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Effect of super dosing of phytase enzyme on the productive performance of laying hens under varying levels of phosphorous

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ABSTRACT

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A study was carried out to find out the effect of super dosing of enzyme phytase (One g contained 3410 U of phytase activity) supplemented at 300, 600, 900 and 1200 U/kg in layer chicken diets containing available phosphorus (AP) at 0.20, 0.3, and 0.40 per cent from 25 to 40 weeks of age. The inclusion of phytase in layer chicken diets containing different levels of available phosphorus 0.2, 0.3 and 0.4 per cent has significantly (P≤0.0l) improved the body weight of layer chicken when compared to unsupplemented groups. During the laying period the data on hen day egg production showed significant increase in egg production by supplementation of phytase. The significant (P<0.05) difference in overall (25-40 weeks) mean feed consumption was observed. The higher feed consumption (g/bird/day) was recorded in 0.2 AP (available phosphorus) without phytase. When phytase was added, the feed efficiency (kg of feed per dozen eggs) was higher than in the corresponding unsupplemented groups. The performance of layers fed diet with 0.20 per cent AP with 1200 *IU* per kg phytase supplementation was comparable to the BIS recommendation.

Keywords: Phytase, Egg production, Feed efficiency, Body weight

INTRODUCTION

About two thirds of the phosphorus in plant seeds is located as phytate, which is the main form of phosphorus stored in plant feed components (Cosgrove, 1966 and Maenz, 2001). Despite having phytase activity in the brush border membrane of their digestive tracts, monogastric animals do not effectively utilise the phytate phosphorus found in feed (Maenz and Classen, 1998). As a consequence, inorganic phosphorus is added to feed to facilitate optimal growth and production. This practice ultimately causes a significant amount of dietary phosphorus to be expelled in the animal's faeces rather than being used by the animal. In order to hydrolyze phytate in the digestive system and increase the amount of phytate phosphorus that the animal can consume, exogenous phytase can be added to diets, reducing the requirement for supplementing diets with inorganic phosphorus (Van Der Klis *et al.*, 1997 and Maenz, 2001). Benefits of dietary phytase supplementation on laying hens' body weight increase (Keshavarz, 2003) at the age of 42 weeks. According to reports by El-Shikha *et al.* (2013), Hasan and Zeynep (2016), and Divya shet *et al.* (2018), hens fed diets contain 0.2% available phosphorus and supplemented with phytase had significantly (Pd"0.01) greater feed consumption compared to no phytase supplementation. Supplementation of phytase in layer diet significantly improved the feed conversion and Egg production (Hassanien and Elnagar (2011), Hasan and Zeynep (2016). Hence the present study was made to find out the amount of phytase enzyme in layer diets depending on growth and egg production performance, as well as to determine the impact of phytase use on egg quality attributes.

MATERIALS AND METHODS

The study, "effect of super dosing of phytase on productive performance of layers under varying levels of phosphorous" using White Leghorn commercial layer chicken. It was carried out at the Veterinary College, Shivamogga, Karnataka (Karnataka Veterinary and Animal and Fisheries Sciences University) Poultry Experimental Unit, Department of Livestock Farm Complex. Up until the start of the research project, the Poultry Experimental Unit raised nine hundred experimental birds according to regular management procedures. Exactly eight hundred and ten weeks old White Leghorn pullets of the BV-300 strain were the experimental participants; they were chosen at random. The guidelines set forth by the Institute of Animal Ethics Committee were adhered to while using poultry birds in ethical approval experiments. Randomly, the pullets were split up into 15 groups (T1, T2, T3, T4, T5T6, T7, T8, T9, T10, T11, T12, T13, T14, and T15) for each treatment group, comprising six replicates (R1, R2, R3, R4, R5, and R6), each of which had nine birds. The birds were placed in a factorial layout and given three different types of meals at random: T1,

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T2, T3, T4, T5, T3 and T10 received 0.2%, T6, T7, T8, T9, and T10 received 0.3%, while T11, T12, T13, T14, and T15 received 0.4% of the available phosphorus. The following concentrations of the phytase enzyme were added to each of the five experimental diets: 0, 300, 600, 900, and 1200 units/kg. The standard layer ration (CP 18%, ME 2600 kcal/kg diet) prepared in compliance with BIS (2007) was fed to the birds (Table 2). Five different experimental diets were developed for T1 through T15. The following table 1 lists the five phytase levels (0, 300, 600, 900 and 1200 IU/kg diet) that were employed from 26 weeks to 40 weeks, as well as the three accessible phosphorus levels (0.2, 0.3 and 0.4%). At the beginning of the feeding trial (25 weeks of age) and at the end of the experiment (40 weeks of age), the body weight of each replicate bird was recorded. Every bird in the trial had daily data on egg production obtained from it and the percentage of hen-day eggs produced was computed. The weight of every egg gathered over the course of the last three consecutive days of the 28-day period was used to calculate the weight of the eggs. The total number multiplied by the average weight of eggs the egg mass per period (g) was given as g/hen, or the number of eggs produced in each replication. Throughout the study, feed intake was recorded replication-wise at the conclusion of each week, and the amount of feed each bird consumed each day was computed period-wise for different treatment groups. Feed efficiency (feed per dozen eggs) was calculated using the kilogram of feed required to produce one dozen eggs, and it was done replicate-wise across each 28-day period. Using the SPSS program (Version 16), a statistical analysis was performed on the data collected from the two phases. The interaction between phytase and available phosphorus was also examined using a two-way two-variance analysis of variance with a generalised linear model. The methods of treatment were rated with a significance level of $P<0.05$ and $P<0.01$ using Duncan's multiple range test (Duncan, 1955). Every statistical method was carried out in accordance with Snedecor and Cochran (1994).

Table 1: Experimental treatments and feeds

Treatment	Details of treatment
T_1	SLD(standard layer diet)+0.2% Available phosphorus
T_2	SLD+0.2% Available phosphorus+300 units of Phytase
T_3	SLD+0.2% Available phosphorus+600 units of Phytase
T_4	SLD+0.2% Available phosphorus+900 units of Phytase
T_5	SLD+0.2% Available phosphorus+1200 units of Phytase
T_6	SLD+0.3% Available phosphorus
T_7	SLD+0.3% Available phosphorus+300 units of Phytase
T_8	SLD+0.3% Available phosphorus+600 units of Phytase
T_9	SLD +0.3% Available phosphorus+900 units of Phytase
T_{10}	SLD+0.3% Available phosphorus+1200 units of Phytase
T_{11}	SLD+0.4% Available phosphorus
T_{12}	SLD+0.4% Available phosphorus+300 units of Phytase
T_{13}	SLD+0.4% Available phosphorus+600 units of Phytase
T_{14}	SLD+0.4% Available phosphorus+900 units of Phytase
T_{15}	SLD+0.4% Available phosphorus+1200 units of Phytase

SLD- Standard layer diet

RESULTS AND DISCUSSION

Table 2: Ingredient composition of SLD (standard layer diet) fed during experiment

Ingredients	Phase I		
	0.2%AvP	**0.3%AvP**	**0.4%AvP**
Maize	56	56	56
Deoiled rice bran	6.00	6.00	6.00
Sunflower meal	4	4	4
Soybean meal	23	23	23
Limestone powder	5.00	5.00	4.25
Shell Grit	5.00	5.00	5.00
Dicalciumphosphate	0.25	0.7	1.3
Salt	0.50	0.50	0.50
Total	100.00	100.00	100.00
AB_2D_3K[1]	10.00	10.00	10.00
B-complex[2]	20.00	20.00	20.00
Trace mineral[3]	100.00	100.00	100.00
Lysine	40.00	40.00	40.00
Methionine	100.00	100.00	100.00
Nutrients (per cent)	0.20	0.30	0.40
CP	18.01	18.01	18.03
Dry matter	90.09	90.09	90.09
Crude fibre	5.39	5..51	5.45
Ether extract	2.80	2.59	2.84
ME(Kcal/kg)*	2603	2603	2603
Calcium	3.72	3.75	3.70
Total phosphorus	0.51	0.63	0.75
Phytate phosphorus	0.33	0.35	0.38
Methionine*	0.40	0.40	0.40
Lysine*	0.97	0.97	0.97
Total ash	12.46	12.60	12.67

*Calculated values

AvP: Available phosphorus

[1]One gram of Vitamin AB_2D_3K supplement contained 82500 IU of Vitamin-A, 50 mg of Vitamin-B_2, 12000 IU of Vitamin-D_3 and 10 mg of Vitamin-K.

[2]One gram of B-Complex supplement contained 8 mg of Vitamin-B_1, 16 mg of Vitamin-B_6, 80 mcg of Vitamin B_{12}, 80 mg of Vitamin-E, 120 mg of Niacin, 8 mg of Folic acid, 80 mg of Calcium pantothenate, 120 mg of Calcium and 300 mg of Phosphate.

[3]One gram of Trace Minerals contained 54 mg of manganese, 52 mg of zinc, 20 mg of iron,
2 mg of iodine and 1 mg of cobalt.

Note: One gram of phytase enzyme contained 3410 IU of phytase activity.

Table 3: The effect of super dosing of phytase enzyme on performance of layer chicken under varying levels of phosphorous

a. Production parameters during 25-40 weeks (Interaction effect).

Treatment	25thwk BW	40thwk BW	FC (gm)	FE	EP (%)
T1(0.2% avP)	1.23	1.30	105.09	1.35	86.68^{e}
T2(0.2% avP+300IU Enz	1.24	1.31	104.23	1.27	90.51^{d}
T3(0.2% avP+600IU	1.22	1.31	103.83	1.25	92.40^{c}
T4(0.2% avP+900IU	1.24	1.34	103.88	1.23	92.64^{bc}
T5(0.2% avP+1200IU	1.23	1.34	103.70	1.21	93.51^{abc}
T6(0.3% avP	1.24	1.33	104.57	1.25	92.53^{bc}
T7(0.3% avP+300IU	1.23	1.32	103.89	1.22	92.99^{abc}
T8(0.3% avP+600IU	1.23	1.34	103.57	1.22	93.29^{abc}
T9(0.3% avP+900IU	1.22	1.35	103.74	1.22	93.63^{abc}
T10(0.2% avP+1200IU	1.22	1.37	103.55	1.21	93.90^{ab}
T11(0.4% avP)	1.25	1.38	104.23	1.24	94.08^{a}
T12(0.4% avP+300IU	1.22	1.37	104.04	1.22	93.84^{ab}
T13(0.4% avP+600IU	1.25	1.39	103.78	1.19	93.68^{abc}
T4(0.4% avP+900IU	1.24	1.39	103.71	1.21	93.87^{ab}
T15(0.2% avP+1200IU	1.24	1.39	103.76	1.22	93.91^{ab}
SEM	0.030	0.039	0.41	0.07	1.05
P value	0.716	0.976	0.285	0.557	0.01

BW: Body weight; FC: Feed consumption; FE: Feed efficiency; EP: Egg production

b. Effect of Available Phosphorous (%)

Treatment	25th wk BW	40th wk BW	FC(gm)	FE	EP(%)
0.2% avP	1.23	1.32^{c}	104.15^{a}	1.26^{a}	91.15^{c}
0.3% avP	1.23	1.34^{b}	103.86^{b}	1.22^{b}	93.27^{b}
0.4% avP	1.24	1.38^{a}	103.91^{b}	1.21^{b}	93.88^{a}
P value	0.475	0.01	0.02	0.015	0.01

BW: Body weight; FC: Feed consumption; FE: Feed efficiency; EP: Egg production

c. Effect of Phytase (IU/kg)

Treatment	25th wk BW	40th wk BW	FC (gm)	FE	EP (%)
0	1.24	1.34	104.63^{a}	1.28^{a}	91.09^{c}
300	1.23	1.34	104.05^{b}	1.24^{ab}	92.45^{b}
600	1.23	1.35	103.73^{c}	1.22^{b}	93.12^{ab}
900	1.23	1.36	103.78^{c}	1.22^{b}	93.38^{a}
1200	1.23	1.36	103.67^{c}	1.21^{b}	93.77^{a}
P value	0.883	0.148	0.01	0.028	0.01

BW: Body weight; FC: Feed consumption; FE: Feed efficiency; EP: Egg production

Means with different superscripts (^{a,b}) differ significantly with in column ($P<0.05$, $P\leq0.01$).

Effect of Super dosing of Phytase on Body Weight

The Impact of Varying Amounts of enzyme supplementation on mean body weights of layers during phase I are presented in Table 3. The interactions among P and phytase levels were non-significant on live weight at forty weeks of age which clearly indicates that phytase addition with the three level of avP did not bring any significant change in the BW at 40th week of age. Similarly, lower supplementation of avP alone could bring change in the BW. Therefore, phytase addition for BW improvement is not compulsory. Similar results were recorded by El-Shikha, *et al.* (2013) where the interactions among P and phytase levels had non-significant effect on live body weight changes between 20 and 36 weeks of age. There was an avP by phytase interaction ($P<0.05$) because hens eating 0.1% avP without phytase reduced their body weight more than hens ingesting higher avP levels (Punna and Roland 1990).

Effect of Super dosing of Phytase on Feed Consumption

The period wise daily body weight at 36 weeks of age and the variation in body weight between 20 and 36 weeks of age are presented in Table 3. A significant avP

by phytase interaction (P<0.05) was noted for body weights. This was attributed to a bigger drop in body weight in hens fed 0.1% avP without phytase as opposed to hens fed higher. The interactions among P and phytase levels had non-significant effects on feed consumption at 25 to 40 weeks of age. It showed that, in comparison to the lower levels of avP and phytase, there was no effect on the amount of feed consumed by laying hen at lower levels of avP and phytase supplementation in the layer diets irrespective of their laying periods. However, 0.2% avP level and 300 IU phytase in the diet had a beneficial effect when compare to non-phytate supplemented group with 0.2% avP The current findings support the findings of Gordon and Roland (1997), who discovered that there was no discernible variation in the amount of feed that birds consumed on a daily basis when phytase was added to layer diets containing 0.2, 0.3, 0.4, and 0.5 percent inorganic P. Additionally, Scott *et al.* (1999) found no discernible variation in the daily feed intake of hens fed corn soya layer diet containing varying levels of calcium and inorganic phosphorus with or without addition of phytase. Similar observations were made by Keshavarz (2000), Sohail and Roland (2000), Jalal and Scheideler (2001), Ranade *et al.* (2004) Kannan *et al.* (2006), Hughes *et al.* (2008), Zaghari *et al.* (2008), Alps *et al.* (2010), Hassanien and Elnagar (2011), Meyer and Parsons (2011) and A.B. Patel *et al.* (2017).

Effect of superdosing of phytase on feed efficiency

The mean feed efficiency (FE) values expressed as kilograms of feed per dozen eggs produced due to different levels of enzyme phytase supplementation in layer chicken diets from 25th week to 40th week of age are presented in Table 3. The interactions among P and phytase levels had non-significant effects on feed efficiency from 25 to 40 weeks of age except during 33-36 wk of age (P<0.01).

Higher level of phytase and avP did not influence feed efficiency of laying hens when compare to lower level of avP and phytase supplementation in the layer diets irrespective of their laying periods. 300 IU/kg of phytase and 0.2% avP was sufficient to bring change in feed efficiency particularly during peak egg production where nutrients demand is more upto 36 wk and further in the next period i.e, 37-40 week, addition of avP and phytase was not beneficial. Similar results were obtained by El-Shikha *et al.* (2013) where interactions among the dietary treatments were not significant.

Effect of super dosing of phytase on egg production

Interaction among avP and phytase supplementation was significant on hen day egg production during all the experimental periods except in period I.It indicated that higher levels of avP and phytase did not influence the HDEP of layers when compared to the lower level of avP and phytase supplemented in the layer diets irrespective of their laying periods. However, 0.2% avP and 1200 IU phytase in the diet group had highest hen day egg production when compared to phytase unsupplemented group with 0.2% avP. Similar results were obtained by Lim *et al.* (2003) where in The interaction between phytase and non phytate phosphrous (NPP) levels showed that phytase increased egg production in hens fed a diet containing 0.25% NPP.

It can be concluded, therefore, that the Superdosing of enzyme phytase (One gm contained 3410 IU of phytase activity) at 1200 IU/kg diet with 0.2% avP on layer chicken diet improved the body weight, feed consumption, feed efficiency and egg production of layer chicken from 25 to 40 weeks of age.

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