Effect of enzymes supplementation on growth performance, haematological and serum biochemical responses of grower rabbits fed sorghum based diets

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Abstract

A study was conducted to investigate the effect of sorghum based diets supplemented with enzyme on haematological and serum biochemical responses of grower rabbits. A total of twenty four grower rabbits were used for the investigation which lasted eight weeks. Four experimental diets were formulated which included maize based diet (Control), sorghum based diet supplemented with; Protease (D2), Phytase (D3) and Phytase with Protease (D4). The rabbits were randomly assigned to the four dietary treatments in a completely randomized design. Rabbits fed diet containing sorghum with phytase (D3) had high significant ($p < 0.05$) value of 115.10g for final weight. Least statistically similar values of 1136.80g and 1033.60g were obtained for rabbit fed sorghum with protease plus phytase (D4) and control diet, respectively. The weight gain followed similar trend with the final weight. The dietary treatments had no significant influence ($p > 0.05$) on all haematological parameters determined. A range of $2.90\text{--}3.15 \times 10^4/\text{l}$ was recorded for red blood cell, and $5.70\text{--}10.60 \times 10^9/\text{l}$ for White blood cell While MCH and MCV ranged from 27.16 – 32.75pg and 88.55 – 89.35fl, respectively. Sorghum based diet supplemented with enzymes showed significant ($p < 0.05$) on serum biochemical indices. Parameters that were significantly influenced include; Total protein, globulin, urea, creatinine and cholesterol. Rabbits fed sorghum based diet supplemented with phytase (D3) revealed highest ($p < 0.05$) values for total protein and globulin. Highest ($p < 0.05$) value of 7.05mmol/l, 102.25mmol/l and 4.50mmol/l were recorded for urea, creatinine and cholesterol, respectively in the control diet. In conclusion, sorghum based diets supplemented with enzyme improved rabbit performance, had no allergic effect on health status of rabbit and enhanced serum protein bioavailability with efficient nutrient utilization.

Keywords: Sorghum, phytase, protease, haematology, serum biochemistry, rabbit.

Introduction

Inadequate animal protein in the diets of people in developing countries has called for the integration of some micro livestock in the farming system as sources of animal protein. Taylor *et al.* (1989) reported that rabbit meat is of excellent protein quality, as well as saturated fat and cholesterol. Livestock productivity depends to a large extent on their ability to utilize feeds that are less competitive between human and animal. Supply of meat always remains a major constraint in animal production due to the ever increasing cost of conventional

feedstuffs occasioned by the competition between man and livestock. The insufficient supply of feedstuffs at economic prices has continued to limit livestock production and thus, availability of animal protein in the diets of humans in the developing countries of the world. High cost of maize due to competitiveness between human and poultry industry result to high cost of production. This situation has compelled animal nutritionists to gear research into alternative feed sources to reduce cost of animal proteins. In animal nutrition, sorghum is scarcely used as an energy source, however,

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inclusion of sorghum is limited due to anti nutritional factor. Sorghum contains some antinutritional factors which inhibits the utilization of important nutrient like protein, energy and mineral like phosphorus, calcium, zinc and magnesium. For improvement of sorghum utilization in poultry diet, exogenous enzymes are put into consideration. Enzyme is what nutritionists had realised for a long time but could not be accessed until 1980's (Khattak *et al.*, 2006). Some of the enzymes that have been used over the past several years and maintain the potential for use in the feed industry include cellulase, xylanase, phytases, proteases and galactosidases (Khusheeba and Sajid, 2013). The role of enzymes as feed additive in poultry diet has been reported to reduce viscosity of the ingesta in the intestine and show marked improvement on the various morphological effects of feeding fibrous material to monogastrics (Adeyemi *et al.*, 2013; Iyayi and Yahaya 1999). Multienzyme in term of enzyme combination has been reported to produce synergetic effect (Ovimaps, 2014). This study was therefore designed to assess the effect of enzymes supplementation on growth performance and blood indices of grower rabbits fed sorghum based diets

Materials and methods

Experimental animals and management

A total of forty eight grower rabbits of mixed breed were weighed and allotted to four dietary treatments with three replicates, each having 12 rabbits in a complete randomized design. The rabbits were raised in a cage system during the period of the experiment which lasted for 8 weeks. The rabbits were fed *ad-libitum* and necessary routine management practices were duly followed.

Experimental diets

Four isocaloric and isonitrogenous diets

were formulated to meet the nutrient requirement of rabbits with sorghum and enzymes as dietary source of variation as presented below:

Diet 1: Control maize based diet.

Diet 2: sorghum based diet with protease.

Diet 3: sorghum based diet with phytase.

Diet 4: sorghum based diet with protease and phytase.

Data collection

Growth Performance

The rabbits were weighed at the commencement of the study and subsequently on weekly basis for eight weeks. The feed intake was calculated on daily basis as feed offered minus feed left over.

Collection of blood sample

At the end of the feeding trial, 4ml of blood was collected from one rabbit per replicate that is, three from each treatment. The blood was collected through their ear vein with a syringe. 2ml of blood sample was transferred into a bottle containing Ethylene Diamine Tetra Acetic Acid (EDTA) for haematological analyses. The parameters determined include Packed Cell Volume (PCV), White Blood Cell (WBC), Haemoglobin(Hb), Red Blood Cell (RBC), Mean Cell Haemoglobin Concentration (MCHC), Mean Cell Haemoglobin(MCH) and Mean Cell Volume (MCV)

Another two meals of blood sample collected was transferred into a plain bottle for serum analysis. The serum metabolite such as Serum Total Protein, Albumin, Globulin, Cholesterol, Creatinine, and Urea were determined.

Statistical analysis

Data collected were subjected to analysis of variance using the SPSS software (2012) and means were compared using Duncan's New Multiple Range Test (DNMRT) of the same software.

Table 1: Percentage composition of grower rabbits diets

Ingredient	D1 Maize (control)	D2 Sorghum + Protease	D3 Sorghum + phytase	D4 Sorghum + Protease + phytase
Maize	45.00	0.00	0.00	0.00
Sorghum	0.00	45.00	45.00	45.00
Palm oil	0.00	1.00	1.00	1.00
SBM	16.50	13.30	13.30	13.30
GNC	7.80	9.60	9.60	9.60
Fish meal	2.00	2.00	2.00	2.00
Rice offal	24.40	24.80	24.80	24.80
Bone meal	2.00	2.00	2.00	2.00
Limestone	1.50	1.50	1.50	1.50
Lysine	0.10	0.10	0.10	0.10
Methionine	0.25	0.20	0.20	0.20
Salt	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25
Total	100	100	100	100
Supplementation				
Protease (kg)	-	+	-	+
Phytase (kg)	-	-	+	+
Calculated analysis				
ME (kcal/kg)	2,550.04	2,502.41	2,502.41	2,502.41
Crud protein (%)	18.17	18.46	18.46	18.46
Fibre (%)	5.95	5.95	5.95	5.95
Fat (%)	4.34	3.91	3.91	3.91
Calcium (%)	1.18	1.19	1.19	1.19
Phosphorus (%)	0.51	0.61	0.61	0.61
Lysine (%)	0.99	0.96	0.96	0.96
Methionine (%)	0.47	0.42	0.42	0.42

+ = with enzyme   - = without enzyme

Table 2: Growth response of grower rabbits fed sorghum based diet supplemented with Enzymes

Parameter	D1 Maize (control)	D2 Sorghum + Protease	D3 Sorghum + phytase	D4 Sorghum + protease+phytase	SEM
Initial weight(g)	549.19	548.45	550.07	549.61	0.26
Final weight(g)	1033.60 ^b	1050.20 ^{ab}	1150.10 ^a	1136.80 ^b	20.31
Weight gain(g)	487.70 ^b	501.73 ^{ab}	600.02 ^a	587.22 ^{ab}	20.17
Daily weight gain (g/rabbit)	8.71 ^b	8.96 ^{ab}	10.72 ^a	10.49 ^{ab}	0.36
Daily feed intake (g/rabbit)	48.58	46.96	48.52	48.81	0.33
FCR	5.64 ^a	5.26 ^{ab}	4.55 ^b	4.68 ^{ab}	0.18

^{ab}Mean values in the same row having different superscripts are significantly different (P<0.05)

Results and discussion

The Results of growth response of grower rabbits fed sorghum based diet supplemented with enzymes are presented in Table 2. Inclusion of sorghum based diet with enzymes supplementation revealed

significant ($p < 0.05$) influence on final weight, weight gain, daily weight gain and feed conversion ratio. Numerically, rabbits fed diet containing sorghum with phytase (D3) reveal high significant ($p < 0.05$) value of 115.10g for final weight. Least

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statistically, similar values of 1136.80g and 1033.60g were obtained for rabbit fed sorghum with protease plus phytase (D4) and control diet, respectively. The weight gain followed similar trend with the final weight. The result showed a definite pattern with rabbits on (D3) obtaining highest significant ($p < 0.05$) value for weigh gain and rabbits on the control diet being the least. Observed improved performance in this study could be attributed to ability of enzyme to improve the overall feed utilization by causing degradation of fibre and non-starch polysaccharide (NSP) component of the sorghum based diet in to soluble metabolizable energy (Choct, 2006). Exogenous enzymes are commonly associated to hydrolysis of non-starch polysaccharide and consequently reduce the negative effect of polysaccharide by making the nutrient available for the rabbits. Daily weight gain followed the same trend with rabbits fed diet containing sorghum with phytase (D3) revealing high significant ($p < 0.05$) value of 10.72g/r/d compared to 8.71g/r/d recorded by rabbits on the control diet. Statistical similar values of 8.96g/r/d and 10.49g/r/d were obtained for rabbits fed diet containing sorghum with protease (D2) and sorghum with protease plus phytase supplementation. Daily weight gain ranged between 8.71-10.72g which was similar to 10.1g for rabbits as reported by Adama and Nma (2002) when groundnut leaves were fed to rabbit but lower than 17.65 -18.80g recorded by Agunbiode *et al.* (1999) on cassava leaf and peel meal. This result could be associated to observation of sekoni *et al.* (2008) on increase in crude fibre digestibility and stated that enzyme might have acted on cellulose, glucuronoxylans and arabinoxylans thereby increase the energy content and NFE digestibility for tissue buildup. Rabbit

fed diet containing sorghum with phytase (D3) revealed least significant ($p < 0.05$) value of 4.55 for feed conversion ratio (FCR) compared to other dietary groups. A lower feed conversion ratio indicated better performance in terms of turning feed to flesh. 45.5-5.64 feed to gain ratio is chose to range values reported by literature (Adejumo, 2002; Adegbola and Okonkwo 2002). Dietary treatments did not show any significant ($p > 0.05$) influence on daily feed intake.

The results of haematological parameter of grower rabbits fed sorghum based diets supplemented with enzymes is presented in Table 3. Sorghum based diet with enzymes supplementation had no significant ($p > 0.05$) effect on all the parameters determined. This suggested that the dietary groups had no allergic effect on the experimental rabbits. Haematological parameters are used to determined health status of the animal and stress due to environment, nutrition and pathological factors (Afolabi *et al.*, 2010). Values recorded for packed cell volume (PCV) ranged from 26.00%-28.00% with rabbits fed diet containing sorghum with phytase being the least and rabbit on diet containing sorghum with phytase plus protease being the highest. The ranged values recorded for PCV as shown in this study agreed with the range of 27-30% recorded in the literature (Oladipo *et al.*, 2015). Values below 21-35% for PCV is an indication that the animal is anaemic and is attributed to poor quality protein (Daramola *et al.*, 2005). Numerically, similar values were obtained for haemoglobin across dietary treatments. Ranged values of 9.15-9.55 as observed in this study corroborated the result of Oladipo *et al.* (2015) who reported ranged value of 9.17g/dl-9.97 g/dl for broiler chicken fed sorghum based diet supplemented with enzyme. This observation is an indication that the rabbit

had sufficient oxygen carrying capacity, thus healthy living. Rabbit fed diet containing sorghum with phytase revealed least numerical value $2.90 \times 10^{14}/l$ for RBC compared to other dietary groups. This observed similar values for RBC across dietary treatments is an indication of moderate number and morphology of the cellular elements of the blood. The result revealed least value of $5.70 \times 10^9/l$ for white blood cell (WBC) in the rabbits fed diet containing sorghum with protease compared to rabbit on D3 and D4. Highest value of $10.60 \times 10^9/L$ as observed in this study closed to the range of 12.07-

$12.17 \times 10^9/L$ reported for normal animal (Odoemelam *et al.*, 2004). Values obtained in this study across dietary groups were moderate as low value is an indication of susceptibility to infection (Akinmutimi 2004). MCHC and MCV were not significantly ($p > 0.05$) affected by the dietary treatments. Ranged values of 34.30-35.20 observed in this study are higher than the value of 25.35% reported by Kwari *et al.* (2011). MCHC and MCV are used to diagnose for anaemia (Aleto *et al.*, 1992). Improved values for MCHC and MCV as observed in this study suggested sufficient availability of iron.

Table 3: Haematological parameters of grower rabbits fed sorghum based diets supplemented with enzymes

Parameter	D1 Maize (control)	D2 Sorghum + Protease	D3 Sorghum + phytase	D4 Sorghum + protease+phytase	SEM
Packed cell volume (%)	27.00	27.50	26.00	28.00	0.61
Haemoglobin (g/dl)	9.30	9.45	9.15	9.55	0.11
Red blood cell ($\times 10^{14}/L$)	3.05	3.10	2.90	3.15	0.08
White blood cell ($\times 10^9/L$)	7.00	5.70	10.40	10.60	0.90
MCHC (g/dl)	34.70	34.40	35.20	34.30	0.37
MCH (pg)	30.70	27.16	32.75	30.70	1.05
MCV (fl)	88.55	88.65	89.65	89.35	0.49

MCHC = Mean Corpuscular Haemoglobin Concentration, MCH = Mean Corpuscular Haemoglobin, MCV = Mean Cell Volume

The result of serum biochemistry grower rabbits fed sorghum based diets supplemented with enzymes are presented in Table 4. Dietary supplementation of sorghum based diet with enzymes revealed significant ($p < 0.05$) effects on total protein, globulin, urea, creatinine and cholesterol. Rabbits fed sorghum based diet supplemented with phytase (D3) had a higher value total protein (69.55g/l) compared to other dietary groups. Though albumin was not significantly ($p < 0.5$) influenced by dietary treatments, rabbit fed diet containing sorghum with phytase recorded numerically higher value of 40.50 g/dl at comparative level. Globulin showed similar trend with total protein with rabbit

on D3 having statistically higher ($p < 0.5$) value of 29.05 g/dl. Rabbits fed control diet and diet supplemented with protease D2 revealed similar statistical values of 26.15g/dl and 26.85g/dl for globulin, respectively. Significantly improved total protein and globulin as observed in this study suggested adequacy of the diet in supplying the protein needed by the rabbits. Observed improved values for total protein and globulin as shown in this result could be attributed to efficacy of enzyme to enhance overall feed utilization by causing degradation of fibre and non-starch polysaccharide (NSP) components of the sorghum based diet into soluble

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metabolizable energy (Choct, 2006). Exogenous enzymes are commonly associated to hydrolysis of non-starch polysaccharide by making the nutrient available for the rabbits for tissue build up (Yuan *et al.*, 2017).

Rabbits on the control diet had a significantly ($p < 0.5$) higher value of 7.05mmol/l for urea compared to other dietary groups as high level of urea is an indication of excess nitrogenous waste due to protein deamination. This observation

suggested less efficient protein utilization by the rabbits on the control diets compared to other dietary groups. Creatinine revealed similar pattern as urea. Rabbits fed maize based diet without enzyme (control) showed highest ($p < 0.5$) value of 102.25mmol/l for creatinine as high creatinine is suggestive of muscle wastage. Numerically, rabbits fed control diet revealed highest ($p < 0.05$) value of 4.50mmol/l for cholesterol at comparative level. This observation suggested less efficient of fat metabolism in the rabbits.

Table 4: Serum biochemical indices of grower rabbits fed sorghum based diets supplemented with enzymes

Parameters	D1 Maize (control)	D2 Sorghum + Protease	D3 Sorghum + phytase	D4 Sorghum + protease+phytase	SEM
Total protein(g/l)	64.15 ^b	64.35 ^b	69.55 ^a	60.00 ^b	1.17
Albumin (g/l)	38.00	37.50	40.50	36.50	0.69
Globulin (g/l)	26.15 ^{ab}	26.85 ^{ab}	29.05 ^a	23.50 ^b	0.77
Glucose(mmol/l)	4.70	4.50	4.40	4.70	0.08
Urea (mmol/l)	7.05 ^a	5.75 ^{ab}	6.35 ^{ab}	4.00 ^b	0.47
Creatinine (mmol/l)	102.25 ^a	83.40 ^{ab}	92.30 ^{ab}	58.00 ^b	6.87
Cholesterol (mmol/l)	4.50 ^a	3.45 ^b	3.58 ^{ab}	4.05 ^{ab}	0.17

^{ab}Mean values in the same row having different superscripts are significantly different ($P < 0.05$)

Conclusion and recommendations

This study revealed that diets containing sorghum with enzyme supplementation can be an alternative source of energy for grower rabbits without negative effect on growth performance, haematological and serumbiochemical indices. Rabbits fed sorghum based diet supplemented with phytase showed higher values for weight gain and total protein. Research effort should be intensified using multienzymes to investigate higher inclusion level of sorghum in rabbit diets.

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