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Performance and blood profile of rabbits fed varied dietary lanthanum oxide

O. A. Adu[1], O. S. Omoleye[2] and O. H. Asolo[3]

[1]Department of Animal Production and Health, Federal University of Technology, Akure, Nigeria.

[2]State Veterinary Hospital, Akure, Nigeria.

[3]Department of Agricultural Technology, Rufus Giwa Polytechnic, Owo, Nigeria.

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ABSTRACT

35 female weanling rabbit of an average weight of 510g were used in a feeding trial that lasted 12 weeks to evaluate the effect of inclusion of different levels of REE (0, 100, 200, 300 and 400ppm) on the performance, blood and serum parameters of the animals. The animals were randomly allotted to five treatments of 7 replicates (1 animal per replicate) per treatment. The initial weight, final weight and fed intake were monitored, recorded and analysed. Blood samples was collected and used for the haematological analysis. There was significant ($p>0.05$) difference in the final weight, daily weight gain, daily feed intake and feed conversion ratio. However, the daily weight gain and feed conversion ratio increases as the inclusion level of dietary REE increase likewise the. Haemoglobin (Hb), Packed cell volume (PCV), Red blood cell (RBC), White blood cell (WBC), neutrophils, eosinophils and lympocytes were not significantly ($p>0.05$) influenced among the dietary treatment. The total protein, albumin, globulin, cholesterol and urea were also not significantly ($p>0.05$) different, though all higher numerically in supplemented diets compared to the control.

Introduction

Growth promoters or performance enhancers are used worldwide in animal production. Rare earth elements (REE) have been shown to influence growth performance in animal, especially in pigs but rarely in rabbit. In China for more than 40 years, special mineral salts called REE or lanthanides with the elements lanthanum, cerium and others are used as feed additives in animal production.

Numerous reports in the Chinese literature described that a small amount of these REE or its mixtures in the diet can increase the body weight gain of pigs, cattle, sheep and chicken and it is also reported that they increase milk and egg production. These finding was totally unnoticed in the tropical world.

The purpose of this study was to investigate the effect of REE on the physiological performance and blood characteristics of weanling female rabbits under the tropical conditions.

Materials and Methods

Experimental Site

The feeding trial was carried out at the Rabbit Unit of the Teaching and Research Farm, University of Ibadan, Ibadan and further laboratory analyses carried out at the Animal Physiology Laboratory of the Department of Animal Science of the University of Ibadan, Ibadan, Nigeria.

Thirty-five female weanling rabbits aged 5-6 weeks with average weight of 510±47.93g were used in the experiment.

Pre-experimental Operations

All the 35 female weanling rabbits were individually housed in wire-mess cages measuring 75 x 45x 45 and 80cm above the ground for a 2-week physiological adjustment period before the commencement of the feeding trial and were fed daily at 0800 and 1600h *ad libitum* with same feed for the 2-week physiological adjustment period. Kepromec Oral (Ivemectin®) was administered through drinking water against potential ecto- and endo-parasites for two days at recommended dosage by the manufacturer.

Experimental Layout and Feeding Trial

Five experimental diets were formulated: control (diet 1) with non-inclusion of REE, diets 2, 3, 4 and 5 had 100, 200ppm 300 and 400ppm inclusion of REE (Lanthanum oxide) respectively as shown in Tables 1. The diets were used in 12week feeding trial. The diets were isocaloric and isonitrogenous and satisfied the nutrient requirements of the animals as recommended by NRC (1998).

At the end of the 2-week physiological adjustment period, the thirty-five rabbits were randomly allocated to each of the 5 treatment diets, each treatment comprised 7 animals. The animals were provided fresh, clean water and appropriate feed *ad libitum* daily at 0800 and 1600h throughout the feeding period.

Data

Feed intake for each animal was measured daily by difference between the daily feed supplied and left over, and changes in live weight of the animals were taken weekly throughout the experimental period.

Blood

At the beginning of the experiment and at the last day, blood sample was collected from the ear vein of each animal into labeled bottles, one set of which contained Ethylene diaminetetraacetic acid (EDTA), an anti-coagulant while the others were without EDTA for serum biochemistry.

The blood without anti-coagulant was allowed to stand in test tube rack in the laboratory in a slanting position. The serum separated from each blood sample was then decanted after centrifugation. The sera were later analysed for serum biochemicals. The blood samples in the EDTA bottles were used for haematological analyses.

Tele:

E-mail addresses: adufem_bunmi@yahoo.com

Blood samples were analysed for PCV, RBC, Hb, WBC, Total Protein, Globulin and Albumin as described by Tietz (1995). The serum creatinine and urea nitrogen were estimated by deproteinisation and Urease-Berthelot colorimetric methods respectively, using a commercial kit (Randox Laboratories Ltd., U.K.). Also the free cholesterol was determined by nonane extraction and enzymatic colorimetric methods respectively using commercial test kits (Quimica Clinica Applicada, S.A.), while the serum enzymes alanine aminotransferase (ALT) and aspartate aminotransferase (AST) were obtained using the Randox Laboratories Ltd, UK test kits.

Statistical Analysis

The design used for the experiment is Completely Randomised Design (CRD). All the data obtained were subjected to statistical analysis using analysis of variance (ANOVA). The significant treatment means were compared using the Duncan option of the same software.

Results

The performance of weanling female rabbits fed diets containing various inclusions of REE is presented in Table 2. The performance differed significantly ($p<0.05$) in terms of final live weight, daily dry matter intake was improved by 3.63-13.23% in the REE supplemented diets, daily weight gain which improved by 7.4-22.7% and feed conversion ratio between 0.5-9.6%. Growth responses were lower in groups fed the control diet compared to those fed diets supplemented with REE. The growth performance was noticed to be dose-dependent across the treatments.

Table 3 showed that the haematological parameters across the treatments are not significantly ($p>0.05$) different, there were also no statistically significant differences among the serum protein analysed (Table 4).

Discussion

Positive effects of rare earths on pig performance in China and the West have been widely published (Mavromichalis, 2001; Azer, 2003; Bayerischer Rundfunk, 2003 and Süss, 2004) and all these observation agreed with the result of this study using rabbit in the tropics where there was improved body weight gain, improved feed conversion and daily dry matter intake.

Rambeck *et al*., (1999a) reported positive results with improved body weight gain and feed conversion rate of 2.5% and 7%, respectively, were noticed in piglets after rare earth application. Even better effects in terms of increased body weight gain of 12-19% related to 7.4-22.7% recorded in this study using rabbits in the tropics and improved feed conversion of 3-11% were described in growing pigs and could be proven statistically (Rambeck *et al.,* 1999b; He and Rambeck, 2000; He *et al.,* 2001; Borger, 2003) and 0.5-9.6% as observed in the present study. Fattening pigs that received rare earth citrates, presented significant higher body weight gain of 851g, which was improved by 8.8% compared to the control group's weight gain.

Similarly, improvements in feed conversion of 3.6-5.5% were also reported in piglets (8-30kg) in another feeding trial using rare earth in citrate form along with increased body weight gain of 3.7-25% (Knebel, 2004). However, performance enhancing effects were not only demonstrated under controlled experimental conditions, but also in field trials. Thus, rare earth chlorides were shown to improve body weight gain and feed conversion rate by 10% and 2%, respectively, in pigs that are kept under field conditions (Zehentmayer, 2002; Eisele, 2003). Besides pigs, significant growth promoting effects were also observed in growing rats. Dietary supplementation of rare earth chlorides improved their body weight gain and feed conversion by 4-7% and 3-11%, respectively (He *et al.*, 2003a). In addition, rare earths were also shown to have ergo-tropic effects in terms of increased end weights of 7% on broilers (Halle *et al.,* 2002a), while feed conversion was improved by 1-3%. A recent study further reported performance enhancing effects in veal cattle after rare earths were supplemented to milk substitute (Meyer *et al.,* 2006).

Yet, there are also studies, in which performance enhancing effects after dietary supplementation of rare earth elements could not be observed (Schuller, 2001; Böhme *et al*., 2002 ; Eisele, 2003; Kraatz *et al.*, 2004; Gebert *et al.*, 2005 and Miller, 2006).

From the result of this study,it is evidence that all biochemical blood parameters were within the physiological range. Additionally, urea and creatinine were increased in animals supplemented with rare earth chlorides, which might indicate a possible impact of rare earths on protein metabolism (He *et al*., 2003a). Yet, total cholesterol, total protein and albumin were unaffected.

Blood samples taken from rats, whose diet was supplemented with rare earths for 16 days, also revealed increases in both creatinine and urea concentrations as also observed in this study, which may also indicate an impact on protein metabolism through the intermediate metabolism (He *et al*., 2003a). Though, at the same time neither total protein nor albumin were affected and no influence on any of these parameters was observed in other feeding trials performed on pigs (He *et al.,* 2001; Borger, 2003)

Conclusion

It can be concluded from the result of this study that dietary REE at a dose of 400ppm improve body weight gain, improved feed conversion and daily dry matter intake without any detrimental effect on the blood parameters indicating a good health status of the animals.

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Table 1: Gross composition (%) of the weanling rabbit test diets

Ingredients	Diet 1 Control	Diet 2 100ppm	Diet 3 200ppm	Diet 4 300ppm	Diet 5 400ppm
Maize	14.00	14.00	14.00	14.00	14.00
Maize offal	36.40	36.40	36.40	36.40	36.40
Soya bean cake	25.00	25.00	25.00	25.00	25.00
Palm kernel cake	20.00	20.00	20.00	20.00	20.00
Fish meal	2.00	2.00	2.00	2.00	2.00
Oyster shell	1.20	1.20	1.20	1.20	1.20
Bone meal	0.80	0.80	0.80	0.80	0.80
Vitamin Premix	0.20	0.20	0.20	0.20	0.20
Salt	0.40	0.40	0.40	0.40	0.40
Lanthanum oxide (ppm)	-	100	200	300	400
Total	100.00	100.00	100.00	100.00	100.00
Calculated nutrient					
Crude protein	18.66	18.66	18.66	18.66	18.66
ME (Kcal/kg DM)	2,518.01	2,518.01	2,518.01	2,518.01	2,518.01
Crude fiber	9.19	9.19	9.19	9.19	9.19

ME: Metabolisable Energy

Table 2: Performance of weanling rabbits fed varied levels of dietary lanthanum oxide

Parameters	Diet 1 Control	Diet 2 100ppm	Diet 3 200ppm	Diet 4 300ppm	Diet 5 400ppm	±SEM*
Initial live weight (g)	514.29	502.86	521.43	517.14	495.00	47.93
Final live weight (g)	1452.14^{c}	1517.14^{b}	1677.71^{a}	1680.71^{a}	1700.00^{a}	40.06
Daily dry matter intake (g)	65.30^{c}	70.34^{ab}	73.94^{a}	73.17^{a}	67.67^{bc}	3.90
Daily weight gain (g)	11.20^{c}	12.10^{b}	13.77^{a}	13.85^{a}	14.35^{a}	1.25
Feed conversion ratio	5.83^{a}	5.81^{a}	5.37^{b}	5.28^{b}	4.71^{c}	0.22

abc: Means on same row with different superscripts differ significantly ($P<0.05$).
±SEM* Standard Error of Mean

Table 3: Haematology of weanling rabbits fed varied levels of dietary lanthanum oxide

Parameters	Diet 1 Control	Diet 2 100ppm	Diet 3 200ppm	Diet 4 300ppm	Diet 5 400ppm	±SEM*
Packed cell volume (%)	35.02	37.17	34.90	35.68	35.22	4.63
Haemoglobin(g/dl)	11.58	11.92	11.88	11.62	11.74	1.38
Erythrocytes(10^9/l)	5.49	5.51	5.60	5.45	5.86	0.59
Leukocytes(10^9/l)	6.36	7.08	6.58	6.65	6.89	1.11
Neutrophils (%)	37.84	37.62	39.11	37.29	37.94	3.50
Eosinophils(%)	1.87	2.10	1.79	1.81	1.88	0.74
Lymphocytes (%)	42.44	41.38	41.12	41.72	42.23	2.15
Basophils (%)	3.21^b	3.22	3.24	3.20	3.25	0.91
Monocytes(%)	7.66	7.71	7.96	7.67	8.18	1.06

±SEM* Standard Error of Mean

Table 4: Serum biochemical of weanling rabbits fed varied levels of dietary lanthanum oxide

Parameters	Diet 1 Control	Diet 2 100ppm	Diet 3 200ppm	Diet 4 300ppm	Diet 5 400ppm	±SEM*
Total protein(g/dl)	6.84	6.72	6.98	7.00	6.88	0.55
Albumin (g/dl)	3.52	3.91	3.75	3.72	3.55	0.34
Globulin (g/dl)	3.29	3.67	3.23	3.27	3.33	0.42
Albumin/Globulin	1.06	1.07	1.16	1.14	1.10	0.35
Cholesterol (mg/dl)	26.44	27.82	27.78	28.38	29.02	5.20
Creatinine (mg/dl)	1.20	1.25	1.26	1.31	1.32	0.24
Urea (mg/dl)	13.51	14.21	13.58	13.92	14.47	2.53
ALT (IU/l)	51.33	51.76	51.94	52.21	51.83	1.34
AST (IU/l)	62.50	62.65	63.20	63.25	62.70	2.70

±SEM* Standard Error of Mean, ALT: Alanine aminotransferase,
AST: Aspartate aminotransferase