

Original Research Article

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## Effect of Dietary REE Supplementation on Blood Biochemical Parameters in Layer Chicken

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### ABSTRACT

A biological study was conducted to determine the effects of dietary supplementation of different levels of rare earth elements (lanthanum and cerium) on blood biochemical parameters namely calcium, phosphorus, total protein, albumin and globulin in laying hens. A total of 96 White Leghorn laying hens of 52 weeks of age were used in 8-week feeding trial. Birds were randomly allotted to three dietary treatments each with four replicates and 8 hens per replicate. Treatments consist of basal diet supplemented with 0, 250mg (lanthanum 100mg and cerium 150 mg) and 500mg/kg (lanthanum 200mg and cerium 300 mg) of rare earth elements. Blood was collected from the birds at monthly intervals and plasma was separated to analyse calcium, phosphorus, total protein and albumin using UV spectrophotometer. The results in this study showed that rare earth elements (lanthanum and cerium) supplemented at 250mg/kg to the diets of layers had significantly ( $P<0.05$ ) increased plasma calcium and phosphorus levels at first and second month, whereas in 500mg/kg experimental group plasma calcium and phosphorus had significantly ( $P<0.05$ ) increased in first month but no significant changes was found in second month of the trial. The total protein, albumin and globulin were not significantly affected compared to the control. Hence it was concluded that at low dose of rare earth elements, the birds had significant effect in plasma calcium and plasma phosphorus level compared to higher dose.

#### Keywords

Layers, REE,  
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### Introduction

Rare earth elements literally refer to three members of group IIIB, namely scandium, yttrium, lanthanum, and the 14 chemical elements found in group IIIA of the periodic table called lanthanoids (cerium, praseodymium, neodymium, promethium, samarium, europium, gadolinium, terbium, dysprosium, holmium, erbium, thulium, ytterbium and lutetium). Lanthanum and

Cerium are REE widely existing in earth (Raja and Sethuraman, 2008). Lanthanum resembles the element calcium in size, bonding, and coordination geometry and donor atom preference and it may act as calcium analog in various biological processes in laying hens. In animal production, excellent results have also been obtained by incorporating REE in animal diets in Chinese literatures (Redling 2006). The proper concentrations of REE in diet can improve animal growth performance without

affecting quality of products (He *et al.*, 2001). Growth performance enhancing effects due to dietary supplementation of rare earth elements at low concentrations are described for nearly all categories of farming animals, including beef cattle, sheep, pigs, rabbits, ducks, chickens, shrimps and fish (Redling, 2006).

Therefore the aim of this study was to investigate the effects of dietary rare earth element on blood biochemical indices of laying hens.

### **Materials and Methods**

A total of 96 White Leghorn layers of 52 weeks of age were randomly assigned to three dietary treatments for 8-week feeding trial and the experiment was conducted at the Poultry Farm Complex, Department of Poultry Science, Veterinary College and Research Institute, Namakkal, Tamil Nadu. Laying hens were randomly assigned to three treatments with four replicates per treatment, and there were 8 hens in each replicate. The layers were reared in cages in gable roofed open sided, elevated platform house. All the birds were provided with uniform cage floor, feeder and water space and were reared under standard management conditions throughout the experimental period. The experimental layer diets were formulated according to the breeder's specification (Venkateshwara Hatcheries Private Limited). Basal diet supplemented with 0, 250 (La 100mg, Ce 150mg) and 500mg/kg (La 200, Ce 300 mg) of REE. The ingredients and proximate analysis of nutrients done as per AOAC (1995) are presented in Table 1. Blood (2 ml) was collected from wing vein using 24 G needles in sodium fluoride vacutainer tubes from 18 birds (six birds per treatment) at monthly intervals. The collected blood was immediately centrifuged for 10 min at 2,000 rpm and the separated plasma was stored at -20°C for further biochemical analysis. The blood biochemicals were analyzed with UV-

VIS double beam spectrophotometer (SYSTRONICS, Model 2202, India) using commercial kits (Span diagnostics Ltd., India). Calcium (Trinder, 1960) and phosphorus (Gomorii, 1942), total protein (Lowry *et al.*, 1951), albumin (Johnson *et al.*, 1999) and globulin were determined in the plasma samples as per the manufacture's protocol.

### **Statistical analysis**

The data collected were analysed using SPSS® 20.0 software package. Post hoc analysis was done by Duncan's multiple descriptive significant difference. All the statistical procedures were performed based upon Snedecor and Cochran (1994).

### **Results and Discussion**

The influence of REE at different levels on the blood biochemical constituents of layer chickens were presented in Table 2 and 3.

The plasma calcium and phosphorus levels were significantly ( $P < 0.05$ ) high in REE supplemented groups (Table 2). The results in this study showed that rare earth elements (lanthanum and cerium) supplemented at 250mg/kg to the diets of layers had significantly increased plasma calcium and phosphorus levels at first and second month, whereas in 500mg/kg experimental group plasma calcium and phosphorus had significantly increased in first month but no significant changes was found in second month of the trial. The level of calcium and phosphorus recorded in the present study are accordance with that of Zohravi (2006) who reported significant increase in serum calcium by addition of REE (50 to 100 mg/kg) in Japanese quail compared to control birds. Bolukbas *et al.*, (2016) also reported that significantly ( $p < 0.05$ ) increased serum calcium and phosphorus by supplementing cerium oxide (100 mg/kg) in layer.

**Table.1** Ingredients and nutrient composition of experimental layer diet (DM %)

Ingredients	Kg/100 kg diet
Maize	50.5
DORB	13.5
SFOC	6.0
SOYA	17.5
Calcite/LSP	5.5
Grit	5.0
Di calcium phosphate	1.5
Methionine	0.164
Lysine	0.117
NSP Enzyme	0.05
Salt	0.137
Nutrient compositions (%)	
Crude protein	16.67
Crude fibre	6.4
Calcium	4.0
Ether extract	3.0
Available phosphorus*	0.41
Lysine*	0.89
Methionine*	0.45
Metabolizable Energy* (kcal/kg)	2550

\* Calculated values

Additives and supplements (per 100 kg): Vitamin premix (<sup>1</sup>Hyblend) - 10 g, trace mineral (<sup>2</sup>Ultra TM) - 100 g, toxin binder - 25 g, Vitamin B-complex (<sup>3</sup>Meriplex) - 10 g, liver stimulant (hepatocare) - 25 g, choline chloride (60 %) - 50 g, oxytetracycline (10 %) - 50 g

<sup>1</sup>Hyblend – nutritional value per gram- vitamin A - 82500 IU, vitamin B2 - 50 mg, vitamin D3 - 12000 IU, menaphthone sodium bisulphate and vitamin K (stabilized) - 10 mg.

<sup>2</sup>Ultra TM - Each 5kg contains manganese - 270 g, zinc - 260 g, iron - 100 g, iodine - 10 g, copper - 10 g, cobalt - 5g selenium - 1.5 g

<sup>3</sup>Meriplex - each gram contains vitamin B<sub>1</sub> - 8 mg, vitamin B<sub>6</sub> - 16 mg, vitamin B<sub>12</sub> - 80 mcg, vitamin E<sub>50</sub> - 80 mg, niacin - 120 mg, folic acid - 8 mg, calcium D pantothenate - 80 mg, calcium - 86 mg.

**Table.2** Mean ( $\pm$  SE) plasma calcium and phosphorus (mg/dl) of White Leghorn layers fed different levels of REE

TREATMENTS	Calcium (mg/dl)			Phosphorus (mg/dl)		
	Age in weeks					
	52	56	60	52	56	60
T1 Control	26.57 $\pm$ 0.48	26.50 <sup>a</sup> $\pm$ 0.36	26.72 <sup>a</sup> $\pm$ 0.45	6.98 $\pm$ 0.14	7.01 <sup>a</sup> $\pm$ 0.13	7.00 <sup>a</sup> $\pm$ 0.11
T2 250 mg REE (La 100 mg +150 mg Ce)	25.81 $\pm$ 0.78	28.17 <sup>b</sup> $\pm$ 0.51	28.95 <sup>b</sup> $\pm$ 0.33	6.97 $\pm$ 0.10	8.03 <sup>b</sup> $\pm$ 0.15	7.78 <sup>b</sup> $\pm$ 0.22
T3 500 mg REE (La 200 mg +300 mg Ce)	26.48 $\pm$ 0.52	28.12 <sup>b</sup> $\pm$ 0.56	27.08 <sup>a</sup> $\pm$ 0.35	7.02 $\pm$ 0.17	7.67 <sup>b</sup> $\pm$ 0.18	7.20 <sup>a</sup> $\pm$ 0.6

Means bearing different superscript within the column differ significantly (P<0.05)

**Table.3** Mean ( $\pm$  SE) plasma total protein, albumin and globulin (g/dl) of White Leghorn layers fed different levels of REE

TREATMENTS	Total protein (g/dl)			Albumin (g/dl)			Globulin (g/dl)		
	Age in weeks								
	52	56	60	52	56	60	52	56	60
T1 Control	3.88 $\pm$ 0.07	3.91 $\pm$ 0.12	3.88 $\pm$ 0.10	2.29 $\pm$ 0.01	2.37 $\pm$ 0.05	2.38 $\pm$ 0.06	1.59 $\pm$ 0.07	1.54 $\pm$ 0.09	1.50 $\pm$ 0.06
T2 250 mg REE (La 100 mg +150 mg Ce)	3.91 $\pm$ 0.07	3.92 $\pm$ 0.07	3.90 $\pm$ 0.04	2.34 $\pm$ 0.03	2.40 $\pm$ 0.06	2.31 $\pm$ 0.07	1.57 $\pm$ 0.08	1.51 $\pm$ 0.02	1.58 $\pm$ 0.05
T3 500 mg REE (La 200 mg +300 mg Ce)	3.92 $\pm$ 0.08	3.90 $\pm$ 0.10	3.85 $\pm$ 0.10	2.37 $\pm$ 0.03	2.38 $\pm$ 0.06	2.32 $\pm$ 0.07	1.55 $\pm$ 0.05	1.52 $\pm$ 0.12	1.52 $\pm$ 0.14

Brown *et al.*, (1990) reported that REE were considered to be as analogous to Ca, especially lanthanum (La) had been named as super calcium. REEs locate at the same binding sites in organisms as Ca and thus show a similar effect with that of Ca. It is thought that REE may also increase Ca ratio of serum in this study.

The mean plasma total protein, albumin and globulin concentration did not show any significant variation among the treatment groups (Table 3). The results of the present study concurred with He *et al.*, (2001) at 300mg/kg in pigs, Adu *et al.*, (2009); Adu *et al.*, (2011b) at 100,200,300,400 ppm in rabbits and Adu *et al.*, (2011a); Igbasan and Adebayo (2012) at 100,200,300 ppm supplementation of REE in broilers.

In conclusion 250 mg/kg REE had significant effect on plasma calcium and phosphorus levels in laying hens. Growth promoters or performance enhancers are used worldwide in animal production. Rare earth elements (REE) have been shown to influence growth performance in animals. Probiotics, prebiotics, organic acids and enzymes are already known as replacements for antibiotics as feed additives but rare earth elements (REEs) might be the new generation of growth promoters.

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