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Effect of phytase supplementation in low energy-protein layer diet on availability of certain trace minerals

P.Ponnuvel* **and Binoj Chacko**
Centre for Advanced Studies in Poultry Science
College of Veterinary and Animal Sciences
Kerala Veterinary and Animal Sciences University
Kerala, India- 680651.
*Associate professor, RIVER, Pondicherry
*Corresponding author: *ponnuvelpalanivel@gmail.com*

Abstract

An experiment was carried out using two hundred Athulya birds divided into 10 treatments (T1-T10) to find out the effect of phytase enzyme on availability of certain trace minerals. Phytase was supplemented at 0, 500 and 1000 units/kg in low energy, low protein and low energy- protein layer chicken diets containing available phosphorus of 0.30 per cent from 21 to 40 weeks of age. A standard layer ration was offered to birds in T1. After the laying period, four birds from each treatment were randomly selected to conduct a metabolism trial and data on availability of manganese, copper, zinc and iron were determined. The availability of trace minerals in phytase supplemented experimental diets fed treatment groups was significantly ($P<0.01$) higher when compared with all the negative control diets fed groups.

Keywords: Phytase, low energy-protein, trace minerals

Introduction

For the past four decades, Indian layer industry has become a commercial agricultural sector with a annual growth rate of 5 to 8 per cent. Feed production and availability of feed ingredients are limited to meet the demand of this fast growing industry. Most of the cereals and their by-products used in poultry diets have phytate which is considered as an anti-nutritional factor and not fully utilized by the birds. Phytate has strong chelating potential to form a variety of complexes with cations like magnesium, zinc, manganese and copper and rendering them biologically unavailable (Davies and Reid, 1979). This research work has been aimed to increase the availability of manganese, copper, zinc and iron by supplementation of exogenous phytase enzyme in low nutrient layer diets.

Materials and Methods

Two hundred, White Leghorn hybrid pullets at 16 weeks of age were selected and housed in individual cages. They were divided into ten treatments with four replicates each having five hens. A Standard Layer ration (CP-18 per cent, ME-2600 kcal/kg diet, available phosphorus-0.5 per cent) was formulated as per BIS (1992) and offered to birds in T1. Experimental diets from T2 to T10 were formulated with two levels of crude protein (18 and 16 percent), two levels of metabolisable energy (2600 and 2400 ME kcal/kg diet) and three levels of phytase (0,500 and 1000 units/kg) . The available phosphorus level in all treatments except T1 was 0.3 per cent. The experimental rations (Table. 1) viz., Standard layer ration (SLR), Low energy ration (LER), Low protein ration (LPR) and Low energy-protein ration (LEPR) were offered *ad libitum* from 21 to 40 weeks of age. During the experimental period, the birds were offered standard layer diet (SLD-positive control) T1, low energy diet (LED) T2, LED supplemented with phytase 500 and 1000 units/kg (T3 and T4), low protein diet (LPD) T5, LPD with phytase 500 and 1000 units/kg (T6 and T7), low energy-protein diet (LEPD) T8 and LEPD with phytase 500 and 1000 units/kg (T9 and T10). Treatments T2, T5 and T8 were termed as negative controls.

At the end of production period, a metabolism trial was conducted using forty birds (one bird from each replicate) selected randomly. Birds were housed in individual metabolism cages with facilities for feeding, watering and excreta collection. Water was provided *ad libitum*. Excreta were collected for three consecutive days over 24 hour period using total collection method as described by Summers *et al.* (1976). Excreta collected daily from each bird were weighed and representative samples were taken after thorough mixing. The total amount of feed consumed and excreta voided for each individual bird were recorded.

The excreta samples were dried in the oven at 100˚C overnight and ground prior to the estimation of minerals and rest of the proximate principles. The manganese, copper, zinc and iron contents of both feed and faecal samples were analyzed using Atomic Absorption Spectrophotometer (Perkin Elmer AAS Model 3110) after wet digestion, using nitric acid and perchloric acid (2:1). Data collected on various parameters were statistically analyzed by Completely Randomized Design (CRD) as described by Snedecor and Cochran (1994).

Table 1. Per cent ingredient composition of experimental diets

Ingredients	SLD	LED	LPD	LEPD
Yellow maize	58.00	46.00	58.50	47.00
Soya bean meal	28.35	27.00	22.10	21.00
Wheat bran	2.00	4.10	4.00	5.10
De oiled rice bran	2.00	13.00	5.50	17.00
Dicalcium phosphate	2.00	0.75	0.75	0.75
Shell grit	7.00	8.50	8.50	8.50
Salt	0.20	0.20	0.20	0.20
Merivite[1]	0.015	0.015	0.015	0.015
DL-methionine	0.100	0.100	0.100	0.100
Tefroli[2]	0.100	0.100	0.100	0.100
Meriplex[3]	0.015	0.015	0.015	0.015
Choline chloride[4]	0.120	0.120	0.120	0.120
Ultra TM[5]	0.100	0.100	0.100	0.100
Total	100	100	100	100

Merivite[1]: A+B_2+D_3+K (Wockhardt Ltd., Mumbai) : Each gram contains : Vitamin A: 82,500 IU, Vitamin B_2:52 mg, Vitamin D_3:12,000 IU, Vitamin K: 10mg, Calcium: 166 mg, Phosphate: 395 mg. (Vetroquinol India Animal Health Pvt.Ltd. Mumbai.)
Tefroli[2] : Liver tonic powder. Dr. Herbs India, Vellore, Tamil Nadu.
Meriplex[3] : Each gram contains: Vitamin B_1: 8mg, Vitamin B_6: 16mg, Vitamin B_{12}: 80mcg, Vitamin E: 80mg, Niacin: 120mg, Folic acid: 8mg, Calcium pantothenate : 80mg, Calcium: 86mg. (Vetroquinol India Animal Health Pvt.Ltd. Mumbai.)
Choline chloride[4] : NB group Co-Ltd. Mumbai.
Ultra TM[5]: Each gram contains: Manganese: 54mg, Zinc: 52 mg, Iron: 20mg, Copper: 2mg, Iodine: 2mg and Cobalt: 1mg.

Results and Discussion

Manganese availability

The statistical analysis revealed significantly (P<0.01) higher manganese availability in all phytase supplemented experimental diets and SLD fed birds when compared with negative controls. The per cent improvement in manganese availability due to phytase supplementation was 8.74, 7.7, 8.16, 9.19, 7.4 and 8.67 for T3, T4, T6, T7, T9 and T10 respectively when compared with their respective negative controls.

Copper availability

The per cent increment observed in copper availability due to phytase supplementation in various dietary treatments was 8.31, 8.35, 6.91, 9.97, 7.91 and 7.30 for treatments T3, T4, T6, T7, T9 and T10 respectively when compared with their respective negative controls. When data were subjected to statistical analysis, significantly (P<0.01) higher copper availability was recorded in all phytase supplemented experimental diet and SLD fed birds when compared with negative controls.

Zinc availability

The per cent increment observed in zinc availability due to phytase supplementation in various dietary treatments was 6.49, 6.16, 4.31, 6.28, 6.11 and 6.43 for T3, T4, T6, T7, T9 and T10 respectively when compared with their respective negative controls. Statistical analysis of data revealed significantly (P<0.01) high zinc availability values in all phytase supplemented experimental diet and SLD fed birds.

Iron availability

The per cent increment observed in iron availability due to phytase supplementation in various dietary treatments was 4.34, 4.84, 4.74, 3.62, 4.62 and 4.11 for T3, T4, T6, T7, T9 and T10 respectively when compared with their respective negative controls. When data were subjected to statistical analysis, significantly (P<0.01) high iron availability recorded in all phytase supplemented experimental diets fed birds when compared with negative controls.

The present finding is in close agreement with that of Chisato *et al.* (2001) who reported that addition of phytase at 500 units/kg in corn soya broiler diet reduced the excretion of copper and zinc up to 7 per cent when compared with that of unsupplemented diet. Ceylan *et al.* (2003) also reported that addition of phytase at 300 units/kg in layer diet significantly improved the per cent trace minerals retention viz., zinc (16.8 per cent) and copper (11.2 per cent). Pirqozliev *et al.* (2012) also recorded significant improvement in zinc utilization of broilers due to addition of phytase.

Phytate has strong chelating potential to form a variety of complexes with cations such as zinc, manganese, copper and iron which make them biologically unavailable to birds. Addition of phytase might have hydrolyzed the phytate, which in turn blocked the chelation of trace minerals in the gut and increased their availability. On perusal of data and research findings of others, it is inferred that addition of phytase in layer diet improved the availability of manganese, copper, zinc and iron.

Effect of phytase supplementation in low energy-protein diet on per cent trace minerals availability in Athulya layer^{+}

Treatments	Manganese availability**	Copper availability**	Zinc availability**	Iron availability**
T1	$60.84^{b} \pm 0.92$	$49.72^{b} \pm 1.84$	$60.64^{b} \pm 1.27$	$51.15^{bc} \pm 1.41$
T2	$54.58^{a} \pm 1.85$	$41.23^{a} \pm 0.52$	$55.21^{a} \pm 0.90$	$48.49^{a} \pm 0.45$
T3	$63.32^{b} \pm 1.78$	$49.54^{b} \pm 1.34$	$61.70^{b} \pm 1.55$	$52.83^{c} \pm 0.58$
T4	$62.28^{b} \pm 0.81$	$49.58^{b} \pm 1.03$	$61.37^{b} \pm 1.11$	$53.33^{c} \pm 0.42$
T5	$55.58^{a} \pm 1.05$	$41.50^{a} \pm 0.38$	$55.23^{a} \pm 0.57$	$49.20^{ab} \pm 0.80$
T6	$63.74^{b} \pm 0.74$	$48.41^{b} \pm 1.08$	$59.54^{b} \pm 1.15$	$53.94^{c} \pm 0.82$
T7	$64.77^{b} \pm 1.48$	$51.47^{b} \pm 1.68$	$61.51^{b} \pm 1.05$	$52.82^{c} \pm 0.91$
T8	$55.78^{a} \pm 1.13$	$43.53^{a} \pm 1.38$	$54.95^{a} \pm 0.41$	$49.19^{ab} \pm 0.94$
T9	$63.18^{b} \pm 1.01$	$51.44^{b} \pm 1.07$	$61.06^{b} \pm 0.61$	$53.81^{c} \pm 0.48$
T10	$64.45^{b} \pm 0.68$	$50.83^{b} \pm 1.54$	$61.38^{b} \pm 0.96$	$53.30^{c} \pm 0.89$
P-value	0.00	0.00	0.00	0.00

$^{+}$Mean of four values with SE

Means bearing different superscripts within the same column differed significantly **(P<0.01)

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