Growth performance, carcass characteristics, digestibility and economics of broiler production fed diets containing different levels of camel rumen content in the Semi-Arid Zone of Nigeria

¹Mohammed, G., ¹Asheikh, L. G., ¹Kolo, U. M., ¹Abbator, F. I., ¹Chana, Z. M., ¹Musa, A. A. and ²Usman, Y.

¹Department of Animal Science, University of Maiduguri, Maiduguri, Nigeria.

²Sir Kashem Ibrahim College of Education Maiduguri, Maiduguri, Nigeria

Correspondence email address; uskolo220@gmail.com

*Corresponding Author Phone number: +2348038329041

Abstract

The feeding value of different levels of camel rumen content in broiler diet was investigated using 150 Hover marshal broiler chickens from one-day to 63-days of age. The birds were randomly allotted to five /diets with two replicates of 15 birds each. The diets (starter and finisher) were formulated to contain 0, 5, 10, 15 and 20% camel rumen content in T1, T2, T3, T4 and T5 diets respectively. At nine week of the experiment three birds per replicate were selected for carcass measurement. The backs, hearts, kidneys, lungs, liver and spleen were not significantly ($P > 0.05$) different among the treatment groups while other parameters were significantly ($P < 0.05$) different among the treatment groups. At week eight of the experiment three birds per replicate were selected for digestibility study. At the starter stage, the daily feed intake and daily weight gain were significantly ($P < 0.05$) different among the treatment groups but only the feed conversion ratio was not affected ($P > 0.05$) by the camel rumen content (CRC) in the diets. However, broiler chicks fed CRC T1 (0%), T2 (5%), T3 (10%) and T4 (15%) had better daily weight gain than those fed T5 (20%). During the finisher stage, all the growth parameters were not affected ($P > 0.05$) by CRC except final body weight which was affected ($P < 0.05$) by the test material. Economic of production showed that CRC diets were not profitable in terms of cost of feed per kg weight gain during the starter stage. At finisher stage the cost of feed per kg weight gain were better in broilers chicken fed CRC based-diets. The result of the experiment showed that camel rumen content can replace maize and groundnut cake up to 15% level without deleterious effect on the productive performance of broiler chicks. However, at finisher stage up to 20% dietary maize and groundnut cake could be replaced with CRC without adverse effect on the growth performance, carcass parameters, digestibility and economics of production.

Keywords: Broiler chickens, camel rumen content, performance, carcass parameters, economics analysis

Introduction

A major problem facing the developing countries especially Nigeria, is the uncontrolled increase in population without a corresponding increase in the animal production. Animal products contribute only 15-20% of the total protein intake of an average Nigerian contrary to 33% recommended by FAO and WHO (Taiwo *et*

al., 2004). The wide margin between the recommended protein intake and the average consumption rate has resulted in an ever increasing demand for animal protein by the Nigerian populace. Azubuike (2002) reported that an increase in poultry production is one of the solutions to the increasing demand for animal protein in Nigeria.

Broiler production fed diets containing different levels of camel rumen

Broiler production represents one of the most economic and easiest means of bridging the supply-demand gap of animal protein due to their rapid growth rate and superior feed conversion ratio. Moreover, compared to other livestock species, broilers enjoy a relative advantage of easy management, quick returns to capital investments and wide acceptance of its meat for human consumption (Onu *et al.*, 2011). However, the enormous potential of broiler chickens in many tropical and sub-tropical countries is affected by scarcity and high cost of conventional protein feed ingredients (Esonu *et al.*, 2006).

Efforts have been made to reduce the high cost of feeds and therefore, the cost of poultry product by focusing on the use of cheaper and locally available alternative agro-by-products especially those that have no nutritional value to mankind (Onu, 2007; Otuma, 2008). Some of the agro-by-products that have been evaluated for poultry feeding are bovine and goat rumen contents by some authors (Adeniji and Balogun, 2001; Adeniji and Balogun, 2002; Gwayo *et al.*, 2006). This study was therefore, conducted to evaluate the effects of different levels of camel rumen content (CRC) on growth performance, digestibility and economics of production of broilers.

Materials and methods

Location of the study

The study was conducted at the Livestock Teaching and Research Farm, Department of Animal Science, University of Maiduguri, Maiduguri, Borno State, Nigeria. Maiduguri is located on latitude 11° 15' North and longitude 30° 05' East and on an altitude of 345 m above sea level (Ugherughe and Ekedolum, 1986). The relative humidity ranges from 30 to 50% (Encarta, 2007). The rainfall is between 500

to 600 mm. It has a short period of rainfall (3 to 4 months) usually from June to September followed by long period of dry season (8 to 9 months) (Encarta, 2007).

Preparation of the camel rumen content (test ingredient)

The camel rumen contents were collected in a clean container during slaughter from Maiduguri abattoir, Borno State, Nigeria. The camel rumen content was sun-dried for five days on a clean dry slab. The dried sample was ground in a hammer mill and analysed for proximate composition (AOAC, 2000).

Experimental diets

The experimental diets for broiler starter are presented in Table 1 while broiler finisher diets are showed in Table 2. The experimental diets were locally formulated with ingredients including maize, wheat offal, camel rumen content (test ingredient), groundnut cake, fish meal, bone meal, premix, methionine, lysine and salt. The camel rumen content was included at 0, 5, 10, 15, and 20% levels into T1, T2, T3, T4 and T5 diets, respectively.

Experimental birds and management

One hundred and fifty day-old broilers (Hover Marshal breed) were used for the experiment. The broilers were purchased in Maiduguri but their source was Obasanjo Farm Nigerian Ltd, Abeokuta, Ogun State. At the beginning of the experiment, all the birds were weighed and grouped based on their average weight and randomly assigned to treatments consisting of two replicates with 15 birds each. The locally prepared diets were fed in two stages: stage one was fed with broiler starter mash from day old to four weeks and stage two was fed with broiler finisher mash from 5-9 weeks. Each treatment was fed with their diet and provided with water *ad libitum* in a deep litter system. Feed intake was recorded

Table 1: Ingredient composition of the experimental broiler starter diets

Ingredients	Treatments/ Levels of camel rumen content in the Diets (%)				
	T1(0%)	T2(5%)	T3(10%)	T4(15%)	T5(20%)
Maize	47.95	44.90	41.85	39.20	36.30
Ground nut cake	33.35	31.40	29.45	27.10	24.95
Camel rumen content	0.00	5.00	10.00	15.00	20.00
Wheat offal	10.00	10.00	10.00	10.00	10.00
Fish meal	5.00	5.00	5.00	5.00	5.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Premix*	0.25	0.25	0.25	0.25	0.25
Methionine	0.10	0.10	0.10	0.10	0.10
Lysine	0.10	0.10	0.10	0.10	0.10
Salt	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00

*Each Premix 2.5kg contains: Vit.A -10,000,000IU; Vit. D3 -2,000,000IU; Vit. E-20,000IU; Vit. K- 2,2250mg; Thiamine -175mg; Riboflavin -5,000mg; Pyridoxine -2,750mg; Niacin -27,500mg; Vit.B₁₂ -15mg; Pantothenic acid -7,500mg; Folic acid -7,500mg; Biotin -50 mg; Choline chloride -400 g; Antioxidant -125 g; Manganese-80g; Zinc -50g; Iron -20 g; Copper -5 g; Iodine -1.5g; Selenium-200mg and Cobalt-200mg

Table 2: Ingredients composition of the experimental broiler finisher diets

Ingredients	Treatments/ Levels of camel rumen content in the Diets (%)				
	T1(0%)	T2(5%)	T3(10%)	T4(15%)	T5(20%)
Maize	56.29	53.67	51.04	48.40	45.78
Groundnut cake	24.96	22.58	20.21	17.85	15.47
Camel rumen content	0.00	5.00	10.00	15.00	20.00
Wheat offal	12.00	12.00	12.00	12.00	12.00
Fish meal	3.00	3.00	3.00	3.00	3.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Premix*	0.25	0.25	0.25	0.25	0.25
Methionine	0.10	0.10	0.10	0.10	0.10
Lysine	0.10	0.10	0.10	0.10	0.10
Salt	0.30	0.30	0.30	0.30	0.30
Total	100.00	100.00	100.00	100.00	100.00

*Premix supplied the following per 100kg of diet. Vit.A -15,000IU; Vit. D3 -300,000IU; Vit. E-30000IU; Vit. K- 2.50mg; Thiamine -2005mg; Riboflavin(B₂) -600mg; Pyridoxine(B₆) -600mg; Niacin -40mg; Vit.B₁₂ -2mg; Pantothenic acid -10mg; Folic acid -100mg; Biotin -8mg; Choline chloride -50 g; Antioxidant -12.5g; Manganese -96g; Zinc -6g; Iron -24g; Copper -0.6g; Iodine -0.14g; Selenium-24mg and Cobalt-214mg

daily as the difference between the feed offered and the leftover. All the birds were weighed weekly in order to obtain their weekly weight gain. Feed conversion ratio was calculated as the total feed consumed divided by the body weight gain. The birds were vaccinated against Gumboro disease at weeks 2-4 and Newcastle disease at week 3.

Carcass characteristics

At the end of the experiment, nine chickens (three chickens from each replicate based on average weight of the group) from each treatment, were selected for slaughter. They were deprived of feed for 12 hours as

recommended (Mann, 1960). Drinking water was provided. Withholding feed for 12 hours before slaughter reduced the volume of gut contents and hence bacteria, and therefore reduced the risk of contamination of the carcass during dressing without adversely affecting meat yield and quality. The chickens were weighed in the morning and slaughtered by cutting transversely across the trachea, oesophagus, large carotid arteries and jugular veins to ensure maximum bleeding. Slaughtered birds were scalded in hot water (about 50 °C) for one minute, after which feathers were manually removed. Dressing

Broiler production fed diets containing different levels of camel rumen

percentage was obtained as percentage of the dressed weight after removing the feathers. They were then eviscerated for carcass yield and organ weight determination. The carcass yield and organ weight were weighed and calculated as percentage of the dressed weight.

Digestibility trials

The nutrient digestibility study was conducted at the week eight of the experiment. Faecal samples were collected from six broilers per treatment (i.e. three birds from each replicate) for a period of seven days using fine wire mesh trays placed under the metabolism cages. The amount of faeces voided daily was weighed and allowed to dry for 24 hours at 80 °C in an oven. The dried faecal samples were stored in air -tight bottles for chemical analysis. The proximate composition of the diets and faecal samples were determined according to AOAC (2000).

Statistical analysis

All the data collected were subjected to analysis of variance (ANOVA) using the randomized complete block design (Steel and Torrie, 1980). Means were separated, where applicable, using the Duncan's multiple range test (Duncan, 1955).

Results and discussion

Proximate composition of the experimental diets and camel rumen content

The proximate composition of the experimental diets and camel rumen content are shown in Table 3. The camel rumen contents (CRC) had 93.70% dry matter, 23.70% crude protein, 28.10% crude fibre, 3.00% ether extract, 12.00% ash and 33.70% nitrogen-free extract. The proximate composition of the CRC is comparable to the values of CRC reported (Mohammed *et al.*, 2008). Onu *et al.* (2011) reported that the nutrient quality of

feed ingredient is one of the most essential apart from availability (which sometime is a function of the cost and season) for production of good quality feeds. The essential nutrients that cannot be overemphasized in feed formulation are protein and energy (Zeitler *et al.*, 1984). The crude protein of the diets ranged from 23.90 – 24.10% and 19.50 – 20.80% in both starter and the finisher diets, respectively. This result is in agreement with the report by Gwayo *et al.* (2006) that fed broiler chickens diets containing goat rumen content and reported similar values as adequate for broiler starter and finisher, respectively. Similarly, Kekeocha (1984) stated that 22 – 24% crude protein is ideal for broiler starter diet. The crude fibre of broiler starter ranged from 3.63 – 8.62% and that of broiler finisher 3.71 – 8.69%. The crude fibre levels in the diets increased linearly as the levels of CRC increased. This could be attributed to the higher crude fibre level of CRC compared to groundnut cake and maize which had lower crude fibre. The ether extract of both the starter and the finisher diets ranged from 2.50 – 3.30% and 2.00 – 7.50%, respectively. The ash content of the diets ranged from 2.50 – 3.30% in broiler starter and 3.00 – 9.00% in broiler finishers and the values are ideal for broiler diets as reported (Gwayo *et al.*, 2006). The nitrogen-free extract in both the starter (61.98-66.97%) and finisher (60.12-67.85%) diets were numerically similar. The metabolizable energy of broiler starter was 2834.91 - 3121.34 Kcal/kg and 3001.08 - 3271.25 Kcal/kg for broiler finisher diets. Generally the CRC based-diets contained lower energy compared to control diet. This was attributed to the higher energy content of groundnut cake and maize compared to CRC. However, all the values obtained in the diets were adequate for broiler starter and finisher in

Nigeria as recommended by Olomu (1995).

Growth performance

The results of the growth performance of the broiler chickens fed diets containing different levels of camel rumen content (CRC) are presented in Table 4. The initial live weights of the broilers at day-old were similar among the treatment groups. There was significant ($P < 0.05$) difference in daily feed intake and daily weight gain in broiler chicks. The chicks fed T5 (20% CRC) diet consumed more feed than the birds in T1 (0% CRC) and T2 (5% CRC) diets but did not differ ($P > 0.05$) from T3 (10% CRC) and T4 (15% CRC) diets. The higher feed consumption in CRC based-diets may be attributed to lower energy content of the diets, since chickens eat to satisfy their energy requirement. The results of daily feed intake were lower than values (61.20 – 64.30g) reported (Cheeke, 1987) who fed broiler chicks with goat rumen content. Broiler chicks fed control (0% CRC), T2 (5% CRC) and T3 (10% CRC) diets gained more weight than those on T5 (20% CRC) diet but were similar ($P > 0.05$) to broiler chicks fed T4 (15% CRC) diet. The decrease in daily weight especially in T5 (20% CRC) could be attributed to the increase in the level of dietary fibre. However, the values obtained in the treatment groups were similar ($P > 0.05$) to the values (19.22 – 24.94g) reported Joseph, et al. (1994) who fed goat rumen content to broiler chicks. Feed conversion ratio of broiler chicks were not significantly ($P > 0.05$) different. The body weight at four weeks for broiler chickens fed control (0% CRC) diet was heavier ($P < 0.05$) than those fed T4 (15% CRC) and T5 (20% CRC) diets but were similar ($P > 0.05$) to those fed T2 (5% CRC) and T3 (10% CRC) diets. Despite the reduction in the cost of the feed, the cost per kilogram gain of broiler at 4 weeks was higher in CRC based-diets as a

result of the higher feed intake and lower weight gain recorded during this period. Diets have no effect on the mortality of the birds because T1 (0% CRC) recorded the highest percentage mortality compared to other treatments. The results agreed with the observation of Gwayo *et al.* (2006) who fed goat rumen content to broiler chickens. During the finisher stage there were no significant ($P < 0.05$) differences on daily feed intake, daily weight gain and feed conversion ratio except final body weight which was significantly ($P < 0.05$) different among the treatment groups. However, the result contradicts the observation of Onu *et al.* (2011) who fed bovine blood-rumen content mixture to broiler finisher and reported significant ($P < 0.05$) difference in daily feed intake, daily weight gain and feed conversion ratio. The difference may be due to different test material (bovine-blood rumen content vs CRC) used in the experiments. Broiler chickens fed control (0% CRC), T2 (5% CRC) and T3 (10% CRC) diets had heavier ($P < 0.05$) final body weight than those fed T4 (15% CRC) and T5 (20% CRC) diets. This may be attributed to high fibre content in the diets containing higher levels of CRC. This result agreed with the report of Atuahene (1986) who revealed that higher fibre level in poultry diets depressed digestibility of nitrogen which may affect the final body weight of broiler chickens. Daily feed intake of broiler finisher fed camel rumen content had the range of 102.13-117.04g for T2 (5% CRC) and T3 (10% CRC) respectively, which was inferior to the values reported by Gwayo *et al.* (2006) who fed diets containing goat rumen content to broilers and reported a range of 138.20-150.20g. The insignificant daily feed intake recorded during the finisher stage may be an indication that older birds tolerate more fibre than younger ones. The daily weight

Broiler production fed diets containing different levels of camel rumen

gain was similar among the treatments and the values agreed with the report by Gwayo *et al.* (2006) who obtained daily weight gain of 27.63-42.34g at finisher stage. The feed conversion ratio was similar in all the treatment groups. The feed conversion ratio of broiler at finisher stage was better than the values (3.34-5.94g) reported by Adeniji (2001) who fed goat rumen content to broiler finisher. Mortality recorded in all the treatments neither depicted any pattern not implicated CRC as the cause of death. Adeniji (2001) stated that rumen content, if well processed, can be used as feedstuff in poultry diet without health hazard. Generally, there was improvement in the growth performance during the finisher stage compared to the starter stage.

The cost of kg diet (N) was linearly reduced for both broiler starter and finisher as dietary CRC increased in the diets. At the time of the experiment camel rumen content was obtained at N5/kg against N66/kg and N80/kg for maize and groundnut cake, respectively. This explains the reduction in the cost of kg feed as the level of camel rumen content increased. During the starter stage the feed cost (N) per kg of weight gain was affected ($P<0.05$) by the level of CRC in the diets of broiler chicks. The best cost per kg gain was obtained in broiler chicks fed control (0% CRC) diet followed by those fed diet T3 (10% CRC) while the poorest was obtained by broiler chicks fed diet T5 (20% CRC). This may be attributed to poor utilization of fibre in CRC based-diets at younger stage. At the finisher stage broilers fed T2 (5% CRC) diet showed the best feed cost (N) per kg gain, followed by broilers fed T4 (15% CRC) diet and the poorest was recorded in broilers fed T3 (10% CRC) diet.

Carcass characteristics

The carcass characteristics are presented in Table 2. The back, heart, kidneys, lungs,

liver and spleen were not significantly ($P>0.05$) different among the treatment groups. The result indicated that there were no effects on these organs, even at higher levels of 20% CRC inclusion in the diets of broilers at finisher stage. The live weight, dressing percentage, thighs, breast, drumstick, head, neck, intestine weight, proventriculus and gizzard were significantly ($P<0.05$) different among the treatment groups. The live weights of broiler chickens fed control (0%) and 5% CRC diets were heavier compared to other treatments. The broiler chickens fed 15% CRC diet had better dressing percentage than those on 20% CRC diet but were similar ($P>0.05$) to other treatment groups. The thighs of broiler chickens fed 15% CRC diet was significantly ($P<0.05$) heavier weight than those fed 20% CRC diet but did not differ from those fed control (0%) and 5% CRC diets. However, the lowest thighs weight value was obtained in broiler chickens fed 20% CRC diet. The breast of broiler chickens fed control (0%), 10% and 15% CRC diets were heavier ($P<0.05$) in weight than those fed 20% CRC diet but were similar to those broiler chicken fed 5%. The drumstick and head were heavier in weight at 15% CRC compared to those fed other treatment groups. The neck of broiler chicken fed 15% CRC diet was superior compared to broiler chicken fed 10 and 20% CRC diets but were not significantly ($P>0.05$) different from those fed control (0%) and 5% CRC diets. The intestine of broiler chickens fed 20 % CRC diet was heavier in weight compared to those fed control (0%) and 5% CRC diets but were similar to broiler chickens fed 10% and 15% CRC diets. The heavier weight of the intestine of broiler chickens on CRC – based diets may be attributed to higher fibre of these diets. Esonu *et al.* (2008) reported increase in

Table 3: Proximate composition of the experimental diets and camel rumen content

Nutrients(%)	Treatments/ Levels of camel rumen content in the Diets (%)									
	Starter Diets					Finisher Diets				
	T1(0%)	T2(5%)	T3(10%)	T4(15%)	T5(20%)	T1(0%)	T2(5%)	T3(10%)	T4(15%)	T5(20%)
Dry matter (DM)	89.20	87.90	90.50	87.30	89.30	90.90	94.10	93.80	91.8	92.70
Crude Protein (CP)	23.90	24.00	24.10	24.00	23.90	20.00	19.90	20.80	19.7	19.50
Crude fibre (CF)	3.63	4.89	6.13	7.38	8.62	3.71	4.98	6.20	7.45	8.69
Ether extract (EE)	3.00	3.50	2.00	1.50	2.50	7.50	6.00	3.70	2.00	2.00
Ash	2.50	2.50	3.00	3.00	3.00	4.60	9.00	4.90	3.00	4.50
Nitrogen -free extract (NFE)	56.17	53.01	55.27	51.42	51.28	54.19	54.22	54.50	59.65	58.01
Metabolizable Energy(Kcal/kg ME)	3121.34	3053.36	3015.79	2834.91	2907.24	3271.25	3147.11	3004.05	3008.48	3001.08

ME = Metabolizable energy calculated according to the formula of Pauzenga Pauzenga, U. (1985) Pauzenga, U. (1985)

ME = $37x\%CP + 81x\%EE + 35.5x\%NFE$.

CRC = camel rumen content

Broiler production fed diets containing different levels of camel rumen

weight and length of the various segments of the gastro-intestinal tract in rabbits fed high fibre diets. He explained this as an adaptation to accommodate more feed to compensate for the reduced energy density of high fibre diets. Also the proventriculus of broiler chickens fed 20% CRC diet was heavier weight than those fed 15% CRC diet but did not differ from other treatment diets. The gizzard of broiler chickens fed 20% CRC diet heavier in weight than control (0%) CRC diet but did not differ from other treatments diets. The pattern of gizzard weights could be linked to the slightly higher feed intake of the groups on CRC-based diets. All the parameters measured were similar to results obtained by (Esonu, *et al.*, 2006) who slaughtered broiler chickens with similar weight and ages. As protein quality is an important factor in muscle deposition, the similarity in the yield of carcass and organs weight with other workers may indicate the protein utilization was not significantly affected by the different levels of camel rumen content.

Apparent digestibility

The apparent digestibility of broiler chickens fed different levels of camel rumen content is shown in Table 5. The crude protein and crude fibre digestibilities were not significantly ($P > 0.05$) different among the treatments. The values (61.20 – 73.03%) for crude protein digestibility were similar to the values (58.05 – 72.06%) reported by Esonu *et al.* (2011) who fed broiler finishers with diets containing mixture of fermented bovine blood-rumen digesta. This present study may be an

indication that all the treatment groups utilized the crude protein effectively. The crude fibre digestibility ranged from 33.70 to 51.70% and was lower than the values (58.05 – 72.06%) reported by Esonu *et al.* (2011). There was significantly ($P < 0.05$) different in ash utilization of the broiler chickens. The broiler chickens fed T1 (0% CRC) and T2 (5% CRC) diets had better mineral (ash) absorption than those fed T4 (15% CRC) and T5 (20% CRC) diets but did not differ from those fed T3 (10% CRC) diet. However, the values (33.30 – 72.20%) obtained were inferior to the values (71.30 – 73.70%) reported by Esonu *et al.* (2011). The ether extract was affected ($P < 0.05$) by inclusion of different levels of CRC in the diets. Broiler chicken fed control (0% CRC) and T3 (10% CRC) diets had better ether extract digestibility than those broilers fed T4 (15% CRC) diet but were similar ($P > 0.05$) to broiler chickens fed T2 (5% CRC) and T5 (20% CRC) diets. The values (36.67 – 72.23%) obtained was lower than the values (71.20 – 74.70%) reported by Esonu *et al.* (2011). The variation of the nutrient utilization observed in this study could be due to higher crude fibre content of the test material (CRC) which tends to increase the total fibre content of the diets and dilute other nutrients, which may probably have interrupted the digestibility and effective utilization of the nutrients in the diets. These results agree with earlier studies by some authors who fed diets containing bovine rumen content to broilers and layers (Esonu *et al.*, 2006; Adeniji and Balogun, 2002).

Table 4: Growth performance of broiler chickens fed different levels of camel rumen content

	Treatments/ Levels of camel rumen content in the Diets (%)					
	T1(0%)	T2(5%)	T3(10%)	T4(15%)	T4(20%)	SEM
Parameters						
0 – 4 weeks (1-28 days)						
Initial body weight (g/birds)	34.34	35.19	34.35	35.82	34.50	1.02 ^{NS}
Body weight at 4 weeks (g/bird)	773.64 ^a	722.73 ^{ab}	737.57 ^{ab}	680.20 ^b	613.32 ^c	34.44 [*]
Daily feed intake (g/bird)	43.08 ^b	44.14 ^b	46.71 ^{ab}	46.56 ^{ab}	53.93 ^a	3.83 [*]
Daily weight gain (g/bird)	21.11 ^a	19.85 ^a	20.06 ^a	18.61 ^{ab}	16.54 ^b	1.33 [*]
FCR (feed : gain)	2.08	2.23	2.24	2.57	3.18	0.32 ^{NS}
¹ Cost of feed (₦/kg)	71.60	68.28	64.96	61.58	58.19	NA
Feed cost (₦/kg gain)	117.60	122.71	121.57	125.08	151.49	NA
Mortality (%)	8.00	6.00	3.00	2.00	4.00	NA
5 – 9 weeks (29-63 days)						
Final body weight (g/bird)	2782.10 ^a	2657.10 ^a	2494.60 ^a	2369.00 ^b	2346.70 ^b	2.55 [*]
Daily feed intake (g/bird)	110.75	102.13	117.04	107.78	114.73	8.28 ^{NS}
Daily Weight gain (g/bird)	40.94	40.65	41.81	39.80	37.64	4.35 ^{NS}
FCR (feed : gain)	2.82	2.67	2.94	3.04	3.61	0.54 ^{NS}
¹ Cost of feed(₦/kg)	69.60	66.20	62.81	59.43	56.05	NA
Feed cost(₦/kg gain)	135.02	122.45	146.30	132.57	134.12	NA
Mortality (%)	3.00	5.00	3.00	3.00	1.00	NA

SEM = Standard error of mean; NA = Not analysed; FCR = Feed conversion ratio; Calculated based on the market price of the ingredients (₦/kg) at the time of the experiment (maize = 66.00; wheat offal = 41; groundnut cake = 80; fish meal = 83; camel rumen content = 5; bone meal = 30; premix = 600; salt = 50, methionine = 1500; lysine = 1000); ₦ 160 = \$1 at the time of the experiment (2012)

Table 5: Carcass characteristic of broilers chicken fed graded levels of camel rumen

Parameters	Levels of different camel rumen content in the diets					SEM
	0% CRC	5% CRC	10% CRC	15% CRC	20% CRC	
Live weight	2782.10 ^a	2657.10 ^a	2494.60 ^b	2369.00 ^b	2346.70 ^b	72.55 [*]
Dressing percentage (%)	69.21 ^{ab}	70.23 ^{ab}	68.94 ^{ab}	76.14 ^a	64.54 ^b	4.07 [*]
As % of slaughter weight						
Thighs	11.61 ^{ab}	11.67 ^{ab}	10.91 ^{bc}	12.50 ^a	10.21 ^c	0.06 [*]
Back	16.95	17.72	16.28	17.64	15.28	1.40 ^{NS}
Breast	17.15 ^a	16.09 ^{ab}	17.10 ^a	17.36 ^a	14.86 ^b	0.98 [*]
Drumstick	9.53 ^b	9.50 ^b	9.08 ^b	10.85 ^a	9.08 ^b	0.46 [*]
Head	3.20 ^b	2.88 ^b	3.16 ^b	3.84 ^a	3.26 ^b	0.24 [*]
Neck	4.94 ^{ab}	4.72 ^{ab}	4.36 ^b	5.88 ^a	4.36 ^b	0.62 [*]
Heart	0.43	0.57	0.53	0.51	0.51	0.09 ^{NS}
Kidney	0.61	0.55	0.45	0.52	0.56	0.17 ^{NS}
Liver	2.77	3.39	3.06	3.41	2.93	0.36 ^{NS}
Lungs	0.70	0.62	0.74	0.68	0.56	0.14 ^{NS}
Intestine weight	8.13 ^b	7.95 ^b	9.66 ^{ab}	10.39 ^{ab}	11.23 ^a	1.19 [*]
Proventriculus	0.55 ^{ab}	0.74 ^{ab}	0.60 ^{ab}	0.41 ^b	0.56 ^a	0.13 [*]
Gizzard	4.00 ^b	4.51 ^{ab}	4.69 ^{ab}	5.04 ^{ab}	5.52 ^a	0.53 [*]
Spleen	0.15	0.22	0.22	0.14	0.22	0.06 ^{NS}

NS = Not significant (P>0.05); * = Significant; a, b, c = Means within the rows bearing different superscripts differ significantly (P < 0.05); SEM = Standard error of mean

Broiler production fed diets containing different levels of camel rumen

Table 6: Apparent digestibility of broiler chickens fed different levels of camel rumen content

	Treatments/ Levels of camel rumen content in the Diets (%)					
Nutrient (%)	T1(0%)	T2(5%)	T3(10%)	T4(15%)	T5(20%)	
SEM						
Crude Protein	63.23	73.03	61.20	69.17	71.80	6.99 ^{NS}
Crude Fibre	42.13	51.70	38.10	43.50	33.70	13.88 ^{NS}
Ash	64.60 ^a	72.20 ^a	53.17 ^{ab}	33.30 ^b	33.30 ^b	10.67*
Ether Extract	66.07 ^a	50.00 ^{ab}	72.23 ^a	36.67 ^b	50.00 ^{ab}	11.08*

NS = Not significant (P > 0.05); * = Significant; a, b = Means within the rows bearing different superscripts differ significantly
SEM = Standard error of mean

Conclusion

The study indicated that up to 15% level of camel rumen content (CRC) can be fed to broiler chicks without deleterious effects on growth performance. However, at broiler finisher stage up to 20% level of CRC can be included in the diets without adverse effect on growth performance. The use of camel rumen content as feed ingredient reduced feed cost and lowered cost per kg weight gain at finisher stage. Finally, there is need to explore other processing methods or the use of exogenous enzymes that will enhance better utilization of camel rumen content in the diet of broiler chickens.

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