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***Research Article***

# INFLUENCE OF LYSINE LEVELS ON PERFORMANCE OF LAYERS WITH SUB OPTIMAL PROTEIN IN DIET

**SV Rama Rao, *K Naga Raja Kumari, T Sri Latha, MLN Raju and AK Panda**
*Department of Poultry Science, College of Veterinary Science, Project Directorate on Poultry, Rajendra Nagar*
**Author for Correspondence*

**ABSTRACT**
Crude protein can be effectively reduced with supplementation of Essential amino acids like lysine without affecting the performance of birds. An experiment was conducted with suboptimal Crude Protein (16.5 *and* 15%) and graded concentrations of Lysine (0.65, 0.70, 0.75 and 0.80%) in WL layer (39-74wks) diet. The ratio in between lysine (Lys) to methionine (Met), Lysine to Threonine (Thr) and Lysine to Tryptophan (Try) were maintained constant with diets containing varied levels of Lys. The Egg Production, Feed Intake, Feed Efficiency, and Egg Mass were not affected ($P>0.05$) by either sub – optimal CP (up to 15%) or Lys (0.65%) concentrations in diet, whereas Egg Weight decreased and mortality increased significantly ($P<0.05$) by reducing dietary protein from 18 to 15% during certain periods of production. Based on the overall performance of layers during 39 to 74 weeks of age a level of 15% protein and 0.65% lysine appear to be adequate for layers for optimum egg production with an average egg weight of 53.4g.

***Key Words**: Graded Lysine, Production Performance, Sub-Optimal Protein, WL Layers*

## INTRODUCTION

The profit from poultry can be attained by minimizing feed cost which accounts75% of the total cost of egg production. Several commercial guidelines for laying hens (Lohmann, 2010; Brown, 2011) were recommended for CP levels, which vary from 17.4 to 18.2% (19.1 to 20.0 g of CP/d) per hen. Which appeared to higher than the recommendation of many recent reports (Rao *et al.*, 2011; Bonilla *et al.*, 2012) Higher levels of protein / amino acids in diet will increase nitrogen excretion and taxing the eco system by contamination surface water bodies (Latshaw and Zhao, 2011) and also often result in higher feed cost. Blair *et al.*, (1999) obtained optimum layer performance when they were fed on low-protein diet (13.5%) which was properly supplemented with essential amino acids compared to layers fed 17% CP diet. Supplementation of the low protein diets with crystalline amino acid is becoming relevant in feed formulation to minimize the nitrogen excretion and cost of production (Chung *et al.*, 1998; Khajali, 2007).

Lysine is considered as the standard amino acid in relation to other amino acids, and is primarily associated with the synthesis of egg mass protein (Novak *et al.*, 2004; Gunawardana *et al.*, 2008[a,b]). Dietary Lys level is also associated with improved feed conversion efficiencies and egg mass in laying hens (Liu *et al.*, 2004). So, the Lys is prioritised in protein synthesis, the correct levels of Lys and other amino acids in layer diet ensure maximum utilization of dietary protein (Namazu *et al.*, 2008). Optimal proportion of Lys to other essential amino acids (Trindade *et al.*, 2010) in diet improves the layer performance. Formulation of diet with low protein content and supplementing the diet with synthetic amino acid to maintain ideal amino acid levels is one of the strategies to decrease the cost of production and to reduce environment pollution.

The present study was conducted to find out the possibility of reducing dietary CP by optimizing concentrations of essential amino acids keeping constant ratios between Lys and other amino acids (methionine - Met and threonine - The) in diet in layer diet during post peak egg production phase (39 to 74 weeks of age).

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**MATERIALS AND METHODS**

***Experimental Design***

A total of 5544 birds (BV300,Venkateswara Hatcheries Pvt. Ltd, Hyderabad) aged about 35wk were randomly placed in 1386 colony cages (4 birds/cage), and 22 adjacent colony cages having a common feeder were considered as a replicate to calculate the group feed intake and other parameters at 28d intervals. The cages were housed in an open sided house fitted on elevated platforms. Fluorescent bulbs were used to provide 16h of light daily, including normal daylight.

***Feeding Programme***

A control diet with 18% CP and 2550 kcal ME/kg using maize, soybean meal, sunflower cake, Deoiled rice bran and maize gluten meal and two low protein (15 and 16.5%) basal diets with 2550 kcal ME/kg were prepared. Each basal diet was supplemented with synthetic lysine at four concentrations (i.e. 0.60, 0.70, 0.75 and 0.80%). Each diet was randomly allotted to 7 replicates offered *ad libitum* from 39 to 74 weeks of age.

**Table 1: Ingredients and nutrient composition (g/kg) of control and basal diets with different protein and amino acid levels**

| Ingredient | Control | Basal 16.5 | | | | Basal 15 | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Lysine, %** | **0.80** | **0.65** | **0.70** | **0.75** | **0.80** | **0.65** | **0.70** | **0.75** | **0.80** |
| **Maize** | 46.53 | 48.84 | 4.888 | 4.893 | 4.918 | 5.244 | 5.216 | 5.227 | 5.271 |
| **Soybean Meal** | 7.022 | 1.251 | 0.793 | 0.336 | 1.219 | 0.00 | 0.00 | 0.00 | 2.158 |
| **Sunflower** | 4.441 | 7.952 | 8.214 | 8.475 | 7.751 | 8.043 | 7.968 | 7.893 | 6.233 |
| **Deoiled Rice Bran** | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 |
| **Maize Glutein** | 10.00 | 10.00 | 10.00 | 10.00 | 9.490 | 7.812 | 7.638 | 7.464 | 6.469 |
| **Salt** | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| **Dicalcium Phosphate** | 0.382 | 0.341 | 0.339 | 0.337 | 0.350 | 0.355 | 0.358 | 0.361 | 0.387 |
| **Stone Grit** | 8.406 | 8.479 | 8.484 | 8.489 | 8.474 | 8.478 | 8.476 | 8.474 | 8.439 |
| **Lime Powder** | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 |
| **Dl Methionine** | 0.089 | 0.029 | 0.055 | 0.082 | 0.111 | 0.057 | 0.084 | 0.112 | 0.143 |
| **L Lysine** | 0.325 | 0.298 | 0.377 | 0.456 | 0.500 | 0.354 | 0.421 | 0.489 | 0.500 |
| **Threonine** | 0.055 | 0.040 | 0.044 | 0.084 | 0.119 | 0.050 | 0.088 | 0.126 | 0.156 |
| **Premix** | 0.030 | 0.030 | 0.030 | 0.030 | 0.030 | 0.030 | 0.030 | 0.030 | 0.030 |
| | | | | **Nutrient Composition** | | | | | |
| **Me[2] mcal/kg** | 2.55 | 2.55 | 2.55 | 2.55 | 2.55 | 2.55 | 2.55 | 2.55 | 2.55 |
| **Crude Protein[3]%** | 18 | 16.5 | 16.5 | 16.5 | 16.5 | 15 | 15 | 15 | 15 |
| **Lysine[4]%** | 0.80 | 0.65 | 0.70 | 0.75 | 0.80 | 0.65 | 0.70 | 0.75 | 0.80 |
| **Npp[4]%** | 0.33 | 0.33 | 0.33 | 0.33 | 0.33 | 0.33 | 0.33 | 0.33 | 0.33 |
| **Calcium[3]%** | 3.6 | 3.6 | 3.6 | 3.6 | 3.6 | 3.6 | 3.6 | 3.6 | 3.6 |
| **Metthionine[4]%** | 0.40 | 0.325 | 0.35 | 0.375 | 0.40 | 0.325 | 0.35 | 0.375 | 0.40 |
| **Threonine[4]%** | 0.56 | 0.4550 | 0.49 | 0.525 | 0.56 | 0.455 | 0.49 | 0.525 | 0.56 |

[1]*Provided the following (mg/kg of diet); Thiamine, 1; Pyridoxine,2; Cynaocobalamin, 0.01; Niacin, 15; Pantothenic Acid, 10; α-Tocopherol, 10; Riboflavin, 10; Biotin, 0.08; Menadione, 2 ; Retinol Acetate, 2.75; Cholecalciferol, 0.06; Choline, 650; Copper, 8; Iron, 45; Manganese, 80; Zinc, 60; Selenium, 0.18; hydrated sodium calcium aluminosilicates, 800.*

[2]*Calculated*

[3]*Analyzed*

[4]*Calculated based on analysed ingredient composition*

***Parameters***

Egg production was recorded twice daily and expressed on hen-day basis. Measured quantity of feed was offered thrice daily. At the end of every 28-d period, the residue left was deducted from the total feed offered, and the average daily feed intake (ADFI) was calculated as g per bird per day based on hen days. The quantity of feed consumed to produce 12 eggs (i.e g of feed consumed/g of egg weight) was calculated and compiled at 28-d intervals (period). The average egg weight (EW) was recorded by randomly selecting 45eggs per each replicate during the last 3days of each period. Egg mass was calculated by multiplying the average EW with the total number of eggs produced and was expressed as grams per hen per day. The experiment was conducted following the guidelines of the Animal Ethics Committee of the Institute.

***Statistical Analysis***

All the parameters were compiled for 9 periods, each period with 4 wks interval for a total length of 39-74 wks and entire data was subjected to statistical analysis. The data was subjected to 2x4 Factorial designs, with the levels of CP and Lysine as independent variables and production parameters as dependent variables. Differences were considered significant at $P<0.05$.

## RESULTS AND DISCUSSION

***Performance and Mortality***

Egg production (EP), feed intake (FI), feed efficiency ( FE), egg weight (EW), egg mass (EM) and mortality (Table 2) were not influenced either by graded lysine or by interaction of CP and Lysine. Similarly dietary variation in level of CP also did not influence the EP, FI, EM and FE while the mortality was significantly higher in 15% CP compared to those fed other levels of protein. Performance was not affected by the graded levels of lysine in the diet.

***Egg Weight and Egg Mass***

The interaction between CP and Lysine concentration did not significantly influence the EP and EM (except P3) at different periods tested and also pooled over the experiment from 1 to 9 periods (Table 3). The egg weight was significantly influenced by dietary CP levels at P4, P5 and P7, where the EW was significantly reduced with reducing level of CP from 18 to 15% and was interminable in groups fed with 16.5% CP diet. The average EW during P1 to P9was significantly higher in groups fed with 18% CP when compared to those fed with 16.5% or 15% CP diet. The EW was not affected by the concentration of lysine in diet.

***Effect of Dietary Lysine Level***

EP, FI, EW, FE, EM and mortality were not influenced by increased dietary levels of lysine from 0.65 to 0.80 % either during individual periods or on pooled data from 39 to 74 weeks of age. These data are in agreement with the findings of our previous study (Rama Rao *et al.*, 2011) and Prochaska *et al.,* (1996) and Novak *et al.,* (2004).

In contrast to this study Panda *et al.,* (2010), reported that increasing the dietary Lys from 0.60 to 0.70% did not influence the EP, but Lys at 0.75% resulted in significant higher EP in layers during 28-44wks of age. Trindade *et al.,* (2011) reported higher performance (FI, FE, BWG, EW and EP) in layers fed higher levels of Lys (0.560, 0.612, 0.677, 0.749, and 0.851%) in diet.

***Effect of Protein Level***

Significant improvement in EW was observed with increase in CP from 15 to 16.5% and other production parameters were not affected, which indicates higher requirement of CP for egg weight compared to other production parameters. Novak *et al.,* (2006) and Khajali *et al.,* (2007) recommended that 16 to 16.3% CP for layers during the initial laying phase (up to 32 weeks of age) to sustain EW similar to those fed 17.8 to 18% CP diet.

**Table 2: Egg Production, egg mass, feed intake and feed efficiency in Lohmann layers (39 to 74 weeks of age) fed different concentrations of CP and Lysine[1]**

| CP% | Lys% | Egg Production % Period | | | | Egg Mass, g/h Period | | | | FI, g/b/d | FI/egg |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | P1-2 | P3 | P4-9 | P1-P9 | P1-2 | P3 | P4-9 | P1-P9 | P1-P9 | P1-P9 |
| Age | Weeks | 39-46 | 47-50 | 51-74 | 39-74 | 39-46 | 47-50 | 51-74 | 39-74 | 39-74 | 39-74 |
| **18** | **0.8** | 90.78 | 87.16[b] | 82.39 | 85.08 | 1404 | 1300[ab] | 1226 | 1280 | 98.16 | 115.5 |
| **16.5** | **0.65** | 91.91 | 86.36[b] | 81.56 | 84.75 | 1415 | 1285[b] | 1212 | 1272 | 97.39 | 115.1 |
| **16.5** | **0.70** | 91.51 | 88.63[ab] | 82.35 | 85.42 | 1396 | 1313[ab] | 1220 | 1276 | 97.98 | 114.8 |
| **16.5** | **0.75** | 90.42 | 88.06[ab] | 82.66 | 85.53 | 1390 | 1307[ab] | 1228 | 1282 | 99.88 | 116.8 |
| **16.5** | **0.80** | 91.91 | 87.95[ab] | 83.10 | 85.91 | 1419 | 1303[ab] | 1228 | 1285 | 99.01 | 115.3 |
| **15.0** | **0.65** | 91.75 | 87.78[b] | 83.78 | 86.27 | 1412 | 1291[b] | 1238 | 1289 | 99.10 | 115.0 |
| **15.0** | **0.70** | 90.95 | 86.99[b] | 82.09 | 84.92 | 1399 | 1284[b] | 1214 | 1269 | 99.04 | 117.0 |
| **15.0** | **0.75** | 91.24 | 86.99[b] | 83.45 | 85.84 | 1398 | 1289[b] | 1240 | 1285 | 101.1 | 118.4 |
| **15.0** | **0.80** | 91.49 | 88.09[ab] | 83.29 | 86.00 | 1400 | 1313[ab] | 1235 | 1286 | 100.6 | 117.2 |
| **SEM** | | 1.178 | 0.721 | 1.336 | 0.746 | 19.75 | 12.53 | 20.45 | 11.58 | 1.840 | 2.63 |
| **CP, %** | | | | | | | | | | | |
| **18.0** | | 90.78 | 87.16 | 85.08 | 82.39 | 1404 | 1300 | 1296 | 1280 | 98.16 | 115.4 |
| **16.5** | | 91.44 | 88.25 | 85.40 | 82.42 | 1405 | 1309 | 1222 | 1279 | 98.56 | 115.5 |
| **15.0** | | 91.36 | 87.59 | 85.76 | 83.15 | 1402 | 1297 | 1232 | 1283 | 99.98 | 116.9 |
| **SEM** | | 0.814 | 0.481 | 0.497 | 0.891 | 13.17 | 8.355 | 13.63 | 7.72 | 1.226 | 1.754 |
| **Lys, %** | | | | | | | | | | | |
| | **0.65** | 91.83 | 87.07 | 82.67 | 85.51 | 1413 | 1293 | 1225 | 1280 | 98.24 | 115.0 |
| | **0.70** | 91.23 | 87.81 | 82.21 | 85.17 | 1397 | 1299 | 1217 | 1272 | 98.51 | 115.9 |
| | **0.75** | 90.61 | 88.53 | 83.06 | 85.68 | 1394 | 1313 | 1234 | 1284 | 100.5 | 117.6 |
| | **0.80** | 91.40 | 87.90 | 82.93 | 85.67 | 1408 | 1305 | 1230 | 1284 | 99.28 | 115.9 |
| | **SEM** | 0.825 | 0.486 | 0.902 | 0.504 | 13.23 | 8.455 | 13.79 | 7.814 | 1.241 | 1.774 |
| **P value** | | | | | | | | | | | |
| **CP X Lysine** | | 0.868 | 0.011 | 0.596 | 0.585 | 0.849 | 0.037 | 0.650 | 0.775 | 0.997 | 0.972 |
| **CP** | | 0.619 | 0.203 | 0.510 | 0.624 | 0.694 | 0.324 | 0.712 | 0.824 | 0.427 | 0.727 |
| **Lysine** | | 0.549 | 0.208 | 0.620 | 0.761 | 0.49 | 0.387 | 0.596 | 0.683 | 0.567 | 0.804 |

[a,b]*Means in a column having no common superscript are significantly differ ($p<0.05$)*
[1] *Data are means from 7 replicates of 90 birds in each replicate.*

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**Table 3: Egg weight on layers (39 to 74 weeks of age) fed different concentrations of CP and Lysine[1]**

| CP% | Lys% | Period P1-3 | P4 | P5 | P6 | P7 | P8-9 | P1-9 |
|---|---|---|---|---|---|---|---|---|
| **Age** | **Weeks** | **39-50** | **51-54** | **55-58** | **59-62** | **63-66** | **67-74** | **39-74** |
| **18** | **0.8** | 54.61 | 53.03 | 51.89 | 51.69 | 54.89 | 54.21 | 53.69 |
| **16.5** | **0.65** | 54.38 | 52.84 | 51.70 | 51.53 | 54.55 | 54.56 | 53.54 |
| **16.5** | **0.70** | 53.96 | 52.63 | 51.73 | 51.64 | 54.54 | 53.98 | 53.30 |
| **16.5** | **0.75** | 54.29 | 52.79 | 51.35 | 51.99 | 54.76 | 54.26 | 53.50 |
| **16.5** | **0.80** | 54.41 | 52.54 | 51.71 | 52.01 | 54.21 | 53.32 | 53.38 |
| **15.0** | **0.65** | 54.31 | 52.90 | 51.76 | 51.94 | 53.91 | 53.27 | 53.34 |
| **15.0** | **0.70** | 54.21 | 52.77 | 52.20 | 51.87 | 53.75 | 53.58 | 53.35 |
| **15.0** | **0.75** | 54.14 | 52.88 | 52.22 | 51.97 | 54.11 | 54.04 | 53.46 |
| **15.0** | **0.80** | 54.11 | 52.91 | 52.03 | 51.78 | 53.99 | 54.03 | 53.39 |
| **SEM** | | 0.238 | 0.132 | 0.163 | 0.138 | 0.323 | 0.357 | 0.099 |
| **CP, %** | | | | | | | | |
| **18.0** | | 54.61 | 53.03$^{a}$ | 52.05$^{a}$ | 51.89 | 54.89$^{a}$ | 54.21 | 53.69$^{a}$ |
| **16.5** | | 54.26 | 52.87$^{ab}$ | 51.89$^{ab}$ | 51.79 | 54.52$^{ab}$ | 54.02 | 53.58$^{b}$ |
| **15.0** | | 54.19 | 52.70$^{b}$ | 51.62$^{b}$ | 51.69 | 53.94$^{b}$ | 53.73 | 53.38$^{b}$ |
| **SEM** | | 0.117 | 0.088 | 0.109 | 0.092 | 0.215 | 0.238 | 0.066 |
| **Lys, %** | | | | | | | | |
| | **0.65** | 54.34 | 52.87 | 51.73 | 51.74 | 54.23 | 53.92 | 53.44 |
| | **0.70** | 54.09 | 52.70 | 51.96 | 51.75 | 54.14 | 53.78 | 53.33 |
| | **0.75** | 54.21 | 52.84 | 51.78 | 51.98 | 54.43 | 54.15 | 53.48 |
| | **0.80** | 54.38 | 52.83 | 51.88 | 51.83 | 54.36 | 53.86 | 53.49 |
| | **SEM** | 0.160 | 0.089 | 0.110 | 0.093 | 0.218 | 0.241 | 0.067 |
| **CP X Lysine** | | 0.577 | 0.396 | 0.798 | 0.554 | 0.766 | 0.736 | 0.577 |
| **CP** | | 0.163 | 0.041 | 0.002 | 0.301 | 0.008 | 0249 | 0.163 |
| **Lysine** | | 0.770 | 0.492 | 0.513 | 0.245 | 0.741 | 0.578 | 0.770 |

[A,b]*Means in a column having no common superscript are significantly differ (p<0.05)*
[1]*Data are means from 7 replicates of 90 birds in each replicate.*

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**Table 4: Mortality on layers (39 to 74 weeks of age) fed different concentrations of CP and Lysine[1]**

| **CP%** | **Lys%** | **Period** | | | | | |
|---|---|---|---|---|---|---|---|
| | | **P1** | **P2-5** | **P6** | **P7** | **P8-9** | **P1-9** |
| **Age** | **Weeks** | **39-42** | **43-58** | **59-62** | **63-66** | **67-74** | **39-74** |
| **18** | **0.8** | 0.328 | 2.964 | 0.721 | 0.381 | 0.142 | 1.679 |
| **16.5** | **0.65** | 0.474 | 2.109 | 1.638 | 0.914 | 0.260 | 1.466 |
| **16.5** | **0.70** | 0.641 | 2.648 | 0.931 | 0.000 | 0.367 | 1.566 |
| **16.5** | **0.75** | 0.640 | 2.348 | 0.369 | 0.365 | 0.188 | 1.369 |
| **16.5** | **0.80** | 1.290 | 2.585 | 1.646 | 8.331 | 0.178 | 1.682 |
| **15.0** | **0.65** | 0.638 | 3.442 | 2.007 | 0.584 | 0.000 | 2.125 |
| **15.0** | **0.70** | 1.131 | 2.754 | 1.664 | 0.000 | 0.306 | 1.765 |
| **15.0** | **0.75** | 0.802 | 3.025 | 2.412 | 0.198 | 0.423 | 1.992 |
| **15.0** | **0.80** | 2.589 | 2.610 | 1.708 | 0.797 | 0.633 | 2.021 |
| **SEM** | | 0.474 | 0.736 | 0.514 | 0.244 | 0.200 | 0.227 |
| **CP, %** | | | | | | | |
| **18.0** | | 0.328[b] | 2.964 | 0.721[b] | 0.381 | 0.142 | 1.521[a] |
| **16.5** | | 0.761[ab] | 2.423 | 1.146[ab] | 0.319 | 0.248 | 1.679[ab] |
| **15.0** | | 1.290[a] | 2.958 | 1.948[a] | 0.395 | 0.340 | 1.976[ab] |
| **SEM** | | 0.316 | 0.491 | 0.343 | 0.162 | 0.133 | 0.151 |
| **Lys, %** | | | | | | | |
| | **0.65** | 0.557[b] | 2.776 | 1.822 | 0.749[a] | 0.130 | 1.795 |
| | **0.70** | 0.885[ab] | 2.701 | 1.297 | 0.000[b] | 0.337 | 1.666 |
| | **0.75** | 0.721[a] | 2.686 | 1.391 | 0.281[ab] | 0.306 | 1.681 |
| | **0.80** | 1.402[ab] | 2.720 | 1.358 | 0.392[ab] | 0.318 | 1.794 |
| | **SEM** | 0.320 | 0.496 | 0.347 | 0.164 | 0.135 | 0.153 |
| **CP X Lysine** | | 0.594 | 0.419 | 0.242 | 0.111 | 0.305 | 0.696 |
| **CP** | | 0.009 | 0.539 | 0.034 | 0.907 | 0.463 | 0.020 |
| **Lysine** | | 0.023 | 0.527 | 0.716 | 0.029 | 0.566 | 0.815 |

[a, b]*Means in a column having no common superscript are significantly differ ($p<0.05$)*
[1]*Data are means from 7 replicates of 90 birds in each replicate.*

These results were in agreement with Latshaw and Zhao (2011), where change in the level of protein in diet did not affect rate of EP and EM. Similar to the present findings the published data from our lab (Rao *et al.,* 2011) and Liyunyu *et al.,* (2012) also reported significant improvement in EW with increase in dietary protein during initial phase of production (21 to 28wks and 19 to 36 wks of age respectively).

In contrast to these observations, Roberts *et al.,* (2007) found significant reductions in EP and EM, but not EW and BW, in layers fed 19, 18 and 17% CP compared with those fed 20, 19 and 18% protein during 23 to 31 wks, 32 to 44wks and 45 to 58 wks of age respectively. The reduced EP and EM with a 1% reduction in CP in their study might be due to lower intake of feed(97 vs 99g/b/d) owing to the higher concentration of ME (2,840 to 2900vs.2600 kcal of ME/kg of diet), and bigger egg size (60 vs.53g), observed in their study compared to our data.

The calculated average daily intake of protein in groups fed 15% CP diet in the present experiment was 14.99g/bird per day, Similarly, Khajali et.al.,(2007), reported that layers can perform well on diets containing lower levels of balanced CP (16.3 %) compared with those fed a diet with 17.8% CP.

***Interaction between CP and Lysine Levels***

The interaction between levels of CP and lysine in diet did not significant (P>0.05) for majority of parameters studied. Similarly Liu *et al.,* (2005) also reported that there was no interaction (P>0.05) between protein (14.3 *and* 13.6%) and added synthetic lysine level (0.0, 0.025, 0.05 and 0.075%) on EP, EM and EW.

Hen day EP and EM were similar in layers fed with control diet having 18% CP and low-protein group with 15% CP during majority of periods except in P3. In P3, the EP increased with increase in concentration of Lys in diet containing low CP levels (15 and 16.5%). These findings were in agreement with Blair *et al.,* (1999), Keshavar and Austic (2004), who suggested the possibility of maintaining optimum EP at reduced dietary protein levels like14% CP. Similarly, Harms and Russell (1993) fed a low-protein diet of 13% CP with recommended concentration of essential amino acids (NRC, 1984) and reported similar EP compared to the groups fed with 17% protein.

Overall, the experimental data indicated that FI, FE, EW and mortality were not affected (P>0.05) in layers fed 15% CP with the lowest concentration of lysine tested (0.65%) during 39 to 74 wks of age. These results were in agreement with Harms and Russell (1993), Panda *et al.,* (2010) and Bonilla *et al.,* (2012) who reported non- significant effect of protein levels in performance of layers during 28 – 34 wks of age, with 15 or 13% CP and limiting AA (Lys, Met, Trp, Arg, Thr, Val, and Ile), 14.4% CP diet with 0.75% lysine in Layers with 28-44wks of age, and 16.5% CP diet to 22 to 50wks layers respectively.

***Conclusion***

Based on the data of the current study, it is concluded that WL layers (39-74 wks of age) can perform well on diets containing 15% CP (14.99g/b/d) and 0.65% lysine (640 mg/b/d) without affecting the bird performance. However higher level of CP is needed for bigger egg size.

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