up to 75% of the total production cost (Kekeocha, 1984; Ubosi and Sekuna, 2000).

Roselle (*Hibiscus sabdariffa* LINN) belongs to the family Malvaceae and is a popular vegetable in Indonesia, India, West Africa and many tropical regions. The vegetable is widely grown in the North-Eastern and middle belt regions of Nigeria (Akanya *et al*., 1997). The plant has been found to thrive on a wide range of soil conditions. It can perform satisfactorily on relatively infertile soils but for economic purposes, a soil well supplied with organic materials and nutrients is essential. It can tolerate relatively high temperature throughout the growing and fruiting periods. The plant requires an optimum rainfall of approximately 45-50 cm distributed over a 90-120 day growing period (Tindal, 1986).

Roselle is a plant of increasing interest for its applications in health and medicine, beverages and cosmetic products. The most exploited part of a Roselle plant is its calyces. Calyces are obtained by removing the calyces or petals of the flower from its capsules containing seed. The flowers or calyces are most popular for preparation of cold and warm beverage, herbal drink, jams and jellies. Calyces from the Roselle flower, which are very high in vitamin C, are processed to produce juices. 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. Furthermore, other studies have reported that it is good in reducing hypertension (Odigie, *et al*., 2003; Herrera-Arellano *et al*., 2004). This study is therefore aimed at evaluating the effect of graded level of red variety of Roselle calyx extract on the performance of broiler chickens.

MATERIALS AND METHODS

Experimental site: This study was carried out at the Teaching and Research Farm of the University of

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Ibadan, Oyo State. University of Ibadan is located five miles from the city of Ibadan which is geographically located on latitude 7°27´N and longitude 3°53´E. The city is characterized by a tropical wet and dry climate, the wet season runs from March through October while November to February forms the city's dry season. Temperature vary between 27-31°Celcius, mean annual rainfall of 1038mm and relative humidity of 79%.

Experimental birds and their management: A total of two hundred Arbor acres day old broiler birds were obtained from CHI Farms Limited in Ibadan, Oyo state. The chicks were brooded for seven days on a deep litter system using 200 watts electricity bulbs and coal pots. The birds were brooded on treatment basis. After brooding, the chicks which had already been randomly assigned to 5 treatments (40 birds per treatment), were replicated four times and 10 birds were allotted to each replicate. Necessary vaccination programme NDV (intraocular), Gumboro (Infectious Bursal Disease) and Newcastle Disease Vaccine (Lasota) were carried out at appropriate times. Anti-stress was also administered to the birds on arrival and after each weighing.

Experimental material and diet: Feed ingredients used were purchased from the Adom feedmill in Ibadan and experimental diet formulated to meet the NRC (1994) nutrient requirement for broiler chickens. The birds were fed starter diet (22.60% Crude protein, 3219.60 kcal/kg Metabolizable energy) from 1-21 days and finisher diet (20.21% Crude protein and 3101.20 kcal/kg Metabolizable energy) from 22 to 42 days. Table 1 shows the dietary composition and chemical analysis of the experimental diets.

Dried roselle calyces were purchased from Oja Oba market also in Ibadan. The calyces were measured into respective graded levels and these were boiled in water for 30 min (Chumsri *et al*., 2008; Bolade *et al*., 2009; Gartaula and Karki, 2010; Unigwe, 2011) and allowed to cool. The extract obtained were served to the broiler chickens *ad libitum* in lieu of water except for the control throughout the experiment. Table 2 shows the chemical composition of graded levels of the roselle calyx extract.

Experimental treatments:

Treatment 1 = Broiler chickens without roselle calyx extract but on water only (control)
Treatment 2 = Broiler chickens on 2 g of roselle calyx boiled in 1s L of water
Treatment 3 = Broiler chickens on 4 g of roselle calyx boiled in 1 L of water
Treatment 4 = Broiler chickens on 6 g of roselle calyx boiled in 1 L of water
Treatment 5 = Broiler chickens on 8 g of roselle calyx boiled in 1 L of water

Table 1: Dietary composition of experimental diets

Ingredients	Starter phase	Finisher phase
Maize (%)	57.00	55.00
Soyabean meal (%)	26.70	22.00
Full fat soyabean (%)	10.00	9.30
Wheat offal (%)	0.00	9.00
Fishmeal (%)	2.25	1.00
DiCalcium Phosphate (%)	2.00	2.00
Limestone(%)	1.00	1.00
Salt (%)	0.25	0.25
*Premix (%)	0.25	0.25
Methionine (%)	0.20	0.20
Lysine (%)	0.10	1.00
Total	100.00	100.00
Calculated analysis		
Crude protein (%)	22.60	20.21
Metabolizable energy (kcal/kg)	3219.60	3101.20
Crude fibre (%)	3.84	4.06
Calcium (%)	1.06	0.97
Available Phosphorus (%)	0.50	0.50
Methionine (%)	0.58	0.53
Lysine (%)	1.30	1.33
Calorie:Protein ratio	142.24:1	153.45:1
Chemical analysis		
Moisture (%)	8.80	8.93
Crude protein (%)	22.93	19.60
Ether extract (%)	13.13	13.07
Ash (%)	5.32	7.07
Crude fibre (%)	7.77	9.03
Nitrogen free extract (%)	42.14	42.30

Composition of Vitamins/1.25 kg: A-12,000,000 iu D3-3000,000 iu E-30 g, K3-2.5 g B1-2 g, B2-2.5 g, Niacin-40 g, calpan-10 g, B6-3.5 g, B12-0.02 g, Folic Acid-1 g, Biotin-0.08 g, Antioxidant-125 g.
Composition of minerals/kg:Sodium chloride-8 g, Potassium chloride-50 g, sodium bicarbonate-30 g, Sodium Acid Phosphate-8 g, Sodium Citrate-65 g Calcium lactate-17 g Lactose-250 g.

Table 2: Chemical composition of Graded levels of roselle calyx extract.

Parameters	Graded levels of roselle calyx boiled in 1 L of water			
	2 g (T_2)	4 g (T_3)	6 g (T_4)	8 g (T_5)
Moisture content (%)	91.73	91.17	90.63	90.07
Total solids (%)	8.27	8.83	9.37	9.93
Crude protein(%)	4.80	4.93	5.00	5.33
Crude fat (%)	0.10	0.13	0.17	0.17
Ash (%)	0.13	0.17	0.20	0.23
Nitrogen free extract (%)	3.23	3.60	4.03	4.13

Data collection: Data were collected on the following parameters during the period of the experiment.

Average daily feed intake: Feed given to the birds were weighed daily in each treatment and its replication. The leftover were also collected and weighed every morning before feeding. Daily record of feed supply and feed consumption per bird was obtained by dividing the total feed consumed by number of live birds. This is mathematically represented as:

$$\text{Average feed consumed} = \frac{\text{Total feed consumed}}{\text{No. of live bird}}$$

Average daily weight gain: Birds were weighed weekly to observe body weight changes with the use of a weighing balance. The weight was recorded and body weight gain was calculated by subtracting initial weight from final weight.

Average daily fluid intake: On daily basis, solution gotten from boiling graded quantity of roselle in 1 L of water for 30 min as described above was served *ad libitum* in lieu of water except the control throughout the experiment and leftover of the solution was measured every morning to determine the daily fluid intake of the birds.

Feed conversion ratio: Feed conversion ratio was obtained by dividing the average feed intake per live bird/day by the daily weight gain of the bird:

$$\text{Feed conversion ratio} = \frac{\text{Feed intake}}{\text{Weight gain}}$$

Livability: Mortalities were recorded for each replicate as they occur and expressed in percent livability.

Carcass characteristics: At the end of the sixth week, 2 birds were randomly selected from each of the replicates, starved for 12 h, weighed, slaughtered and dressed. Dressed carcass and internal organ weights were recorded.

Statistical analysis: Data generated were subjected to Analysis of Variance using SAS (2011) package and means were further separated using Duncan Multiple Range Test of the same software.

RESULTS

Performance of broiler chickens administered graded levels of roselle calyx extract: The performance of broiler chickens administered the graded levels of Roselle calyx extract at the starter phase (0-3 weeks) is shown in Table 3 and finisher phase (4-6 weeks) in Table 4.

Fluid intake: The birds had statistically similar fluid intake throughout the starter phase. The values varied from 73.25 ml/bird/day in Treatment 1 (control) and progressed downward to 66.70 ml/bird/day in Treatment 5 for the average daily fluid intake. During the finisher phase, there was no significant difference among the treatment means for the average daily fluid intake. However, the total fluid intake for this phase showed significant difference ($p<0.05$) among the means. Birds in treatment 3 had the highest value for total fluid intake (6.22 L/bird) and birds in treatment 4 had the lowest value of (5.18 L/bird).

Feed intake: The values obtained from the daily feed intake at the starter phase, showed no significant difference among treatment means. However, birds in Treatment 1 had the highest value of 43.14 g/bird/day for feed intake and Treatment 5 the lowest value of 40.81 g/bird/day. Treatment 2, 3 and 4 had values 42.22, 42.98 and 40.86 g/bird/day, respectively. For the finisher phase, results showed that the average daily feed intake showed significant difference ($p<0.05$) among treatment means. Treatment 1 had the highest feed intake value of 155.95 g/bird and was statistically similar to Treatment 2 and 5 with values 139.31 and 141.92 g/bird/day, respectively. Treatment 3 and 4 had the lowest values of 133.79 and 125.97 g/bird/day, respectively, although statistically similar to treatment 2 and 5. The total feed intake also showed similar pattern.

Weight gain: The daily weight gain across the treatment levels in the starter phase, was similar with Treatment 3 having the highest value of 22.84 g/bird/day and a total weight gain value of 479.68 g/bird and Treatment 5 the lowest value of 20.96 g/bird/day and total weight gain value of 436.22 g/bird. However, at the finisher phase, average daily weight gain among treatment means showed statistical difference with Treatment 3 having the highest value of 47.83 g/bird/day and Treatment 4 the lowest value of 38.84 g/bird/day. Values obtained for total weight showed no significant difference.

Feed conversion ratio: The result of the feed conversion ratio showed no significant difference among the treatment means for the starter phase, while the result of the feed conversion ratio at the finisher phase, showed significant difference among treatment means. Treatment 3 had a better feed to gain ratio compared to the other treatments with a value of 2.80, while treatments 1, 2, 4 and 5 had values 3.51, 3.35, 3.26 and 3.36, respectively.

Livability: Result of livability showed no significant difference among treatment means for both starter and finisher phases.

Carcass characteristics of broiler chickens given graded levels of roselle (*Hibiscus sabdariffa*) calyx extract: Table 5 showed the carcass characteristics of the birds administered graded levels of the extract. The results indicated that there were significant ($p<0.05$) differences in the dressing percentage, breast meat heart, gizzard, liver and proventriculus across the treatment means.

DISCUSSION

Performance of broiler chickens administered graded levels of roselle calyx extract: There was no marked ($p>0.05$) variation in the aqueous average daily Roselle calyx extract intakes of the broiler chickens among the treatment means. The total fluid intake was slightly lower than the report of Nworgu *et al.* (2007) (77.66-79.97 ml/bird/day). Variations could be attributed to the type of bird, season, test ingredient and environment in which the experiment was carried out. Treatment 3 had

Table 3: Performance of broiler chickens administered graded levels of roselle calyx extract at the starter phase (0-3 Weeks)

Parameters	T1	T2	T3	T4	T5	SEM	p-value
T.FI.I (L/bird)	1.57	1.47	1.49	1.41	1.45	58.73	0.46
A.D.FI.I (ml/bird/day)	73.25	70.71	70.69	67.83	66.70	2.23	0.29
T.W.G (g/bird)	470.61	460.64	479.68	461.74	436.22	13.79	0.28
A.D.W.G (g/bird/day)	22.31	21.94	22.84	22.01	20.96	0.63	0.36
T.F.I (g/bird)	905.91	862.58	873.58	850.55	855.51	33.49	0.78
A.D.F.I (g/bird/day)	43.14	42.22	42.98	40.86	40.81	1.59	0.74
F.C.R	1.95	1.92	1.88	1.86	1.95	0.08	0.87
Initial weight (g/bird)	35.59	36.59	35.61	36.10	34.00	1.05	0.10
Final weight (g/bird)	507.22	497.23	515.29	497.35	470.22	13.79	0.25
Livability (%)	98.50	99.00	98.75	98.75	98.75	0.43	0.95

T.FI.I: Total fluid intake | A.D.FI.I: Average daily fluid intake | T.W.G: Total weight gain
A.D.W.G: Average daily weight gain | T.F.I: Total feed intake | A.D.F.I: Average daily feed intake
F.C.R: Feed conversion ratio | SEM: Standard error of mean | p-value: Probability value

Table 4: Performance of broiler chickens administered graded levels of roselle calyx extract at the finisher phase (4-6 weeks)

Parameters	T1	T2	T3	T4	T5	SEM	p-value
T.FI.I (L/bird)	5.89^{a}	5.92^{a}	6.22^{a}	5.18^{b}	5.89^{a}	203.80	0.03
A.D.FI.I (ml/bird/day)	284.85	329.67	295.88	241.76	279.29	45.82	0.75
T.W.G (g/bird)	890.73	971.94	969.40	865.02	886.64	63.82	0.66
A.D.W.G (g/bird/day)	44.44^{ab}	41.77^{bc}	47.83^{a}	38.84^{c}	42.24^{bc}	1.32	0.003
T.F.I (kg/bird)	3.21^{a}	2.84^{ab}	2.79^{ab}	2.65^{b}	2.99^{ab}	129.94	0.07
A.D.F.I (g/bird/day)	155.95^{a}	139.31^{ab}	133.79^{b}	125.97^{b}	141.93^{ab}	5.98	0.03
F.C.R	3.51^{a}	3.35^{a}	2.80^{b}	3.26^{ab}	3.36^{a}	0.15	0.05
Initial weight (g/bird)	507.22	497.23	515.29	497.35	470.22	13.79	0.25
Final weight (g/bird)	1397.95	1469.16	1484.68	1362.37	1356.86	67.07	0.55
Livability (%)	99.50	99.75	100.00	100.00	99.25	0.27	0.28

a,b,c: Rows with different superscripts are statistically different ($p<0.05$)
T.FI.I: Total fluid intake | A.D.FI.I: Average daily fluid intake | T.W.G: Total weight gain
A.D.W.G: Average daily weight gain | T.F.I : Total feed intake | A.D.F.I: Average daily feed intake
F.C.R: Feed conversion ratio | SEM: Standard error of mean | p-value: Probability value

Table 5: Carcass characteristics of broiler chickens given graded levels of roselle calyx extract

Parameters	T1	T2	T3	T4	T5	SEM	p-value
Live weight(g)	1170.38^{b}	1233.88^{b}	1377.33^{a}	1315.92^{ab}	1266.00^{ab}	67.71	0.03
De-feathered weight(g)	1112.13^{b}	1125.88^{ab}	1246.38^{a}	1179.00^{ab}	1191.00^{ab}	59.06	0.18
Eviscerated weight(g)	911.63^{bc}	934.38^{bc}	1044.88^{a}	881.63^{c}	988.88^{ab}	47.58	0.01
Percentage live weight							
Dressing (%)	77.91^{ab}	75.65^{ab}	75.18^{ab}	71.58^{b}	78.52^{a}	2.03	0.18
Head (%)	3.28	3.27	3.01	3.34	3.35	0.20	0.42
Neck (%)	5.89	5.50	5.49	5.55	5.53	0.59	0.96
Shank (%)	5.09	5.15	4.51	4.79	5.14	0.32	0.21
Drum stick (%)	10.75	10.23	9.94	10.16	10.35	0.48	0.54
Breast (%)	17.49^{ab}	16.48^{bc}	17.25^{ab}	15.68^{c}	18.66^{a}	0.72	0.003
Back (%)	14.86	14.43	15.12	14.26	14.86	0.81	0.82
Heart (%)	0.80^{a}	0.59^{ab}	0.57^{b}	0.62^{a}	0.64^{ab}	0.09	0.15
Gizzard (%)	2.95^{a}	2.59^{a}	2.36^{b}	2.87^{a}	2.66^{ab}	0.21	0.05
Liver (%)	3.02^{ab}	2.37^{b}	2.28^{b}	3.34^{a}	2.99^{ab}	0.38	0.04
Thigh (%)	10.07	10.47	9.99	9.59	10.50	0.59	0.52
Wing (%)	9.41	9.19	8.66	8.92	9.30	0.40	0.35
Spleen (%)	0.22	0.19	0.15	0.17	0.18	0.04	0.55
Proventriculus (%)	0.63^{ab}	0.67^{ab}	0.58^{b}	0.76^{a}	0.17^{ab}	0.06	0.04
Abdominal fat (%)	0.76	0.63	0.78	0.97	0.84	0.19	0.59

a,b,c: Rows with different superscripts are statistically different ($p<0.05$). SEM: Standard Error of mean T-Treatment

the highest total fluid intake while birds in treatment 4 recorded the lowest total fluid intake.

Feed intake showed significant difference among treatment means. Birds in the control consumed more feed than the other treatment groups and this could be attributed to the fact that the calyx of Roselle contains feed nutrients as well. Birds in treatment 4 had the lowest feed intake value and are statistically comparable to values obtained from birds in treatment 3.

The importance of nutrition as the most influential factor in animal growth and development cannot be overemphasized. Birds in treatment 3 (offered Roselle calyx extract that was prepared by boiling 4 g of the calyx in 1 L of water for 30 min) had the highest weight gain and was significantly different ($p<0.05$) from the other treatments though statistically comparable to values obtained from treatment 1. The other treatments were statistically comparable. This result disagrees with the findings of Unigwe (2011), who recommended administering 3 g of roselle calyx boiled in 1 L of water to broiler chicks.

Feed conversion ratio is a measure of feed utilization or the efficiency of converting unit feed into unit gain. Treatment 3 (2.50) had the best feed to gain ratio while treatment 1 (2.99) had the least favourable feed conversion ratio which is statistically comparable to

treatments 2, 4 and 5. This is possibly because Roselle calyx extract increases digestibility of feed (Brown, 1995) thereby making more nutrients available to the broiler chickens.

Livability: The result of the study revealed good livability of birds among treatment groups and was not altered by any dietary treatments. The percentage livability of birds under the different treatments was statistically non-significant. The value ranged between 98.50% and 99.00% at the starter phase and 99.25-100.00% at the finisher phase.

Carcass characteristics of broiler given graded levels of roselle calyx extract: The results indicated that there were significant ($p<0.05$) differences in the values obtained for dressing percentage, breast, heart, gizzard, liver and proventriculus weights across the treatments. The value obtained for breast weight showed that treatment 5 was significantly higher than treatments 2 and 4 but significantly similar with treatments 1 and 3. Summer *et al.* (1988) noted that breast meat contributes about 30% of the total carcass and as much as 50% of total edible carcass protein. The liver showed that treatment 4 was significantly similar with treatments 1 and 5 but significantly higher ($p<0.05$) than treatments 2 and 3. It was observed on the breast weight that treatment 5 had the best utilization of the roselle calyx extract.

Conclusion: From the results obtained from the study above, it can be concluded that, Roselle calyx extract is not toxic to broiler chickens and can be administered to the birds at a graded level of 8 g of Roselle calyx boiled in 1 L of water for 30 min to achieve best result in terms of performance to improve the feed to gain ratio, increased breast meat weight and its not in any way lethal to the birds.

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