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Performance and organ characteristics of broiler chickens fed varying levels of rumen content

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Abstract

A trial was carried out to evaluate the effect of replacing wheat offal with rumen content on the growth performance of broiler chickens. A total of one hundred and fifty (150), one day-old broiler chicks were randomly allotted to five (5) dietary treatments containing 0, 5, 10% inclusion levels of sundried rumen content and 5 and 10% inclusion levels of roasted rumen content as a replacement to wheat offal. Each treatment was replicated three times with five (5) birds per replicate in a completely randomized design experiment. The trial lasted for eight (8) weeks. The results showed that there were no significant differences in the final weights, daily feed intake, daily weight gain and feed conversion ratio at the starter phase and finisher phases. Furthermore, no significant differences in the final weight (1346.60-1508.50g), daily feed intake (83.57-100.00g), and daily weight gain (36.43-39.53g), and were observed for the overall performance. However, there was a significant difference ($P<0.05$) in the feed conversion ratio with the highest being 2.69g and the lowest 2.33g in the overall performance. From these findings, it could be concluded that rumen content could replace wheat offal without any detrimental effect on the performance of broiler chickens.

Keywords: Rumen content, broiler, chicken and organ.

Introduction

A major problem facing the development of broiler chicken production is the availability and high cost of feedstuff. A significant cost of production faced by poultry farmers is that of feed (55 – 70%) and because it is usually unaffordable by the poor peasant farmers, the output is generally poor, thus leading to a shortage in the availability of protein to the citizenry (Atteh, 2003). There is also competition between man and poultry for conventional feedstuff like maize, wheat, soya bean among others. There is, therefore, the need for alternative and non-conventional feedstuffs to be used (Biobaku *et al.,* 1999). Rumen content is a solid waste generated daily at abattoirs in Nigeria with about 50,000 metric tonnes available per year (Makinde, 2008). The content is made up of plant materials at various stages of digestion and is rich in microbial protein (Emmanuel 1978; McDonald *et al.,* 1990). The nutrient content and chemical composition of the diets destined for poultry feeding have been modified in the last decade with the aim of improving feed intake and productivity. An increase in nutrient concentration and digestibility of the ingredients together with a reduction in feed particle size to improve quality are some of the changes introduced. The implementation of these strategies has resulted in a decrease in crude fibre content of the diets and variations of the overall structure of the feed. The growth in Nigeria's poultry sector is constrained by the persistent scarcity and high cost of major feed inputs such as corn and soya bean meals. On the other hand, there is a need to increase animal productivity in order to make animal protein sources available and more affordable to Nigeria's populace. This could be enhanced by turning discarded rumen content to a useful

source of nutrient**.** Esonu *et al*. (2006) and Dairo *et al*. (2006) state that rumen content is the consumed plant material that ruminant animals ingest and is later harvested while it is at various stages of digestion. It is rich in protein and other micro-flora such as fungi, protozoa, and bacteria. Rumen content from cattle and other ruminants like sheep and goats is a substantial waste that is readily available daily at abattoirs (Odunsi *et al*., 2004). Although, monogastric species cannot digest cellulose and other fibrous materials in rice milling waste, yet the available protein in rumen digesta can be utilized by broilers to obtain useful nutrients. Therefore, the use of rumen digesta can reduce feed costs thereby increasing the rate of profit to the poultry producers. The study was therefore conducted to assess the performance and organ characteristics of broiler chickens fed diets containing varying levels of rumen content.

Materials and method

Experimental site

The research was carried out at the poultry research farm of Bauchi State College of Agriculture. The college is located at Yelwan along Tafawa Balewa road in Bauchi Local Government Area of Bauchi State. The State lies between longitude $10^{0}10^{1}$ to 30^{1}N and latitude 9041 and $10^{0}31^{1}$E at an altitude of 6902 metres above sea level (Bauchi State Agricultural Development Programme, nd).

Experimental birds and their management

A total of 150, day-old chicks were purchased from Zartech hatchery. The chicks were brooded in well ventilated pens for two weeks and fed commercial feed during the brooding period. After brooding, chickens were randomly allotted to five experimental treatments, each treatment was replicated three times with ten birds per replicate. Vaccination of the birds with infectious bursal disease vaccine (IBDV) was conducted at the first week and repeated at third week, while Newcastle disease vaccine (Lasota) was administered at the second and fourth weeks. The experimental diet and water were given ad-libitum from the second week up to the eighth week of the study. Medications were also administered during this experimental period.

Experimental diets

Five diets were formulated as diets A, B, C, D and E, each for the starter and finisher phases. Diet A for both the starter and finisher phases did not have rumen content (i.e control) while diet B, C, D and E contained rumen content as a replacement to wheat offal. Diet B and C comprised of sun dried rumen content at 5% and 10% levels of inclusion respectively, while roasted rumen content was included also at 5% and 10% in diets D and E, respectively. The various diets were compounded manually; the starter contained 23% crude protein while the finisher contained 21% crude protein. The percentage composition and calculated analysis of the experimental diets are shown in the Tables 1 and 2.

Experimental design

The experimental design was a completely randomized design (CRD). Five different diets formed the treatments and each treatment was replicated three times with ten birds per replicate.

Data collection

The experiment lasted for eight (8) weeks during which data were collected from the third to eighth week on several parameters monitored. Feed intake was calculated by deducting left over from feed offered. Birds were weighed using a weighing scale while weight change was determined by subtracting the initial weight from the final weight.

Data analysis

Data collected were subjected to analysis of variance using SPSS statistical package 21 and least significance differences (LSD) were differentiated as described by Steel and Torrie (1984).

Table 1: Composition of experimental diets at starter phase

	Diets				
		SRC		RRC	
Ingredients	**A (0%)**	**B (5%)**	**C (10%)**	**D (5%)**	**E (10%)**
Maize	50.70	50.70	50.70	50.70	50.70
Soya bean meal	33.00	33.00	33.00	33.00	33.00
Wheat offal	10.00	5.00	-	5.00	-
Rumen content	-	5.00	10.00	5.00	10.00
Fish meal	2.00	2.00	2.00	2.00	2.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Limestone	1.50	1.50	1.50	1.50	1.50
Premix	0.25	0.25	0.25	0.25	0.25
Salt	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
Toxail binder	0.10	0.10	0.10	0.10	0.10
TOTAL	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

SRC= sun dried rumen content; RRC= roasted rumen content
A=0%; B =5% SRC, C=10% SRC, D=5% RRC, E=10%RRC

Table 2: Composition of experimental diets at finisher phase

Ingredient	**A**	**B**	**C**	**D**	**E**
Maize	49.60	49.60	49.60	49.60	49.60
Soya bean meal	29.10	29.10	29.10	29.10	29.10
Wheat offal	15.00	7.50	-	7.50	-
Rumen content	-	7.50	15.00	7.50	15.00
Fish meal	2.00	2.00	2.00	2.00	2.00
Limestone	1.50	1.50	1.50	1.50	1.50
Lysine	0.10	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10	0.10
Premix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Toxil binder	0.10	0.10	0.10	0.10	0.10
Bone meal	2.00	2.00	2.00	2.00	2.00
TOTAL	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

SRC= sun dried rumen content; RRC= roasted rumen content
A=0%; B =5% SRC, C=10% SRC, D=5% RRC, E=10%RRC

Results

Performance of broiler chickens fed graded levels of rumen content based diets at starter phase

The performance of broiler chickens fed graded levels of rumen content is presented in Table 3. All values obtained were not significantly different among the treatments. The initial weight ranged from 118.75 g in birds on diet A to 123.75 g in chicks on diet B. The final weights obtained were 668.75 g, 666.67 g, 611.46 g and 639.58 g for diets A, B, C, D and E, respectively. The daily feed intake varied from 49.42 g in chicks fed diet D to 50.74 g in birds on diet A. The daily weight gain was found to be 19.57 g, 18.53 g, 18.38 g, 19.24 g and 17.34 g for diet A, D, B, E and C respectively; however, all the daily weight gains were similar. The higher feed conversion value was obtained in birds on diets C while the lowest value was obtained in diet A.

Table 3: Performance of broiler chickens fed graded levels of rumen content based diet at starter phase

Parameter	A (0%)	B (5%)	C (10%)	D (5%)	E (10%)	SEM	LS
Initial weight	118.75	123.75	116.88	120.63	115.92	1.20	NS
Final weight	668.75	666.46	611.46	49.42	600.46	56.00	NS
Daily feed intake	50.74	49.62	49.59	49.42	49.45	1.34	NS
Daily weight gain	19.57	18.38	17.34	18.53	18.35	1.30	NS
FCR	2.26	2.87	2.87	2.66	2.75	0.35	NS

SEM= Standard Error of Mean; NS= Not Significant; FCR= Feed Conversion Ratio, SRC= sun dried rumen content; RRC= roasted rumen content
A=0%; B =5% SRC, C=10% SRC, D=5% RRC, E=10%RRC

Performance of broiler chickens fed graded levels of rumen content based diets at the finisher phase

Table 4 shows the performance of broiler chickens fed on graded levels of rumen content based diets at finisher phase. The initial weight ranged from 668.75 g in birds on diet A to 611.67 g in chickens on diet C. The means did not differ among the dietary treatments. Similarly, values of the final weight were not statistically different with the final weights varying from 2350.4 g in birds on diet B to 2257.8 g in chickens on diet A. The feed intake, daily weight gain and feed conversion rations were also not different statistically. The daily feed intakes were 151.59 g, 117.52 g, 137.59 g, 132.97 g and 135.45 g for diets A, B, C, D and E, respectively. While the highest daily weight gain value was obtained in birds on diet B, the lowest value was obtained with diet C. Furthermore, the feed conversion ratio obtained in birds on diet C with a value of 2.50 was found to be higher compared to 1.96 on diet B.

Table 4: Performance of broiler chickens fed graded levels of rumen content based diets at the finisher phase

Parameter	A (0%)	B (5%)	C (10%)	D (5%)	E (10%)	SEM	LS
Initial weight	688.75	666.67	611.46	639.58	661.54	36.56	NS
Final weight	2257.80	2350.40	2081.70	224.70	221.55	76.10	NS
Daily feed intake	151.59	117.52	137.59	132.97	135.69	13.50	NS
Daily weight gain	58.26	60.71	55.35	57.92	56.99	3.50	NS
FCR	2.47	1.96	2.50	2.45	2.15	0.23	NS
Mortality	6	9	4	8	5		

SEM= Standard Error of Mean; NS= Not Significant, FCR= Feed Conversion Ratio, SRC= sun dried rumen content; RRC= roasted rumen content
A=0%; B =5% SRC, C=10% SRC, D=5% RRC, E=10%RRC

Overall performance of broiler chickens fed graded levels of rumen content based diets

The performance of broiler chickens fed graded levels of rumen content is presented in Table 5. All values were not significantly different between the dietary treatments. The final weight of the birds ranged from 1508.50 g on diet B to 1346.60 g for birds on diet C. The daily feed intakes were 100.00g, 83.57 g, 93.56 g, 91.29 g and 92.55 g for diets A, B, C, D and E respectively. The daily weight gain varied from 39.53 g in birds fed diet B to 36.34 g for birds on diet C. The highest feed conversion values were obtained in birds on diet C with a value of 2.69 and the lowest in diet B with a value of 2.33 g.

Table 5: Overall performance of broiler chicken fed graded levels of rumen content based diets

		SRC		RRC			
Parameter	**A (0%)**	**B (5%)**	**C (10%)**	**D (5%)**	**E (10%)**	**SEM**	**LS**
Final weight	1485.50	1508.50	1346.60	1443.00	1453.11	39.36	NS
Daily feed intake	100.00	83.37	93.56	91.29	92.21	4.43	NS
Daily weight gain	38.92	39.34	36.34	38.24	37.59	1.50	NS
FCR	2.37	2.33	2.69	2.48	2.55	0.08	*
Mortality	0	0	0	0	0	0	

SEM= Standard Error of Mean; NS= Not Significant, FCR= Feed Conversion Ratio, SRC= sundried rumen content, RRC= roasted rumen content ; A=0%; B =5% SRC, C=10% SRC, D=5% RRC, E=10%RRC

Based on the study findings, the data on the carcass weights of broilers at the end of the experiment (Table 6 below) revealed that there was no significant difference in the live weights of the broilers between the different treatments. However, birds fed with diet E had the least live weight (2100 g) whereas the highest value was recorded in birds fed with the control diet. A weight of 2350 g was obtained for both diets B and D. The plucked weights indicated that there was a significant difference ($p<0.05$) between the treatments. The weights of birds fed with diet C were similar to those of birds fed with diet D. The highest plucked weights were recorded in birds fed with the control diet (2220 g) followed by birds fed with diet B (1999 g) while the least were observed in birds fed with diet E (1704 g). The carcass weights of the broilers revealed that there was no significant difference ($p>0.05$) between all the treatments. Birds in the control diet with a 0% inclusion level of rumen content had the highest carcass weight (1602 g) while the least was recorded in 10% SRC (diet C) with 1258 g.

Table 6: Carcass, organs and gut weight expressed as percentage of live weight

Parameters	**A**	**B**	**C**	**D**	**E**	**SEM**
Final live weight (g)	2450.00	2350.00	2200.00	2350.00	2100.00	0.23^{NS}
Pluck weight (g)	2220.00^{c}	1999.00^{b}	1941.00^{ab}	1803.00^{ab}	1704.00^{a}	0.21^{*}
Carcass weight (g)	1602.00	1424.00	1258.00	1277.00	1302.00	0.27^{NS}
Dressing %	65.44	60.81	57.77	54.34	62.13	0.72^{NS}
Liver weight (%)	2.54^{c}	1.57^{ab}	1.43^{a}	1.64^{a}	1.48^{ab}	0.00*
Heart weight (%)	0.82^{b}	0.75^{b}	0.50^{a}	0.43^{a}	0.43^{a}	0.001*
Spleen weight (%)	0.93^{c}	0.75^{b}	0.57^{ab}	0.58^{ab}	0.55^{a}	0.010*
Gizzard weight (%)	4.10^{b}	4.22^{b}	3.86^{ab}	3.21^{a}	3.90^{ab}	0.093^{NS}
Large intestine weight (%)	5.52^{b}	4.42^{a}	3.78^{a}	3.70^{a}	3.82^{a}	0.009*
Small intestine weight (%)	1.47	1.49	1.34	1.28	1.33	0.793^{NS}
Head and leg weight (%)	6.79	5.58	5.21	5.11	5.45	0.284^{NS}

^{a,b,c}=*Means in the same row with different superscripts are significantly different (p>0.05 ;)* NS = Not Significant, *SEM = Standard Error of Mean; SRC= Sundried Rumen Content; RRC= Roasted Rumen Content A=0%; B =5% SRC, C=10% SRC, D=5% RRC, E=10%RRC*

The organ weights, expressed as a percentage of live weights are shown in Table 6 above. There was a significant difference ($p<0.05$) on values obtained for liver weights between the different treatments, with the highest percentage being recorded among birds fed the control diet while the least value was recorded in diet C (1.43%) and then diet E with 1.48%. There were no significant differences ($p>0.05$) in the heart weights between the treatments, with the highest percentage (0.82%) value recorded in birds fed diets without the rumen content (control) whereas the least (0.43 %) was recorded at both diets of the RRC. On the other hand, the spleen weight values were significantly different ($p<0.05$) between the treatments, with the

control diet having the highest spleen weight (0.93%) followed by the 5% SRC (diet B) with 0.74%. The least value (0.55%) of spleen weight was obtained with diet E. The gizzard weights in relation to live weights indicated a non-significant difference between the treatments ($p>0.05$). Birds fed with 5% sun dried rumen content (diet B) had the highest value of 4.3% of gizzard weight followed by the control group while the least among the values obtained was observed in birds fed 5% RRC (3.210%). The 10% SRC and 10% RRC (C and E) diets recorded values of 3.86% and 3.90% respectively. The results also indicated that there were significant differences ($p<0.05$) in the large intestine weights recorded. Birds with 5.52% on the control treatment had the highest value while birds fed with 5% RRC had the least percentage large intestine weights of 3.70%. The small intestine weights had no significant differences between the treatments and the weights ranged from 1.49% to 1.28% of live weight, where the highest value was recorded for birds fed with the 5% SRC diet. Furthermore, birds fed with 10% SRC had the least percentage of the head and leg weights (5.21%) whereas the highest percentage of head and leg weights were recorded for birds fed with the control diet (6.790%). There were no significant differences ($p>0.05$) in the percentage weights of legs and heads of the broilers on different treatments.

Discussion

The daily feed intake was not significantly different between all the dietary treatments in the starter (49.42-50.74 g) and finisher (117.52-151.59 g) phases. This result was in conformity with the findings of Adeniji and Jimoh (2007), who fed different inclusion levels of rumen content to pullet chicks and obtained similar values of feed intake. The daily weight gains observed at the starter (49.42-50.74 g) and finisher (117.52-151.59 g) phases were not affected by the dietary levels of inclusion of rumen content. A similar trend was also found at the overall weight gain (36.34-39.53 g). In contrast to these findings, Yakubu *et al.* (2007) reported that, broiler chickens fed urea treated rumen content at 12% showed a significantly higher carcass yield and liver weight. This difference could be due to the urea treatment done to the rumen content. The feed conversion ratio at the starter (2.26-2.87) and finisher (1.96-2.5) phases were statistically similar among the dietary treatments. However, there was a significant difference among the treatments at the overall feed conversion ratio. The values obtained for the final live weight indicated that there was no significant difference ($p>0.05$) in the final live weight of broiler chickens fed the differently processed rumen content. The findings agreed with the earlier work of Gwayo *et al*. (2006) who reported no significant difference in the final live weight of broilers fed different inclusion levels of goat rumen digesta. Also, the finding was in line with t Elfaki *et al*. (2015) that there is no significant difference on the live weight of broilers fed with dietary processed dried rumen content. The findings indicate that the significant difference ($p<0.05$) among the treatments on the percentage plucked weight did not agree with the observation made by Gwayo *et al.* (2006), who observed no significant difference between the control group and the treatment groups fed rumen digesta as a replacement for wheat offal as a dietary fibre source at both starter and finisher phases. The experiment carried out on the carcass weights had no significant ($p>0.05$) effect on the percentage live weights of broilers fed with sun dried and roasted rumen content. This agreed with the earlier work of Elfaki *et al.* (2015) that there was no observable difference in the carcass weights of broilers fed dietary treated rumen content. Table 6

shows the organ weights of broilers at the end of the research. The gizzard weight was not different between all means and ranged from (4.22 to 3.21%). On the other hand, Gwayo *et al.* (2006) reported differences in weights of gizzard and the heart while all other organs were not significantly different. This may likely be due to differences in the processing method and the source of biodigesta between the two studies. However, the results agreed with the findings made by Elfaki *et al.* (2015) that there was no significance difference in the weights of spleens between the treatment groups. The result on the weights of the small intestines indicated no significant difference ($p > 0.05$) between the treatment means and thus agreed with observations made by Elfaki *et al.* (2015).

Conclusion and recommendation

The results of the study indicated that dried rumen content can be incorporated in broiler diets at 10% replacement level of wheat offal without adverse effects on carcass yield. Therefore, using rumen biodigesta in poultry diet could reduce the cost of feeding and subsequently prevent environmental pollution which the biodigesta may have caused. Furthermore, up to 10% of dried rumen content can be used as a cheap source of energy and protein for poultry, though, its inclusion must be done with caution, as studies have not yet determined the microbial impact it might have. As such, the need for more researches cannot be over emphasised.

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