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Nutrient digestibility of rabbits fed diets containing varying inclusion levels of acha offal supplemented with Maxigrain® enzyme

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Target Audience: rabbit farmers, Feed additive suppliers, Consumers

Abstract

Conventional feed ingredients used in formulating feed most especially cereals and protein sources obtained from maize and soybean are scarce and expensive because they suffer stiff competition with channels in the food chain that commands higher priority and which can pay higher prices than the compound feed industry. Acha (Digitaria exilis) offal is one of the non-conventional feedstuffs and has been advocated to replace maize in the diet of rabbits. This study aimed at determining the nutrient digestibility of rabbits fed diets containing varying levels of Acha Offal (AO) supplemented with Maxigrain® enzymes. Forty eight (48) rabbits of mixed breeds and similar live weight (0.4-0.9kg) were used in two experiments consisting of weaner and grower phases which lasted 42 days each. Six treatments diets namely T1, T2, T3, T4, T5 and T6 were compounded to be isocaloric of 2700kcal/kg and iso-nitrogenous of (18% crude protein) for weaner phase while (15% crude protein) and isocaloric of 2500kcal/kg for grower phase. Each treatment was replicated 4 times with 2 rabbits each arranged in a 3x2 factorial fitted into Completely Randomized Design having AO (0, 15 and 30%) and enzyme (0 and 200ppm) as the main factors. Feed and water were provided to the rabbits daily and all standard routine management practices were strictly observed throughout the experiment. Similarly, at the end of the feeding trial of each phase, faecal samples were collected from two rabbits in each of the 6 units for proximate analyses. At weaner phase; Rabbits on 30% acha offal recorded higher digestibility of Crude Protein (CP) (75.55%) and Crude Fibre (CF) (30.73%) than those on 0 and 15% AO. There was significant (P<0.05) increased digestibility of Neutral Detergent Fibre (NDF) in 0% (21.58%) and 30% (21.33%) diets than 15%. Rabbits fed 15% (11.25%) and 30% (10.80%) AO diets showed improvement in the digestibility of Acid detergent Fibre (ADF) than on 0%. Diets supplemented with 200ppm enzyme recorded higher (P>0.05) digestibility of Nitrogen Free Extract (NFE) (36.50%) and acid detergent lignin (29.25%) but decreased CP (70.67%) and hemicellulose (36.67%) digestibility.T5 had significantly (P<0.05) higher CP (81.10%) and lower NFE (13.05%) than the rest of the treatments. During the growing phase; 0% AO showed significant (P<0.05) lower CF (28.69%) digestibility than 15(35.13%) and 30% (36.42%) diets. There was no significant (P>0.05) effect of enzyme between the diets in all the parameters measured except in NFE where 0ppm (37.05%) had significant (P<0.05) increased digestibility than 200ppm (36.73%) enzyme. There was significant (P<0.05) higher digestibility of nitrogen free extract in T3 (37.35%) although not significant (P>0.05) different from T1 and T2. However, T6 (36.58%) showed lower significant (P<0.05) digestibility of NFE and was not different (P>0.05) from T1, T4 and T5. Based on the results of this research; acha offal 30% and supplemented with 200ppm Maxigrain® enzyme in the diets of rabbits had no adverse effect in their ability to digest the nutrient therein.

Keywords: *Acha offal, nutrient digestibility, enzyme, rabbits, Maxigrain®*

Description of the Problem

Rabbits have several characteristics that if properly harnessed can be used to bridge the gap in protein intake. The small body size, short generation interval, rapid growth rate, genetic diversity and high reproductive potentials are characteristics which make rabbits suitable as meat producing mini-livestock in developing countries (1; 12; 15). Rabbits are classified as monogastric

herbivores because of their ability to eat and digest forage but do not possess four stomach compartments neither do they chew cud nor regurgitate. Conventional feed ingredients used in formulating feed most especially cereals and those of energy and protein sources obtained from maize and soybean which are scarce and expensive because they suffer stiff competition with channels in the food chain that commands higher priority and which can pay higher prices than the compound feed industry (10; 11). Acha (*Digitaria exilis*) offal is one of the non-conventional feedstuffs and has been advocated to replace maize in the diet of rabbits by (20). It contains 13.06% crude protein, 12.02% crude fibre, 2.11% ether extract, 61.32% nitrogen free extract, 0.47g/kg calcium, 2.21g/kg phosphorus, 1.95g/16N methionine and 3.09g/16N lysine (19).Acha (Fonio) is also called "hungry man rice" as it is perceived as the food for the poor probably due to its unique small grains (7). However, the presence of anti-nutrients such as phytate has been a major limiting factor to the extensive utilization of acha and its by-products (5; 6). Fonio is highly rich in amino acids and iron (8). It is also very nutritious for pregnant women and children. It is free of gluten and is a great alternative for gluten-intolerant people, in particular those living with Celiac Disease (8). Due to its high fiber content, this grain is also recommended for the elderly, and people suffering from digestive problems. Moreover, because of its insulin secreting properties, Fonio products have found that diabetic's patients are their key customers. Fonio is richer in calcium, magnesium, zinc and manganese than other grains. This grain also contains high levels of methionine and cystine, amino acids essential to our health which our body cannot produce on its own. Fonio grains can play a vital role in nourishing human health. The problem with utilization of offal in rabbit production is their high fibrous nature and presence of anti-nutritional factors which could depress feed digestion and nutrient absorption in the gastrointestinal tract. According to (2), many of the cereals by-product and grains contain some phytochemicals which can be reduced by enzymes supplementation. Enzymes are beneficial to rabbits diets in; reduction in digesta viscosity, enhanced digestion and absorption of nutrients especially fat and protein, improved Apparent Metabolizable Energy value of the diet, increased feed intake, weight gain, increased feed gain ratio, reduced beak impaction and vent plugging, decreased size of gastrointestinal tract, altered population of microorganism in gastrointestinal tract, reduced water intake, reduced water content of excreta, reduced production of ammonia from excreta, reduce output of excreta and also reduced nitrogen and phosphorus (13). However, there is little information on utilization of acha offal and how enzyme could influence the performance of rabbits fed acha offal based diets. Therefore the aim of this study was designed to determine the nutrient digestibility in rabbits fed acha offal based diets supplemented with Maxigrain® enzyme.

Materials and Methods

Location of the Experiment

This experiment was conducted at the Teaching and Research Farm of Animal Science Department of the Faculty of Agriculture, Nasarawa State University Keffi, Shabu-Lafia Campus. Shabu-Lafia is located in the Southern Guinea Savannah Zone of Nigeria on Latitude $8^0 35^!$ N and longitude $8^0 33^!$ E. The average minimum temperature is 23^0C and maximum temperature is 36.9^0C; mean monthly relative humidity is 74%. The mean annual rainfall is 823mm; the mean monthly temperature is 35.06^0C (NIMET, 2019). Atthe time of the experiment, temperature, relative humidity and rainfall was obtained from the metrological station of the Faculty of Agriculture, Nasarawa State University, Keffi, Shabu Lafia campus.

Experimental diets and Animal Management

Acha offal was sourced from the local

acha processors within Riyom Local Government Area of Plateau State and preserved under natural condition. Six experimental diets were formulated to be isocaloric (2700kcal/kg) and isonitrogenous (18% crude protein) for the weaner phase while isonitrogenous (15% crude protein) and isocaloric of (2500kcal/kg) for the grower phase with three levels of inclusion of the acha offal (0, 15 and 30%). The treatments T1, T2, T3, T4, T5 and T6 were TI was 0% AO with 0ppm enzymes (control), T2 15% AO with 0ppm enzymes, T315% AO with 200ppm enzymes, T40% AO with 0ppm enzymes (control),T5 30% AO with 0ppm enzymes andT6 30% AO with 200ppm enzymes respectively. Forty-eight (48) rabbits of similar live weight were randomly assigned to the test diets in a 3x2 factorial. Each of the experimental treatment was replicated four times in each pen having 2 rabbits each. The gross compositions of the diets are presented in Table 2 and 3.

Table 1: Percentage Proximate and fiber fraction composition of Acha offal

Parameters	Percentage (%)
Moisture	9.55
Ash	5.10
Crude protein	13.93
Crude fibre	11.75
Ether extract	4.08
Nitrogen free extract	55.95
Metabolizable energy (kcal/kg)	2819.74
Neutral detergent fibre	37.87
Acid detergent fibre	19.09
Acid detergent lignin	5.67

Data Collection

Chemical analysis

Proximate analysis of the feed was carried at the Institutes of Tropical Agriculture (IITA) Ibadan using the standard procedure (3). Nitrogen Free Extract (NFE) was calculated using the formula: NFE (%) = 100 – CP + CF + EE + Moisture + Ash, Metabolizable energy (ME) was calculated using (16), ME =37 x % CP + 81 x %EE + 35.5 x % NFE. The proximate and fibre fraction composition of acha offal is presented in Table 1.

Nutrient digestibility trial

Rabbits were fed the diets for a period of 42days each during weaner and grower phases. Faeces were collected to evaluate the nutrient utilization of diet containing different levels of treatments at the last 7 days of the trial of each phase. The required quantity of feed were weighed daily with a sensitive scale before given to the animal. Left over were measured and subtracted from feed offered to get actual feed intake. Fecal samples were collected over the period of one week. One (1) from each of the 6 units was used for digestibility studies. The droppings collected were oven-dried for a period of 18 hours at a temperature of 105^0C and weighed daily. At the end of the collection period, the fecal samples collected from each replicate per day were bulked, ground and thoroughly mixed to obtain a homogenous mixture. Samples of the droppings were taken for proximate analysis according to standard methods (4) and the results obtained was used to calculate the apparent digestibility by using the formula below:

$$\text{Apparent digestibility coefficient (\%)} = \frac{\text{Nutrient in feed} - \text{Nutrient in faeces}}{\text{Nutrient in feed}} \times \frac{100}{1}$$

Table 2: Composition of the experimental diets for weaner rabbits

% of maize replace by Acha offal						
Ingredients (%)	T1(0%AO +0ppm)	T2 (15%AO +0ppm)	T3 (15%A0 +200ppm)	T4 (0%AO +0ppm)	T5 (30%AO +0ppm)	T6 (30%AO +200ppm)
Maize	44.00	37.40	37.40	44.00	30.00	30.00
AO	0.00	0.00	6.60	0.00	13.20	13.20
Maize bran	11.75	11.75	11.75	11.75	11.75	11.75
GNC	10.00	10.00	10.00	10.00	10.00	10.00
Rice bran	14.00	14.00	14.00	14.00	14.00	14.00
Bone meal	2.00	2.00	2.00	2.00	2.00	2.00
Full fat soya	10.00	10.00	10.00	10.00	10.00	10.00
palm oil	2.00	2.00	2.00	2.00	2.00	2.00
Fish meal	5.00	5.00	5.00	5.00	5.00	5.00
Salt	0.25	0.25	0.25	0.25	0.20	0.20
*Premix	0.25	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25	0.25
Toxic binder	0.25	0.25	0.25	0.25	0.25	0.25
Enzymes	0.00	0.00	200.00	0.00	0.00	200.00
Total	100.00	100.00	100.00	100.00	100.00	100.00
Calculated nutrient and energy compositions						
ME (Kcal/Kg)	2894.45	2860.12	2860.12	2894.45	2825.78	2825.78
Crude protein%	18.24	18.58	18.58	18.24	18.93	18.93
Lysine%	1.32	1.30	1.30	1.32	1.29	1.29
Methionine %	0.53	0.51	0.51	0.53	0.50	0.50
Moisture %	0.72	1.04	1.04	0.72	1.35	1.35
Ether extract%	6.56	6.59	6.59	6.56	6.62	6.62
Crude fibre%	10.90	10.53	10.53	10.90	10.17	10.17
Calcium%	0.79	0.79	0.79	0.79	0.79	0.79
Phosphorus%	0.81	0.79	0.79	0.81	0.77	0.77

AO = acha offal, ME = metabolizable energy,* A15,000 I.U, vitamin D3 300,000 I.U.,vitamin E 3,000 I.U., vitamin K 2.50mg, vitam(thiamin) 200mg, Riboflavin (B_2) 600mg, pyridoxine (B_6), Niacin 40.0mg, vitamin B_{12} 2mg, Pantothenic acid 10.0mg, folic acid 100mg, Biotin 8mg, choline chloride 50mg, anti-oxidant 12.5mg, manganese 96mg, zinc 6mg, Iron 24mg, Copper 0.6mg, Iodine 0.14mg, Selenium 24mg, cobalt 214mg

Statistical data analysis

Data obtained were subjected to Two Way Analysis of Variance (ANOVA) for factorial experiment using (18) Model and significant different means were separated at 5% level of significant using Duncan's Multiple Range Test (DMRT) as described by (9). The following statistical model was used: $Y_{ijk}= U +A_I +B_J + (AB)_K+e_{ijk}$ where Y_{ijk}=individual observation, U= population mean, A_i = effect of factor A, B_j= effect of factor B, and AB_K = effect of interaction of factor A&B.

Result and Discussion

Main and interaction effect of acha offal and enzyme on nutrient digestibility in weaner rabbits is presented in Table 4, 5 and 6. There was significant ($P<0.05$) effect of acha offal meal on digestibility of crude protein, crude fibre, nitrogen free extract, neutral detergent fibre, acid detergent fibre and hemicelluloses while ether extract, ash, dry matter and acid detergent lignin were not significantly ($P>0.05$) affected. Rabbits on 30% (75.77%) acha offal recorded higher digestibility of

crude protein and crude fibre than those on 0 (71.75%) and 15% (69.50%) acha offal. This might be attributed to the increased in the level of acha offal in the diets which is higher than in others. The range of crude protein digestibility in this study is 69.50 – 75.55% in 15 and 30% acha offal respectively is greater than the values 60.40, 67.50 and 68.20% in sorghum offal, millet offal and maize offal respectively, reported by (21) in weaner rabbits. The variation might be related to the type of cereal bye products used. Additionally, Digestibility of Nitrogen free extract was significantly (P<0.05) higher in 0% than 15 and 30% acha offal fed rabbits. There was significant (P<0.05) higher digestibility of neutral detergent fibre in rabbits on 0 (21.58%) and 30% (21.33%) diets than those on 15(19.75%). This means that 30% diets compare favourably with the control diet. Rabbits fed 15 (11.25%) and 30% (10.80%) acha offal diets showed significantly (P<0.05) higher digestibility of acid detergent fibre than those on 0% (7.75%). Hemicellulose digestibility was significantly (P<0.05) lower in 0% (34.50%) followed by 30 (38.18%) and 15% (41.55%) diets.

The effect of enzymes supplementation on nutrient digestibility of acha offal based diets fed to weaner rabbits showed significant (P<0.05) difference between the diets (0 and 200ppm enzyme) in crude protein, nitrogen free extract, neutral detergent fibre, acid detergent lignin and hemicelluloses digestibility. However, no significant (P>0.05) difference was recorded between the diets in digestibility of ether extract, crude fibre, ash, dry matter, acid detergent fibre and cellulose. Rabbits fed diets supplemented with 200ppm enzymes recorded significantly (P<0.05) higher (36.50%) digestibility in nitrogen free extract and acid detergent lignin but had significant (P<0.05) lower crude protein (70.67%) and hemicellulose (36.67%) digestibility than 29.69%, 73.87% and 39.48% recorded in 0% diet respectively. The resulting higher digestibility of nitrogen free extract in 200ppm enzymes might be attributed to the activities of enzymes which enhance feed digestion especially the energy component of the feed. According some authors, (2) and (14); digestion of fibrous feedstuffs containing phytochemicals could be improved by the supplementation with exogenous enzymes.

There was significant (P<0.05) interactive effect of acha offal and enzyme in crude protein, nitrogen free extract and hemicellulose digestibility, however no significant (P>0.05) difference digestibility were recorded in ether extract, crude fibre, ash, dry matter, neutral detergent fibre, acid detergent fibre, acid detergent lignin and cellulose. Rabbits on T5 had significantly (P<0.05) higher crude protein (81.10%) and lower nitrogen free extract (13.05%) than those on T1 (71.50 and 37.50%), T2 (72.00 and 36.00%) T3 (69.00 and 38.51%), T4 (70.00 and 37.50%) and T6 (70.00 and 36.00%). This indicates that digestibility of crude protein and nitrogen extract in 30% acha offal diets was higher than 15% acha offal supplemented with enzyme. Hemicellulose was significantly (P<0.05) higher in T3 (41.60%), T4 (41.50%) and T5 (41.85%) fed rabbits than those on T1 (35.00%), T2 (34.00%) and T6 (34.50%).Main and interaction effect of acha offal and enzyme on nutrient digestibility in weaner rabbits. There was significant (P<0.05) difference between the diet in crude fibre digestibility but no significant (P>0.05) difference were observed between the diets in the rest of the parameters. Rabbits on 0% (28.69%) acha offal showed significant (P<0.05) lower crude fibre digestibility than those 15(35.13%) and 30% (36.42%) diets. This resulting better digestibility of crude fibre in 15 and 30% diets might be attributed to increased contents of acha offal in the diets. According to (20) acha offal could replace maize in rabbit's diet.

Table 3: Composition of the experimental diets for grower rabbits

% of maize replace by acha offal						
Ingredients (%)	T1(0%AO +0ppm)	T2 (15%AO +0ppm)	T3 (15%A0 +200ppm)	T4 (0%AO +0ppm)	T5 (30%AO +0ppm)	T6 (30%AO +200ppm)
Maize	45.00	38.40	38.40	45.00	31.50	31.50
AO	0.00	6.60	6.60	0.00	13.50	13.50
Maize bran	15.00	15.00	15.00	15.00	15.00	15.00
G	7.00	7.00	7.00	7.00	7.00	7.00
Rice bran	17.75	17.75	17.75	17.75	17.75	17.75
Bone meal	2.00	2.00	2.00	2.00	2.00	2.00
Full fat soya	5.00	5.00	5.00	5.00	5.00	5.00
palm oil	2.00	2.00	2.00	2.00	2.00	2.00
Fish meal	5.00	5.00	5.00	5.00	5.00	5.00
Salt	0.25	0.25	0.25	0.25	0.25	0.25
*Premix	0.25	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25	0.25
Toxic binder	0.25	0.25	0.25	0.25	0.25	0.25
Enzymes	00.00	0.00	200.00	0.00	0.00	200.00
Total	100.00	100.00	100.00	100.00	100.00	100.00
Calculated nutrient and energy compositions						
ME (Kcal/Kg)	28812.00	2777.67	2777.67	28812.00	2741.77	2741.77
Crude protein%	15.79	16.14	16.14	15.79	16.50	16.50
Lysine%	1.05	1.04	1.04	1.05	1.03	1.03
Methionine%	0.53	0.51	0.51	0.53	0.50	0.50
Moisture%	0.72	1.03	1.03	0.72	1.36	1.36
Ether extract%	5.94	5.97	5.97	5.94	6.00	6.00
Crude fibre%	16.68	17.32	17.32	16.68	17.99	17.99
Calcium%	0.78	0.78	0.78	0.78	0.78	0.78
Phosphorus%	0.84	0.82	0.82	0.84	0.80	0.80

AO = acha offal, ME = metabolizable energy,* A15,000 I.U, vitamin D3 300,000 I.U.,vitamin E 3,000 I.U., vitamin K 2.50mg, vitamin B_1 (thiamin) 200mg, Riboflavin (B_2) 600mg, pyridoxine (B_6), Niacin 40.0mg, vitamin B_{12} 2mg, Pantothenic acid 10.0mg, folic acid 100mg, Biotin 8mg, choline chloride 50mg, anti-oxidant 12.5mg, manganese 96mg, zinc 6mg, Iron 24mg, Copper 0.6mg, Iodine 0.14mg, Selenium 24mg, cobalt 214mg *protein intake=Feed intake (DM) ×Percentage Protein in Diet

Table 4: Main effects of Acha offal on nutrient digestibility in weaner rabbits

Parameters (%)	**Inclusion of Acha offal (AO)**				
	0%	**15%**	**30%**	**SEM**	**LOS**
Crude protein	71.75^{b}	69.50^{b}	75.55^{a}	0.88	*
Ether extract	61.00	65.23	64.00	1.24	NS
Crude fibre	24.25^{b}	23.00^{b}	30.73^{a}	1.43	*
Ash	74.00	73.00	73.25	3.54	NS
Dry matter	87.03	83.75	85.75	0.79	NS
Nitrogen free extract	36.75^{a}	38.00^{a}	24.53^{b}	0.56	*
Neutral detergent fibre	21.58^{a}	19.75^{b}	21.3	0.42	*
Acid detergent fibre	7.75^{b}	11.25^{a}	10.80^{a}	0.69	*
Acid detergent lignin	27.03	21.50	28.75	2.12	NS
Hemicellulose	34.50^{c}	41.55^{a}	38.18^{b}	0.27	*
Cellulose	33.13	23.75	26.75	3.25	NS

ab means on the same row having different superscript differ significantly ($p<0.05$); ns = not significantly Different ($p>0.05$); SEM = standard error of mean; LOS = level of significance.

Table 5: Main effects of enzymes supplementation on nutrient digestibility of weaner rabbits

Parameters	Enzymes supplementation			
	0ppm	100ppm	SEM	LOS
Crude protein	73.87[a]	70.67[b]	0.72	*
Ether extract	63.83	62.98	1.01	NS
Crude fibre	24.32	27.67	1.17	NS
Ash	73.67	73.17	2.89	NS
Dry matter	84.83	86.18	0.65	NS
Nitrogen free extract	29.69[b]	36.50[a]	0.46	*
Neutral detergent fibre	20.22	21.56	0.34	NS
Acid detergent fibre	9.37	10.50	0.56	NS
Acid detergent lignin	22.27[b]	29.25[a]	1.73	*
Hemicellulose	39.48[a]	36.67[b]	0.22	*
Cellulose	26.50	29.25	2.66	NS

ab means on the same row having different superscript differ significantly ($p<0.05$); ns = not significantly different ($p>0.05$); SEM = standard error of mean; LOS = level of significance;

Table 6 : Interactive effects of acha offal and enzymes supplementation on nutrient digestibility of weaner rabbits

Parameters (%)	Enzymes	Acha offal inclusion level				
		0%	15%	30%	SEM	LOS
Crude protein	0ppm	71.50[b]	69.00[b]	81.10[a]	1.24	*
	200ppm	72.00[b]	70.00[b]	70.00[b]	1.24	*
Ether ex tract	0ppm	60.50	67.00	64.00	1.76	NS
	200ppm	61.50	63.45	64.00	1.76	NS
Crude fibre	0ppm	21.50	23.00	28.45	2.02	NS
	200ppm	27.00	23.00	33.00	2.02	NS
Ash	0ppm	75.00	72.00	74.00	5.00	NS
	200ppm	73.00	74.00	72.50	5.00	NS
Dry matter	0ppm	86.00	84.00	84.50	1.12	NS
	200ppm	88.05	83.50	87.00	1.12	NS
Nitrogen free extract	0ppm	37.50[a]	38.51[a]	13.05[b]	0.79	*
	200ppm	36.00[a]	37.50[a]	36.00[a]	0.79	*
Neutral detergent fibre	0ppm	21.15	19.50	20.00	0.59	NS
	200ppm	22.02	20.00	22.65	0.59	NS
Acid detergent fibre	0ppm	6.00	10.50	11.60	0.97	NS
	200ppm	9.50	12.00	10.00	0.97	NS
Acid detergent lignin	0ppm	23.30	21.00	22.50	3.00	NS
	200ppm	30.75	22.00	35.00	3.00	NS
Hemicellulose	0ppm	35.00[b]	41.60[a]	41.85[a]	0.38	*
	200ppm	34.00[b]	41.50[a]	34.50[b]	0.38	*
Cellulose	0ppm	28.00	25.50	26.00	4.60	NS

ab means on the same row having different superscript differ significantly ($p<0.05$); ns = not significantly different ($p>0.05$); SEM = standard error of mean; LOS = level of significance;

Table 7: Main effects of Acha offal on nutrient digestibility in growing rabbits

Parameters	Inclusion of Acha offal (AO)				
	0%	15%	30%	SEM	LOS
Crude protein	71.68	72.04	70.41	0.43	NS
Ether extract	60.93	61.21	63.12	1.47	NS
Crude fibre	28.690[b]	35.133[a]	36.418[a]	0.90	*
Ash	79.72	73.47	75.03	2.57	NS
Dry matter	85.62	86.56	87.80	0.64	NS
Nitrogen free extract	37.06	36.93	36.68	0.10	NS
Neutral detergent fibre	36.62	36.60	36.42	0.45	NS
Acid detergent fibre	20.04	20.25	20.29	0.62	NS
Acid detergent lignin	44.95	45.80	49.03	1.31	NS
Hemicellulose	51.16	52.38	50.72	1.08	NS
Cellulose	33.70	33.08	33.13	0.56	NS

ab means on the same row having different superscript differ significantly ($p<0.05$); ns = not significantly different ($p>0.05$); SEM = standard error of mean; LOS = level of significance.

Table 8: Main effects of enzymes supplementation on nutrient digestibility of grower rabbits

Parameters	Enzymes supplementation			
	0ppm	100ppm	SEM	LOS
Crude protein	71.28	71.47	0.35	NS
Ether extract	62.60	60.90	1.20	NS
Crude fibre	33.04	33.78	0.74	NS
Ash	77.54	74.61	2.10	NS
Dry matter	86.53	86.80	0.53	NS
Nitrogen free extract	37.05[a]	36.73[b]	0.08	*
Neutral detergent fibre	36.38	36.71	0.37	NS
Acid detergent fibre	20.21	20.18	0.51	NS
Acid detergent lignin	45.15	48.04	1.07	NS
Hemicellulose	51.57	51.27	0.88	NS
Cellulose	33.44	33.17	0.46	NS

ab means on the same row having different superscript differ significantly ($p<0.05$); ns = not significantly different ($p>0.05$); SEM = standard error of mean; LOS = level of significance;

The effect of enzymes supplementation on nutrient digestibility of acha offal based diets fed to growing rabbits is presented in table 7, 8and 9. Showed no significant ($P>0.05$) difference between the diets in all the parameters measured except in nitrogen free extract where rabbits on 0ppm (37.05%) enzymes had significant ($P<0.05$) higher digestibility than those on 200ppm (36.73%). This indicated that addition of enzyme did not impact in the digestibility of the parameters and lead to even reduction in the nitrogen free extract digestibility. (17).Earlier reported no significant effect of enzyme supplementation on performance of finisher broiler chickens.

The result showed no significant ($P>0.05$) interactive effect between acha offal and enzyme on all the parameters measured except in Nitrogen free extract digestibility. There was significant ($P<0.05$) higher digestibility of nitrogen free extract in T3 (37.35%) although not significant ($P>0.05$) different from T1 (37.02%) and T2 (37.11%). However, T6 (36.58%) showed lower significant ($P<0.05$) digestibility of nitrogen free extract and was not significant ($P>0.05$) different from T1

(37.02%), T4 (36.51%) and T5 (36.78%). This shows that addition of enzyme in 15% influenced the digestion of acha offal by reducing the digestibility of nitrogen free extract; hence the lower values in T4 than T3.

Table 9: Interactive effects of acha offal and enzymes supplementation on nutrient digestibility of grower rabbits

Parameters (%)	Enzymes	Acha offal inclusion level				
		0%	15%	30%	SEM	LOS
Crude protein	0ppm	71.20	72.36	70.29	0.61	NS
	200ppm	72.16	71.72	70.53	0.61	NS
Ether extract	0ppm	62.16	60.16	65.49	2.07	NS
	200ppm	59.70	62.26	60.76	2.07	NS
Crude fibre	0ppm	29.19	33.40	36.55	1.29	NS
	200ppm	28.19	36.87	36.29	1.28	NS
Ash	0ppm	85.83	73.17	73.63	3.64	NS
	200ppm	73.61	73.77	76.44	3.64	NS
Dry matter	0ppm	85.09	87.15	87.33	0.91	NS
	200ppm	86.15	85.97	88.27	0.91	NS
Nitrogen free extract	0ppm	37.02^{abc}	37.35^{a}	36.78^{bc}	0.14	*
	200ppm	37.11^{ab}	36.51^{c}	36.58^{c}	0.14	*
Neutral detergent fibre	0ppm	36.23	36.78	36.13	0.64	NS
	200ppm	37.01	36.42	36.72	0.64	NS
Acid detergent fibre	0ppm	19.87	20.61	20.15	0.88	NS
	200ppm	20.21	19.90	20.42	0.88	NS
Acid detergent lignin	0ppm	43.90	46.69	44.86	1.86	NS
	200ppm	45.99	44.91	53.21	1.85	NS
Hemicellulose	0ppm	50.58	53.87	50.27	1.52	NS
	200ppm	51.75	50.90	51.18	1.52	NS
Cellulose	0ppm	34.19	32.57	33.56	0.80	NS
	200ppm	33.22	33.60	32.70	0.80	NS

ab means on the same row having different superscript differ significantly ($p<0.05$); ns = not significantly different ($p>0.05$); SEM = standard error of mean; LOS = level of signifi

Conclusion and Applications

1. Based on the results of this research; acha offal 30%, supplemented with 200ppm Maxigrain enzyme in the diets of rabbits can be included without adverse effect in their ability to digest the nutrient therein
2. Acha offal at 30% inclusion supplemented with Maxigrain enzyme in the diets of rabbits had improved nutrient digestibility.

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