



Original Research

Effect of Low Protein Diets on Egg Quality and Egg Composition of Vanaraja Laying Hens

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Abstract

The research work was done to study the effect of feeding low levels of protein on egg quality traits in Vanaraja laying hens (35-46 weeks). A total of 108 Vanaraja laying hens were selected at random at 35 weeks of age. The birds were distributed into four treatment groups with three replicates of nine birds in each replicate pen in a complete randomized design. According to the experimental groups, four levels of dietary protein (13, 14.5, 16 and 17.5% crude protein) with similar energy content (2,600 metabolisable energy kcal/kg) were given to the hens and the ratio of lysine and methionine to CP were kept constant in all the diets. There was no influence of dietary CP level on any of the egg quality parameters except albumen and yolk percentage in eggs at 38 weeks of age and egg shell percentage which was highest ($P < 0.05$) at 16% CP diet compared to 13 and 14.5% CP diets at 42 weeks of age. The protein and fat content of the eggs did not vary significantly due to variation in protein content of the diets.

Key words: Egg Quality, Low Protein Diet, Yolk Percentage, Vanaraja

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Introduction

Animal protein plays a very vital role in meeting the nutritional requirements of the growing world population. The high plane of animal protein obtained from poultry eggs and meat forms an indispensable component in the fulfilment and satisfaction of the high quality nutritional requirement of an ever expanding human population. Chicken also has the unique distinction of the best converter of agricultural by products and nutritionally poor feedstuffs into high quality meat and egg. The importance of small scale poultry





farming in rural areas has been recognized globally to alleviate poverty, hunger and malnutrition in developing countries. Majority of the population in India still lives in villages and they are getting access only to 25% of total poultry products. The incidence of protein deficiency among the susceptible groups like children, women, pregnant mothers and aged people can be alleviated by adopting small scale poultry farming in backyard or rural households. Many chicken varieties have been developed across the country for rural poultry farming, however due to high market price of Vanaraja egg, many farmers are rearing 'Vanaraja' under intensive system of production.

Among the nutrients needed by the bird, protein is essential for growth, feed utilization, immune function and production performance (Panda *et al.*, 2011). Protein is also an important component of chicken eggs and one normal egg contains around 6.5 to 7 gram protein. Thus, dietary protein has a major influence on production performance of the bird (Rama Rao *et al.*, 2007). To our knowledge, there is no available information in the literature on the influence of dietary protein on egg quality of Vanaraja laying hens during intensive system of production. Therefore, the present experiment was conducted to evaluate the effect of low protein diets on egg quality of Vanaraja laying hens from 35 to 46 weeks of age.

Materials and Methods

Experimental Birds, Management and Diets

A total of one hundred eight, Vanaraja laying hens (35 weeks of age) were selected randomly and were distributed into four treatment groups with three replicates of nine birds in each group in a complete randomized design. The experiment was carried out for a total period of 12 weeks. Four diets were formulated with same level of metabolizable energy (ME) but different levels of crude protein (CP). The dietary treatments were: T1- diet contains 13% CP; T2- diet contains 14.5% CP; T3- diet contains 16% CP and T4- diet contains 17.5% CP. The ratio of lysine and methionine to CP were kept constant in all the diets. The calcium (Ca) and non phytate phosphorus (NPP) was constant in all the diets (Table 1). A measured quantity of feed was given on daily basis. The birds were given restricted amount of 140g of feed per bird for first four week, then 145 gram of feed for next four week and 150 gram of feed per bird for last four week. The feed was provided once in a day in the morning time and water for drinking was provided twice a day.

Egg Quality Estimation

Twelve eggs were randomly chosen from each dietary group from the eggs during the last four days of each 28-day period to measure the egg quality parameters like egg weight, yolk weight, the shell weight shell thickness and Haugh unit. Egg weight was recorded by an electronic balance. The height of the albumen



was measured half way between the yolk and the edge of the inner thick albumen by using a spherometer at three different points and the mean value was calculated.

Table 1: Ingredient and nutrient composition of experimental diets (% as such basis)

Ingredients	Parts per Quintal			
	T ₁ (13% CP)	T ₂ (14.5% CP)	T ₃ (16% CP)	T ₄ (17.5% CP)
Maize	62.35	60.25	58.05	56.25
Soyabean meal	12.7	16.7	21.5	25.7
Deoiled rice bran	12.7	10.8	8.2	5.8
Shell grit	9.72	9.72	9.72	9.72
Dicalcium phosphate	1.16	1.16	1.16	1.16
DL - methionine	0.7	0.7	0.7	0.7
Common salt	0.4	0.4	0.4	0.4
Vitamin premix	0.05	0.05	0.05	0.05
Antibiotics	0.05	0.05	0.05	0.05
Toxin Binder	0.05	0.05	0.05	0.05
Mineral mixture*	0.12	0.12	0.12	0.12
Total	100	100	100	100
Nutrient Composition (Calculated Value)				
ME(kcal/kg)	2600	2597	2598	2596
CP (%)	13.03	14.48	16.02	17.5
Lysine (%)	0.61	0.7	0.81	0.9
Methionine (%)	0.31	0.33	0.35	0.35
Calcium (%)	3.23	3.24	3.25	3.24
Phosphorous (%)	0.35	0.35	0.35	0.35

*TraceMin CB (Venky's India Private Limited, Pune); Composition: Each 1 kg TraceMin CB contains Manganese: 90g, Zinc: 80 g, Iron: 90.0g, Copper: 15.0g, Iodine: 2.0g, Selenium: 300mg.

The weight of yolk was measured after separating the albumen completely and expressed as percent of whole egg weight. The albumen weight was calculated by subtracting yolk weight from egg weight and measured as percent of whole egg weight. The cleaned eggshells were dried for 24 h, weighed and expressed as percent of whole egg. The shell thickness was measured at three different locations (middle, broad and narrow ends) using a micrometer gauge and mean value was taken as thickness.

Estimation of Egg Composition

For analyzing the egg composition nine eggs (three eggs per replicate) were randomly chosen from each dietary treatment from the eggs laid during the last three consecutive days of 46th week. The protein and fat content of the eggs were analysed by following the method of AOAC (1995) official method of analysis.

Statistical Analysis

The data obtained from the experiment were statistically analyzed according to Snedecor and Cochran (1989). The data were subjected to analysis of variance (ANOVA) and Duncan Multiple Range (DMR) Test (Duncan, 1955) to test the difference between treatments means, wherever necessary.

Results

The effect of low protein diets on egg quality of Vanaraja laying hens at 38th, 42nd and 46th weeks of age is presented in Table 2, 3 and 4, respectively.

Table 2: Effect of low protein diets on egg quality of Vanaraja laying hens at 38 weeks of age

Parameters	%CP in the Diet				SEM	P value
	13 (T ₁)	14.5 (T ₂)	16 (T ₃)	17.5 (T ₄)		
Egg weight (g)	55.15	53.91	54.67	56.05	0.413	0.352
Albumen (%)	56.11 ^{ab}	53.59 ^a	56.10 ^{ab}	57.03 ^b	0.502	0.051
Yolk (%)	34.29 ^{ab}	36.83 ^b	34.14 ^{ab}	33.63 ^a	0.481	0.05
Egg shell (%)	9.58	9.56	9.74	9.32	0.089	0.444
Haugh unit	62.53	61.67	61.33	60.31	1.28	0.225
Shell Thickness(mm)	0.37	0.359	0.361	0.354	0.003	0.356

^{a,b} Means with different superscript in a row differs significantly ($P < 0.05$); SEM – Standard Error of Mean

Table 3: Effect of low protein diets on egg quality of Vanaraja laying hens at 42 weeks of age

Parameters	%CP in the Diet				SEM	P value
	13 (T ₁)	14.5 (T ₂)	16 (T ₃)	17.5 (T ₄)		
Egg weight (g)	55.59	55.93	54.64	56.37	0.394	0.298
Albumen (%)	57.16	55.92	57.2	56.39	0.322	0.44
Yolk (%)	33.41	34.69	32.76	33.86	0.327	0.206
Egg shell (%)	9.42 ^a	9.37 ^a	10.03 ^b	9.74 ^{ab}	0.101	0.052
Haugh unit	64.87	65.86	64.37	66.47	1.04	0.9
Shell Thickness (mm)	0.353	0.358	0.359	0.362	0.003	0.79

^{a,b} Means with different superscript in a row differs significantly ($P < 0.05$); SEM – Standard Error of Mean

Table 4: Effect of low protein diets on egg quality of Vanaraja laying hens at 46 weeks of age

Parameters	%CP in the diet				SEM	P value
	13 (T ₁)	14.5 (T ₂)	16 (T ₃)	17.5 (T ₄)		
Egg weight (g)	56.9	57.97	58.3	57.6	0.304	0.414
Albumen (%)	57.86	56.83	57.01	57.63	0.377	0.751
Yolk (%)	32.96	34.39	33.65	32.85	0.378	0.461
Egg shell (%)	9.17	8.77	9.33	9.5	0.122	0.117
Haugh unit	67.86	68.68	67.56	69.16	0.874	0.918
Shell Thickness(mm)	0.345	0.347	0.349	0.353	0.003	0.897

SEM – Standard Error of Mean

The albumen and yolk content of the eggs differed significantly ($P < 0.05$) by the CP levels in the diet at 38 weeks of age, the percentage of albumen decreased and percentage of yolk increased in the diet containing 14.5% CP compared to that of highest CP diet (17.5%). Significantly higher egg shell percentage was noticed in 16% CP diet ($P < 0.05$) compared to either 13 or 14.5% CP diet at 42 weeks of age but enhancing the protein content from 16 to 17.5% in the diet did not result in additional advantage in the eggshell percentage. The Haugh unit and shell thickness did not vary significantly at any stage of experimental period. The egg production did not vary significantly between then dietary groups during the experimental period.

The effect of low protein diets on egg composition of Vanaraja laying hens at 46 weeks of age is presented in Table 5. There was no significant effect of dietary protein content on either protein or fat content of the egg. The analyzed protein and fat per cent of eggs varied from 12.89 (T₄) to 13.01 (T₁) and 12.15 (T₃) to 12.27 (T₂), respectively which were comparable among all the dietary treatments.

Table 5: Effect of low protein diets on composition of eggs of Vanaraja laying hens (35-46 weeks)

Parameters	%CP in the diet				SEM	P value
	13 (T ₁)	14.5 (T ₂)	16 (T ₃)	17.5 (T ₄)		
Protein (%)	13.01	12.92	13	12.89	0.243	0.742
Fat (%)	12.09	12.27	12.15	12.07	0.317	0.863

SEM – Standard Error of Mean

Discussion

The egg quality studied at 38 weeks of age revealed no effect of dietary CP levels on egg quality parameters (egg weight, egg shell percentage, Haugh unit and shell thickness) except albumen and yolk percentage in eggs, however, no definite trend could be observed. At 42 weeks of age highest egg shell percentage was noticed in 16% CP diet compared to 13 and 14.5% CP, while other egg quality parameters were not significant. There was no influence of dietary CP level (13, 14.5, 16 and 17.5%) on any of the egg quality parameters studied at 46 weeks of age. Concomitant to the findings of the present study Hamilton (1978) observed no influence of reduction in dietary CP levels from 17 to 13% on egg quality parameters (Haugh unit, specific gravity and eggshell thickness). Wu *et al.* (2007) also reported no significant effect of dietary protein (14-16%) on Haugh unit, egg specific gravity and egg shell thickness. Few other studies reported higher egg quality in laying hens with increase in dietary protein levels (Adeyemo *et al.*, 2012; Khajali *et al.*, 2007). Protein and amino acids, especially methionine has a large influence on egg size (Panda *et al.*, 2007). There was no variation in egg weight between diets containing 0.31% methionine (13% CP) and 0.35% methionine (17.5% CP) in the present study. Thus, 0.31% methionine in diet of 13% CP is adequate for optimum egg weight in Vanaraja laying hens. The non variation in other egg quality parameters like albumin quality (Haugh unit) and egg shell parameters (egg shell thickness and egg shell percentage) in the

present study further suggested that 13% CP was adequate in eliciting optimum egg quality. Similarly, Salah uddin *et al.* (1992) reported comparable egg shell thickness and eggshell percentage in the diets containing 13 to 22% CP, conforming the findings of the present study. The non-significant difference in egg production in the various dietary groups suggest that the lowest level of CP (13%) employed in the present study was adequate in maintaining optimum production during 35 to 46 weeks of age in Vanaraja laying hens.

The protein and fat content of the eggs did not vary significantly due to variation in protein content of the diet. The above findings thus, revealed that the lowest level of CP employed in the present study was enough to optimize the protein and fat concentration in egg. Similar to the finding of present study Salah uddin *et al.* (1992) did not observe the effect of dietary protein level (13, 16, 19 or 22%) on albumin protein, yolk protein and yolk fat. Dietary protein containing 13% CP resulted in similar albumin protein, yolk protein and yolk fat to that of 22% CP diet. The present study contradict with Gracia *et al.* (2005) who reported the yolk protein content was significantly higher in layers fed 18 or 20% CP diet compared to the layers fed 16% CP diet. The present study also contradicts Andersson *et al.* (1995) and Akbar *et al.* (1983) who stated that yolk protein content increased with higher CP level in the diet.

Conclusion

It was concluded that, there was no influence of dietary CP level on any of the egg quality parameters except albumen and yolk percentage in eggs at 38 weeks of age and egg shell percentage which was significantly higher at 16% CP diet compared to 13 and 14.5% CP diets at 42 weeks of age. The protein and fat content of the eggs also did not vary significantly due to variation in protein content of the diets. Thus, it is suggested that 13% dietary CP is adequate for maintaining optimum egg quality and composition in Vanaraja laying hens.

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