EGG QUALITY AND EGGSHELL QUALITY CHARACTERS OF COMMERCIAL CHICKEN LAYERS BY THE DIETRY INCLUSION OF ENZYME PHYTASE

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ABSTRACT

A study was carried out to find out the effect of enzyme phytase (One gram contained 2410 IU of phytase activity) supplemented at 300, 600, 900 and 1200 IU/kg in layer chicken diets containing available phosphorus at 0.20, 0.25, and 0.30 per cent from 21 to 52 weeks of age. A control group fed with diet containing 0.50 per cent available phosphorus alone was also maintained. During the laying period the data on egg quality traits viz. egg weight, specific gravity, shell percentage, shell thickness, broken shell, albumen index, Haugh unit and yolk index were measured at the end of every week. The egg quality characteristics viz. specific gravity, shape index, albumen index, Haugh unit and yolk index did not show any significant difference among treatments. Where as egg weight and egg mass significantly (P<0.05) increased after 40 weeks of age. Higher shell percentage and shell thickness (P<0.01) of layer chicken eggs were observed in enzyme phytase supplemented groups than in unsupplemented control. The incidence of broken eggs was more pronounced in low (0.2 per cent) available phosphorus group and that could be minimized by increasing levels of phosphorus with or without phytase.

Key words: Phytase, egg quality, eggshell quality and broken eggs.

INTRODUCTION

Phosphorus is an essential nutrient in several metabolic processes and it is one of the major mineral elements required by poultry. Phosphorus along with calcium plays a major role in the development and maintenance of the skeletal system and for eggshell formation. About two-third of the total phosphorus in cereal seeds, grain legumes and oil-bearing plants are present as phytate phosphorus (Simons et al., 1990) and only one third of phytate phosphorus is absorbed and the balance is excreted. This work has been emphasized to increase the digestibility of ingredients for poultry feeding, to reduce the phosphorus requirement of laying hen and to improve the eggshell quality.

MATERIALS AND METHODS

Three hundred and thirty six commercial White Leghorn pullets of sixteen weeks age grown from a single hatch were purchased and reared for adaptation up to 20 weeks of age. Then birds were weighed, leg banded and randomly allotted into sixteen treatment groups with three replicates of seven birds each.

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Layer diets were formulated as per the standards prescribed (B.I.S 1992) except for the available phosphorus content which was kept low at the levels of 0.20, 0.25 and 0.30 per cent.

The biological experiment included studies on egg quality and eggshell quality. The egg quality traits viz. egg weight, specific gravity, shell percentage, shell thickness, broken shell, albumen index, Haugh unit and yolk index were measured at the end of every week.

All the parametric data obtained in this study were subjected to analysis of variance for statistical significance as per the methods of Snedecor and Cochran (1989). Angular transformation was applied to percentages wherever needed before carrying out statistical analysis.
Treatment Egg weight (g) Egg mass (kg) Specific gravity Albumen Index Yolk Index
T1-0.2% Available phosphorus 48.15 ± 0.34d 9.54 ± 0.31d 1.094 ± 0.004 0.115 ± 0.001 0.485 ± 0.003
T2-0.2% A.P + 300 U Phytase 48.71 ± 0.22ed 9.75 ± 0.05cks 1.089 ± 0.003 0.112 ± 0.001 0.480 ± 0.002
T3-0.2% A.P + 600 U Phytase 49.35 ± 0.55be 10.06 ± 0.18ed 1.085 ± 0.002 0.114 ± 0.001 0.485 ± 0.003
T4-0.2% A.P + 900 U Phytase 49.48 ± 0.58k 10.01 ± 0.16ce 1.086 ± 0.004 0.112 ± 0.001 0.485 ± 0.002
T5-0.2% A.P + 1200 U Phytase 49.90 ± 0.31ab 9.92 ± 0.18kes 1.084 ± 0.002 0.113 ± 0.002 0.483 ± 0.002
T6-0.25% Available phosphorus 49.57 ± 0.14bc 9.63 ± 0.07ke 1.085 ± 0.001 0.110 ± 0.001 0.484 ± 0.002
T7-0.25% A.P + 300 U Phytase 49.21 ± 0.42bc 10.11 ± 0.11ed 1.083 ± 0.002 0.112 ± 0.001 0.482 ± 0.002
T8-0.25% A.P + 600 U Phytase 50.05 ± 0.11bc 10.16 ± 0.15e 1.084 ± 0.003 0.109 ± 0.002 0.485 ± 0.002
T9-0.25% A.P + 900 U Phytase 49.61 ± 0.44bc 10.02 ± 0.16e 1.083 ± 0.002 0.111 ± 0.002 0.483 ± 0.002
T10-0.25% A.P + 1200 U Phytase 49.61 ± 0.49bc 10.22 ± 0.10cke 1.085 ± 0.003 0.110 ± 0.001 0.489 ± 0.003
T11-0.3% Available phosphorus 49.97 ± 0.53ab 10.12 ± 0.13ed 1.087 ± 0.002 0.112 ± 0.001 0.481 ± 0.002
T12-0.3% A.P + 300 U Phytase 50.18 ± 0.32abc 10.32 ± 0.10ab 1.085 ± 0.003 0.109 ± 0.001 0.480 ± 0.002
T13-0.3% A.P + 600 U Phytase 50.19 ± 0.42abc 10.14 ± 0.36abc 1.085 ± 0.002 0.113 ± 0.001 0.488 ± 0.002
T14-0.3% A.P + 900 U Phytase 49.80 ± 0.75abc 10.23 ± 0.16abc 1.086 ± 0.002 0.110 ± 0.001 0.483 ± 0.002
T15-0.3% A.P + 1200 U Phytase 50.28 ± 0.31ab 10.37 ± 0.07ab 1.061 ± 0.026 0.111 ± 0.001 0.486 ± 0.002
T16-0.5% Available phosphorus 50.80 ± 0.18a 10.49 ± 0.09a 1.085 ± 0.003 0.111 ± 0.002 0.482 ± 0.002

a-e Means within a column with no common superscript differ significantly (P<0.05)

**RESULT S AND DISCUSSION**

**Egg quality characteristics**

The mean egg mass (kg), egg weight, specific gravity, albumen index, and yolk index are presented in Table 1.

The statistical analysis revealed no significant difference in mean egg weight up to 44 weeks of age. But there was significant difference in egg weight during 45-48 (P<0.05) and 49-52 weeks (P<0.01). There was significant difference (P<0.05) in overall egg weight from 21-52 weeks of age.
<table>
<thead>
<tr>
<th>Treatment</th>
<th>Egg shell per cent</th>
<th>Broken eggs per cent</th>
<th>Egg Shell thickness (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1-0.2% Available phosphorus</td>
<td>8.40 ± 0.07&lt;sup&gt;TD&lt;/sup&gt;</td>
<td>2.27 ± 0.36&lt;sup&gt;C&lt;/sup&gt;</td>
<td>0.322 ± 0.003&lt;sup&gt;D&lt;/sup&gt;</td>
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<tr>
<td>T2-0.2% A.P + 300 U Phytase</td>
<td>8.48 ± 0.08&lt;sup&gt;TD&lt;/sup&gt;</td>
<td>1.97 ± 0.29&lt;sup&gt;BC&lt;/sup&gt;</td>
<td>0.324 ± 0.002&lt;sup&gt;CD&lt;/sup&gt;</td>
</tr>
<tr>
<td>T3-0.2% A.P + 600 U Phytase</td>
<td>8.63 ± 0.08&lt;sup&gt;BCD&lt;/sup&gt;</td>
<td>1.79 ± 0.26&lt;sup&gt;BC&lt;/sup&gt;</td>
<td>0.327 ± 0.002&lt;sup&gt;A-D&lt;/sup&gt;</td>
</tr>
<tr>
<td>T4-0.2% A.P + 900 U Phytase</td>
<td>8.61 ± 0.13&lt;sup&gt;BCD&lt;/sup&gt;</td>
<td>1.88 ± 0.44&lt;sup&gt;BC&lt;/sup&gt;</td>
<td>0.327 ± 0.002&lt;sup&gt;A-D&lt;/sup&gt;</td>
</tr>
<tr>
<td>T5-0.2% A.P + 1200 U Phytase</td>
<td>8.65 ± 0.07&lt;sup&gt;BCD&lt;/sup&gt;</td>
<td>1.37 ± 0.34&lt;sup&gt;ABC&lt;/sup&gt;</td>
<td>0.330 ± 0.003&lt;sup&gt;A-D&lt;/sup&gt;</td>
</tr>
<tr>
<td>T6-0.25% Available phosphorus</td>
<td>8.54 ± 0.07&lt;sup&gt;CD&lt;/sup&gt;</td>
<td>1.50 ± 0.17&lt;sup&gt;ABC&lt;/sup&gt;</td>
<td>0.326 ± 0.002&lt;sup&gt;BCD&lt;/sup&gt;</td>
</tr>
<tr>
<td>T7-0.25% A.P + 300 U Phytase</td>
<td>8.81 ± 0.07&lt;sup&gt;AB&lt;/sup&gt;</td>
<td>1.19 ± 0.17&lt;sup&gt;AB&lt;/sup&gt;</td>
<td>0.331 ± 0.001&lt;sup&gt;A-D&lt;/sup&gt;</td>
</tr>
<tr>
<td>T8-0.25% A.P + 600 U Phytase</td>
<td>8.82 ± 0.05&lt;sup&gt;AB&lt;/sup&gt;</td>
<td>1.02 ± 0.29&lt;sup&gt;AB&lt;/sup&gt;</td>
<td>0.328 ± 0.004&lt;sup&gt;A-D&lt;/sup&gt;</td>
</tr>
<tr>
<td>T9-0.25% A.P + 900 U Phytase</td>
<td>9.00 ± 0.08&lt;sup&gt;A&lt;/sup&gt;</td>
<td>1.02 ± 0.29&lt;sup&gt;AB&lt;/sup&gt;</td>
<td>0.334 ± 0.002&lt;sup&gt;ABC&lt;/sup&gt;</td>
</tr>
<tr>
<td>T10-0.25% A.P + 1200 U Phytase</td>
<td>8.96 ± 0.10&lt;sup&gt;A&lt;/sup&gt;</td>
<td>1.02 ± 0.29&lt;sup&gt;AB&lt;/sup&gt;</td>
<td>0.336 ± 0.002&lt;sup&gt;A&lt;/sup&gt;</td>
</tr>
<tr>
<td>T11-0.3% Available phosphorus</td>
<td>8.91 ± 0.02&lt;sup&gt;AB&lt;/sup&gt;</td>
<td>1.02 ± 0.29&lt;sup&gt;AB&lt;/sup&gt;</td>
<td>0.333 ± 0.003&lt;sup&gt;ABC&lt;/sup&gt;</td>
</tr>
<tr>
<td>T12-0.3% A.P + 300 U Phytase</td>
<td>8.89 ± 0.04&lt;sup&gt;AB&lt;/sup&gt;</td>
<td>1.02 ± 0.29&lt;sup&gt;AB&lt;/sup&gt;</td>
<td>0.335 ± 0.003&lt;sup&gt;AB&lt;/sup&gt;</td>
</tr>
<tr>
<td>T13-0.3% A.P + 600 U Phytase</td>
<td>8.85 ± 0.09&lt;sup&gt;AB&lt;/sup&gt;</td>
<td>0.88 ± 0.14&lt;sup&gt;AB&lt;/sup&gt;</td>
<td>0.333 ± 0.003&lt;sup&gt;ABC&lt;/sup&gt;</td>
</tr>
<tr>
<td>T14-0.3% A.P + 900 U Phytase</td>
<td>8.86 ± 0.11&lt;sup&gt;AB&lt;/sup&gt;</td>
<td>1.02 ± 0.29&lt;sup&gt;AB&lt;/sup&gt;</td>
<td>0.328 ± 0.003&lt;sup&gt;ABC&lt;/sup&gt;</td>
</tr>
<tr>
<td>T15-0.3% A.P + 1200 U Phytase</td>
<td>8.88 ± 0.08&lt;sup&gt;AB&lt;/sup&gt;</td>
<td>0.68 ± 0.17&lt;sup&gt;A&lt;/sup&gt;</td>
<td>0.334 ± 0.003&lt;sup&gt;ABC&lt;/sup&gt;</td>
</tr>
<tr>
<td>T16-0.5% Available phosphorus</td>
<td>9.08 ± 0.08&lt;sup&gt;A&lt;/sup&gt;</td>
<td>0.68 ± 0.17&lt;sup&gt;A&lt;/sup&gt;</td>
<td>0.335 ± 0.003&lt;sup&gt;AB&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

A-D Means within a column with no common superscript differ significantly (P<0.01)

Table 2
Effect of enzyme phytase supplementation on mean per cent (+ S.E.) egg shell per cent, broken eggs and eggshell thickness in layer chicken at 49-52 weeks of age
Similarly, no significant difference was noticed in egg mass among treatment groups up to 44 weeks of age. But there was significant difference in egg mass during 45-48 and 49-52 (P<0.01) weeks and the overall egg mass from 21-52 weeks (P<0.05) of age.

Similar findings of increase in egg weight and egg mass were noticed by Boling et al., (2000) when phytase supplemented in 0.1 per cent available phosphorus diet. The finding of non-significant effect was due to phytase supplementation on egg weight during initial laying period (20-40 weeks) were on par with the findings of Van der Klis et al., (1997).

The improvement in egg weight observed in layers fed with phytase enzyme may be due to the release of phosphorus from phytate-mineral complex (Qian et al., 1996) and increased utilization of protein (Camovale et al., 1988).

The egg quality characteristics viz. shape index, specific gravity, albumen index, Haugh unit and yolk index did not show any significant differences. Similar findings were observed by Um and Paik (1999) in Haugh unit value.

**Eggshell quality characteristics**

The mean egg shell percentage, eggshell thickness and broken eggs per cent are presented in Table 2.

Due to incorporation of enzyme phytase (One g contained 2410 IU of phytase activity) egg shell quality did not differ significantly up to 44 weeks of age. However, significant increase in shell percentage and shell thickness was noticed after 44 weeks of age.

Similar findings of significant increase in eggshell thickness were observed by Kaminska et al., (1996) and Rama Rao et al., (1999). This might be due to liberation of phytate bound minerals by phytase enzyme.

The per cent broken eggs did not differ significantly up to 48 weeks of age due to phytase supplementation. But there was significant (P<0.01) difference in per cent broken eggs during 49-52 weeks of age. The incidence of broken eggs was more pronounced in low available phosphorus groups. Significant (P<0.01) reduction in per cent broken eggs was observed with increased levels of available phosphorus with or without phytase supplementation. Similar finding was observed by Lettner et al., (1995) as significant decrease in the cracked eggs from 7.60 to 3.81 per cent in phytase supplemented groups.

The decrease in broken eggs per cent was due to increase in shell thickness which in turn due to increased liberation of minerals from phytate-mineral complex by phytase during eggshell formation.

**REFERENCES**


Egg quality and egg shell quality.....


