Journal of Biotechnology Research
ISSN(e): 2413-3256, ISSN(p): 2413-8878
Vol. 6, Issue. 1, pp: 1-6, 2020
URL: https://arpgweb.com/journal/journal/16
DOI: https://doi.org/10.32861/jbr.61.1.6

Academic Research Publishing Group

Original Research **Open Access**

Nutrient Digestibility of Broiler Birds Fed Sugarcane Scrapping Bark Fermented with Rumen Liquor for 4 and 8 Days at Different Grade Levels

Nwosu G. C. (Corresponding Author)
Department of Animal Science, Faculty of Agriculture, University of Abuja, Nigeria
Email: chinelo.gloria246@gmail.com

Adeniji A. A.
Department of Animal Science, Faculty of Agriculture, University of Abuja, Nigeria

Adeniji A. A.
Department of Animal Science, Faculty of Agriculture, University of Abuja, Nigeria

Article History
Received: December 9, 2019
Revised: January 3, 2020
Accepted: January 10, 2020
Published: January 12, 2020

Abstract

This study was conducted to evaluate the nutrient retention of treated sugarcane bark scrapping fermented with rumen liquor (TSBS) on the broiler chickens. Six experimental diets coded as T_1 (0%), T_2(7.5%), T_3(15%) for 4 days' fermentation and T_4(0%), T_5(7.5) and T_6(15%) for 8 days. T_1 (0%) and T_4 (0%) are the control in both 4 and 8days fermentation. The feed formulation was compounded such that TSBS replaced maize at 0%, 7.5% and 15% levels respectively in broiler finisher diet. A total of one hundred and eighty (180) birds of four (4) weeks old broilers were randomly allotted into six treatment groups, each treatment had three replicates in a 2x3 factorial in a randomized experimental design. The facal sample was collected for 7 days at the end of experiment. Results on nutrient retention of the birds fed TSBS showed that the dietary levels had significant effect ($P<0.05$) on digestibility efficiency of dry matter, crude protein, crude fibre, ash, and N.F.E retention. However, no significant ($P>0.05$) difference was observed in ether extract (EE) across the treatments measured. Fermentation days (4 and 8 days) had no significant ($P>0.05$) effect on digestibility efficiency of all the parameters measured except crude fibre and ash retention. However, interaction of fermentation days and level of TSBS in the diet significantly ($P<0.05$) affect all the parameters measured except ether extract retention. The interaction between 4 and 8 days shows that irrespective of the levels of inclusion of TSBS 0%, 7.5% and 15% and number of days of fermentation 4 and 8 days, the birds performed well. There was no significant ($P>0.05$) effect notice from the inclusion of 0%: 4days fermentation and the same for 0%: 8days in all the parameters measured in the feed trials. In 7.5%: 4days, 7.5%:8 days, 15%:4 days, 15%: 8days show also no significant ($P>0.05$) difference in the experiment. The interaction on the nutrient retention show that there was significant different ($P<0.05$) observed in the broiler fed TSBS. The study shows that there was no significant different between 4 and 8 days fermentation, therefore 4 days' fermentation is recommended to use to avoid time taken and stress in fermentation for longer period.

Keywords: Monogastric; Non-conventional feedstuff; Sugarcane; Broiler; Nutrient retention.

1. Introduction

The digestive system of animals is involved in the mechanical and chemical digestion of food, absorption of nutrients, and elimination of indigestible materials from the body. The main difference between monogastric and ruminant digestive system is that the digestion in the monogastric digestive system mainly occurs in the stomach whereas the digestion in the ruminant digestive system is a foregut fermented type digestion. Non-ruminant animals lack the enzyme cellulose that can digest the components of the fiber in rice offal and other fibrous by products. This is so, at least in the small intestinal tract, which is the site for most nutrient absorption [1]. There is evidence that pre-digestion or any attempt to initiate the hydrolysis of feed components often enhances the digestibility and utilization when fed in animal diets.

It is otherwise known as non-conventional feedstuff (NCFS), which is refer to all those feeds that have not been traditionally used in animal feeding and or are not normally used in commercially produced rations for livestock. Or the feedstuff which have not been used traditionally in animal feeding or are not commonly used in rations, produced commercially for livestock. NCFS normally consist of a variety of feeds from perennial crops and feeds of animal and industrial origin. They can also be categorized as new sources of feedstuffs as pallet oil mill effluent and palm press fiber (oil palm by-products), single cell proteins, and feed material derived from agro industrial by-products of plant and animal origin. NCFR also includes poor-quality cellulosic roughages from farm residues. Studies on non-conventional feed says if properly processed and harnessed, one of such non-conventional feed source could be rumen content which is a waste material from abattoir and slaughter houses. Sun-dried rumen content (SDRC), a potential alternative feed source obtained from the rumen of ruminant animals consists of fermented and non-fermented dietary feeds that passed various stages of digestion in the rumen [2].

High competition existing between animals and man for these feedstuffs has created the need to maximize the efficiency of the conventional feeds and also rumen content contains no anti nutritional factor. This can be achieved by reducing the quantity of expensive feedstuff substituting them with unconventional feedstuff like bovine rumen content, this greatly reduces production cost. Adeniji [3], put the estimate output of blood rumen content from bovine and caprine source from abattoir at 9,634 tones and 18,067 tones, per annum respectively. The food article (residues) in the rumen may be considerably influenced by the type of diet fed to the ruminant and the time interval of feeding and slaughtering.

SUGARCANE Scientific Name – Saccharum Officinarum

Sugarcane is a very large tropical grass that does a stupendous job of making and storing simple sugar molecules. It is a large strong growing species of grass in the genus saccharum. It originated in Southeast Asia. Muslims brought it in contemporary Spain, the only place in Europe where it grows. It arrived in the new world with the Spanish and it now cultivated to tropical and sub-tropical countries worldwide for the production of sugar and other products.

The main product of sugarcane is sucrose, which accumulate in the stalk internodes. Sucrose extracted and purified in specialized mill lactones, is used as raw material in human food industries or is fermented to produce ethanol. Ethanol is produced by Brazilian sugarcane industry. Poultry convert feed into food products quickly and efficiently. They are highly prolific with short generation intervals and rapid growth rate [4]. Their high rate of productivity results in relatively high nutrient needs. Feed intake is one of the important factors that may influence animal live performance, health and carcass characteristics. Feed cost is a major factor representing 50 – 70 percent of the total cost of animal production [5, 6].

2. Materials and Methods

This research was carried out at the poultry unit of Teaching and Research farm of Animal Science Department, Faculty of Agriculture, University of Abuja, along airport road, main campus. The project site lies between latitude 8.917°N, 7.1811°E.

The experimental birds were obtained from a commercial hatchery with good record of bird's performance. Fresh bovine rumen content was collected in a large quantity from carcasses of bovine slaughtered at a local abattoir in Suleja-Niger State. The cattle were slaughtered and eviscerated, and their gastrointestinal tracts (GIT) were immediately emptied into a clean container. The solid materials were discarded while the fluid (liquor) part of the content was transferred into a white nylon bags after using a sieve to separate the content from the fluid. This process took approximately 40-50 minute. The sugarcane bark scrapping (SBS) were source from local sugarcane market within Suleja and Madalla area of Niger State, sun-dried, milled to form the sugarcane bark scrapping meal (SBSM).

Milled sugarcane bark was measured into two places and equal portion of fresh rumen liquor was also measured out for both 4 and 8 days' fermentation. The fresh rumen liquor was sprayed on top of the sugarcane bark scrapping meal (SBSM) that was measured. After spraying and mixing of the two to moist to enable fermentation take place. It was packed into black industry polyethylene bags, which were made airtight to secure an anaerobic fermentation in the drums. The SBSM were fermented in the two different drums of about 70 liters each for a total of four 4 days and eight (8) days which became treated sugarcane bark scrapping (TSBSM). At end of the fermentation days they were sun-dried for about 4days to reduce the moisture content. The dried feedstuffs were used in compounding the broiler finisher feeds for the experimental diets. The samples from dried fermented TSBSM for 4 and 8 days were taken for proximate analysis according to the procedure of AOAC [7].

Table-1. Composition of Broiler Finisher Diets

Days of fermentation	**4**			**8**		
	0%	7.5%	15%	0%	7.5%	15%
Maize	63.65	58.15	52.65	63.65	58.15	52.65
TSBSM	0	7.50	15.00	0	7.50	15.00
SBM	31.00	29.00	27.00	31.00	29.00	27.00
Fish meal	2.0	2.0	2.0	2.0	2.0	2.0
Limestone	1.00	1.00	1.00	1.00	1.00	1.00
Bone meal	1.80	1.80	1.80	1.80	1.80	1.80
Salt	0.30	0.30	0.30	0.30	0.30	0.30
Vitamin premix*	0.25	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100	100
Analyzed values						
Dry matter	93.15	92.67	90.46	93.15	93.41	92.98
Crude protein	22.75	21.75	20.75	22.75	21.69	20.15
Crude fiber	5.08	6.23	6.19	5.08	5.66	7.08
Ether extract	5.10	5.42	4.69	5.10	5.01	4.33
Ash	7.31	7.11	6.38	7.31	8.01	6.55
Nitrogen free extract	52.91	52.22	59.05	52.91	52.98	58.27
MEKCAL/KG	3137.24	3099.69	3225.46	3137.23	3094.85	3188.67
Feed cost (N)	143.16	140.88	136.84	143.16	140.88	136.84

*Bio Mix Finisher(BIO-ORGANICS) Premix used containing the following per kg: Vit A: 8,000.000 I.U., Vit E : 7,000mg, Vit K: 1,500mg, Vit B1:2,000mg, Vit B2: 2,500mg, Niancin: 15,000mg, Pentatonic Acid: 5,500mg, Vit B6:2000mg, Vit B12: 10mg, Folic Acid: 500mg, Biotin Hg: 250mg, Chroline Chloride: 175,000mg, Cobalt:200mg, Copper:3,000mg, Iodine: 1,000mg, Iron:21,00mg, Manganese: 40,000mg, Selenium:200mg, Zinc:31,000mg, Antioxidant:1250mg

The experimental design was a 2 x 3 factorial arrangement, consisting of two days of fermentation (4 and 8 days) and three levels (0, 7.5, and 15%) of inclusions of TSBSM. A total of one hundred and eighty (180) four (4) weeks old broilers were used for the experiment. The birds were randomly allotted to six (6) treatments with each treatment having three (3) replicates containing 10 birds per replicate making a total of 30 birds on each treatment. The birds were housed in a deep litter system, measuring 6 feet by 6 feet square meter (m^2) to allow for adequate ventilation and demarcated into 18 mini pens for each replicate.

Nutrient retention trial was carried out at the end four weeks feeding trial using metabolic cages for 7 days. Three (3) birds were randomly selected from each replicate. The birds were allowed for five (5) days of adjustment period before the commencement of the nutrient retention in metabolic cage system for adaptability of the birds in the cage. The birds were fed with the experimental diets. A flat polythene bag was attached beneath the cage for collection of the fecal samples. The birds were fasted for 24 hours with only water given to them before samples were collected. Equal quantity of experimental diets was given to each bird by 10 am daily and fecal sample was collected daily, labeled, dried and kept. At the end, each fecal sample of each birds were weighed, after it was thoroughly mixed and grinded and taken for proximate analysis. The Nutrient Retention was calculated using the formula shown below.

$$\text{Nutrient retention} = \frac{Nutrient\ intake - nutrient\ output}{nutrient\ intake} \text{x } \frac{100}{1}$$

3. Determination of the Proximate Composition of Feed Ingredient Formulated Diets

A small sample (about 2.0g) was taken from each of the milled ingredients and the formulated diets. The samples were taken to the laboratory to determine their proximate composition. The Nitrogen free extract (NFE) on dry matter basis was calculated by simply subtracting the values of crude protein, crude fiber, ether extract and ash from 100. Mathematically NFE= 100 (%CP + %CF + EE + %ASH) the metabolizable energy of that diets were calculated from the proximate composition data using the formula described by Pauzenga [8].

MEKCal/kg = 37 × %CP + 81.8 × %EE + 35.5 × %NFE

4. Chemical and Statistical Analyses

The samples of sugarcane bark scrapping (SBS), treated sugarcane bark scrapping (TSBS) for both 4 and 8 days and fecal samples were subjected to proximate analysis according to the procedure described by AOAC [7]. All data generated were subjected to SPSS—statistical package for sciences, version 23 window. Significant difference among treatment means were separated using Duncan's multiple range test [9]. Means were considered different at ($P < 0.05$).

5. Results and Discussion

5.1. Proximate Analysis

The results of proximate analysis of SBSM and TSBS presented in Table 1 below shows that dry matter of 92.45% declined of SBSM to 88.366% and 89.53% of TSBSM 4 and 8 days', crude fiber decline from 13.13% of SBSM to 4.62% and 4.38% for both 4 days and 8 days respectively. The crude protein increase from 8 in SBSM to 10.75% and 9.20% in TSBSM for both 4 and 8 days' fermentation. The ash and ether extract also show improvement after fermentation, the value of ash before fermentation was 4.22% in SBSM and in TSBS of 4 and 8 days was 5.93% and 5.40% respectively. Ether extract increased from 0.82 % to 2.56% and 2.50% in both 4 and 8 days.

Table-2. Proximate compositions of sugarcane bark scrapping and fermented TSBSM

Nutrients (%)	SBSM	Fermentation in days (TSBSM)	
		4	8
Dry matter%	92.45	88.36	89.53
Crude protein%	8.00	10.75	9.20
Crude fibre%	13.13	4.62	4.38
Ether extract%	0.82	2.56	2.50
Ash%	4.22	5.93	5.40
Nitrogen free extract	66.28	64.74	67.81
MEKcal/kg	2716.02	2966.83	2952.15

Sugarcane bark scrapping. **TSBSM**: treated sugarcane bark scrapping. Sugarcane bark scrapping. **SBSM**. Untreated. DM is dry matter, NFE is Nitrogen Free Extract, CP is Crude Protein, CF is Crude Fiber, EE is Ether Extract

Results on proximate analysis of SBSM and TSBSM shows that dry matter decline from 92.45% to 88.36% and 83.53% in both 4 and 8 days after fermentation. The Crude fiber content drop from 13.13% to 4.62% and 4.38%, for 4 and 8 days which was in line with the report of Adeyemi and Familade [10], they did notice similar effect when

corn-cobs were fermented with rumen filtrate. The CP level was increased from 8 to 10% and 9.20% for 4 and 8days which was an improvement. These finding support the reports of Adeyemi and Sipe [11], Adeyemi, *et al.* [12]. and Dairo, *et al.* [13] who observed an increase in the CP in cassava root meal that was fermented with rumen filtrate and nitrogen source. The CP of 8 days' fermentation declined when compared to 4 days which I suggest that it could be that the protein denatured on longer fermentation days. The ether extract, increase from 0.82% to 2.56% and 2.50%, ash also increased from 4.22% to 5.93 and 5.54% in both 4 and 8 days of fermentation while nitrogen free extract showed increase after fermentation of SBS with rumen filtrate from 66.28% to 66.45% and 67.81%. From this, result, it is clear that fermentation of SBS with rumen liquor is known to improve protein, ether extract, Ash and nitrogen free extract and reduce the crude fiber.

TSBSM will go a long way in the improvement of the environmental and sanitary conditions of our country. The broiler tolerated up to 15% within the number of days on the feeding trail of twenty-eight days that the trial last. Broilers are monogastric animal and are not known to utilize much fibrous materials efficiently for there is no symbiotic relationship between the animals with simple stomach (broiler) and microbial population anywhere in the gut. therefore 15% inclusion of the TSBSM will be too high for birds if they are to stay more than twenty-eight days in feeding trial.

The mortality rate was also lower than 1% which is below a mortality rate of less than 4% regarded as normal for broiler birds [14]. There was no observable adverse effect on the health of the broiler within the trial days. TSBSM can be a dietary replaced feedstuff in broiler feed.

5.2. Nutrient Retention of Broilers Fed Treated Sugarcane Scrapping Meal (TSBSM) at Different Levels of Inclusion and Days of Fermentation

The result of the nutrient retention of broiler chickens fed TSBSM were shown on the Table 2. Dietary levels of TSBSM had significant effect ($P<0.05$) on the digestibility efficient of dry matter (DM), crude protein (CP), crude fiber (CF), ash and nitrogen free extract (NFE) retention, however, the result showed that dietary treatment had no significant ($P>0.05$) effect on the ether extract retention. It was observed that broilers fed diets containing 7.5% levels of TSBSM had significantly higher dry matter, crude protein, ash and nitrogen free extract retention, although there was no significant different between birds fed 7.5% and 15% TSBSM on ash and nitrogen ether extract. Broilers fed diets containing 15% levels of TSBSM had significantly better ash and nitrogen free extract retention than broilers fed 0% TSBSM.

Table-3. Nutrient retention of broiler birds fed TSBSM

Levels of TSBS	Dry matter	Crude protein	Crude fiber	Ash	EE	NFE
0%	72.27^{b}	60.91^{b}	46.16^{c}	57.43^{b}	77.66	36.76^{b}
7.5%	80.83^{a}	66.14^{a}	66.12^{b}	64.82^{a}	80.48	48.31^{a}
15%	75.22^{b}	58.72^{b}	69.37^{a}	61.79^{a}	79.38	46.02^{a}
SEM	1.8	1.5	1.1	1.4	1.6	1.9
Level of significance	S	S	S	S	NS	S
Fermentation						
4 DAYS	75.25	60.65	59.05^{b}	59.55^{b}	79.62	42.63
8 DAYS	76.96	63.20	62.05^{a}	63.10^{a}	78.73	44.76
SEM	1.5	1.2	0.9	1.2	1.3	1.6
Level of significant	NS	NS	S	S	NS	NS
Interaction						
0%:4days	72.27^{b}	60.91^{b}	46.16^{c}	57.43^{c}	77.66	36.76^{c}
0%:8days	72.27^{b}	60.91^{b}	46.16^{c}	57.43^{c}	77.66	36.76c
7.5%:4days	81.90^{a}	67.00^{ab}	66.05^{b}	63.04^{ab}	82.27	48.15^{a}
7.5%:8days	79.77^{a}	65.28^{c}	66.19^{b}	66.60^{a}	78.68	48.48^{a}
15%:4days	71.59^{b}	54.04^{c}	64.96^{b}	58.18^{bc}	78.93	43.00^{b}
15%:8days	78.86^{a}	63.40^{ab}	73.79^{a}	65.26^{a}	79.84	49.05^{a}
SEM	2.6	2.1	1.6	2.1	2.3	2.7
Level of significant	S	S	S	S	NS	S

a, b, c means in the same column having different superscripts are significant ($P<0.05$), NS= Not Significant ($P>0.05$) SEM= Standard Error of Means TSBS: Treated sugarcane bark scrapping, S: Significant

Fermentation days (4 and 8) had no significant ($P>0.05$) difference in dry matter, crude protein, ether extra and nitrogen free extract retention. However, there was significant ($P<0.05$) difference in crude fiber and ash retention of birds fed the experimental diets. 4 days' fermentation had the higher values in all the parameter measure except in ether extract.

The interaction on the nutrient retention shows that there was significant different ($P<0.05$) observed in the broilers fed TSBSM in the entire nutrient measured except in ether extract which showed no significant ($P>0.05$). It was observed that 7.5%: 4 days performed better than 7.5%: 8 days in dry matter, crude protein and ether extract while 7.5%: 8 days' performance better in Ash and NFE. For 15%: 8 days had the best retention capacity in all the parameter measure than 15%:4 days.

6. Nutrient Retention

The dietary levels of TSBS had significant effect on the digestibility efficient of dry matter (DM), crude protein (CP), crude fiber (CF), ash and nitrogen free extract (NFE) retention, which could be attributed to the level of TSBSM inclusions however, the result showed that dietary treatment had no significant effect on the ether extract retention in all the three levels of inclusion (0,7.5, and 15%). It was observed that broilers fed diets containing 7.5% levels of TSBSM had significantly higher dry matter, crude protein, ash and nitrogen free extract retention, which disagrees with [15], who reported decrease in nutrient after fermentation with rumen liquor. Although there was no significant different between birds fed 7.5% and 15% TSBS on ash and nitrogen free extract. Broilers fed diets containing 15% levels of TSBSM had significantly better retention than broilers fed 0% TSBSM,

Fermentation days (4 and 8) had no significant difference in dry matter, crude protein, ether extra and nitrogen free extract retention. However, there was significant difference in crude fiber and ash retention of birds fed the experimental diets.

The interaction on the nutrient retention show that there was significant different observed in the broiler fed TSBS in the entire nutrient measured except in ether extract which show no significant.

6.1. Interaction between Fermentation Days and Inclusion Levels

Interaction between the levels of inclusion 0, 7.5 and 15% and the number of days of fermentation of TSBSM. Irrespective of the level of inclusion of TSBS 0, 7.5 and 15% and fermentation days 4 and 8, the birds performed well. Therefore, at this particular fermentation days, it was immaterial to the level of inclusion of TSBSM to be extended further 8 days. Also from all indication it shows that the gap between the 4 and 8days does not influence the performance of the birds. The level of inclusion of TSBSM on the other hand was adequately okay for the broiler in this particular experiment because the birds performed fine when compared to the treatment one with 0% (control) and the birds are healthy throughout the experimental days. It also implies that the broiler birds utilized TSBSM without problem between the 4 and 8days of fermentation

7. Conclusion Recommendation

There is need for alternative feed materials such as treated sugarcane bark scrapping meal in feeding animals because of high cost of concentrate feedstuffs and high competition that exist between man and animal. All the birds remained healthy throughout the experiment. Although they have challenges of coccidiosis at early stage but was taken care of with embazine fort and it was controlled. Implying that consumption of diets with TSBS for twenty-eight days (four weeks) had no adverse effects on their health

The nutrient composition of TSBSM was recommended advantages to serve as an Alternative feedstuff to broiler chicken. It will be better if fermentation days will be left at 4 days since there was no significant difference observed in both 4 days and 8 days. This will save stress and time of fermentation. Based on the finding of this study also, 7.5% and 15% of TSBSM also performed well but 15% is recommended furthermore, the cost was not left out. This study suggested that the use of SBSM will not only serve as feed ingredient to livestock because of the nutrient content as in Table but recycling it will improve the sanitary condition of our environment.

SBSM is a waste in our environment and during the experiment on TSBSM was seen to be promising feedstuff which is locally, readily available and can be obtained at cheaper price and when is properly fermented, it will not be harmful to broilers. The utilization of these waste would reduce the unhygienic nature of SBS in the environment. Based on the parameter assessed, there were no significant difference between the 4 and 8 days' fermentation except for protein and ash retention. I wish to recommend that 4 days' fermentation is preferred to be used and 15% inclusion Judging from the result but due to the fibrous nature and the low crude protein level of the sugarcane bark scrapping meal (SBSM). 4 days' fermentation will save time and effort. I also recommend more research should be carried out to investigate the carcass characteristic of birds that consumed SBSM.

References

[1] Holness, D. H., 1991. *The tropical agriculturalist: Pigs*. London and Basingstoke: The Macmillan Press Ltd., pp. 49-59.

[2] Adeniji, A. A. and Balogun, O. O., 2002. "Utilization of flavour treated blood-rumen content mixture in the diets of laying hens." *Nigeria Journal of Animal Production,* vol. 29, pp. 34-39.

[3] Adeniji, A. A., 1996. *The value of bovine blood. Rumen content meal as a feedstuff for pullets*. Phd. Thesis department of animal protection university of Ibadan.

[4] Cheeke, P. R., 1980. "Editorial: The potential role of the rabbit in meeting world food needs." *Journal of Applied Rabbit Research*, vol. 3, pp. 3-5.

[5] Bawa, G. S., Tegbem, T. S. B., Ogundipe, S. O., Dafwang, I. I., and Abu, E. A., 2003. "The effect of duration of cooking lablab seeds on the level of some anti-nutritional factors." In *Procedure 28thAnnual Conference of the Nigerian Society for Animal Production Held in Ibadan 16 – 20th March 2003.* pp. 213–215.

[6] Ogundipe, O. O., Moody, J. O., Akinyemi, T. O., and Raman, A., 2003. "Hypoglycemic potentials of methanolic extracts of elected plant foods in alloxanised mice." *Plant Foods Human Nutrition,* vol. 58, pp. 1-7.

[7] AOAC, 1995. *Association official methods of analysis association of officials analysis chemist*. Washington, USA: AOAC International. pp. 1-16.

[8] Pauzenga, U., 1985. *Feeding parent stock Zootechician International*, pp. 22-24.
[9] Duncan, D. B., 1955. "multiple range and multiple test." *Biometerics,* vol. 11, pp. 1-42.
[10] Adeyemi, O. A. and Familade, F. O., 2003. "Replacement of maize by rumen filtrate fermented corn-cob in layer diet." *Bio-Resource Tech*, vol. 90, pp. 221-224.
[11] Adeyemi, O. A. and Sipe, B. O., 2004. "In vitro improvement in the nutritional composition of whole cassava root-meal by rumen filtrate fermentation." *Indian Journal of Animal Science*, vol. 74, pp. 321-323.
[12] Adeyemi, O. A., Eruvbetine, D., Oguntona, T., Dipeolu, M. A., and Agunbiade, J. A., 2007. "Enhancing the nutritional value of whole cassava root meal by rumen filtrate fermentation." *Archivosde Zootecnia,* vol. 56, pp. 261-264.
[13] Dairo, F., Aina, A., Omoyeni, L., and Adegun, M. K., 2011. "Ensiled cassava peel and caged layers' manure mixture as energy in broiler starter diets." *Journal of Agricultural Science and Technology,* vol. 1, pp. 519-524.
[14] Zanu, H. K., Azameti, M. K., and Asare, D., 2017. "Effects of dieting inclusion of cassava root flour in broiler diets on growth performance, carcass characteristics and hematological parameters." *International Journal of Livestock Production,* vol. 8, pp. 28-32.
[15] Yashim, S. M., Jokthan, G. E., and Lamidi, O. S., 2015. "Effect off inclusion level and feeding regime on nutrient digestibility and nitrogen retention of growing Yankasa rams fed concentrate supplement containing ficus sycomorus leaf meal." *Journal of Tropical Biosciences,* vol. 10, pp. 28-37.