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ASSESSMENT OF ABATTOIR WASTES (BOVINE BLOOD AND RUMEN CONTENT) ON CARCASS CHARACTERISTICS, INTERNAL ORGANS AND ORGANOLEPTIC PROPERTIES OF BROILER BIRDS

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ABSTRACT
A study using (120) Abor acre broilers was conducted to assess impact of abattoir waste --BBRCM (bovine blood and rumen content mixture) on the carcass characteristics; internal organs and organoleptic properties of broilers. One hundred and twenty (120) birds were randomly assigned to four treatments replicated three times in a Completely Randomized Design (CRD). Four experimental diets were formulated to meet the nutrient requirement of broilers such that the birds were fed sun-dried abattoir waste (bovine blood and rumen content mixture) included at 0%, 5%, 10% and 15% representing treatment 1, 2, 3 and 4 respectively, with treatment 1 as the control. Each treatment consisted of 30 birds with 10 birds per replicate. The experimental diets and clean water were supplied throughout the experimental period. At the end of the 56 days feeding trial, four (4) birds from replicate were randomly selected for carcass characteristics, organ weight measurements and organoleptic properties assessment. The birds were slaughtered, de-feathered and eviscerated. The breast meat was cooked for 20mins. The cooked meat was cut into smaller pieces and labeled according to their respective treatments and presented to 10 panelist provided with a questionnaire that addressed the organoleptic properties (taste, juiciness, tenderness, flavor, color and acceptability) after preliminary training of the panelists. The proximate composition of the abattoir waste showed that its moisture content, crude protein, ether extract, crude fiber, ash and NFE were found to be 9.34%, 35.35%, 3.60%, 15.67%, 10.98%, and 25.06% respectively. Data collected were subjected to analysis of variance (ANOVA). Results showed significant differences ($P<0.05$) on live weight, dressed weight, carcass characteristics and internal organs. Live weight reduces from 1666.67g in T_1 to 1400.00g in T_2. Dressed weight reduced from 1471.33g in T_1 to 1193.00g in T_2. The breast weight reduced from 271.67g in T_1 to 175.33g in T_2. The weight of the gizzard reduced from 66.00g in T_1 to 54.67g in T_2. The results also showed that there were no significant difference ($P>0.05$) on the organoleptic properties of broilers fed the experimental diets. Therefore, feeding broilers with abattoir wastes could reduce feed cost in broiler production.

Keywords: Rumen content, Abattoir waste, Organoleptic, Broiler, Organ and Carcass

Introduction

The problems of food insecurity and hunger in developing countries have caught the attention of experts and governments (Emaikwu, *et al.*, 2011). Population growth, urbanization and income improvements are the main stimulants of increased demand for foods of animal origin in developing countries (Abdullah, *et al.*, 2011; Steinfeld, 2003). As a result, growing demand has led to a rise in the production of animal protein from poultry like never before (FAO, 2010). The popularity of poultry has resulted from the comparative advantages of poultry over other livestock. Poultry birds are good converters of feed into protein on meat and eggs. The cost per unit of production is relatively low, and the return on investment is relatively high. Farmers need relatively small amount of capital to start a

poultry farm. Also, poultry meat is tender and acceptable to consumers, regardless of religious beliefs. The production cycle is also short and capital is not tied up for a very long period (Ojo, 2003; Aboki, *et al,* 2013).

The cost of poultry feed has increased due to shortage and high cost of feed ingredients, particularly the protein supplements (Khan, *et al.,* 2010: Chand, *et al.,* 2014).Conventional protein sources are becoming costly due to high demand from human and animal. The continued increase in the price of poultry feed ingredients is a compelling reason for alternative protein feed resource that not only have good nutritive value but also cheap and readily available (Laudadio, *et al.,* 2012; Tufarelli, *et al.,* 2012). Efforts to reduce the high cost of feeds and the cost of poultry products have diversified the use of cheaper and locally available agro by-products particularly those that have little nutritional value to man (Onu, 2007; Onu and Otuma, 2008, Okonkwo *et al.,* 2008, Oladunjoye and Ojebiyi, 2010). Bovine blood /rumen content mixture (BBRCM) is an abattoir by product that offers a tremendous potential as a cheap and locally available alternative feedstuffs for livestock. Investigation has revealed that bovine blood /rumen content mixtures are good source of protein for monogastrics (Adeniji and Balogun, 2001; Dairo, *et al,* 2005; Mohammed, *et al.,* 2008). However, literature reports on the effects of the abattoir waste on poultry and on its organoleptic properties of broiler meat is relatively scarce and inconsistent. Therefore, the aim of this study was to determine the proximate composition of bovine blood and rumen content mixture, assess the impact of inclusion of abattoir waste (Bovine blood and rumen content mixture) on the internal organs, carcass characteristics and on the organoleptic properties of broiler meat.

Materials and Methods

Experimental location

The experiment was carried out at the poultry unit of the Teaching and Research farm of the Department of Animal Science and Technology, Faculty of Agriculture, Nnamdi Azikiwe University, Awka, Anambra State. The location lies within the rainforest region of the South Eastern Nigeria, having an annual rainfall of 1500mm and mean ambient temperature of about 34°c within longitude of 7°08'31.9"E and latitude 6º15'10.1'N. It experiences seven months of heavy tropical rains (April-October), followed by five months of dryness (November-March).

Collection and Processing of Abattoir Wastes

Fresh rumen content and blood were collected from freshly eviscerated cattle, from the slaughter house of an abattoir located at Obunago—Kwata, Awka, Anambra state, Nigeria. The rumen contents was collected and emptied into a clean bag and the rumen fluid was locally squeezed out using hands to reduce the moisture content and bulkiness of the rumen content. The rumen content was spread on a clean nylon sheet for sun drying in a well aerated environment. During drying, it was turned regularly to facilitate drying. The dried rumen content was milled using a FFC-45 hammer milling machine to a fine ground rumen content meal. The blood was collected as the cattle were being slaughtered. The blood was then transferred into a drum and heated using a stove for coagulation. It was sieved after coagulation and excess water removed. The coagulated blood was sun dried in a well aerated environment on a clean aluminum sheet and frequently turned to facilitate drying. The dried blood was milled using a FFC-45 hammer mining machine to a fine ground blood meal. The ground rumen content meal and the ground blood meal were used in formulating the experimental diets. Four experimental diets were formulated to meet the nutrient requirement of broilers such that the birds were fed sun-dried bovine blood and rumen content mixture meal incorporated at 0%, 5%, 10% and 15% representing treatment 1, 2, 3 and 4 respectively, with treatment 1 as the control. The gross and proximate compositions of experimental diets are presented in Table 1 and 2.

Table 1: Gross composition of the experimental diets

Ingredients (%)	T1 (0%)	T2 (5%)	T3 (10%)	T4 (15%)
Maize	55.00	55.00	55.00	55.00
Soybean meal	25.00	20.00	15.00	11.00
Fish meal	2.00	2.00	2.00	2.00
BBRCM	0.00	5.00	10.00	15.00
Wheat offal	7.00	7.00	7.00	6.00
PKC	6.00	6.00	6.00	6.00
Bone meal	4.00	4.00	4.00	4.00
Salt	0.25	035	035	035
Lysine	035	035	035	035
Methionine	035	035	035	035
Vit/min Premix*	0.25	035	0.25	0.25
Total	100.00	100.00	100.00	100.00

BBRCM = Bovine blood and rumen content mixture

*Premix composition (per kg of diet): vitamin A, 12,500 IU; vitamin D3, 2500 IU; vitamin E, 50.00mg; vitamin K3, 2.50mg; vitam in B1, 3.00mg; vitamin B2, 6.00mg; vitamin B6, 6.00mg; niacin, 40mg; calcium pantothenate, 10mg; biotin, 0.08mg; v itamin B12, 0.25mg; folic acid, 1.00mg; chlorine chloride,300mg; manganese, 100mg; iron, 50mg; zinc, 45mg; copper, 2.00mg; iodine, 1.55mg; cobalt, 0.25 mg; selenium, 0.10mg; antioxidant, 200mg.

Table 2: Proximate composition of experimental diets

Parameter (%)	T_1 (0%)	T_2 (5%)	T_3 (10%)	T_4 (15%)
Moisture content	13.95	10.32	11.90	11.47
Ash content	15.15	8.77	9.08	8.75
Crude protein	20.19	19.74	19.29	19.10
Crude fiber	4.07	4.99	5.93	6.84
Ether extract	3.38	3.79	3.63	3.47
Lysine	1.26	1.12	0.99	0.86
Methionine	0.57	0.55	0.52	0.50
Calcium	1.60	1.59	1.59	1.59
Phosphorus	0.89	0.87	0.85	0.83
Energy (ME Kcal/kg)	2885.60	2884.75	2883.90	2891.35

Experimental animals and management

One hundred and fifty (150) day old Abor acre broilers chicks were purchased from a reputable hatchery in Ibadan, Oyo State, Nigeria. Two weeks pre-experimental period were used to acclimatize the broiler chicks to the experimental procedures. Thereafter, One hundred and twenty (120) 2weeks old broilers were selected and randomly assigned to four treatments replicated three times with 10 birds per replicate in a completely randomized design feeding trial that lasted 56 days. They were managed on deep litter pens throughout the experimental period and were fed experimental diets with water supplied ad libitum. Routine management practices were also carried out appropriately.

Proximate analysis

The proximate analysis of the bovine blood/rumen content meal and the experimental diets were carried out using the method of A.O.A.C (1990). The following parameters were determined: moisture content, carbohydrate content, crude fiber, crude protein, ash and fat content.

Moisture content

A petri-dish was washed and dried in the oven. 2g of the sample was weighed into a petri dish. The weight of the petri-dish and sample was noted before drying. The petri dish and sample were put in the oven and heated at 100°c for 1hour. The result was noted and heated for another 1hour until a steady result was obtained and the weight noted. The drying procedure was continued until a constant weight was obtained.

% moisture content was calculated thus: $\frac{W_1 - W_2}{\text{Weight of sample}} \times 100$

Where $\mathbf{W_1}$ = weight of petri dish and sample before drying

$\mathbf{W_2}$ = weight of petri dish and sample after drying.

Carbohydrate determination (differential method)

100- (%Protein + %Moisture + %Ash + %Fat + % Fiber)

Ash content

The empty platinum crucible was washed, dried the weighed and noted. 2g of the samples were weighed into the platinum crucible and placed in a muffle furnace at 500°c for 3 hours. The sample was cooled in a desiccator after burning and weighed. The percentage ash content was calculated thus:

$$\% \text{ Ash content} = \frac{W_3 - W_1}{W_2 - W_1} \times \frac{100}{1}$$

Where:

W_1 = weight of empty platinum crucible,

W_2 = weight of platinum crucible and sample before burning

W_3 = weight of platinum and ash.

Crude fiber content

2g of each of the samples were defatted with petroleum ether. It was boiled under reflux for 30 minutes with 200ml of a solution containing 1.25g of H_2SO_4 per 100ml of solution. The solution was filtered through linen or several layers of cheese cloth on a fluted funnel. It was wash with boiling water until the washings are no longer acidic. The residue was transferred to a beaker and boil for 30 minutes with 200ml of a solution containing 1.25g of carbonate free NaOH per 100ml. The final residue was filtered through a thin but close pad of washed and ignited asbestos in a Gooch crucible. It was dried in an electric oven and weigh. It was incinerate, cool and weigh again. The loss in weight after incineration x 100 became the percentage crude fiber. The crude fiber is calculated thus:

$$\% \text{ Crude fiber} = \frac{\text{weight of fiber}}{\text{Weight of sample}} \times 100$$

Crude fat (Soxhlet fat extraction method)

This method was carried out by continuously extracting a food with non- polar organic solvent such as petroleum ether for about 1 hour or more. 250ml clean boiling flasks was dried in oven at 105 - 110°c for about 30 minutes. It was transfer into a desiccator and allowed to cool. Cooled boiling flasks were labeled and weighed. The boiling flasks were filled with about 300ml of petroleum ether with boiling point of about 40 - 60°c. The extraction thimble was plugged lightly with cotton wool. The soxhlet apparatus was assembled and allow to reflux for 6 hours. The thimble was removed with care and the collected petroleum ether in the top container of the set - up and drain into a container for reuse. The flask was removed and dries when the flask was almost free of petroleum ether at 105°c - 110°c for 1 hour. The substance was transferred from the oven into a desiccator and cooled and finally weigh.

Percentage crude proteins

The method is the digestion of sample with hot concentrated sulphuric acid in the presence of a metallic catalyst. Organic nitrogen in the sample is reduced to ammonia. This is retained in the solution as ammonium sulphate. The solution is made alkaline, and then distilled to release the ammonia. The ammonia is trapped in dilute acid and then titrated. 0.5g of each of the sample was weighed into a 30ml kjehdal flask (gently to prevent the sample from touching the walls of the side of each and then the flasks were stoppered and shaken. Then 0.5g of the kjedahl catalyst mixture was added. The mixture was heated cautiously in a digestion rack under fire until a clear solution appeared. The clear solution was then allowed to stand for 30 minutes and allowed to cool. After cooling about 100ml of distilled water was added to avoid caking and then 50ml was transferred to the kjedahl distillation apparatus. A 100ml receiver flask containing 5ml of 2% boric acid and indicator mixture containing 5 drops of Bromocresol blue and 1 drop of methlene blue was placed under a condenser of the distillation apparatus so that the tap was about 20cm inside the solution. The 5ml of 40% sodium hydroxide was added to the digested sample in the apparatus and distillation commenced immediately until 50 drops gets into the receiver flask, after which it was titrated to pink color using 0.0IN hydrochloric acid. Percentage Nitrogen and protein was Calculated thus:

$$\% \text{ Nitrogen} = \text{Titre value} \times 0.01 \times 1\ 4 \times 4$$

$$\% \text{ Protein} = \% \text{ Nitrogen} \times 6$$

Experimental design

The study was a CRD with 4 treatments consisting of sun-dried abattoir waste (bovine blood and rumen content mixture) included at 0%, 5%, 10% and 15% representing treatment 1, 2, 3 and 4 respectively, with treatment 1 as the control. The treatments were replicated 3 times in a completely randomized experimental design. Each treatment consisted of 30 birds with 10 birds per replicate.

The experimental model is as follows:

$Yij = U + Ti + eij$

Where Yij = individual observation on the broiler characteristics.

μ = overall mean

Ti = treatment effect

eij = random error assumed to be independently, identically and normally distributed with zero means and constant variances.

Preparation of the broiler meat for organoleptic analysis

The breast parts of the broiler meat were used for the organoleptic examination. The breast parts of the broilers were dissected into retail cuts. The retail cuts of the breast meats of each treatment were weighed using SF-400/sensitive digital weighing scale, washed properly and placed into different pots. They were cooked at 80^0C for 20 minutes without salt and spices. After cooking, the meats were packaged according to the treatments using a transparent plastic plates numbered according to the individual treatment.

Preparation of questionnaire

A questionnaire was prepared using 1-5 point hedonic scale (where 1 is the least ranking and 5 the highest ranking). The organoleptic properties include: juiciness, tenderness, color, taste, flavor and preference. Juiciness evaluation ranged from very juicy (5point) to slightly juicy (1point). Tenderness ranked from very tender (5 point) to tough (1point). Flavor ranked from very flavored (5point) to slightly flavored (1point). Color ranked from very bright (5point) to slightly bright (1point). Taste ranked from very tasty (5point) to slightly tasty (1point). Preference ranked from like extremely (5point) to neither like nor dislike (1point). Ten panelists were randomly selected comprising of adult male and female individuals of varying ages. Each panelist was provided with water, soap, hand sanitizer and a mouth wash. They were instructed on arrival to wash their hands with soap and water and to rinse their mouth repeatedly with water before and after each judgment. They were also informed on how to fill the questionnaire based on their appraisal.

Data collection and evaluation

Initial body weights of the broilers were measured on arrival to the pen. Subsequently, body weights and other growth performance parameters were taken at weekly interval throughout the study. All weight measurements were done using a sensitive digital weighing scale (SF-400). Weight gain was calculated from the difference between the final weight and initial weight. Feed intake was recorded while feed conversion ratio was calculated. At the end of the 56 days experiment, 4 birds from each replicate were randomly selected, starved for 24 hours but given drinking water, weighed and slaughtered. Each bird was weighed before and after dressing using a SF-400/sensitive digital weighing scale. The carcass was eviscerated and the dressed weight obtained after the removal of the head, shank and visceral organ. The carcass analyses were carried out immediately after dressing. The internal organs were removed, weighed and recorded.

Data Analysis

Data collected on different parameters were subjected to Analysis of Variance (ANOVA) in accordance with the methods of Steel and Torie, (1980). Significant means were separated using Duncan's New Multiple Range test (Duncan, 1955).

Results and Discussion

The result of proximate analysis of abattoir waste (Bovine blood and rumen content mixture--BBRCM) is presented in Table 3.

Table 3: Proximate composition of the abattoir waste (Bovine blood and rumen content mixture)

Parameters (%)	BBRCM
Moisture content	9.34
Crude protein	35.35
Ether extract	3.60
Crude fiber	15.67
NFE	25.06
Ash	10.98

The moisture content, crude protein, ether extract, crude fiber, ash and NFE were found to be 9.34%, 35.35%, 3.60%, 15.67%, 10.98%, and 25.06% respectively. However, the chemical compositions of the abattoir waste vary with the reports of some authors. Odunsi (2003) reported a higher value of crude protein (46.1%), and ash (23.4%) and a lower value of ether extract (2.13%), crude fiber (6.38%), and NFE (16.0%). The differences in the proximate composition values may be due to several factors such as differences in chemical composition of the pastures grazed by the cattle before slaughtering, degree of fasting prior to slaughtering, feed resource diversity, selectivity by the animal, pre-slaughter feeding regimen, length of holding period between feeding and slaughter and season of the year (Cole, 1991; Rezakhani, et al., 2008; Agbabiaka, et al., 2012; Cherdthong, et al., 2014; Elfaki and Abdelatti, 2015). The difference could also be due to the rumen microflora, different processing methods, shelf life and preservation methods of the abattoir waste. The carcass characteristics of broilers fed different levels of bovine blood and rumen content mixture are presented in Table 4.

Table 4: Carcass weights (g) and body parts length (cm) of broiler fed abattoir waste (Bovine blood and rumen content mixture)

Parameter	T_1 (0%)	T_2 (5%)	T_3 (10%)	T_4 (15%)
Live weight	1666.67±115.47^{a}	1400.00±200.00^{c}	1500.00 ± 200.00^{b}	1500.00±400.00^{b}
De-feathered	97.33±19.04 ^{a}	61.33±5.86^{c}	77.00±19.08^{bc}	86.33±36.25^{b}
Dressed weight	1471.33±103.23^{a}	1193.00±208.81^{c}	1295.67±181.78^{bc}	1292.33±360.01^{bc}
Wing length	22.03±1.53	21.00±2.65	20.87±0.58	21.33±0.58
Wing weight	71.67±4.04^{a}	56.00±18.33^{b}	55.67±3.21^{b}	57.00±11.36^{b}
Thigh length	16.33±2.52	16.17±0.58	16.33±2.01	17.07±1.16
Thigh weight	173.00±14.18^{a}	138.00±28.79^{c}	157.33±16.62^{b}	168.67±47.65^{a}
Head length	10.00±1.00^{a}	8.00±1.01^{b}	8.33±0.58^{b}	9.67±1.53^{a}
Head weight	62.67±9.07^{a}	54.00±3.61^{b}	55.33±8.08^{b}	56.33±12.66^{b}
Breast length	17.10±1.00	16.80±2.00	18.00±0.50	16.94±1.03
Breast weight	271.67±78.99 1^{a}	175.33±73.57^{c}	211.67±1739^{b}	207.33±41.43^{b}
Shank length	15.33±1.16^{a}	15.33±1.16^{a}	12.80±0.35^{b}	15.67±1.53^{a}
Shank weight	44.67±8.02^{a}	42.67±6.11^{ab}	38.33±9.29^{b}	45.67±11.02^{a}

^{abcd}: means with different superscripts along rows are significantly different ($p<0.05$). Mean ± Standard deviation.

The result from Table 4 revealed that there was no significant difference ($p>0.05$) on the wing length, thigh length and breast length of the broilers fed bovine blood and rumen content mixture compared to the control. Significant reduction ($P<0.05$) were observed on live and dressed weight, weights of the breast, wing, thigh, head and shank; and on the head and shank length. This means that the inclusion of bovine blood and rumen content mixture reduced the live weight, dressed weight, carcass weight and organ parts of the broilers. It was observed that 5% inclusion of abattoir waste meal on the diets of broilers produced the least results. The reduction on these parameters might have resulted from increased fibre content of the test diets; poor digestibility of processed blood and rumen contents when fed to poultry. This poor

digestibility of blood and poor digestibility of abattoir waste by the digestive tract of poultry arises from the peculiarity of avian digestive tract with absence of rumen and microbial digestion.

The internal organ weight of broilers fed different levels of bovine blood and rumen content mixture is presented in Table 5.

Table 5: Organ weights (g) and length (cm) of broiler fed abattoir waste (Bovine blood and rumen content mixture)

Parameter	T1 (0%)	T2 (5%)	T3 (10%)	T4 (15%)
Spleen weight	1.33± 0.58	1.00 ± 0.00	2.00± 0.00	1.33±0.58
Kidney weight	9.67± 2.08	7.30± 1.00	9.00± 3.00	7.67±201
Intestine length	244.67±10.26a	198.33± 20.84b	203.33± 10.26b	154.67±40.10c
Intestine weight	100.67±10.26a	92.00± 4.36a	82.67± 14.01bc	75.00±9.50c
Lung weight	5.00± 3.46b	9.00± 2.00a	8.67± 1.16a	8.67±1.10a
Liver weight	35.00± 4.58a	29.67± 3.22b	31.00± 5.29b	30.67±506b
Heart weight	9.67± 1.53	8.60± 1.02	7.33± 0.58	9.00±1.01
Gizzard weight	66.00± 8.72a	54.67± 4.93b	67.67± 10.41a	67.00±1000a

[abcd]: means with different superscripts along rows are significantly different (p<0.05). Mean ± Standard deviation.

From Table 5, it was observed that there was no significant difference (p>0.05) on the weight of the spleen, kidney and hearts of broilers fed bovine blood and rumen content mixture compared to the control. Moreover, significant differences (P<0.05) were observed on the length and weight of the intestine, weight of the lungs, liver and the gizzard. There were significant reduction (P<0.05) on the length and weight of the intestine, weight of the liver and gizzard compared to the control. The reduction on the weight and length of these organs might have contributed to the reduction on the live weights, dressed weights and carcass weights of the broilers. The inclusion of bovine blood and rumen content mixture significantly increased (P<0.05) the weights of the lungs compared to the control. These result is in line with the work of Mohmoud Elfaki, *et al*., (2015) who reported that there was no significant difference (p>0.05) in the spleen of broilers fed BBRCM. The significant reduction (p<0.05) on the length of the intestine may be due to different levels of crude fibre in the diets. This observation is in line with the work of Esonu, *et al.*, (2004) who reported that crude fibre activates the intestine and reduces peristaltic movement of the intestine. Also, Elfaki *et al.* (2015) reported significant reduction (p<0.05) on the gizzard when he fed BBRCM. This reduction in the weight of the gizzard may signify reduction in the breaking down of the feed particles and the resultant reduction in digestion by the intestine in processing BBRCM; thus may increase the musculature of the gizzard to work faster.

Organoleptic properties of broilers fed bovine blood and rumen content mixture is presented in Table 6.

Table 6: Organoleptic properties of broilers fed bovine blood and rumen content mixture

Parameters	T_1 (Control)	T_2 (5%)	T_3 (10%)	T_4 (15%)
Tenderness	3.5±0.5	3.8±0.85	3.9±0.13	4.1±0.84
Juiciness	3.6±0.17	3.8±0.70	3.6±0.46	4.0±0.30
Taste	4.0±0.66	4.6±0.77	4.8±0.15	4.7±0.81
Flavor	4.2±0.13	4.1±0.26	4.2±0.45	4.6±0.66
Color	4.0±0.69	4.1±0.30	4.2±0.92	4.4±0.47
Acceptability	3.9±0.77	4.6±0.49	4.4±0.58	4.5±0.26

[abcd]: means with different superscripts along columns are significantly different (p<0.05). Mean ± Standard deviation.

From Table 6, there was no significant difference (P>0.05) on the tenderness, juiciness, taste, color, flavor, and acceptability of the broiler meat fed bovine blood and rumen content mixture compared to the control. From these results on organoleptic examination of broiler meat fed abattoir waste, it was observed that that T_4 was ranked high in tenderness, juiciness; flavor and

color.T_3 were ranked highest on taste, while T_2 was ranked highest on acceptability. This means that the inclusion of bovine blood and rumen content mixture at these levels did not have adverse effect on the tenderness, juiciness, taste, color, flavor, and on the overall acceptability of the meat. This observation is in agreement with the findings of Elfaki *et al.* (2015), who stated that the inclusion of dried rumen content in broiler diet did not affect the color, tenderness, flavor, juiciness and acceptability of broiler meat. Therefore, bovine blood and rumen content mixture can be included up to 15% in the diets of broilers without negatively affecting the organoleptic properties of the broiler meat.

Conclusion

The proximate composition of the abattoir waste shows that it contain high crude protein, crude fibre and nitrogen free extract. The use of abattoir waste reduced significantly the weight gain, dressed weight, carcass characteristics, body parts and the internal organs of the broilers. The study also showed that the mixture of bovine blood and rumen content up to 15% inclusion did not have any negative effects on the organoleptic properties of chicken meat. Bovine blood and rumen content is a cheap source of energy and protein. The use of abattoir waste in poultry diets can help to control environmental pollution and hazards resulting from waste disposal from the abattoir. Due to the poor digestibility of the abattoir waste by broilers, it is recommended to include enzymes to the bovine blood and rumen contents to increase its digestibility by the broilers.

References

A.O.A.C, (1990). Association of Official Analytical Chemistry. Methods for Proximate Analysis. 2217-2280.

Abdullah, R.B., W.K. Wan Embong and Soh, H.H. (2011). Biotechnology in animal production in developing countries. *Proceedings of the 2nd International Conference on Agricultural and Animal Science, Singapore,* November 25-27, 2011.

Aboki, E. A., Jongur, A.U. and Onu, J.I. (2013). Productivity and Technical Efficiency of Family Poultry Production in Kunni Local Government Area of Taraba State, Nigeria. *Journal of Agriculture and Sustainability* 4(1):52-66.

Adeniji, A. A. and Balogun, O.O. (2001). Evaluation of Blood rumen content mixture in the diets of starter chicks. *Nigeria Journal of Animal Production,* 28(2):153-157.

Agbabiaka, L.A., Madubuike, F.N., Amadi, S.A. (2012). Studies on Nutrients and Anti-Nutrients of Rumen Digesta from Three Most Domesticated Ruminants in *Nigeria Journal of Nutrition*. 11, 580.

Chand, N., Naz, S., Shah. Z., Khan. S., Shah, A.S. and Khan, R.U., 2014. Growth performance and immune status of broilers fed graded levels of Albizialebbeck seeds. *Pakistan Journal of Zoology 46, 574—577.*

Cherdthong, A., Wanapat, M., Saenkamsom, A. and Waraphila, N. (2014). Dried Rumen Digesta as an Alternative Protein Feedstuff for Native Cattle. *Proceedings of the 16th AAAP Animal Science Congress* Vol. II 10-14 November 2014, Gadjah Mada University, Yogyakarta, Indonesia.

Cole, N.A. (1991). .Effects of animal to animal exchange on ruminal contents of the feed intake and ruminal characteristics of fed and fasted lambs. *Nigerian Journal of Animal Science, 69* (4): 1795-1803.

Dairo, F.A.S., Aina, O.O., and Asafa A.R. (2005). Performance evaluation of growing rabbits fed varying level of rumen content and blood rumen content mixture. *Nigerian Journal of Animal Production,* 32(l):67-73.

Duncan, D. B. (1955). Multiple Range and Multiple f-test. Biometrics 11:1-2.

Elfaki, M.O.A., K.A. Abdelatti, and H.E.E. Malik. (2015). Effect of Dietary Dried Rumen Content on Broiler Performance. Plasma Constituents and Carcass Characteristics. *Global Journal of Animal Scientific Research.,* 3(1): 264-270.

Emaikwu, K.K., Chikwendu, D.O. and Sani, A.S. (2011). Determinants of flock size in broiler production in Kaduna State of Nigeria. *Journal of Agricultural Extension and Rural Development* 3(11): 202-211.

Esonu, B.O., Azubuike, J.C. Emenalom, O.O, Etuk, E.B., Okoli, I.C., Ukwu, H.D.I. and Nneji. C.S. (2004). Effect of enzyme supplementation of the performance of broiler finisher fed *Microdesmis Puberula* leaf meal. *International Journal of Poultry Science,* 3:112-114.

FAO (2010). Agribusiness Handbook: Poultry meat and Eggs. Investment Centre Division.

FAO. Rome, Italy.

Khan, R.U., Durrani, F.R., and Chand, N. (2010). Influence of feed supplementation with *Cannabis sativa* on quality of broilers carcass. *Pakistan Veterinary Journal,* 30,34-38.

Laudadio, V., Passantino, L., Perillo, A., Lopresti, G., Passantino, A., Khan, R.U. and Tufarelli,V. (2012). Productive performance and histological features of intestinal mucosa of broiler chickens fed different dietary protein levels. Poultry Science 91:265-270.

Mohammed, G., Igwebuike, J. U., Ubosi, C.O. and Alade, N.K. (2008). Comparative study of the nutrient composition. Amino acid profile and microbial assay of fresh and dried cattle, camel, sheep and goat rumen content. Proceeding of the 13th Annual Conference of Animal Science Association of Nigeria. (ASAN), ABU, Zaria, Sept. 15th -19thPp: 518-520.

Odunsi, A.A. (2003). Blend of bovine blood and rumen digesta as a replacement for fishmeal and Groundnut Cake in Layer Diets. *International Journal of Poultry Science* 2(1): 58-61.

Ojo, S.O. (2003). Productivity and Technical Efficiency of Poultry Egg Production in Nigeria. *International Journal of Poultry Science* 2 (6): 459-464.

Okonkwo, A.C., Isaac, L.J., Solomon, I.P. and Eyoh, G.D. (2008). Effect of diertary cassava leaf meal on growth performance of weaner rabbits. Proceeding of the 33rd Annual Conference of the Nigerian Society of Animal Production, Ogun. 42 -144.

Oladunjoye, I.O.and Ojebiyi, O.O. (2010). Performance Characteristics of Broiler Chicken (*Gallus gallus*) Fed Rice (*Oriza sativa*) Bran with or Without Roxazyme G2G. *International Journal of Animal and Veterinary Advances* 2(4): 135-140.

Onu, P. N. (2007). The influence of heat- treated sheep manure on the performance, carcass characteristics and economics of production of starter broilers. *Journal of Animal and Veterinary Advances,* 6(11): 1323- 1327.

Onu, P.N. and Otuma, M.O. (2008). Utilization of heat-treated sheep chopping in the diets of broiler finisher chicks. *International Journal of Poultry Science,* 7 (2): 169-173.

Rezakhani, A.H., Abbasi, A., Nejad, N.T., Asadi, M.R. and Ferdowsi, H.R. (2008). Determination of nutritive value of dried rumen contents.Proceedings of the 15th Congress of FAVA - OIE Joint Symposium on Emerging Diseases. FAVA 27-30 October 2008, Bangkok, Thailand.

Steel, R. G. D. and Torrie, J. H. (1980). Principles and Procedures of statistics: A Biometrical Approach (3rd Ed.). McGraw Hill Book Co., New York.

Steinfeld, H. (2003). Economic constraints on production and consumption of animal source foods for nutrition in developing countries. *Journal of Nutrition,* 133(11): 4054-4061.

Tufarelli, V., Khan, R.U. and Laudadio, V. (2012). Evaluating the suitability of field beans as a substitute for soybean meal in early-lactating dairy cows: production and metabolic responses. *Animal Science Journal* 83, 136-140.