INFLUENCE OF COMBINED BOVINE RUMEN DIGESTA ON HAEMATOLOGICAL AND SERUM BIOCHEMICAL INDICES OF FINISHER BROILER CHICKENS

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Abstract: An experiment was conducted to partially substitute graded levels of combined bovine (camel and cattle) rumen digesta (CBRD) for maize and subsequently determined the effect on haematological and serum biochemical indices of finisher broiler chicken. One hundred and fifty day-old (150) (Marshall) broiler chicks were randomly allotted to 5 dietary treatments of three replicates of 10 chicks each. The experimental diets were formulated with cow and camel rumen content (combined rumen content (CBRD)) in the diets of broilers (ratio of 1:1) at 0, 20, 25, 30 and 35% inclusion levels and designated as T_1, T_2, T_3, T_4 and T_5, respectively. Data obtained were subjected to analyses of variance in a completely randomized design (CRD) using SAS (2009) and significant means were separated using Duncan's Multiple Range Test of same statistical package at 5% level of probability. Feed and water were supplied *ad libitum* for 8 weeks. Data were generated for haematological and serum biochemical parameters. Results from the blood analysis revealed no significant (P>0.05) effect of CBRD on haematological parameters measured. The PCV ranged between 37.25% for birds fed 35% CBRD diet to 33.10% for birds fed 25% CBRD diet. The WBC value ranged from 253.75 ($x10^3/mm^3$) for birds fed 35% CBRD diet to 233.25 ($x10^3/mm^3$) for birds on control diet. Similarly, the result of biochemical indices showed no significant (P>0.05) influence on all the parameters measured. The creatinine value ranged from 0.045 to 0.041 mmol/dl (0, 25 and 30%), respectively. AST value ranged from 32.50 for birds fed control diet to 27.00 for birds fed 20% CBRD diet. ALT values ranged from 17.83 to 16.33 (0, 30%), respectively. It was concluded that CBRD supplementation up to 35% inclusion levels could be used to substitute maize partially in the diets of finisher broiler chickens as it does not pose any health risk to the chicken based on the results of the haematological and serum biochemical indices.

Keywords: Combined bovinerumen digesta, haematological, serum biochemical indices

Introduction

The feed nutritionist played a major role in the formulation and preparation of balanced feed by selecting the available materials based on their nutritional properties, availability, price and constituent proportions, in order to meet the nutrient requirements of the various categories of animals. Meanwhile, feed cost is a major obstacle to poultry production in Nigeria. Feed alone accounts for up to 75% of total cost of broiler production (Ubosi, 2000). The industry in Nigeria has suffered more than any other livestock enterprise as a result of rising costs and short supply of essential raw materials such as maize, ground nut cake and soya bean meal. Some non-conventional feed ingredients, which are available locally, could be incorporated to replace reasonable proportion of the conventional energy and protein ingredients and reduce feed cost. This scenario necessitated the exploration into locally cheap available unconventional feedstuffs such as bovine rumen content waste.

Rumen content is an abattoir waste that can offer a cheap, viable protein and substantial utilizable energy to maize which has become very expensive in Nigeria (Dairo *et al*., 2005). Rumen content contains the end products of microbial metabolic activities such as microbial protein, amino acids, vitamins, volatile fatty acids (VFA) and contains no anti-nutritional factors (Okpanachi *et al*., 2010). Agbabiaka *et al*. (2011) reported that rumen digesta is the partially digested forage mainly found in the rumen of ruminant animals and fairly rich in crude protein content. These waste materials, if properly treated could be used for poultry feed. The rumen content is relatively cheap, constitute disposal problem at the abattoir and locally available. Oladunjoye and Ojebiyi (2010) reported that is cheaper and locally available alternative agro-by-product, especially without nutritional value to mankind. Furthermore, utilization of rumen content as animal feed will increase the flexibility of ration formulation and reduce environmental pollution.

Blood helps in the transportation of nutrients, metabolic waste, gases and other materials to other parts of the body. Evaluation of blood parameters served as pointer for nutritionist, pathologist and physiologist to determine animal's welfare because of its dynamic nature. Blood acts as a reflector of the status of animals exposed to diseases and other conditions (Olafedehan *et al.*, 2010). Haematological profile both in human and animal is an important indicative factor of the physiological state of an individual. Previous findings showed that addition of either cattle (Gebrehawariat *et al.*, 2016) or camel rumen digesta (Makinde *et al.*, 2017) revealed better performance at 15% for poultry birds. This experiment was therefore carried out to determine the effect of higher levels of combined cattle and camel rumen content to replace maize on the haematological and serum biochemical indices of broiler chickens.

Materials and Methods

Collection of rumen digesta and processing

Camel and cattle rumen digesta were collected differently from Dutse abattoir, Jigawa State. After slaughtering, the rumen of each animal was split opened with aid of sharp butcher's knife and the contents emptied into polythene bags. The rumen was allowed to drain in the sack, after draining, the rumen contents were then spread on a cemented floor and allowed to sundry while turning was done between 3 - 4 h interval until the moisture content was below 15% after 4 to 5 days of sun-drying. The dried rumen digesta was then ground and incorporated into the diets.

Experimental site and design

The experiment was carried out at the Poultry Unit of the Teaching and Research Training Unit, Federal University, Dutse, Jigawa State. One hundred and fifty (150) day old-chicks were purchased from a reputable hatchery for the research. The chicks were allotted to five (5) treatments in groups of 30 birds per treatment. Each treatment was replicated thrice with 10 birds each. The birds were raised in a deep litter system for 8 weeks. Feed and clean drinking water were supplied to the birds *ad libitum* during the experiment which lasted for 8 weeks. Five experimental diets for both starter (23.02% CP) and finisher (20.76% CP) phases were formulated in which combined rumen content replaced maize at 0, 20, 25, 30, and 35% designated as treatments T1, T2, T3, T4 and T5, respectively as shown in Tables 1 and 2. At the end of the experimental period, 6 birds per treatment were randomly selected, fasted over night from which blood samples were collected and used for haematological and serum biochemical measurements. Haematological samples were collected into sample tubes containing ethylene diamine tetra-acetic acid (EDTA). Haematological parameters analysed were packed cell volume (PCV), red blood cells (RBC) count, white blood cell (WBC) count, haemoglobin (Hb) concentration, mean cell volume (MCV), mean corpuscular haemoglobin concentration (MCHC) and platelet. They were measured according to the methods of Bush (1991). Serum was obtained after the blood in the anticoagulant free tubes was allowed to stand for two hours at room temperature and centrifuged at 2000 revolutions per minute for 10 min. Total protein (TP), albumin, globulin, creatinine, total cholesterol, uric acid, alanine aminotransferase (ALT) and aspartate aminotransferase (AST) were determined.

Table 1: Gross composition of experimental diets for broiler starter

Ingredients (%)	Treatments (%)				
	0	**20**	**25**	**30**	**35**
Maize	47.00	27.00	22.00	17.00	12.00
Wheat offal	15.00	15.00	15.00	15.00	15.00
Fish meal	3.00	3.00	3.00	3.00	3.00
Camel rumen content	0.00	10.00	12.50	15.00	17.50
Cattle rumen content	0.00	10.00	12.50	15.00	17.50
Soya bean meal	16.00	16.00	16.00	16.00	16.00
Groundnut cake	14.60	14.60	14.60	14.60	14.60
Bone meal	1.80	1.80	1.80	1.80	1.80
Lime stone	1.50	1.50	1.50	1.50	1.50
Premix	0.30	0.30	0.30	0.30	0.30
Salt	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25
Methionine	0.30	0.30	0.30	0.30	0.30
Total	**100**	**100**	**100**	**100**	**100**
Calculated analyses					
Metabolizable Energy	2955	2913	2902	2892	2871
Crude protein	23.02	23.02	23.02	23.02	23.02
Ether extract (%)	4.03	3.85	3.81	3.76	3.71
Crude fiber (%)	3.22	5.21	5.18	4.89	5.13
Calcium (%)	1.16	1.17	1.17	1.17	1. 17
Phosphorus (%)	0.41	0.46	0.47	0.48	0. 49
Lysine (%)	1.29	1.31	1.32	1.32	1. 33
Methionine (%)	0.59	0.58	0.57	0.57	0.57

Table 2: Gross composition of experimental diets for broiler finisher

Ingredients	Treatments (%)				
	0	**20**	**25**	**30**	**35**
Maize	54.00	34.00	29.00	24.00	19.00
Wheat offal	15.00	15.00	15.00	15.00	15.00
Fish meal	2.00	2.00	2.00	2.00	2.00
Camel rumen content	0.00	10.00	12.50	15.00	17.50
Cattle rumen content	0.00	10.00	12.50	15.00	17.50
Soya bean meal	11.00	11.00	11.00	11.00	11.00
Groundnut cake	13.00	13.00	13.00	13.0	13.00
Bone meal	1.50	1.50	1.50	1.50	1.50
Lime stone	1.50	1.50	1.50	1.50	1.50
Premix	0.30	0.30	0.30	0.30	0.30
Salt	0.25	0.25	0.25	0.25	0.25
Lysine	0.20	0.20	0.20	0.20	0.20
Methionine	0.25	0.25	0.25	0.25	0.25
Total	**100**	**100**	**100**	**100**	**100**
Calculated analyses					
Metabolizable energy	2,998	2,966	2,956	2,945	2,935
Crude protein (%)	20.76	20.76	20.76	20.76	20.76
Ether extract (%)	4.09	3.89	3.84	3.79	3.74
Crude fiber (%)	3.66	4.03	4.72	4.85	5.11
Calcium (%)	1.07	1.08	1.08	1.08	1.08
Phosphorus (%)	0.36	0.41	0.42	0.43	0.44
Lysine (%)	1.14	1.16	1.16	1.17	1.17
Methionine (%)	0.57	0.55	0.55	0.55	0.54

Statistical analysis

Data obtained were subjected to analysis of variance in a completely randomized design (CRD) using SAS (2009). Significant means at 5% level of probability were separated using Duncan's Multiple Range Test of the same statistical package.

Results and Discussion

The proximate composition of the combined digesta rumen content is presented in Table 3. The crude fibre and ash values of the CBRD were higher compared to values obtained for cattle and camel singly. The protein of CBRD was high and could serves as good protein source for both starter and finisher phases of broiler chickens. The ether extract and nitrogen free extract were within the same range for CBRD and individual test ingredient.

Table 3: Proximate composition of the test ingredients

Parameters	Camel Rumen	Cattle Rumen	Combined Rumen content (CRC)
Dry matter	91.55	93.70	92.75
Ash (%)	10.85	10.85	12.2
Crude protein (%)	12.76	18.59	25.69
Crude fiber (%)	11.86	11.17	18.49
Ether extract (%)	7.20	5.30	5.90
Nitrogen free extract (%)	57.33	54.08	57.72
Metabolizable energy(Kcal/kg)	2110	3150	3490

Effect of combined rumen digesta on haematological parameters of finisher broiler chickens is shown in Table 4. The haematological parameters measured shows that combined rumen digesta had no significant (P>0.05) influence on all parameters measured. The values obtained for PCV ranged between 37.25 for birds fed 35% CBRD diet to 33.10% for birds fed 25% CBRDdiet. The WBC values ranged from 233.25 to 253.75x10^3/mm^3 for diet T1 and T5, respectively. Similarly, values recorded for RBCs ranged between 2.49x 10^6/mm^3 for birds fed 25% CBRDdiet to 2.77 x 106/mm^3 for birds fed 35% CBRD diet. Bird fed 0, 20, 35% had higher MCV values compared to birds fed 25 and 30% CBRD although the values were not statistically (P>0.05) significant. The MCH value ranged from 40.55 to 42.30

(30%, 20), respectively. Birds fed 30% CBRD diet had the highest MCHC value (32.60) compared to other treatments although not statistically (P>0.05) significant. The differential count was not significantly (P>0.05) affected by the dietary treatment.

Table 4: Effect of combined rumen digesta on haematological parameters of finisher broiler chickens

Parameters	T_1 (0%)	T_2 (20%)	T_3 (25%)	T_4 (30%)	T_5 (35%)	SEM
PCV (%)	33.75	33.70	33.10	34.75	37.25	0.12
RBC ($x10^6/mm^3$)	2.69	2.52	2.49	2.56	2.77	0.14
WBC ($x10^3/mm^3$)	233.25	241.55	239.65	239.65	253.75	0.13
Hb (g/100ml)	11.95	10.60	10.45	10.35	11.60	0.22
MCV (fl)	134.75	134.00	129.00	124.45	134.75	0.12
MCH (pg)	41.20	42.30	41.95	40.55	42.00	0.10
MCHC (%)	30.65	31.50	32.50	32.60	31.20	0.67
Deferential Count (%)						
Platelet	28.00	29.50	28.50	30.0	29.00	0.18
Neutrophils	2.75	3.01	3.16	2.71	3.28	0.10
Eosinophils	1.11	1.33	1.33	1.48	1.28	0.10
Basophilis	1.01	1.11	1.15	1.18	1.32	0.45
Lymphocytes	91.95	92.44	94.41	95.70	95.49	0.16

(P>0.05), SEM= Standard error of mean. CCRC= combine camel and cattle rumen content. PCV= packed cell volume WBC= white blood cell, Hb = haemoglobin. MCV= mean corpuscular volume. MCH= mean corpuscular haemoglobin. MCHC= mean corpuscular haemoglobin concentration. PLT = platelate. NEU = neutrophils. EOS = eosinophils. BAS = basophils. LYM = lymphocytes.

Table 5: Effect of combined rumen digesta on serum biochemical parameters of finisher broiler chickens

Parameters	T_1 (0%)	T_2 (5%)	T_3 (10%)	T_4 (15%)	T_5 (35%)	SEM
Protein (g/dl)	41.00	42.00	40.00	40.00	40.00	0.20
Albumin (g/l)	15.50	17.50	14.50	15.50	16.50	0.11
Cholesterol(mmol/l)	2.80	3.20	2.85	2.70	2.80	0.11
Globulin (g/l)	25.50	24.50	25.50	24.50	23.50	0.18
Glucose(mmol/l)	3.89	3.96	4.04	3.91	3.90	0.16
Uric acid (mmol/l)	2.07	2.07	1.57	1.57	1.95	0.73
Creatinine(mg/dl)	0.045	0.044	0.041	0.041	0.043	0.11
Sodium(Na^+)(mmol/l)	144.50	145.33	151.50	147.00	149.50	1.19
Chlorine(Cl)(mmol/l)	105.50	112.50	109.00	107.00	110.00	0.46
Potassium(K)(mmol/l)	9.85	9.47	9.05	10.15	10.12	0.27
AST (µ/l)	32.50	27.00	28.50	29.50	29.00	0.26
ALT (µ/l)	17.83	16.00	16.00	16.33	16.00	0.29

(P>0.05) SEM= Standard error of mean. CCRC= combine camel and cattle rumen content. ALT=alanine aminotransferase and AST= aspartate aminotransferase, (G/L) gramm per litre, (MMOL) millimole per litre, (µMOL/L) micromole per litre, (µ/l unit per litre, (G/DL) gramm per decilitre

The effect of combined rumen digesta on biochemical parameters of broiler chickens is presented in Table 5. All the serum biochemical parameters measured were not significantly (P>0.05) influenced by the dietary treatment. Birds fed 25, 30, 35% CBRD diet recorded similar value (40.00 g/dl) for total protein while birds on 20% CBRD recorded 42 .00 (g /dl) total protein. Birds fed 25% CBRD diet recorded higher glucose (4.04 mmol/l) compared with bird fed control diet though not statistically (P>0.05) significant. The serum Albumin value ranged from 17.50 to 14.50 g/l (20, 25%), respectively. The ALT and AST activities were not influenced although birds fed control diet are numerically higher than other treatment groups. Birds fed the control diet, 20% and 35% had numerically higher values of creatinine compared to similar values recorded for those on 25 and 30%.

The crude protein (CP) value recorded here was lower compared to 37.63% reported by Togun *et al.* (2009). Similarly, Olukayode *et al*. (2008) reported 47.06% CP when fedsun-dried rumen content blood meal to broiler chickens and Odunsi (2003) reported CP content of 46.1% when fed mixture of bovine blood and rumen digesta to broiler chickens, respectively. Meanwhile, 18.49% of crude fibre reported here corroborated the report of Adenuri and Balogun (2003) who reported 18.71% but lower to values recorded by Onu *et al.* (2011) and Odunsi (2003). The researchers reported a crude fibre of 8.81 and 6.38%, respectively. This variation could be due to the combined effect of the rumen digasta of different species of animals used and the type of feed consumed before slaughtering. The ether extract here (7.20%) which was nearly comparable with report of Olukayode *et al*. (2008) who reported 6.55% slightly higher than values reported by Odunsi (2003) and Adenuri and Balogun (2003) (2.13 and 0.88%), respectively. The difference might be due to the feed ingredients eaten by the animals, the period between feeding and slaughtering time of the animals, the micro flora of the gut and the method of the feed processing.

The blood is often used as a physiological index or indicator for disease diagnosis, nutrition status and health condition of the birds. Olafedehan *et al.* (2010) reported that blood acts as a pathological reflector of the status of exposed animals to disease and other conditions. In addition, Isaac *et al*. (2013) reported that animals with good blood composition were likely to show good performance. Thus, the non-significant effect of haematological indices measured among the treatment groups such as PCV, RBC count, WBC count and Hb concentration add credence to the fact that combined rumen content is a good non-conventional feed stuff, not toxic or deleterious to broiler chickens health which resulted to good blood composition in the broiler chickens. The values fall within the normal range for healthy broiler chickens reported by Anon (1980), Campbell *et al.* (2003) and Abubakar and Yusuf (1991).

Haemoglobin concentration within the normal range for healthy chicken has indicated improved oxygen carrying capacity (Guluwa *et al.*, 2017). Consequently, this implied that the birds had high oxygen carrying capacity. It is an indication that the nutritional profile of the diet was more enriched with combined rumen digesta. Nutrition was reported to influence the haemoglobin level of the blood (Udo, 1987). Pellet and Young (1980) confirmed that haemoglobin levels are positively correlated with protein quality and level in the diets. This observation is in line with the report of Makinde *et al.* (2017) who reported non-significant effect of camel rumen digesta on PCV, RBC and WBC in broiler chickens. The values of MCV, MCH and MCHC observed in this study were not significant and within the normal range reported by Anon (1980) and Igene (1999). Similar result was reported by Makinde *et al.* (2017). The differential blood count which are the neuterophils, lymphocytes, monocytes, eosinophils and basophils were not significantly (P>0.05) different across dietary treatments. These differential counts are the different types of WBCs found in the birds and the values obtained are an indication that their health status was not altered by the test ingredient.

The Serum biochemical indices showed similar non-significant (P>0.05) effect among the treatment groups. Serum albumin is a strong predictor of health; a low albumin concentration is a sign of poor health and predictor of bad outcome (Kastow, 2009). The higher the value of albumin, the higher the clotting ability of blood, thus preventing haemorrhage thus the test ingredient (combined rumen digesta) has no toxic or damage effect on the liver. Creatinine is a nitrogenous waste product formed from the metabolism of creatinine in skeletal muscle. Measurement of creatinine is used as a test of kidney function and high level signifies impaired kidney function. The normal range is 0.2-0.5 mg/dl (Peter, 2002). The values obtained in this study (0.04 - 0.05

mg/dl) is an indication that combined rumen content had no detrimental effect on the birds kidney function and did not result in muscle wastage in the birds (Cheesbrough, 2000). Eggum (1970) observed that total protein is usually a reflection of protein quality of feed thus the similar values recorded across the treatment groups indicated that the protein levels in the combined rumen content were sufficient to sustain the normal protein required in the blood of the broiler chickens.

The serum uric acid, AST and ALT enzymes were not significant across the dietary treatments. The non-significance of serum uric acid recorded may be implicative of efficient protein utilisation. Kumta and Harper (1961) and Eggum (1970) reported a general fall of serum uric acid concentrations with time in nutritionally balanced amino acids based diets. However,the activity of this enzyme is normally very low except in cases when the nutritional plane is very low or the presence of a toxic factor which may affect the liver. The normal range of this enzyme recorded for birds across the dietary treatments add credence to the fact that combined bovine rumen digesta does not contain toxic factors.

Conclusion

Combined bovine rumen digesta up to 35% inclusion levels could be used as partial substitute for energy source to replace maize in the diet of finishing broilers without any adverse effect on the haematological and serum biochemical indices of the broiler chickens.

Conflict of Interest

Authors declare that there is no conflict of interest related to this paper.

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