PAT December, 2018; 14 (2): 9-19 ISSN: 0794-5213
Online copy available at *www.patnsukjournal.net/currentissue*
Publication of Nasarawa State University, Keffi

Effects of Enzyme Supplementation of Rice Husk on Performance of Broiler Chicken

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Abstract
An experiment was conducted to evaluate the effect of xylanase supplementation of rice husk on performance, haematology and some blood biochemical parameters of broiler chickens. A total of 1,920 day old broiler chicks of Arbor Acre strain were used in a completely randomized design with 4 x 2 factorial combinations. Birds were fed a control diet (50%) maize in which rice husk was added at 10, 20 or 30% replacing maize in the control diet. Each of the diets was administered with or without 100ppm xylanase enzyme for a period of five (5) weeks. The replacement of maize with Rice Husk (RH) irrespective of levels supplemented with 100ppm xylanase enzyme caused a reduction in feed intake and an increase in weight gain and better Feed conversion ratio (FCR). The birds fed diet with 10% RH supplemented with xylanase enzyme performed better than birds fed diets with 20 or 30% RH supplemented with xylanase enzyme and closer to the birds fed the control diet which was with better FCR. Enzyme supplementation of RH helped in increasing and improving protein, ether extract and fibre digestibilities. The haematological and serum biochemistry were within normal range for broiler chickens. This showed that replacement of maize with RH irrespective of the levels used in this trial with supplementation of xylanase posed no threat on the health of the birds. The weights of vital organs also showed that the birds were in good health conditions during the trial period. The result of the cost benefit analysis also showed that 10% inclusion level of Rice Husk supplemented with xylanase enzyme gave the best result of a beneficial reduction in the cost of production with the best improved broiler performance.
Key words: *Xylanase enzyme, Rice husk, Fibre digestibility, Broiler nutrition*

Introduction

Food ingredients that are non-digestible or of low digestibility and selectively stimulate the growth of limited number of gut microbiota species are referred to as prebiotics, it confers health benefits to its host (Bach, 1997; Roberfroid *et al*., 2007). They are oligosaccharides and polysaccharides and function as a result of being resistant to gastric acidity and hydrolysis by mammalian enzyme, ease of fermentation by intestinal microflora, and its ability to selectively stimulate growth of intestinal bacteria (Adams, 1993; Bandyopadhyay and Mandal, 2014). Reported examples of prebiotics include galactooligosaccharides (GOS), fructo-oligoaccharides (FOS), soybean oligosaccharides, isomalto-oligosaccharides, inulin and lactulose (Bezkorovainy, 2001; Binns, 2013). Others include Xylo-oligosaccharides (XOS) which consists of xylobiose and xylotriose (Morishita *et al*., 2002; Li *et al*., 2008). Prebiotics are naturally found in fruits, vegetables, bamboo, honey and milk. It can be produced from xylan rich lignocellulosic wastes.

Rice Husk (RH) is a by-product in the rice-milling industry with a lignocellulosic biomass and accounts for about 40 million metric tonnes of wastes from more than 500 million metric tonnes of the world's annual paddy rice production. Its composition is made up of 15-20% oil, 12-16% protein, 6.5% oligosaccharides, 35-55% other carbohydrates and 7-10% silica and other micro elements (Oyawoye and Nelson, 1999). It has a high phytate content which makes it prone to rancidity, high in fibre and contains a trypsin inhibitor (Selle and Ravindran, 2007). Some of these characteristics are responsible for its limited use in poultry diets but this limitation could be reduced with enzyme supplementation. Exogenous microbial enzymes have long been used to improve the nutritional value of high fiber diets (Hosamain *et al*., 2001; Angelovicova *et al*., 2005). However, there is little or no information on the prebiotics potentials of enzyme supplemented rice bran in Chickens. Thus, this study was designed to assess the effect of xylanase enzyme supplemented rice husk on performance, haematology and some biochemical parameters of broiler chickens.

Materials and Methods

Sourcing and Management of birds **–** A total of one thousand, nine hundred and twenty (1,920) day old broiler chicks of Arbor Acre strain purchased from Yammfy Farm hatchery at Ilemona, Kwara State were used for this experiment. The birds were housed in an electrically heated battery cage and fed the experimental diets shown in Table 1. Xylanase enzyme used is a bacteria xylanase feed enzyme (Nutrase, a pure endo-1, 4-beta-xylanase) produced by Bacillus subtilis to break down the arabinoxylan fraction into shorter polysaccharide (xylose monomers) with a decrease of viscosity, liberation of nutrients and improved zoo technical performances. It was supplied by Nutrex, Belgium. The study was conducted following the guidelines of the Research Policy of the University of Ilorin on Animal Welfare and Ethics.

Experimental design - Birds were fed a control diet (50% maize) or diets in which rice husk was added at 10, 20, or 30% replacing maize in the control diet. Each of these diets was given with or without 100 PPM xylanase enzyme in a 4 x 2 factorial combination. Thus, there were 8 treatments each with 8 replicate cages of 30 birds. The experimental diets were formulated to meet NRC (1994) nutrient requirements for broiler, in particular the recommendations for Arbor Acre strain. Each experimental treatment was fed *ad-libitum* with its own diet for a period of 5weeks. Live weight was recorded weekly while feed intake was recorded daily in grams and excreta samples collected over a 72 hour period. Nutrient retention trial was done at the third week of the feeding trial using a total collection method. Excreta samples were oven dried at 70^{o}C, weighed and ground prior to chemical analysis. The experimental diets and excreta samples were analyzed for their chemical constituents using the procedures outlined by AOAC (2008).

Table 1. Composition of experimental diet (%)

Ingredients	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Maize	50	50	40	40	30	30	20	20
Rice Husk	0	0	10	10	20	20	30	30
Xylanase (ppm)	0	100	0	100	0	100	0	100
Basal ingredients	50	50	50	50	50	50	50	50
Total	100	100	100	100	100	100	100	100

*Basal diets : Groundnut cake(GNC) – 26%, corn bran- 1%, soybean meal- 12%, fishmeal(72%)- 4%, palm oil- 2%, oyster shell- 2%, bone meal- 2%, salt- 0.25%, methionine- 0.25%,lysine- 0.25% and vitamin premix- 0.25%.(*Vitamin/ mineral premix contained the following: (Univit. 15 Roche) 1500 I.U, Vit A, 1500 I.U, Vit D, 3000 I.U, Vit E, 3.0g, Vit K, Vit.* B_2 *0.3g, Vit.*B_6*, 8.0mg, Vit.*B_{12}*, 8.0g, Nicotinic Acid, 3.0g, Ca-Pantothenate, 50mg, Fe, 10.00g, Al, 0.2g, Cu, 3.5mg, Zn, 0.15mg, I, 0.02g,* CO_2*, 0.01g, Se).*

.At the end of the experiment, blood samples were taken from 10 randomly selected birds per replicate in each treatment. 4 ml of blood was collected from the jugular vein at the neck of each bird by using sterile needle and syringe to withdraw the blood. The blood samples were put into properly labeled and sterilized tubes without anticoagulant for blood biochemistry. For blood haematology samples were placed in properly labeled and sterilized tubes already treated with

EDTA (Ethylene Diamine Tetra Acetic acid). The following biochemical and haematological parameters were determined: Total protein, Albumin, Urea, Haemoglobin concentration (Hb), Red blood cell (RBC), White blood cell (WBC), and Packed cell volume (PCV). The biochemical parameters were determined as previously described by Aderolu *et al.* (2007). The haematological parameters were determined as previously described by Swenson (1970) and Aderolu *et al.* (2007). The Mean Cell Volume (MCV), Mean Corpuscular Haemoglobin Concentration (MCHC) and Mean Corpuscular Haemoglobin (MCH) were estimated by calculation using a standard formula (Jang *et al.*, 2007).

Cost-benefit Analysis - Cost-benefit analysis was carried out, taking into consideration the cost of maize, rice husk and the enzyme (*xylanase*) as they related to the performance of birds.

Statistical analysis - All Data collected were subjected to two way analysis of variance (ANOVA) using the PRO GLM (General Linear Model) of SAS (2008) at 5% level of significance. All significantly different means were separated using the Duncan's Multiple Range Test of the same software package.

Results and Discussion

Table 2 shows the effects of dietary levels of Rice Husk with or without enzyme supplementation on the performance of broilers. Increase in dietary levels of Rice Husk from 0% t0 30% had a significant effects on the feed intake, Weight gain and feed conversion ratio ($p<0.05$). Feed intake by birds fed the control was significantly lower than those of birds fed diets with dietary levels of rice husk ($p<0.05$). Feed intake by birds fed diet with 30% rice husk was significantly higher than those of birds fed diets with 10% or 20% rice husk($p<0.05$). Weight gain by birds fed the control diet was significantly higher than those of birds fed with dietary levels of RH ($p<0.05$). Birds fed diet with 10% RH gained more weight than those of birds fed diets with 20% or 30% RH($p<0.05$). Feed gain ratio of birds fed the control was significantly lower than those of birds fed with dietary levels of rice husk ($p<0.05$). Feed gain ratio by birds fed diet with 30% rice husk was significantly higher than those of birds fed diets with 10% or 20% rice husk($p<0.05$). Thus, birds fed the control diet had better feed conversion ratio. Enzyme supplementation had significant decreased effects on Feed intake and Feed/gain ration but significant increased effect on the weight gain ($p<0.05$). Crude protein of birds fed control diet was significantly higher than those of birds fed with dietary levels of rice husk ($p<0.05$). Protein retention of birds fed diet with 30% rice husk was significantly lower than those of birds fed diets with 10% or 20% rice husk ($p<0.05$). Crude fibre of birds fed control diet was significantly higher than those of birds fed with dietary levels of RH ($p<0.05$). Crude fibre of birds fed diet with 30% RH was significantly lower than birds fed diet with 10% RH ($p<0.05$), and comparable with those of birds fed diet with 20% RH ($p>0.05$). Ether extract of birds fed the control diet was significantly higher than those of birds fed with dietary levels of rice husk ($p<0.05$). Ether extract retention by those of birds fed diets with rice husk irrespective of levels were comparable ($p>0.05$). Enzyme supplementation had significant increased effects on Crude protein, Crude fibre and Ether extract. There were no significant interaction between enzyme supplementation and dietary levels of rice husk on Crude fibre and Ether extract ($P>0.05$). However, Crude protein shows interaction between the two factors measured ($P<0.05$). The details are shown in tables 3.

Table 2. Effects of Dietary Levels of Rice Husk (RH) with or without Xylanase Supplementation on Performance and nutrient retention of Broilers (0-5wks)

RH (%)	Feed consumed (g/bird/day)	Weight gain (g/bird/day)	FCR	Crude protein (%)	Crude fibre (%)	Ether extract (%)
0	55.10^{c}	32.60^{a}	1.70^{d}	83.10^{a}	73.80^{a}	74.30^{a}
10	57.20^{b}	27.60^{b}	2.10^{c}	69.20^{b}	63.60^{b}	57.40^{b}
20	56.90^{b}	25.30^{c}	2.30^{b}	59.00^{c}	61.60^{bc}	56.90^{b}
30	58.90^{a}	23.80^{d}	2.50^{a}	55.60^{d}	59.20^{c}	54.70^{b}
SE	0.21	0.32	0.03	0.89	0.95	1.52
Enzyme Supplementation (ES)(ppm)						
0	57.40^{a}	26.20^{b}	2.20^{a}	62.70^{b}	60.70^{b}	58.10^{b}
100	56.70^{b}	28.50^{a}	2.00^{b}	70.80^{a}	68.50^{a}	63.50^{a}
SEM±	0.15	0.22	0.02	0.63	0.67	1.07
RH x ES	0.1399	0.0015	0.0204	S	NS	NS

Column means with different superscripts are significantly different ($p<0.05$), *NS: not significant, S: Significant; RH – Rice husk; ES – Enzyme supplemetation*

Table 3. The detail of Interaction on Crude Protein

	Dietary Rice Bran Supplementation (%)			
ES (100ppm)	0	10	20	30
0	80.1^{b}	60.2^{c}	55.2^{d}	55.2^{d}
100	86.0^{a}	78.1^{b}	62.8^{c}	56.1^{d}

Table 4 shows cost benefit analysis for replacing Maize with Rice Husk (RH) with or without enzyme supplementation. The percentage reduction to raise 1kg of broiler occurred at 0% rice husk inclusion level with enzyme supplementation. The percentage reduction was 4.35% as compared to the control diet. The other treatments with or without enzyme supplementation lead to a percentage increase in the cost of raising 1Kg broiler with 10% rice husk inclusion without enzyme supplementation recording the highest cost of raising 1Kg broiler as compared to the control diet. This shows that birds on enzyme supplemented 10% rice husk diet were able to produce 1kg of meat at a reduced cost when compared to the control.

The table 5 shows effects of dietary levels of Rice Husk with or without enzyme supplementation on heamatological parameters of broilers. Increase in dietary levels of rice husk from zero to 30% had significant effect on the PCV, HB and WBC ($p<0.05$), but no significant effects on Neut and Lymn ($p>0.05$). PCV for birds fed the control diet was significantly higher than birds fed with 10% rice husk ($p<0.05$), and comparable with those of birds fed diets with 20% or 30% rice husk ($p>0.05$). PCV for birds fed diet with 10% rice bran was significantly lower than those of birds fed diet with 30% RH ($p<0.05$), but comparable with birds fed diet with 20% RH ($p>0.05$). Hb for birds fed the control diet was comparable to those birds fed with dietary levels of rice husk ($p>0.05$). Hb of birds fed diet with 20% rice husk was comparable with those of birds fed diets

with 10% or 30% rice husk. WBC for birds fed the control diet was significantly higher than birds fed with 10% rice husk (p<0.05), and comparable with those of birds fed diets with 20% or 30% rice husk (p>0.05). WBC for birds fed diets with rice husk irrespective of levels were comparable (p>0.05). There was no significant effects by enzyme supplementation on heamatological parameters
(p>0.05). The interaction between enzyme supplementation and dietary levels of rice husk had no significant (P>0.05) effect on the PCV, Hb, WBC, Neut and Lymn values of the birds across all groups.

Table 4. Cost Benefit Analysis for replacing Maize with Rice Husk (RH) with or without enzyme supplementation

Source of Variation	Cost of Producing/kg (N)	Percentage reduction to Raise 1Kg of Broilers (%)	Cost of Raising 1Kg of Broilers (N)	Percentage reduction to Raise 1Kg of Broilers (%)
Enzyme*Treatment				
Non- Inclusion 0	111.49	0.00	195.11	0.00
Non- Inclusion 10	105.49	5.69	241.83	-23.81
Non- Inclusion 20	99.5	12.05	232.83	-19.33
Non- Inclusion 30	93.49	16.14	239.33	-22.67
Inclusion 0	114.49	-2.62	186.62	4.35
Inclusion 10	108.49	2.69	205.05	-5.09
Inclusion 20	102.5	8.77	221.05	-13.48
Inclusion 30	98.49	13.20	236.38	-21.15

Table 5. Effects of dietary levels of Rice Husk with or without enzyme supplementation on haematological parameters of broilers

Diets	PCV(%)	Hb(g/L)	WBC(x 10^9/L)	Neut.(%)	Lymn.(%)
RH (%)					
0	33.2^a	11.0^{ab}	6.5^a	54.8	45.2
10	32.5^b	10.8^b	5.3^b	54.7	44.5
20	34.3^{ab}	11.4^{ab}	5.5^{ab}	55.2	44.0
30	35.5^a	11.8^a	6.1^{ab}	54.8	43.3
SE	0.93	0.31	0.36	1.74	1.56
ES					
(100ppm)	33.9	11.3	5.5	55.3	43.7
0	33.8	11.2	6.1	54.5	44.8
100	0.66	0.22	0.25	1.23	1.11
SE					
RH*ES	NS	NS	NS	NS	NS

Table 6 shows effects of dietary levels of Rice Husk with or without enzyme supplementation on serum biochemical parameters of broilers. Increase in dietary levels of rice husk from zero to 30% had no significant effect on the TP and ALP (p>0.05), but was significant for, Albumin, Urea, Cholesterol, ALT and AST (p<0.05). Albumin of birds fed the control diet was significantly lower than those of birds fed with dietary levels of RH (p<0.05). Albumin of birds fed diet with 20% RH was comparable with those of birds fed diets with 10% or 30% RH (p>0.05). Urea of birds fed the control diet was significantly lower than those of birds fed with dietary levels of rice husk (p<0.05). Urea of birds fed diets with rice husk irrespective of levels were comparable (p>0.05).). Cholesterol of birds fed the control diet was significantly higher than those of birds fed with dietary levels of RH (p<0.05). Cholesterol of birds fed diets with RH irrespective of levels were comparable (p>0.05). ALT of birds fed the control diet was significantly lower than those of birds fed with dietary levels of rice husk (p<0.05). ALT of birds fed diet with 30% rice husk was comparable with those of birds fed diets with 10% or 20% rice husk (p>0.05). AST of birds fed the control diet was significantly lower than those of birds fed with dietary levels of rice husk (p<0.05). Dietary levels of rice husk had significant increased effects on AST of the birds (p<0.05). Enzyme supplementation had significant increased effect only on the Cholesterol level (p<0.05). There was no significant interaction between enzyme supplementation and dietary levels of rice husk on the Total Protein, Total Albumin, Urea, Cholesterol, ALT, AST and ALP value across all treatments.

Table 6. Effects of dietary levels of Rice Husk with or without enzyme supplementation on serum biochemical parameters of broilers

Diets	Total protein(g/L)	Albumin (g/L)	Urea	Cholesterol (nmol/L)	ALT(µ/L)	AST (µ/L)	Alk phos (nmol/L)
RH (%)							
0	4.8	1.4^{c}	0.3^{b}	117.2^{a}	3.1^{c}	1.1^{d}	11.8
10	4.1	1.9^{b}	2.4^{a}	63.4^{b}	13.2^{b}	10.7^{c}	11.2
20	3.7	2.3^{ab}	3.8^{a}	60.4^{b}	20.5^{a}	17.2^{b}	12.6
30	4.1	2.5^{a}	3.9^{a}	56.0^{b}	17.3^{ab}	23.1^{a}	13.6
SE	0.74	0.17	0.59	4.15	2.10	1.10	1.23
ES (100ppm)							
0	4.2	1.9	2.7	60.7^{b}	15.1	12.7	12.3
100	4.2	2.1	2.5	87.8^{a}	12.0	13.3	12.3
SE	0.52	0.12	0.42	2.93	1.48	0.78	0.87
RH*ES	NS	NS	NS	NS	NS	NS	NS

The significant improvements observed in the group fed enzyme supplemented diets may be due to the ability of the birds to utilize the dietary fibre and other nutrients in the feed due to the activities of the enzyme. This made it possible for birds fed enzyme supplemented diets to consume less feed, yet their energy requirement was met, converted feed efficiently and had a better feed conversion ratio. This result is in agreement with the findings of Koong *et al.* (1985) and Ani *et al* (2008) who reported that reduction of feed intake was due to enhancement of feed, digestibility and nutrient availability. Birds are able to meet their energy requirement faster than when diets are not supplemented with enzymes. Marquardt *et al.* (1994) also reported that the ability of the birds to facilitate access of enzymes to intracellular starch granules, proteins and other nutrients by breaking down otherwise intact bonds between non-starch polysaccharides was the reason for better performance in birds fed enzyme supplemented diets. Bedford (2000) reported that high digesta viscosity causes reduced feed digestion and slows the rate of nutrient absorption and Wu *et al.* (2004) reported that enzymes reduce digesta viscosity induced by the presence of high molecular weight non-starch polysaccharides.

The significant decline in performance as the dietary level of rice husk increased can be attributed to decreased metabolisable energy and increased dietary fibre in the diets as the inclusion level of rice husk increased corroborating the work of Jorgensen *et al.* (1996). Kussaibati *et al.* (1982) and Yunusa *et al.* (2014) reported that the chicken is known to be especially sensitive to dietary energy concentration and Montagne *et al.* (2003) report sensitivity of chicken to dietary fibre in feed. Also, the digesta viscosity is known to increase with increase in fibre level and Bedford (2000) reported that high digesta viscosity caused feed digestion to reduce which subsequently slow down the rate of nutrient absorption.

This reduction in percentage cost of raising 1Kg of broilers at 0% rice husk inclusion level with enzyme supplementation was due to faster growth rate of broilers by enzyme supplementation at this inclusion level. The percentage increase in cost of producing 1Kg broiler in enzyme supplemented diets can be attributed to the extra cost of feed enzyme incurred. While others without enzyme supplementation was due to poor feed conversion ratio of the birds which may be as a result of poor nutrient retention. This partially supports one of the reasons given by Hosamain *et al.* (2001) which was that profit increased due to faster growth rate of broilers by enzyme supplementation but was not in accordance with low feed cost as the feed might not be readily digestible by the birds thereby leading to consumption of more quantity of feed leading to higher cost of production.

The significant reduction with increased dietary rice husk in protein retention in the interaction with enzyme and treatment across all treatments could have been caused by increased dietary fibre level which hindered the digestion and utilization of crude protein in the diets. Oladunjoye and Ojebiyi (2010) reported a similar effect when rice husk was fed with or without enzyme to broiler chickens. The cause was attributed to high fibre in the diets. Montagne *et al.* (2003) also reported that high fibre diets reduced digestibility of the diets stating that birds are sensitive to fibre content of the feed.

Effect of enzyme action which might have acted on the fibre content of the feed to improve the nutritional value might be the reason for groups fed enzyme supplemented diets having a better nutrient retention than groups without enzyme supplementation. Angelovicova *et al.* (2005), Lee *et al.* (2010), and Oladunjoye and Ojebiyi (2010) reported that the use of exogenous microbial enzymes improved the nutritional value of high fiber diets. Khan *et al.* (2006) stated that the use of exogenous microbial enzymes improved nutrient digestibility, destroy anti-nutritional factors and manipulate gut flora population as well as supplementing endogenous enzymes.

Significant reduction in the crude protein retention associated with increased rice husk inclusion was caused by increased dietary fibre which reduced the utilization of the dietary protein as the level of rice bran increased. This agrees with the work of Montagne *et al.* (2003) and Yu *et al.,* (2007) who reported that high dietary fibre (feed diluents) decrease nutrient utilization in monogastric.

The significantly higher percentage weight of spleen in diets without enzyme supplementation could be as a result of higher haemoglobin level which indicated production of higher red blood cell in diets without enzyme supplementation as the spleen is known to involve in the production and removal of blood cells.

The higher percentage weight of spleen in group fed 0% rice husk diets could be as a result of relatively higher haemoglobin level and significantly higher white blood cells as compared to other diets as spleen is known to be involved in the production and removal of blood cells. The significantly lower percentage weight of abdominal fat in rice husk based diets as compared to diet with 0% rice husk inclusion level might be as a result of high level of fibre which acts as diluent thereby preventing excess fat deposition in the body of the animals. This is in agreement with Lee *et al.* (2010) who reported that fibrous feeds, because of their lower content and availability of energy tend to promote better carcasses with higher lean meat and lower fat contents.

Enzyme supplementation significantly increased the cholesterol level of the birds. This can be attributed to the enzyme's activity on the feed which increased the nutrient availability, absorption and utilization thereby breaking down more fats and subsequently deposition of higher serum cholesterol in the blood (Yadi and Yana, 2011).

The serum biochemistry of the birds revealed that total albumin reduced as the dietary levels of rice husk increased in the diets. These showed that rice husk meals were poorly utilized by the broilers at relatively higher dietary inclusion. This is in agreement with Agbabiaka *et al.* (2013).

The significant effect of dietary rice husk supplementation on the urea level could be as a result of reduction in quality protein with inclusion of rice husk in the diets. This is in line with Aderolu *et al.* (2007) who reported that high urea level is an indication of poor quality protein. The similar cholesterol level in rice husk diets which was significantly lower to that of control diet (0% rice husk inclusion level) on the basis of rice husk inclusion level showed that rice husk has cholesterol lowering properties. This result further strengthens the work of Yunusa *et al.* (2014) who reported that cholesterol lowering properties are present in rice husk oil.

Enzyme inclusion at 0% rice husk inclusion level resulted in a significantly ($P<0.05$) lower pH value. Acidic condition has been reported by Hertland *et al.* (2005) to aid digestion. This may be the reason why birds fed enzyme supplemented 0% rice husk diet had a better performance than other diets. Enzyme supplementation resulted to a significant lower faecal coliform count and a numerical higher *Lactobacillus* population. This could be a pointer to the prebiotic property of rice bran as Lactobacillus population increased to significantly reduce the faecal coliform count.

The significant effect of dietary inclusion of rice husk on TCC and LBC can be attributed to the prebiotic properties of rice husk as those with rice husk had a similar TCC and LBC value which was significantly higher than the control diet. Although rice husk inclusion resulted to a higher TCC, there was a numerical decrease in the FCC and a significant increase in the LBC of groups fed rice husk based diets as compared to the control diet (without rice husk inclusion). The similar pH in groups fed rice husk which was higher than that of 0% rice husk diet might be the reason for better nutrient utilization in the 0% rice husk diet as acidic condition has been reported to aid digestion (Ohimain and Ofongo, 2013). Hertland *et al.* (2005) reported that coarse feed particles, such as those provided by the fibrous feeds; remain longer in the upper part of the GIT and as such, birds with lower pH (more acidic) in the upper part of the GIT will be able to digest and utilize fibre more than those with higher pH. Mabelebele *et al.* (2014) reported that lower pH value of crop and gizzard in Venda chickens as compared to broilers may be the reason why indigenous chickens tend to digest fibre better than broiler chickens. The significantly higher value for fungi count in the groups fed 20% rice husk inclusion may be as a result of adequate quantity of carbohydrate fibre called oligosaccharides present in the rice husk. Fungi grow and develop in the presence of starch; the development of a good mold fungus produces the enzyme cellulase spurred in large quantities that can be used to remodel and lower crude fiber. Thrope and Beal (2001) reported that cellulase is an enzyme that can decide β glycosides bond (1.4) on cellulose and Wang (2005) concluded that high population of fungus can increase the crude protein content of the substrate as the mold is a source of single cell protein. This may be the reason behind 20% rice husk inclusion having similar protein retention as 10% rice husk inclusion level.

Conclusion

Results obtained from this study showed that replacement of maize with Rice Husk irrespective of levels supplemented with 100ppm *xylanase* enzyme caused a reduction in feed intake and an increase in weight gain and better FCR. In all these parameters, it is observed that birds fed diet with 10% RH supplemented with *xylanase* enzyme out-performed birds fed diets with 20 or 30% RH supplemented with *xylanase* enzyme and closer to the birds fed the control diet which was with better FCR. It can be deduced that enzyme supplementation of RH helped in increasing and improving protein, ether extract and fibre digestibilities. The haematological and serum biochemistry results in this study were within normal range for broiler chickens. This showed that replacement of maize with RH irrespective of the levels used in this trial with supplementation of *xylanase* posed no threat on the health of the birds. The result obtained for the weights of vital organs in this study showed that the birds were in good health conditions during the period. The result of identification of microbes (Fungi and Bacteria) in this study showed that dietary levels of RH (10, 20 or 30% inclusion) with supplementation of enzyme *xylanase* enhanced the growth of beneficial microbes which resulted in inhibition or elimination of the opportunistic/pathogenic microbes. The result of the cost benefit analysis also showed that 10% inclusion level of Rice Husk supplemented with *xylanase* enzyme gave the best result of a beneficiary reduction in the cost of production with the best improved broiler performance.

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