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Journal of Life & Physical Sciences

*acta*SATECH **4**(1): 15 - 24 (2011)

Research

Effects of Nutrase xyla® Enzyme Supplementation on Haematological Parameters of Growing Pigs Fed Low and High Fibre Diets

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Abstract

A 49- day feeding trial was conducted to determine the effects of fibre and Nutrase xyla® enzyme supplementation on the haematological parameters of growing pigs fed low and high fibre diets. Sixteen Landrace X Large white cross breed pigs were used in a 2x2 factorial arrangement with 2 enzyme levels (0 and 100ppm) and two dietary fibre levels (10 and 15%). Four dietary treatments tagged T_1, T_2, T_3 and T_4 were formulated to be isocaloric (about 3200kcal/kg ME) and isonitrogenous (20% CP) and to contain 5% crude fibre for treatments T_1 and T_2 and 10% crude fibre for treatments T_3 and T_4 respectively. All the haematological parameters determined varied greatly but were not significantly (P >0.05) different among dietary treatments. In conclusion, supplementing fibrous feed with enzyme improves the haematological parameters in growing pigs.

Keywords: Nutrase xyla®; Fibre; Growing pigs; Haematology

Introduction

Swine production among other species has a high potential to contribute to high economic gain, this is because pigs have high fecundity, high feed conversion ratio, early maturing, short generation interval and relatively small space requirement (Lekule & Kyvsgaard, 2003) providing 44 % of meat in the world market (FAO, 2001). However, high cost of raw materials needed for the feed for this animal has been a problem especially the energy source. This high cost is compounded by its low production and high demand for human food, industrial and animal feeds. Monogastric animals like pig compete directly with humans for food, especially grain unsuitable for human consumption (Holness, 1991). To avert this problem, research efforts have been geared towards sourcing for unconventional agro-industrial by-products (Babayemi, 2008) that may replace or supplement the conventional ones (Ayoade *et al*., 2000; Ani & Omeje, 2007; Adeyemi *et al*., 2009). Many of these agro-industrial by-products are fibrous in nature and their use in monogastric animal diets is limited to about 5-7 % (NRC, 1979; Olomu, 1979). Fibrous feed ingredients are in abundant and cheap (Dogari, 1984). It has been documented by several authors that dietary fibre has some beneficial effects in non-ruminant animals (Babatunde *et al*., 1975; Isikwenu *et al*., 2000). These fibrous feedstuffs have been shown to result in increased feed intake, lowering the rate of live weight gain and poorer feed conversion ratio when they replaced maize in diets (Oluokun & Olaloku, 1999; Tuleun *et al*., 1998).

Recent advances in animal nutrition have indicated that exogenous enzyme supplementation renders fibrous polysaccharides and other anti nutritional factors utilizable by non-ruminants (Schigoeth *et al*., 1999; Tanko & Ojewole, 2003; Pillah, 2005) to improve the digestibility of fibrous agricultural products (Viveros *et al.,* 1994; Rotter *et al*., 1999; Tuleun *et al*., 2001). The level of nutrition greatly influences productivity in livestock. It is therefore pertinent to assess the health status of the animals used in various feed trial, and one of the best way to assess it, is the use of haematological parameters (Adenkola *et al*., 2007; Adenkola *et al*., 2009a). Therefore this study was undertaken to investigate the effects of supplementation of high fibre (rice offal) full fat soybean-based diets with a commercial enzyme (Nutrase xyla®) on haematological parameters in growing pigs.

Materials and methods

Experimental site

The experiment was performed at the Livestock Farm of the University of Agriculture, Makurdi (07^0 41′ N, 08^0 37′ E), located in the Southern Guinea Savannah zone of Nigeria. Makurdi is situated along river Benue which is very warm with the temperature range of 26.5 ^{0}C to 37 ^{0}C. The area has an annual rainfall span between 6 - 7 months and ranging from 1,317 – 1,323 mm (Ako, 2000).

Experimental animals and management

Sixteen pigs, including males and non-pregnant and non- nursing females weighing averagely

31.0 kg were used for the study. The animals were conditioned for two weeks prior to the commencement of the experiment, during which they were screened for haemoparasites and endoparasites by taking their blood and faecal samples for laboratory analyses using standard procedures. Pigs found to be infected were treated using oxytetracycline (Kepro B. V®, Hollland) deep intramuscular at the dose of 20 mg/kg and thiobendazole *per os* at the rate of 25 mg/kg body weight (M.S.D AGVET®, U.S.A.) respectively. The pigs were fed *ad-libitum* and had access to drinking water at all times.

Experimental design and diets

The experimental design was a 2 x 2 factorial. Sixteen pigs were randomized and distributed to four treatments at the rate of four pigs per treatment group. Four iso-nitrogenous experimental diets T_1, T_2, T_3, and T_4 containing about 18 % crude protein (CP) were compounded. Treatments 1 and 2 contained about 10 percent crude fibre level (low fibre), while treatments 3 and 4 contained about 15 percent crude fibre level (high fibre). Treatments 2 and 4 contained 100 parts per million of the enzyme (Nutrase xyla®). Treatment 1 served as the control diet for treatment 2 while treatment 3 served as control for treatment 4. All the four dietary treatments varied marginally in caloric content. The Soya bean was toasted using an open-dry pan at about 80^0 C for 20 minutes and then crushed in order to improve its utilization by the pigs and to destroy its anti-nutritional factor. Palm oil was added to increase the energy level of the diet, to reduce dustiness and improve the palatability of the diet. The blood meal was also added to meet the CP requirement of the animal while the bone meal was included to supply the needed calcium to the animals. The percent and analyzed composition of the experimental diets are presented in Table 1.

Blood sample collection

Blood samples were collected from the sixteen pigs before and at the end of 49^{th} day when the experiment was terminated. Five millimeters of blood was drawn aseptically from each animal via the anterior vena cava using a 10 ml syringe and 18 gauge x $1^1/2$ inch sterile needle. The blood was immediately poured inside a sample bottle, containing the anticoagulant, disodium salt of ethylene diaminetetra-acetic acid at the rate of 2 mg/ml of blood (Adenkola *et al.*, 2009b). After collection, the samples were transferred to the Physiology Laboratory of the Department of Physiology and Pharmacology, University of Agriculture, Makurdi, where they were analyzed for packed cell volume (PCV), using microhaematocrit method, total leucocytes and erythrocyte count using haemocytometer method as described by Schalm *et al*. (1975). Haemoglobin (Hb) and leucocytes differential count were also determined (Schalm *et al.*, 1975). Erythrocyte indices of mean corpuscular volume (MCV), mean corpuscular haemoglobin

(MCH) and mean corpuscular haemoglobin concentration (MCHC) were determined from the values of PCV, Hb and total erythrocyte count (Schalm *et al.*, 1975).

Statistical analysis

All data obtained were subjected to analysis of variance (ANOVA), (Steel & Torrie, 1980) and correlation analysis using SPSS version 13.00. When significant difference was observed, treatment means were separated using the Duncan Multiple Range Test (Duncan, 1955). Values of $P < 0.05$ were considered significant.

Table 1: Gross composition of experimental diets for growing pigs

Feed Ingredients	*T_1	T_2	T_3	T_4
Maize	50.35	50.35	39.55	39.55
Full-fat soybean	17.80	17.80	16.60	16.60
Rice offal	25.00	25.00	37.00	37.00
Blood meal	2.00	2.00	2.00	2.00
Palm oil	2.00	2.00	2.00	2.00
Bone meal	2.00	2.00	2.00	2.00
Salt	0.40	0.40	0.40	0.40
+Vitamin-mineral premix	0.25	0.25	0.25	0.25
Methionine	0.20	0.20	0.20	0.20
Nutrase xyla®	-	+	-	+
Total	100.00	100.00	100.00	100.00

*T_1, T_2, T_3 and T_4 are`low fibre without enzyme, low fibre with enzyme, high fibre without enzyme and high fibre with enzyme diets respectively.

+The vitamin – mineral premix supplied the following per 100kg of diet: Vitamin A 15,000 I.U, Vitamin D_3 300,000 I.U., Vitamin E 3,000 I.U., Vitamin K 2.50mg, Thiamin, (B_1) 200mg, Riboflavin (B_2) 600mg, Pyridoxine (B_6) 600mg, Niacin 40.0mg, Vitamin B_{12} 2mg, Pantothenic acid 10.0mg, Folic acid, 100mg, Biotin 8mg, Choline chloride 50g, Antioxidant 12.5g, Manganese 96g, Zinc 6g, Iron 24g, Copper 0.6g, Iodine 0.14g, Selenium 24mg, Cobalt 214mg.

Results

The percent and analyzed chemical composition of the experimental diets are presented in Tables 1 and 2. The highest value of 33.50 % and 11.17 gm/ dl of PCV and haemoglobin concentration was recorded in treatment 2, and there was no significant ($P > 0.01$) correlation between crude protein intake, crude fibre intake and haematological parameters (Tables 4 and 5). However, a significant ($P < 0.01$) correlation exist between crude protein intake, crude fibre intake and haematological parameters ($r = 1.00$). The highest white blood cell count was recorded in animals fed treatment 3 with a value of 8.61 x 10^3/ µl, though no significant ($P < 0.05$) difference exists between the treatment groups, while the highest value of red blood cell count was obtained in animals fed treatment 2 with a value of 3.96 x 10^3/ µl post treatment. The neutrophils : lymphocyte was highest in treatment 4. The final mean corpuscular volume, mean corpuscular haemoglobin concentration, neutrophils were not affected ($P > 0.05$) by either enzyme supplementation or dietary fibre level (Table 3).

Table 2: Analyzed nutrients and energy composition of the experimental diets for growing pigs

Nutrient	*T_1	T_2	T_3	T_4
Crude Protein	18.03	18.03	18.02	18.02
Crude Fiber	10.05	10.05	15.01	15..01
Ether Extract	5.97	5.89	6.07	6.17
Ash	7.71	7.86	7.82	8.02
NFE	60.29	59.92	60.14	60.14
[a]Calcium	0.93	0.93	0.93	0.93
[a]Phosphorus	0.59	0.59	0.62	0.62
[b] ME (Kcal/kg)	3321.11	3317.15	3278.16	3397.37

*T_1, T_2, T_3 and T_4 are `low fibre without enzyme, low fibre with enzyme, high fibre without enzyme and high fibre with enzyme diets respectively.

[a] Calculated from NRC (1979)

[b] Calculated from Pauzenga (1985)

Table 3: The interactive effects of fibre and Nutrase xyla® enzyme supplementation on the haematological parameters of growing pigs.

Parameters	*T1	T2	T3	T4	SEM
Initial Hb (*gm/dl*)	14.76	13.17	9.50	14.58	1.89^{NS}
Final Hb (*gm/dl*)	6.59	11.17	9.92	9.33	3.21^{NS}
Initial PVC (%)	44.50	39.56	28.50	43.75	5.75^{NS}
Final PVC (%)	19.75	33.50	29.75	28.00	10.76^{NS}
Initial RBC ($X10^6/\mu l$)	4.95	5.60	3.45	5.13	0.70^{NS}
Final RBC ($X10^6/\mu l$)	2.58	3.96	3.40	3.74	1.32^{NS}
Initial WBC($X10^3/\mu l$)	12.51	12.80	7.46	12.05	1.68^{NS}
Final WBC($X10^3/l\mu$)	6.06	7.45	8.61	6.90	2.32^{NS}
Initial MCV (*fl*)	79.17	70.77	62.95	87.60	13.49^{NS}
Final MCV (*fl*)	37.97	68.69	66.65	56.54	7.64^{NS}
Initial MCHC(*gm/dl*)	33.33	33.32	25.00	33.33	4.17^{NS}
Final MCHC(*gm/dl*)	16.67	25.00	25.00	25.00	8.67^{NS}
Initial neutrophils (%)	18.00	22.25	25.00	28.50	6.76^{NS}
Final neutrophils (%)	10.00	7.75	12.25	9.00	3.11^{NS}
Initial Lymphocytes (%)	79.25	52.25	73.25	59.50	11.76^{NS}
Final Lymphocytes (%)	89.50	66.75	87.75	40.45	16.24^{NS}

*T_1, T_2, T_3 and T_4 are`low fibre without enzyme, low fibre with enzyme, high fibre without enzyme and high fibre with enzyme diets respectively.

NS= Non significant ($P < 0.05$) difference, SEM- Standard error of means, PCV=packed cell volume, Hb=Haemoglobin, RBC=red blood cells, WBC=white blood cells, MCV=mean corpuscular volume, MCHC=mean corpuscular haemglobin concentration

Discussion

The haematological value recorded in all the treatment groups falls within the physiological range for normal pigs as documented by Schalm *et al*. (1975) and Adenkola *et al.* (2009b). The results of this work support the findings of Angaehie & Madubuike (2004) who noted the effect of supplementation of high fibre (maize cob) full- fat soya bean-based diet with a commercial enzyme (Nutri-enzyme®) on performance and haematological characteristics of broiler chicks, that birds on supplemented enzyme diets produced the best haematological parameters.

Table 4: Relationship between crude protein intake and haematological parameters

Correlated parameters	*T1	T2	T3	T4
Crude protein and packed cell volume	1.00	0.277	0.500	0.434
Crude protein and haemoglobin	1.00	0.274	0.500	0.434
Crude protein and erythrocyte count	1.00	-0.698	0.842	0.987
Crude protein and total white blood cell count	1.00	-0.839	0.755	0.768

*T_1, T_2, T_3 and T_4 are`low fibre without enzyme, low fibre with enzyme, high fibre without enzyme and high fibre with enzyme diets respectively.

This is supported in this work by the higher value of packed cell volume and total red blood cell count obtained in the treatment 2 with low fibre and enzyme supplement this could be interpreted as manifestation of the improvement of feed quality parameters that affected these physiological values and it has been documented that the level of nutrition greatly influences erythropoesis in livestock (Togun & Oseni, 2003; Adenkola *et al.,* 2009a; Egbunike *et al.,* 2009). The fact that there was no positive correlation between the crude fibre intake and haematological parameters indicated that crude fibre intake has no effect on haematological parameters in pigs, though it has been documented that fibrous feed in monogastric animals resulted in decreased feed conversion ratio (Tuleun *et al.,* 1998; Olokun & Olalokun, 1999), however the reverse was the result when the feed was supplemented with enzyme as the enzyme aided degradation of fibrous materials, thus making available to the animals the required nutrients. In conclusion, supplementing fibrous feedwith enzyme improves the haematological parameters in growing pigs.

Table 5: Relationship between crude fibre intake and haematological parameters

Correlated parameters	*T1	T2	T3	T4
Crude fibre and packed cell volume	1.00	0.618	0.411	-0.478
Crude fibre and haemoglobin	1.00	-0.621	0.411	-0.477
Crude fibre and total red blood cell count	1.00	-.0.989	0.930	0.708
Crude fibre and total white blood cell count	1.00	-0.932	0.093	0.969

*T_1, T_2, T_3 and T_4 are`low fibre without enzyme, low fibre with enzyme, high fibre without enzyme and high fibre with enzyme diets respectively.

Acknowledgement

The authors are grateful for the contributions of all staff of Physiology Laboratory of the Department of Physiology and Pharmacology and Teaching and Research Farm of College of Animal Science, University of Agriculture, Makurdi, Nigeria.

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