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Effect of feeding different levels of lysine and protein on the performance of WLH layers

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ABSTRACT

A trial was conducted to evaluate the requirement of digestible lysine at various protein levels in the diet of WLH layers (BV-300) from 25-44 weeks of age. Layers (528) were fed with diets containing two protein levels i.e. 13.36 and 15.78 % each with 5 % concentration variations of lysine (0.50, 0.55, 0.60, 0.65, and 0.70) and a control with 17 % CP and 0.70 % lysine. Each diet was fed to six replicates of eight birds. Egg production, feed intake, body weight were not influenced either by the concentration of lysine or by level of protein in diet. Increased (*P* d" 0.05) egg weight and egg mass were observed with increasing lysine in diets. Better feed efficiency was observed with increasing lysine concentration. It can be concluded that WLH layers require approximately 0.65% lysine with 13.36% CP or 0.63% lysine with 15.78% CP (i.e. 598.80 vs 570 mg/h/day) in diet.

Key words: Lysine, Performance, Protein, WLH layers.

INTRODUCTION

Profit margin in poultry industry directly related to the price of the feed. Feed cost depends on ingredients utilised and prevailing market prices of those ingredients. Methionine and Lysine are first and second limiting amino acids in corn soy based layers diet. Several commercial guidelines for laying hens (Brown, 2011 and Lohman, 2010) for crude protein (CP) levels varies from 17.4% to 18.2% (19.1 20.0 g of CP/d) per hen. Which were higher than the recommendation of many recent reports (Bonilla *et al*., 2012; Lima *et al*., 2012 and Ramarao *et al*., 2011). Higher levels of protein/ amino acids in diet will increase nitrogen excretion, ammonia emission, and taxing the ecosystem by contaminating surface water bodies (Latshaw and Zhao, 2011) also often result in higher feed cost.

In the current ideal protein formulation method, the lysine (Lys) requirement was given a value of 100 and the requirement of the other amino acids (AA) were expressed as relative ratios to Lys. The essential amino acids are related to one another by virtue of need to support production and maintenance. An inadequacy of any one of them (the first timeline) usually necessitate some catabolism of others. Although, the absolute requirement of AA may change in different practical situations, the ratio between amino acid should remain constant. Therefore, knowing the digestible Lys requirement is vital when formulating layer diet for maximum production.

Hence, the objective of present experiment is to assess the concentration of digestible lysine required for optimum production in WLH layers at various protein levels in tropics.

MATERIALS AND METHODS

A total of 528 WLH layers (BV-300) aged 25 weeks were randomly distributed into 11 treatment groups each with 6 replicates of 8 birds. Fluorescent bulbs were used to provide 16 h of light daily including normal day light. The birds were housed in cages with 4 hens in each cage (18" ×15" ×15"). Two adjacent cages were used as treatment replicate. They were fed 11 types of diets as illustrated in Table 1 such that treatment diets consisted of 5 different lysine concentrations (0.50, 0.55, 0.60, 0.65, and 0.70 %) at 2 protein levels i.e. 13.36 (LCP) and 15.78 %(MCP) and control diet with 17% CP and 0.70 % lysine. All these diets were iso caloric (2700Kcal/Kg). A constant ratio was maintained between digestible Mehtionine+ Cysitne, Threonine, Tryptophan, Arginine, Leucine, Iso Leucine and Valine (88, 66, 19, 114, 72 and 80) to lysine.

This trial was conducted for a period of 20 weeks (April–August 2014). The daily minimum and

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Table 1: Ingredient Composition (%) of test diet fed to WLH layers (25-36 weeks) (Diets in Kgs)

d. Lysine (%)	0.50	0.55	0.60	0.65	0.70	0.50	0.55	0.60	0.65	0.70	0.70
	I /13.36					**II /15.78**					17%(Control)
ME (kcal/kg)	2700	2698	2699	2696	2702	2698	2698	2699	2699	2696	2697
group/CP(%)	13.39	13.34	13.40	13.36	13.38	15.76	15.75	15.80	15.79	15.80	17.06
Digestible Lysine	0.501	0.550	0.604	0.650	0.704	0.503	0.553	0.603	0.650	0.701	0.704
Digestible M+C	0.435	0.481	0.522	0.563	0.617	0.493	0.492	0.528	0.570	0.609	0.614
Digestible Threonine	0.408	0.404	0.423	0.432	0.472	0.467	0.464	0.464	0.464	0.463	0.516
Digestible Tryptophan	0.114	0.113	0.113	0.125	0.137	0.119	0.118	0.119	0.130	0.135	0.144
Digestible Arginine	0.708	0.705	0.703	0.736	0.756	0.753	0.748	0.751	0.758	0.761	0.894
Digestible Iso leucine	0.463	0.458	0.457	0.450	0.444	0.543	0.540	0.540	0.538	0.537	0.604
Digestible Valine	0.565	0.559	0.558	0.552	0.548	0.651	0.648	0.647	0.645	0.642	0.701

***Provided (/Kg diet): Vit A 50MIU,Vit D3 14miu, Vit E 20g, Vit K3 8g, Vit B1 3.2g, B2 32g, B6 3.6g, B12 0.024g, Niacin 28g, Calcium pantothenate 16g, Folic acid 5.6g. Trace minerals (in each kg) :Manganese 70g, Zinc 70g, Iron 50g, Cobalt 0.6g, Iodine 0.6g, Copper 10g, Selenium 0.06g. Vit E , C, probiotic, and phytase @0.1% each, B complex @0.4%, sodium bicarbonate, choline chloride @1% each, toxin binder ,Trace minerals@ 0.5% each, acidifier @ 2%.

maximum temperatures, relative humidity were recorded throughout the experiment.

The indices of CP, AA of all the nutrient sources (corn soybean meal , ground nutcake, guar meal, sun flower cake, maize gluten, rape seed meal and DORB) were analysed through NIR. Based on the results obtained, the diets were formulated. Feed and water were provided ad libitum. The protocol of the current study was approved by the Animal Ethics committee of the institute.

Data collection: The BW of 50 % of the birds per replicate (four birds) was recorded at the beginning and at the end of each period (28 days). Feed intake (FI) and FCR (g/g) were measured weekly and pooled for the period. Hen day egg production (HDEP) and mortality were recorded daily. Egg weight (EW) was calculated as mean weight of eggs collected in three consecutive days of each period. Egg mass (egg production × average egg weight) was calculated period wise.

Statistical analysis: Data were statistically analysed by one-way ANOVA using SPSS for windows (SPSS Inc.2002). The significant differences (p< 0.05) seen in between means was determined by Duncans multiple comparison test (Duncan, 1955). The effects of various concentration of d. lysine were determined by using orthogonal polynomials for linear, quadratic, and cubic effects. Quadratic regression and equation were also determined.

RESULTS AND DISCUSSION

HDEP: The HDEP was not influenced by the concentration of lysine as well as level of protein in diet(Table 2). These results corroborated with the findings of Rama Rao *et al.* (2011) who reported that increased concentration of dietary lysine from 0.65 to 0.80 per cent had no effect on EP. Whereas, Li *et al.* (2013) also reported that diets containing varying levels of protein (14.5-17.5%) with balanced essential amino acids had no significant effect (p>0.05) on egg production in brown layers. However, numerical increase in EP with increase in concentration of lysine up to 0.65% in LCP and 0.60% in MCP groups. It was in agreement with Panda *et al.* (2010) who reported significant (p<0.001) increase in EP with increased level of lysine (0.70-0.75%) in layer diet with no further improvement in EP with increasing level of lysine from 0.75 to 0.80% in the diet.

No significant effect on EP by the concentration of lysine in diet might be due to lysine concentration has reached the required thresh hold to meet the EP potential of the bird at this age. Numerically higher EP was observed in MCP group. Lysine requirement was high in LCP group than MCP group. Similarly, Bouyeh and Gevorgian (2011) observed increase in EP with increase in CP from 13 to 14% and increase in lysine from 0.56 to 0.76%. This might be due to lysine deficiency at 0.56% incorporation (Lysine consumption was 588 mgvs.695mg) in their study. But no significant effect in our study might be due to lysine

Table 2: Performance of WLH Layers fed with varying concentrations of d. lysine with low protein in diet (LCP group @13.36% CP)

Parameters/ d.lysine %	0.50%	0.55%	0.60%	0.65%	0.70%	Control	P value
HDEP (%)	83.57	88.70	89.78	90.16	89.07	89.59	0.074
EW(g)	50.38^{bc}	49.94^{c}	51.18^{b}	54.09^{a}	52.10^{ab}	53.80^{a}	0.021
EM(g)	1204^{c}	1301^{bc}	1376^{b}	1402^{ab}	1345^{b}	1414^{a}	0.007
FE(g/g)	2.19^{a}	2.19^{a}	2.02^{ab}	1.90^{b}	2.07^{ab}	1.94^{b}	0.044
BWG(g)	21.31	12.19	125.07	139.60	83.88	166.07	0.084

Table 3: Performance of WLH Layers fed with varying concentrations of d. lysine with high protein in diet (MCP @15.78%CP)

Parameters/ Lysine (%)	0.50%	0.55%	0.60%	0.65%	0.70%	Control	P value
HDEP (%)	87.11	89.03	91.18	90.26	89.99	89.59	0.074
EW(g)	49.61[c]	49.63[c]	52.84[ab]	51.98[b]	51.07[bc]	53.80[a]	0.021
EM(g)	1248[c]	1296[bc]	1478[a]	1340[b]	1349[b]	1414[a]	0.007
FE(g/g)	2.11[ab]	2.18[a]	2.02[ab]	2.09[ab]	2.04[ab]	1.94[b]	0.044
BWG(g)	41.22	80.99	100.53	103.15	79.95	166.07	0.084

consumption reached the optimum threshold. Similar to these findings Harms and Ivery (1993) observed increased EP with increasing the levels of CP (13.79-16.68%) in diet of Hy-Line W- 36 layers.

Feed intake: FI/h/day and FI/egg were not influenced by increasing the lysine concentration in diet which indicated that the lowest level tested (0.50 %) was not deficient enough to influence the feed consumption(Table 3). These were in agreement with Alagawany and Mahrose (2014) who observed non-significant effect by various concentration of lysine (0.74-0.94%) on feed intake from 34-50 weeks of age in brown lohman layers.

It was in agreement with Prochaska *et al.* (1996) and Novak *et al.* (2004) who did not find any difference in FI in layers fed with different dietary concentrations of lysine (677–1613 and 860–959 mg, respectively). But in another trial, Prochaska *et al.* (1996) found significant reduction in FI at the highest intake of lysine (1165 mg/bird per day) compared with those that consumed lower quantities of the amino acid (828 and 1062 mg/bird per day) in Hy-Line W-36 birds (23–38 weeks). The reduction in FI observed in their study might be due to the excess intake of lysine.

Egg weight (EW) and egg mass (EM): These were increased significantly ($p<0.05$) with increase in concentration of lysine up to 0.65% and 0.60% in LCP and MCP groups respectively, indicating that the lysine requirement was higher (>0.65 %) for EW and EM compared with the concentration required for FI (0.50 %)(Table 4&5). These results coincide with Cupertino *et al.* (2009) who verified a quadratic response for egg weight with increase the level of lysine up to 0.71%. Similarly, Schutte and Smink (1998) also reported increased EM output and FE with increase in concentration of lysine (717 to 900 mg/b/ day intake) in Lohmann LSL layers during 24 to 36 weeks. A progressive increase in EW with increasing lysine intake (500 to 1613 mg/bird per day) had been reported (Prochaska *et al.*, 1996). The improved EW and EM with increasing lysine concentration might be attributed to more balanced amino acids at higher lysine levels (>0.65%).

In contrary to this Silva *et al.* (2010) observed non-significant response on EW and EM by various concentrations of lysine in diet. In current study indicating that CP had no effect on EW and EM. Whereas, Abd El Maksound *et al.* (2011), Bouyeh and Gevorgian (2011) inferred that increase in EW with increase in level of protein in diet. But current study indicating that diets with low protein (13.38%) require supplementation of more essential amino acids (0.65%) than higher levels of protein(15.58% vs 0.60%). Similarly Zeweli *et al.* (2011) noted that EP and EM were not influenced by dietary CP levels (12, 14 and 16%) in Baheji laying hens.

Feed efficiency (g/g): Better ($P < 0.05$) FE was observed at 0.65 % lysine in LCP group and 0.60% in MCP group. These findings are in agreement with Panda *et al.* (2010), who reported reduced FCR (2.5-2.2) with increase

Table 4: Quadratic equation summary of Lysine (%) requirements of WLH layers (25-36wks) at LCP (13.36%).

Parameters	Quadratic equation	R^2	Requirement of lysine (%)
Egg production (%)	$Y= 77.941+6.881X-0.939X^2$	0.216	0.653
Egg weight (g)	$Y= 46.956+3.078X-0.387X^2$	0.120	0.700
Egg mass(g/period)	$Y= 1032.25+191.20X-25.494X^2$	0.285	0.700
Feed efficiency (g/g)	$Y= 2.434-0.223X+0.028X^2$	0.206	0.650
Body weight gain(g)	$Y= 1203.144+115.61X-15.678X^2$	0.176	0.700

Table 5: Quadratic equation summary of Lysine (%) requirements of WLH layers (25-36wks) at MCP (15.78%) in the tropics

Parameters	Quadratic equation	R^2	Requirement of lysine (%)
Egg production (%)	$Y= 85.36+2.083X-0.191X^2$	0.119	0.631
Egg weight (g)	$Y= 49.554-0.139X+0.154X^2$	0.103	0.686
Egg mass(g/period)	$Y= 1304.134-59.904X+21.481X^2$	0.231	0.686
Feed efficiency (g/g)	$Y= 1.875+0.234X-0.037X^2$	0.055	0.628
Body weight gain(g)	$Y= 1237.75+69.855X-7.844X^2$	0.144	0.700

in lysine from 0.60 to 0.75per cent in WLH layers at 28-44 wks of age. Similarly, Gunawardana *et al.* (2008) observed better FE (2.03 to 1.91 g/g) and increase in egg mass from 54 to 59.3 g/h/day with increasing dietary lysine from 0.680 to 0.828 % in commercial brown egg layer strains during phase-II (32–56 weeks). On the other hand Rama Rao *et al.* (2011) reported no significant effect on FCR in WLH layers at 21-72wks of age with variation in levels of lysine from 0.65-0.80 per cent at two different CP levels (14.11 to 16.34%). Here the authors has taken entire production cycle (21-72wks) and expressed the FE where in current study the period of experimentation is short (25-44wks). It is indicating that supplementation of amino acids are essential while offering LCP diets than MCP diets for getting optimum production.

Body weight gain: Body weight gain was not influenced by either the level of CP or the concentration of lysine in diet. But numerically lower body weight values were recorded up to 0.55% concentration of lysine in LCP and 0.50 % in MCP could be attributed to the deficiency of either protein or EAA such as lysine and Methionine (Constant ratio between all EAA to lysine). The possible interaction among essential and non-essential amino acids in the LCP diet (12.29 and 12.32 % CP intake at 0.50 and 0.55% lysine respectively) when compared to MCP group (14.68 and 14.72 % CP intake at 0.50 and 0.55% lysine respectively) may also have limited the protein synthesis required for body growth and EM. Similarly Bone kamp *et al.* (2010) observed decreased BW when fed 550mg of lys/day especially in light weight (1478g) compared to heavy weight (1860g) Lohmann layers. These results are not in line with the findings of Rama Rao *et al.* (2011) who reported increase ($p < 0.05$) in body weight (1260-1315g) with increase in lysine (0.65-0.80%) and protein (14.11-16.34%) in diet of WLH layers at 21-72 weeks of age with an average FI of 97.39-98.81g/b/d. Similar findings were also reported by other workers (Panda *et al.,* 2010; Novak *et al.,* 2008) indicating that the level of CP or AA play an important role in maintaining optimal weight gain. Bouyeh and Gevorgian (2011) inferred that body weight gain was significantly influenced by the level of protein in diet; highest value of body weight gain was observed at higher level of CP (14%) than lower CP(13%) level during egg production cycle in Hy-Line layers.

CONCLUSION

Basing on the nutritional and economical aspects of view it can be concluded that the laying hens will perform better even at low protein diets supplemented with more essential amino acids than at medium/high protein groups. Thus dietary concentration of 0.653% lysine at 13.38% CP (Table. 4) or 0.630% lysine at 15.78% CP (Table. 5) with the ratio of other amino acids i.e. methionine+ cystine , threonine, tryptophan, arginine, luecine, isoleucine and valine (88,66,19,114,72,80) to lysine are recommended for feeding WLH hens throughout the period of 25-44 weeks of age.

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