Quality traits of eggs in birds fed diets containing different energy and protein levels with and without fish meal

Deepika Jain, RPS Baghel, Sunil Nayak, Rajesh Kumar and AK Patil

Abstract

The present study was carried out to evaluate quality traits of eggs in birds fed diets containing different energy and protein levels with and without fish meal. Eighty birds divided into eight equal groups (T1, T2, T3, T4, T5, T6, T7 and T8). Birds in all the eight groups were fed maize, soybean meal, fish meal (Jawla fish) and deoiled rice polish (DORP). In the present study egg shell thickness was not significantly influenced by the levels of dietary energy and protein. However this research indicated that reduction of protein from 16.5 to 14.5 per cent caused significant (p<0.05) decline in egg shell quality at the beginning of the second production cycle in birds. Egg quality traits were not influenced due to diets containing different levels of energy and protein with or without fish meal except yolk index which was significantly higher in birds assigned 16 per cent CP and 2700 kcal ME/kg.

Keywords: Egg, fish meal, quality traits, energy and protein

1. Introduction

Poultry is one of the fastest growing segments of the agricultural sector in India today. It is growing at a much faster rate and accounts for 100 billion rupees to the Gross National Product (GNP). In India, egg production is growing at a compounded annual growth rate of over 8 per cent. The production of agricultural crops has been rising at a rate of 1.5 to 2 per cent per annum while that of eggs is at a rate of 8 to 10 per cent per annum. India although is the world’s fifth largest egg producer, its per capita egg consumption is poor i.e. 37 eggs per annum [1]. These levels are too low as compared to the world average of 147 eggs on per capita basis [2]. There is a large variation in the egg consumption among the people of rural and urban areas. Among rural mass, it is only 7.7 per cent in comparison to 17.8 per cent in urban areas. The main source of protein in poultry rations are animal or plant proteins [3]. Vegetable proteins constitute around 30 per cent of total compounded poultry diet. Majority of the vegetable protein sources are deficient in one or more critical amino acids like methionine, lysine, etc [3]. On account of it, a single vegetable protein source cannot be used as a sole source of protein in layer ration. The nutrient requirements of poultry tend to change from one generation to the next because of the applied speed of genetic selection [4]. Several factors influence nutrient requirements of poultry [5]. Efforts are continuously made by the researchers to improve the production potential and efficiency of nutrient utilization in birds.

2. Material and Methods

2.1 Duration of experiment

The experiment was conducted in the department of Animal Nutrition, College of Veterinary Science and Animal Husbandry, Jabalpur, (M.P.). The experiment was conducted for a period of 12 weeks. It was conducted between October to January, 2015 including 3 days metabolic trail.

2.2 Experimental design and dietary treatments

The design of the experiment was completely randomized design. In the beginning of the experiment, one hundred and twenty layer birds were weighed and their egg production was regularly monitored for fifteen days. Eighty birds of average body weights were selected for the experiment. Rests of the birds with higher and lower body weights were rejected. Considering their body weights and egg production, eighty birds were randomly distributed to...
eight different groups and were assigned eight different diets. Thus, each diet was offered to ten layer birds. The experiment consisted of eight dietary treatments. These were containing different levels of energy and protein. In all the diets lysine and methionine amino acids were maintained at least as per \[9\]. The detail description of the dietary treatments is described as follows:

- T1 = CP 14 % and ME 2600 (kcal/kg) without fish meal
- T2 = CP 14 % and ME 2600 (kcal/kg) with fish meal
- T3 = CP 16 % and ME 2600 (kcal/kg) without fish meal
- T4 = CP 16 % and ME 2600 (kcal/kg) with fish meal
- T5 = CP 14 % and ME 2700 (kcal/kg) without fish meal
- T6 = CP 14 % and ME 2700 (kcal/kg) with fish meal
- T7 = CP 16 % and ME 2700 (kcal/kg) without fish meal
- T8 = CP 16 % and ME 2700 (kcal/kg) with fish meal

3. Parameters studied

3.1 Egg Quality Parameters

Following egg quality parameters were recorded from the eggs collected during 40th and 44th weeks of age.

(i) Shape index: Maximum length and width of an egg was measured with Varnier caliper up to 0.1 cm. It is depicted in Plate 2.

\[
\text{Shape index} = \frac{\text{Maximum width}}{\text{Maximum length}} \times 100
\]

(ii) Albumen index: Albumen index was calculated as per the method described by [7]. It is depicted in Plate 3.

\[
\text{Albumen index} = \frac{\text{Albumen height}}{\text{Albumen width}} \times 100
\]

(iii) Yolk index: The yolk index was calculated using the method suggested by [8].

\[
\text{Yolk index} = \frac{\text{Yolk height}}{\text{Yolk width}} \times 100
\]

(iv) Haugh unit score: Haugh Unit score was determined as per the method described by Haugh [9].

\[
\text{Haugh unit score} = 100 \log (H + 7.57 – 1.71 W^{0.37})
\]

H = Albumen height in millimeters.
W = Weight of eggs in grams.

(v) Shell thickness: For shell thickness, 3 pieces of each egg shell (two from both ends and one from the middle portion of egg) were measured with the help of screw-gauge up to 0.02 mm after correcting for error.

4. Statistical analysis

The data obtained during the experiment was analyzed statistically using completely randomized design as per the procedure described by [10] and differences among the treatments were tested for significance by Duncan [11].

5. Results

Egg quality traits of birds

The egg quality traits of birds on diets with different energy and protein levels without and with fish meal are provided in Table 1. Treatment means of the shape index indicated maximum value in birds assigned T6 diet, while it was minimum in those allotted T8 diet, however, differences among treatments were not significant. Similarly, albumin index was maximum in birds fed T7 diet and minimum in those offered T3 diet but among different groups differences were not significant. The yolk index was although maximum in birds assigned T3 diet but statistically it was comparable to those assigned T2 and T3 diet. Minimum yolk index was recorded in birds offered T1 diet. Among the groups assigned T3, T5, T8 and T7 diets, yolk index did not differ significantly. The Haugh unit score was maximum in birds assigned T2 diet and minimum in those allotted T4 diet but among different groups differences were non-significant. Similarly, shell thickness of eggs did not differ significantly among different groups. However, maximum shell thickness was observed in birds raised on T1 diet while it was minimum in those allotted T3 diet.

Table 1: Egg quality traits of birds on diets with different energy and protein levels without and with fish meal

<table>
<thead>
<tr>
<th>T. No</th>
<th>Shape index</th>
<th>Albumen index</th>
<th>Yolk index</th>
<th>Haugh unit score</th>
<th>Shell thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>76.43ab</td>
<td>8.66a</td>
<td>39.74a</td>
<td>80.61a</td>
<td>0.354ab</td>
</tr>
<tr>
<td>T2</td>
<td>78.10a</td>
<td>8.86a</td>
<td>43.90ab</td>
<td>83.60a</td>
<td>0.339ab</td>
</tr>
<tr>
<td>T3</td>
<td>76.51ab</td>
<td>8.60a</td>
<td>44.36ab</td>
<td>82.36a</td>
<td>0.351ab</td>
</tr>
<tr>
<td>T4</td>
<td>77.77ab</td>
<td>8.76a</td>
<td>42.18ab</td>
<td>80.38a</td>
<td>0.339ab</td>
</tr>
<tr>
<td>T5</td>
<td>77.70ab</td>
<td>8.72a</td>
<td>41.39ab</td>
<td>80.85a</td>
<td>0.322a</td>
</tr>
<tr>
<td>T6</td>
<td>78.53ab</td>
<td>8.86a</td>
<td>40.93ab</td>
<td>81.91a</td>
<td>0.326a</td>
</tr>
<tr>
<td>T7</td>
<td>76.40a</td>
<td>8.89a</td>
<td>40.22ab</td>
<td>81.12a</td>
<td>0.350a</td>
</tr>
<tr>
<td>T8</td>
<td>76.32ab</td>
<td>8.82a</td>
<td>45.33ab</td>
<td>80.85a</td>
<td>0.337ab</td>
</tr>
<tr>
<td>LSD</td>
<td>2.254</td>
<td>0.221</td>
<td>2.271</td>
<td>3.393</td>
<td>0.049</td>
</tr>
</tbody>
</table>

\[a, b, c, d\] Values with similar superscript did not differ significantly \(P>0.05\).

The comparative egg quality traits of birds on diets with different energy and protein levels without and with fish meal is presented in Table 2. Among the birds assigned diets without fish meal, the shape index, albumin index, Haugh unit score as well as shell thickness among different groups of birds did not differ significantly and among different parameters, values were not much different. As regards yolk index, values were maximum and significantly higher in birds assigned T3 diet in comparison to other groups. Among remaining three groups (T1, T5 and T8), differences were not significant.
Among the birds assigned fishmeal diets, the shape index, albumin index, Haugh unit score as well as shell thickness did not differ significantly. The yolk index was maximum in birds assigned T₀ diet but it was statistically comparable with those allotted T₂ diet. Significantly (p<0.05) lower yolk index was observed in groups fed T₁ diet.

6. Discussion
In the present study, with 14 or 16 per cent CP diet, use of NRC (1994) level of lysine and methionine did not influence the egg quality traits except the yolk index which was significantly (p<0.05) higher in birds assigned 16 per cent protein and 2700 kcal ME/kg with fish meal. El-Maksoud et al. [12] also observed that best value of egg shape index and Haugh unit score was obtained with 12 per cent CP diet supplemented with amino acid. While, the best yolk weight values were for 14 per cent CP as well as 14 per cent CP supplemented with AA diet. But the best yolk index value was obtained in birds assigned 14 per cent CP diet supplemented with amino acid. Rama Rao et al. [13] observed that dietary concentrations of CP had no effect on egg weight (EW), egg mass (EM), except the egg weight during the initial 3 periods, which was significantly lower in layers fed 15 per cent CP. However, egg weight and EM increased nonlinearly and linearly, respectively, with increasing dietary concentrations of lysine. They also observed that increasing methionine concentrations increased the egg weight nonlinearly but had no influence on EP, shell defects, and BW.

In the present study egg shell thickness was not significantly influenced by the levels of dietary energy and protein. However, [14] indicated that reduction of protein from 16.5 to 14.5 per cent caused significant (p<0.05) decline in egg shell quality at the beginning of the second production cycle in birds.

7. Conclusion
Egg quality traits were not influenced due to diets containing different levels of energy and protein with or without fish meal except yolk index which was significantly higher in birds assigned 16 per cent CP and 2700 kcal ME/kg.

8. Suggestions for further work
Studies should be conducted to evaluate the minimum requirement of protein and energy with supplementation of different essential amino acids in layers.

9. Acknowledgement
Authors are thankful to Dean, NDVSU, Jabalpur, (M.P.) for providing all invaluable insights and regular encouragement throughout the whole study period.

10. References
2. Food and Agriculture Organization (www.fao.org). FAOSTAT.

Table 2: Comparative egg quality traits of birds on diets with different energy and protein levels without and with fish meal

<table>
<thead>
<tr>
<th>T. No</th>
<th>CP/ME</th>
<th>Shape index</th>
<th>Albumin index</th>
<th>Yolk index</th>
<th>Haugh unit score</th>
<th>Shell thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Without fish meal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>14/2600</td>
<td>76.43&lt;sub&gt;a&lt;/sub&gt;</td>
<td>8.66&lt;sub&gt;*&lt;/sub&gt;</td>
<td>39.74&lt;sub&gt;b&lt;/sub&gt;</td>
<td>80.61&lt;sub&gt;*&lt;/sub&gt;</td>
<td>0.354&lt;sub&gt;*&lt;/sub&gt;</td>
</tr>
<tr>
<td>5</td>
<td>14/2700</td>
<td>77.70&lt;sub&gt;a&lt;/sub&gt;</td>
<td>8.72&lt;sub&gt;*&lt;/sub&gt;</td>
<td>40.39&lt;sub&gt;b&lt;/sub&gt;</td>
<td>80.85&lt;sub&gt;*&lt;/sub&gt;</td>
<td>0.322&lt;sub&gt;*&lt;/sub&gt;</td>
</tr>
<tr>
<td>3</td>
<td>16/2600</td>
<td>76.51&lt;sub&gt;a&lt;/sub&gt;</td>
<td>8.60&lt;sub&gt;*&lt;/sub&gt;</td>
<td>44.36&lt;sub&gt;b&lt;/sub&gt;</td>
<td>82.36&lt;sub&gt;*&lt;/sub&gt;</td>
<td>0.353&lt;sub&gt;*&lt;/sub&gt;</td>
</tr>
<tr>
<td>7</td>
<td>16/2700</td>
<td>76.40&lt;sub&gt;a&lt;/sub&gt;</td>
<td>8.89&lt;sub&gt;*&lt;/sub&gt;</td>
<td>40.22&lt;sub&gt;b&lt;/sub&gt;</td>
<td>81.12&lt;sub&gt;*&lt;/sub&gt;</td>
<td>0.350&lt;sub&gt;*&lt;/sub&gt;</td>
</tr>
<tr>
<td></td>
<td>With fish meal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>14/2600</td>
<td>78.10&lt;sub&gt;a&lt;/sub&gt;</td>
<td>8.86&lt;sub&gt;*&lt;/sub&gt;</td>
<td>43.90&lt;sub&gt;b&lt;/sub&gt;</td>
<td>83.60&lt;sub&gt;*&lt;/sub&gt;</td>
<td>0.339&lt;sub&gt;*&lt;/sub&gt;</td>
</tr>
<tr>
<td>6</td>
<td>14/2700</td>
<td>78.53&lt;sub&gt;a&lt;/sub&gt;</td>
<td>8.86&lt;sub&gt;*&lt;/sub&gt;</td>
<td>40.93&lt;sub&gt;b&lt;/sub&gt;</td>
<td>81.91&lt;sub&gt;*&lt;/sub&gt;</td>
<td>0.326&lt;sub&gt;*&lt;/sub&gt;</td>
</tr>
<tr>
<td>4</td>
<td>16/2600</td>
<td>77.77&lt;sub&gt;a&lt;/sub&gt;</td>
<td>8.76&lt;sub&gt;*&lt;/sub&gt;</td>
<td>42.18&lt;sub&gt;b&lt;/sub&gt;</td>
<td>80.38&lt;sub&gt;*&lt;/sub&gt;</td>
<td>0.339&lt;sub&gt;*&lt;/sub&gt;</td>
</tr>
<tr>
<td>8</td>
<td>16/2700</td>
<td>76.32&lt;sub&gt;a&lt;/sub&gt;</td>
<td>8.82&lt;sub&gt;*&lt;/sub&gt;</td>
<td>45.33&lt;sub&gt;b&lt;/sub&gt;</td>
<td>80.85&lt;sub&gt;*&lt;/sub&gt;</td>
<td>0.337&lt;sub&gt;*&lt;/sub&gt;</td>
</tr>
<tr>
<td></td>
<td>LSD</td>
<td>2.254</td>
<td>0.221</td>
<td>2.271</td>
<td>3.393</td>
<td>0.049</td>
</tr>
</tbody>
</table>

<sup>a,b,c,d</sup> Values with similar superscript did not differ significantly (P>0.05)