HAEMATOLOGICAL AND SERUM BIOCHEMICAL PROFILE OF MALE RABBITS FED DIETARY CERIUM OXIDE

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ABSTRACT

In an 8-week feeding experiment, 32 growing buck rabbits with an average weight of 1366.56±37.54g, were used to assess the effects of inclusion of different dietary concentrations of Cerium oxide (CeO), a Rare Earth Element, at 0, 50, 100, 150ppm on blood characteristics.The animals were randomly allotted to the four dietary groups, with eight animals per group. Blood samples were collectedfrom the ear vein of each animal on the last day of the experiment for haematological and serum biochemical analyses. The results showed no significant influence of dietary cerium oxide on serum biochemical parameters and haematology (except for packed cell volume, white blood cell and monocyte that were significantly ($P<0.05$) increased).

INTRODUCTION

The ban of all antibiotic feed additives by the European Union in early 2006 necessitated a strong demand for new, efficient, safe and inexpensive feed additives. Rare earth elements may therefore be a promoting approach. Rare earth elements (REE) are the 15 lanthanide elements with atomic numbers 57 (lanthanum) through 71 (lutetium) of group III A of the periodic table. Chinese literature has reported amazing results achieved by supplying REE in animal diets (Redling, 2006). As feed additives, rare earth elements were shown to improve growth and reproductive performance in nearly all categories of farm animals (Shen *et al.*, 1991; Rosewell, 1995; Duan *et al.*, 1998; Tang *et al.*, 1998; Yang and Chen, 2000; Liu, 2005, Yang *et al.*, 2005 and Akinmuyisitan, 2015). In China REEs have been used as growth enhancer on a large scale and many studies showed that they produce reasonable growth-promoting effects in all classes of livestock (Redling, 2006). This assumption was not noticed in the tropics until 2005 (Adu, 2005). This present study was therefore aimed at evaluating the effects of dietary cerium oxide, a rare earth element on haematology and serum biochemistry of growing male rabbits under tropical conditions.

MATERIALS AND METHODS

The experimental study was carried out at the Rabbit Unit of the Teaching and Research Farm and further analyses were carried out at the Research Laboratory of the Department of Animal Production and Health of the Federal University of Technology, Akure, Nigeria. Thirty-two growing male rabbits of about 12 weeks of age with an average weight of 1366.56±37.54g were used in this experiment. The animals were housed individually in a wire-mesh cage in an in-door pen and randomly assigned into one of the four groups (eight per treatment) after a 2-week physiological adjustment period. Four experimental diets were formulated: control (diet 1) with non-inclusion of REE, diets 2, 3 and 4 with 50, 100 and 150 ppm inclusion levels of cerium oxide, respectively. The diets were isocaloric, isonitrogenous and satisfied the nutrient requirements of the animals as recommended by National Research Council (1998). The animals were provided with fresh, clean water and appropriate feed for eight weeks. On the last day of the experiment, blood samples were collected from the ear vein of each animal into two sets of labeled bottles, one set contained Ethyl diamine tetraacetic acid (EDTA), an anti-coagulant, for haematological analyses while the other set without EDTA for serum biochemical analyses as described by Ewuola and Egbunike (2008). The design used for this experiment was Completely Randomized Design (CRD). Data collected were subjected to statistical analysis using one way ANOVA procedure of SAS (2008). The significant treatments were compared using Duncan's multiple range tests of the same software.

RESULT AND DISCUSSION

Table 1 shows the haematological results of bucks fed varied levels of dietary cerium oxide. The result showed no significant ($P>0.05$) influence on all the parameters The insignificant influence of the majority of the haematological parameters by varied level of cerium oxide shows that dietary REE do not affect the status of the blood parameters, as all were still within the normal

physiological range for rabbits (Mitruka and Rawnsley, 1981; Kerr, 1989 and Jones, 2005). The result of this study concur with the reports of He *et al.* (2001); Adu (2005) and Adu *et al.* (2009) that dietary REE had no negative effect on blood parameters of animals. Packed cell volume (PCV) is within the normal range for rabbits (Mitruka and Rawnsley, 1981; Kerr, 1989 and Jones, 2005). The significant increase in leukocyte count at 100 ppm level of inclusion of cerium oxide and the insignificant increase observed with basophils, neutrophils and eosinophils are all indication of possible interference of dietary cerium oxide with the soldiers of the immune system. The positive effects of dietary REE on the immune system have already been considered as possible mode of action explaining performance enhancing effects in animals (Feldmann, 2003). Therefore, it has been suggested that oral intake of less or slightly more of REE may strengthen the immune system. Investigations on cell lines demonstrated dose-dependent effects of lanthanum and cerium on the production of blood cells within the bone marrow (Flachowski, 2003), as to synthesis and reduction of white blood cells (Redling, 2006).

Serum biochemistry

The serum biochemistry of bucks fed dietary cerium oxide is as shown in Table 2. The result showed that the serum biochemical values obtained in this study were within the normal physiological range for healthy rabbits (Mitruka and Rawnsley, 1981; Kerr, 1989 and Jones, 2005). The results are similar to the reports of He *et al.* (2003) and Adu *et al.* (2009) that dietary REE has no negative influence on serum biochemical parameters in rats and rabbits respectively. The insignificant increase observed with serum protein, albumin and urea as well as the insignificant reduction in globulin concentration are all indication of possible interference of dietary REE with protein metabolism through intermediate metabolism as suggested by He *et al.* (2003). REE may form complexes with protein which in turn may enhance protein uptake or its metabolism (Ou *et al.*, 2000). The insignificant influence of dietary REE on creatinine values observed in this study which is still within the normal physiological range for rabbits is indicative of normal functioning of the kidneys of these bucks, as Hammond and Belilies (1980) reported that with normal kidney function, the amount of creatinine in the blood remains relatively constant and normal. The result of this study on glucose is contrary to the reports of He *et al.* (2003) that dietary REE reduced the blood glucose significantly in four-week old wistar rats, although the glucose level reduced insignificantly at 50ppm (diet 2) and 100ppm (diet 3) in this study indicating possible impact of dietary REE on glucose metabolism. Haese (1956) suggested that cerium is expected to affect carbohydrate metabolism, as it was shown that cerium may break down meta-, pyro- and polyphosphates into ortho-phosphates. The cholesterol levels in this study was within the normal range of 10-80mg/dl reported Mitruka and Rawnsley (1981) for rabbits, this could be due to the suggestion of Redling (2006) that the anti-oxidative effects of REE makes it capable of protecting the fatty acids in animal diets from oxidation and thereby could preserve the nutrients within the feed or more-over, enhance their uptake. The findings of this study on AST and ALT are in agreement with the results of He *et al.* (2001) that dietary REE showed no significant influence on these parameters in crossbred piglets fed diets supplemented with mixtures of REE. It is also in line with the report of Adu *et al.* (2009) in rabbits fed varied levels of dietary REE.The values obtained for AST and ALT in this study are in agreement with the range of 10-98 IU/l and 25-65 IU/l for AST and ALT respectively as reported by Mitruka and Rawnsley (1981) for normal rabbits and this is an indication of normal functioning of the liver of these animals. It can be concluded that dietary REE at 50-150 ppm concentration has no detrimental effect on the blood parameters indicating good health status of the animals.

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Table 1: Haematologicalvalues of bucks fed varied levels of dietary cerium oxide

Parameters	Diet 1 Control	Diet 2 50ppm	Diet 3 100ppm	Diet 4 150ppm	±SEM
Packed cell volume (%)	32.46^{b}	38.69^{a}	34.99^{ab}	37.11^{a}	4.17
Haemoglobin (g/dl)	12.35	12.03	11.85	11.58	0.91
Red blood cell (10^{9}/l)	5.49	5.42	5.46	5.61	0.41
White blood cell (10^{9}/l)	6.29^{b}	7.08^{ab}	7.48^{a}	6.30^{b}	0.87
Monocyte (%)	7.98^{a}	8.15^{a}	7.69^{ab}	6.98^{b}	0.88
Neutrophil (%)	38.86	38.20	38.96	39.70	2.20
Basophils (%)	3.16	3.71	3.86	3.63	0.71
Eosinophils (%)	1.69	2.04	2.13	2.05	0.75
MCV (μ^3)	66.10	64.93	65.28	66.14	3.71
MCH ($\mu\mu$g)	21.21	21.54	21.40	22.24	1.91
MCHC (%)	22.95	22.65	22.19	22.81	1.61

ab: Means on same row with different superscripts differ significantly (P<0.05), MCV- Mean corpuscular volume, MCHC- Mean corpuscular haemoglobin concentration, MCH- Mean corpuscular haemoglobin, SEM- Standard Error of Mean

Table 2: Serum biochemistry of bucks fed dietary cerium oxide

Parameters	Diet 1 Control	Diet 2 50ppm	Diet 3 100ppm	Diet 4 150ppm	±SEM
Serum Protein (g/dl)	6.78	6.93	6.75	6.91	0.51
Albumin (g/dl)	3.18	3.54	3.52	3.58	0.37
Globulin (g/dl)	3.60	3.38	3.24	3.33	0.58
Cholesterol (mg/dl)	27.44	28.45	27.73	28.24	5.69
Urea (mg/dl)	13.54	14.56	14.20	13.09	2.67
ALT (IU/l)	51.93	52.59	52.38	53.08	2.39
AST (IU/l)	61.15	61.05	60.86	61.63	1.40
Creatinine (mg/dl)	1.02	0.99	1.02	0.99	0.20
Glucose (mg/dl)	126.50	114.75	126.50	114.75	16.95

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