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BONE MINERALIZATION CHARACTERISTICS OF RABBITS FED DIETS CONTAINING VARYING LEVELS OF ACHA OFFAL SUPPLEMENTED WITH MAXIGRAIN® ENZYME

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ABSTRACT

This study aimed at evaluating the bone mineralization characteristics 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 were used in the experiment which lasted for 42 days. Six diets (T1, T2, T3, T4, T5 and T6) were compounded to be iso-caloric (2700 Kcal/Kg ME) and iso-nitrogenous (18%) such that T1 had % AO with 0ppm maxigrain enzyme (control) T2 had 15% AO 0ppm maxigrain enzyme, T3 also had 15% AO but supplemented with 200ppm maxigrain enzyme T4 had %AO with 0ppm maxigrain enzyme supplementation (control) Treatment T5 had 30% AO with 0ppm maxigrain enzyme supplementation while T6 had 30% but supplemented with 200ppm maxigrain enzyme. The result revealed a significant ($P < 0.05$) increase in Tibia bone density as the level of acha offal increased from 0% (1.11), 15% (1.22) and 30% (1.30). However, Calcium, Magnesium, Phosphorus, Sodium and Chlorine were not significantly ($P > 0.05$) affected by increasing levels of acha offal. Enzyme supplementation at 200ppm significantly ($P < 0.05$) reduced Calcium (29.25mg/g), Magnesium (0.25mg/g), Phosphorus (10.68mg/g), Sodium (0.62 Mg/g) and Chloride (0.52 mg/g) levels in the bone but did not significantly ($P > 0.05$) affect the tibia bone density. There was significant ($P < 0.05$) interaction effects of acha offal and enzyme supplementation on tibia bone density whereby T5 (1.22m/g) was significantly lower than T6 (1.38m/g). Based on the findings of this study, conclusion of acha offal up to 30% improved tibia bone density in rabbits.

Keywords: Acha, Bone, Enzyme Rabbits, Maxigrain®

INTRODUCTION

Research attention is now geared towards non conventional feedstuff such as by-product that is available and considered as a means of alleviating feed competition with man without affecting the quality. One of such cereal grain by-products is acha offal. Acha is grown in the cereal throughout Nigeria and is intensively cultivated as a staple of many people in the northern part of Nigeria. It has been reported that the methionine and a cysteine in Acha supply sulphur and other compounds required for normal body metabolism and growth while cysteine content is a major constituent of the proteins that make up the hair, nails, skin: it is also involved in major detoxification process in the body (Belton and John, 2002). Acha has received little utilization attention compared to sorghum, millet and maize in livestock. There is limited reference work on the utilization and inclusion of acha by-product as an alternative energy source in livestock production. Ogbeet *al.* (2013) reported increased feed breakdown especially of fibrous feed materials into easily digestible nutrients by exogenous enzyme supplementation in monogastric. Previous study by Ademolaet *al.* (2012) indicated that maxigrain enzyme supplementation in rabbit's feed improved their performance wheat offal; corn bran and brewery dry diets.

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Therefore, the objective of this work is to determine the bone mineralization characteristics of rabbits fed diets containing varying levels of acha offal supplemented with maxigrain[®] enzymes.

MATERIALS AND METHODS

Experimental Site

The experiment was conducted at the Teaching and Research Farm Department of Animal Science Faculty of Agriculture, Nasarawa State University Keffi.

Source of test diet (AO), Animals and Experimental Design

Acha offal was sourced from the local acha processors within Riyom Local Government Area of Plateau State and preserved under natural condition (sun). Six experimental diets were formulated to be isonitrogenous (16% crude protein) and isocaloric of (2500kcal/kg) with three levels inclusion of the acha offal (0, 15 and 30%). The treatments were; T1 = 0% AO with 0ppm enzymes serves as control, T2 = 15% AO with no 0ppm maxigrain enzymes, T3 = 15% AO with 200ppm maxigrain enzymes, T4 = AO% with 0ppm maxigrain enzymes, T5 = 30% AO with 0ppm enzymes and T6 = 30% AO but supplemented with 200ppm maxigrain enzymes. Forty-eight (48) rabbits of similar live weight were randomly assigned to a test diet in a 2x3 factorial Experiment of complete Randomized Design. Treatment was replicated four times in each pen comprising of 2 rabbits each.

Proximate analysis and fiber fraction of test ingredient acha offal

Proximate composition (crude protein, dry matter, ether extract, crude fiber and nitrogen determined using the procedure outlined by AOAC (2006) and fibre fraction as described by Van Soest (1963). *Metabolizable Energy: was calculated using Pausenga Formula (1985).

ME=37 x % CP+81 x % EE+35.5 x % NFE.

Determination of Bone Mineralization of Rabbits

At the end of the experiment two rabbits per treatment were used for bone mineralization and quality determination. The animals were slaughtered thereafter; the tibia bones of the animals were removed carefully, put in warm water for 5 minutes to remove the fat deposits. They were weighed in grams using a top loading digital scale to obtain fresh weight of bones. The length of the tibia bones were measured in cm using a graduated ruler. The fresh bones were oven dried at 100⁰C until a constant weight was obtained. The dry weights were taken. The dry bones were ashed at 550⁰C in a muffle furnace for 6 hours to obtain the percent ash content of the bone. The bones ash were analyzed for percent calcium(Ca), magnesium(Mg), Phosphorus(P), Sodium (Na) and chloride (Cl) content using Atomic Absorption Spectrophotometry (AAS), while phosphorus content using flame photometry. Bone density was calculated as bone weight/bone length (AOAC, 2005).

Statistical Analysis

Data collected were subjected to two way analysis of variance (ANOVA) for factorial experiment using (SPSS, 2007) Model. Significantly different means were separated using Duncan's Multiple Range Test (Duncan, 1955). 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.

RESULTS AND DISCUSSION

Table 3 shows the main and interaction effects of acha offal and enzyme supplementation on bone mineralization of rabbits. The result revealed a significant ($P<0.05$) increase in Tibia bone



density as the level of acha offal increases from 0% (1.11g) 15% (1.22g) and 30% (1.30g). However, Calcium, Magnesium, Phosphorus, Sodium and Chloride were not significantly ($P>0.05$) affected by increasing levels of acha offal. Enzyme supplementation at 200ppm significantly ($P<0.05$) reduced Calcium (29.25mg/g), Magnesium (0.25mg/g), Phosphorus (10.68mg/g), Sodium (0.62 Mg/g) and Chloride (0.52 mg/g) levels in the bone but did not significantly ($P>0.05$) affected the Tibia bone density. There was significant ($P<0.05$) interactive effects of acha offal and enzyme supplementation on Tibia bone density whereby T5 (1.22g) was significantly lower than T6 (1.38g). Moreover, T1 (1.20g), T2 (1.01g) and T4 (1.13g) diets were significantly ($P<0.05$) having lower Tibia bone density than T6 (1.38g) diets fed rabbits. Similarly, serum calcium for bone development in the grower rabbits is not affected by the dietary treatments. The resulting increase in the tibia bone density could be as a result of increasing levels of acha offal in the rabbit's diets.

CONCLUSION AND RECOMMENDATION

Based on the results of this research, it can be concluded that acha offal up to 30% inclusion improved Tibia bone density in rabbits.

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Table 1: Proximate (%) and fiber fraction (%) composition of Acha offal

Parameters	Values
Dry matter	90.45%
Sh	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%

Table 2: Nutrients composition of the experimental diets for grower rabbits

Ingredients (%)	% of maize replace by acha offal					
	T1(0%AO +0ppm)	T2 (15%AO +0ppm)	T3 (15%AO 200ppm)	T4 (A0%AO +0ppm)	T5 (30%AO +0ppm)	T6 (30%AO +200ppm)



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Maize	45.00	45.00	38.40	38.40	31.50	31.50
AO*	0.00	0.00	6.60	6.60	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	200.00	0.00	200.00	0.00	200.00
(Maxigrain)	100.00	100.00	100.00	100.00	100.00	100.00
Total						
Nutrients composition (g/kg)						
ME (Kcal/Kg)	2812.00	2777.67	2777.67	2812.00	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	6.68	7.32	7.32	6.68	7.99	7.99
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 B₁ (thiamin) 200mg, Riboflavin (B₂) 600mg, pyridoxine (B₆), Niacin 40.0mg, vitamin B₁₂ 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

Table 3 : Main and interaction effects of acha offal and enzyme on bone mineralization of rabbits

Parameters	Tibia bone density (g/l)	Calcium (g)	Magnesium (g)	Phosphorus (g)	Sodium(g)	Chlorine (g)
0.00	1.11 ^c	29.61	0.26	10.85	0.66	0.56
0.15	1.22 ^b	29.47	0.25	10.77	0.64	0.53
0.30	1.30 ^a	29.69	0.26	10.88	0.66	0.56
SEM	0.02	0.21	0.00	0.08	0.02	0.02
LOS	*	Ns	Ns	Ns	Ns	Ns
0ppm	1.24	29.93 ^a	0.27 ^a	10.99 ^a	0.69 ^a	0.59 ^a
200ppm	1.17	29.25 ^b	0.25 ^b	10.68 ^b	0.62 ^b	0.51 ^b
SEM	0.02	0.17	0.00	0.07	0.01	0.01

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LOS	Ns	*	*	*	*	*
T1	1.20 ^{bc}	30.12	0.28	11.08	0.71	0.61
T2	1.01 ^d	29.09	0.25	10.63	0.62	0.51
T3	1.30 ^{ab}	29.55	0.25	10.82	0.65	0.54
T4	1.13 ^c	29.39	0.25	10.72	0.63	0.52
T5	1.22 ^{bc}	30.12	0.28	11.07	0.70	0.61
T6	1.38 ^a	29.26	0.25	10.69	0.62	0.51
						0.02
SEM	0.03	0.30	0.01	0.12	0.02	NS
LOS	*	NS	NS	NS	NS	

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