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Effects of Different Levels of Methionine and Lysine Inclusion in Lohmann Silver Layers Ration on Production, Quality, Fertility and Hatchability of Eggs

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Abstract

This study was conducted to evaluate the effects of feeding of inclusion of different levels of methionine and lysine on egg production, quality, fertility and hatchability on subsequent performance of Lohmann silver layers in poultry farm of Debrezeit Agricultural research center. 360 laying hens and 54 cocks of mature Lohmann silver breeds of similar age and weight group were used for this study. The birds were randomly allocated into six treatment groups of 60 birds in each treatment with three replications consisting of 20 layers each and three cocks. The birds were kept in deep litter floor housing covered with teff straw litter material. The treatment rations were T1: Standard layers diet without Met or Lys, T2=0.6% Lys and 0.2% Met, T3=Only 0.7% Lys, T4=Only 0.3% Met, T5=0.7% Lys and 0.3% Met, T6=0.8% Lys and 0.4% Met.

Keywords: livestock, nutrients, statistics, food, agriculture

Introduction

Livestock production constitutes an important component of the agricultural economy of developing countries. Its contribution goes beyond direct food production which includes multipurpose products and uses, such as skins, feathers, fiber, manure for fertilizer and fuel, power and transportation, as well as a means of capital accumulation. Furthermore, they are closely linked to the religious and socio-cultural lives of several million resource-poor farmers for whom animal ownership ensures varying degrees of sustainable farming and economic stability. However, official statistics generally underestimate the overall contribution provided by animals since they underestimate the multipurpose and cultural roles played by livestock in food and agricultural production in developing countries [1].

Poultry production is one of the animal agriculture sectors that contribute as a source of income to the livelihood of the poor. In many developing countries, poultry production is based mainly on traditional extensive poultry production systems. All over the developing world, these low input/low output husbandry systems have been a traditional component of small farms for centuries and are assumed to continue for the foreseeable future. For example, it has been estimated that 80 percent of the poultry population is found in traditional family based poultry production systems, which contribute up to 90 percent of poultry products in some countries. Approximately 20 percent of the protein consumed in developing countries originates from poultry (i.e. meat and eggs) Poultry could play a vital role as a cheap source of animal protein in a country like Ethiopia since it has short generation interval, and higher efficiency of nutrient transformation in to high quality animal protein. In addition, poultry meat is the most palatable and easily digestible animal meat and contains essential amino acids required for human beings, and eggs are richly endowed with nutrients.

Ethiopia is one of the few African countries with a significantly large population of indigenous chickens. The estimated chicken population of the country is close to 38.1 million excluding the population in three zones of Afar region and six zones of Somali region Ethiopian poultry production systems comprise both traditional and modern production systems. Ninety-nine percent of the poultry population consists of local breed types under small holder farm household management conditions. Poultry production though small in scale at the farm level, it plausibly is quite important for the rural economy. Rural poultry production contributed 98.5 and 99.2% of the national egg and poultry meat production, respectively with an annual output of 72,300 metric tons of meat and 78,000 metric tons of eggs.

Materials and Methods

Description of the study area

The study was conducted at Debre Zeit Agricultural Research Centre (DZARC). Debre Zeit is found in the central highlands of Ethiopia. The center is located at about 45 km southeast of Addis Ababa. The area has an altitude of about 1900 meters above sea level, with average annual rainfall of 849 mm. The average minimum and maximum temperatures ranges from 10.5 to 26.10 C with a mean value of 18.7 0 C. The average relative humidity is 58.6 percent [2].

Ingredients and experimental rations

The feed ingredients used in the formulation of the different experimental rations in the present study were maize (Zea mays L.) grain, wheat middlings, noug seed cake, soybean meal, salt, limestone and synthetic methionine and lysine except for the control treatment (Table 1). The ingredients (Maize, Soybean meal, Nug seed cake, Wheat middlings and Salt) were purchased from Debrezeit local market, Vitamin premix, Methionine and Lysine were purchased from Genesis farm. Then feeds were mixed according to the formula used by the DZARC farm which considers the nutritional requirements of commercial layers established by NRC . Different levels of Methionine and Lysine were

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mixed with the formulated standard basal diet as indicated in Table

Proportion of feed in the mix (%)						
Ingredients	T1	T2	T3	T4	T5	T6
Maize	48	51	51	51	51	51
NSC	17.23	17.76	14.08	14.15	14	14
SBM	15	11.3	15	15	15	15
WM	10	10	10	10	10	10
Limestone	8	8	8	8	8	8
vit. Premix	1.47	1.47	1.47	1.47	1.47	1.47
Salt	0.3	0.3	0.3	0.3	0.3	0.3
Lysine	0	0.15	0.15	0	0.15	0.27
Methionine	0	0.02	0	0.08	0.08	0.18
Total	100	100	100	100	100	100

Table 1: Proportions of ingredients used in formulating the experimental rations

Experimental design and treatments

Completely randomized design involving six different rations was employed. The different rations contained Lysine and Methionine combinations was at the rate of 0: 0, 0.6: 0.2, 0.7: 0, 0.3: 0, 0.7: 0.3 and 0.4:0.8 kg /100kg feed representing T1, T2, T3, T4, T5 and T6, respectively The control diet (T1) was commercial layers ration without Methionine and Lysine. All rations were prepared at the farm.

Layout of the treatments

Each treatment was replicated in three pens each with twenty birds of Lohmann silver chicken. The basis for establishing the treatments was the recommended level of methionine and lysine as applicable to temperate areas, i.e., 0.7 kg methionine and 0.3 kg lysine per 100 kg of formulated feed, respectively . Accordingly, the treatment rations consists of the recommended level of methionine and lysine, one unit lower and higher than the recommended level of lysine and methionine combinations and sole inclusions of the two amino acids at recommended level.

Result and Discustion

Chemical composition of experimental feeds

The results of the chemical analysis and estimation of nutritive values of the different feed ingredients are given in Tables, higher levels of crude protein (36.9%) and (44.2 %) were recorded for noug seed cake and soya bean meal. From the calculated value, it can be seen that maize, soya bean meal and wheat middlings contained good amount of metabolizable energy (3402.4, 3925.1 and 2789.6 kcal/kg, respectively). The CP content of maize agrees very well with the results obtained by which was 8.9% and below the result reported by Tekeba (2005). The EE and Ash content of maize were above the amount reported by (2007) which were 5.7% and 1.4%. The energy content of maize was also below the amount reported by Negussie and Alemu (2005; 3654 kcal/kg DM) for yellow seed Maize (Zea mays L.) and Tekeba (2005;4454). The CP contents of noug seed cake is in close agreement with the results reported by and above the result reported by Tekeba (2005; 32.74). The EE and ME content of noug seed cake were below the amount reported by (2007:12.5%) and Negussie and Alemu (2005; 2647 kcal/kg DM), respectively. The CF content of noug seed cake used in the current experiment was below the level reported by Tekeba (2005; 26.90). The CP content of Soya bean meal was the same with that reported by Kassa (2005; 44.31 %).

Chemical composition of treatment diets containing different levels of Methionine and Lysine (Table 2) shows the chemical composition of experimental diets. The CP and ME contents of the experimental diets were within the recommended range for layers ration by Lesson and summers (2001). The protein contents of T5 and T6 are relatively higher than the control and the other treatments, which might be because of the highest inclusion of methionine and lysine in these two treatments [3].

Treatment Group	Rations of Lys to Met	No. of pen	Hens per pen	Total No. of hens
T1	Diet without met and lys	3	20	60
T2	0.6% lys & 0.2% met	3	20	60
T3	Only 0.6% lys/100kg feed	3	20	60
T4	Only 0.3% met/100kg feed	3	20	60
T5	0.7% lys & 0.3% met/100kg feed	3	20	60
T6	0.8% lys & 0.4% met/100kg feed	3	20	60

Table 2: Proportions of ingredients used in formulating the experimental rations

Dry matter intake

The inclusion of different levels of methionine and lysine on Lohmann layers ration resulted in a significant ($P<0.001$) difference in average daily dry matter intake (DMI) between treatments. The average dry matter intake (g/d/hen) of T2 (groups that consumed ration fortified with lysine and methionine mixtures at one unit less than the standard recommendation) was similar to the control group with lower DMI indicating that feed intake declines as the levels of methionine and lysine drops from the standard recommended level. The average dry matter intake (g/d/hen) of T3, T5 and T6 were statistically similar. However, the hens fed with diet fortified with 0.7% lysine only (T3) resulted in higher DMI than the birds consumed only 0.3% methionine. This result showed that inclusion of standard level of sole lysine at least numerically improved DMI than the other treatments, indicating its impact than methionine and their combination. The other important point is that not to meeting the standard level of lysine and methionine at lower level decrease feed intake. The significant difference in daily feed intake between the control and treatment groups were in agreement with the report of a study was conducted to determine the optimal methionine plus cysteine to lysine ratio in Hy-Line W-36 hens that Lysine had an effect on feed consumption of this study in which feed consumption increased as the Lysine level was increased from 0.79-0.97%. Similar result was reported by who reported that adding increasing levels of L-lysine and DL-methionine to broilers rations caused a sequential increase in feed intake and growth response. The current study disagree with the findings of who evaluated the effect of three Met + Cys levels (0.7; 0.875 and 1.05%) and two lysine levels (1.10 and 1.375%) on egg production and quality of laying Japanese quails. Their result revealed that, feed intake was not affected by the increase in lysine and Met+Cys levels. Similar result was reported by Islam and Ramy (2009) that methionine and folic acid levels up to 0.40% and 20 mg/kg, respectively had no effect on the amount of feed intake [4].

Body weight change

There were no significant (P>0.05) differences in average daily weight gain of the birds under inclusion of different level of methionine and lysine between treatments. These findings were in agreement with the reports of Harms and Russell (2003) that a reduction in methionine from 0.36 to 0.30% of the diet of single comb hens from 45 to 54 wk of age did not affect body weight similar results were reported by Islam and Ramy (2009) that methionine and folic acid levels up to 0.40% and 20 mg/kg, respectively had no significant differences in live body weight gain between the experimental treatments of Lohmann Brown laying hens. (Table 3) In contrast, the result disagree with the findings of who reported that adding increasing levels of L-lysine and DL-methionine to deficient diet in both essential amino acids resulted in a significant increase in body weight gain in broilers. The current experimental chickens were in their second phase of production and they attained mature body weight, which must be the reason for absence of significant difference in body weight change between all groups, indicating that inclusion of different levels of methionine and lysine in mature layers do not affect body weight [5].

	Treatments					
	Control	(0.2%Met	(0.7 % Lys)	(0.3%Met)	(0.7%Lys	(0.8%Lys
Chemical components		& 0.6%Lys)			& 0.3%Met)	& 0.4%Met)
	T1	T2	T3	T4	T5	T6
DM (%)	91.8	91.5	91.6	90.9	91.5	91.8
CF (% DM)	8.5	8.3	8.8	8.6	8.9	8.7
CP (% DM)	16.6	16.9	17.2	17.6	18.4	19.8
EE (% DM)	3.7	3.9	4.5	4.2	3.8	3.7
NFE (% DM)	50.8	48.4	46.1	50.1	47.1	49.8
Ca (% DM)	1.1	1.2	1	1.1	1.1	1.2
P (% DM)	0.3	0.2	0.2	0.3	0.21	0.3
Ash (% DM)	12.7	12.8	13.5	13.1	12.6	12.8
ME (kcal/kg)	2876.9	2901.4	2864	2882.2	2853.8	2857.5

Table 3: Chemical composition of feed ingredients

Mean percent mortality

Although the percentage difference among the treatments was high, the result of the statistical analysis showed no significant (P>0.05) difference in percentage mortalities. The overall mortalities recorded were similar to those reported in layers which were between 12% and 14.2%. The cause of mortalities of the hens during the entire experimental period was due to reproductive prolapse. In the study conducted on the same farm higher rate of death as a result of reproductive prolapsed in Lohmann silver strain of layers were reported Usman and Diarra (2008) also reported 9.4% egg prolapsed cases in egg type layers. Egg prolapse has become one of the major issues in egg type layers during the past few years and it caused higher mortality and resulted in huge economic losses.

Egg production

Laying performance of Lohmann silver (LS) layers is presented in (Table-2). There were a significant (p<0.001) difference in hen day egg production (HDEP) and hen housed egg production (HHEP) between treatments. Birds in T2 recorded similar total egg production, HDEP and HHEP with T1 (control group). The depression in laying performance observed in T2 and the control group might be related to reduced feed intake. According to. lack of sulfur amino acids in the diet resulted in reduced laying performance and inclusion of sulfur amino acids in the diet removed depression in laying performance within one week. Even though T3, T4, T5 and T6 had statistically similar results for these parameters, T6 and T3 resulted in numerically higher HDEP and HHEP than T4 and T5. The highest laying performance of birds fed diet consisting sole Met or Lys or their combination at least at recommended level showed the importance of fortifying layers ration with these amino acids. This result agreed with that of who reported that increasing methionine plus cysteine to lysine (Met+Cys/Lys) ratio in the diets of 160 Hy-Line W-36 hens increased egg production and lowering the Met+Cys/Lys ratio in the diet had an adverse effect on egg production [6].

reported that in study conducted to examine the effect of methionine, folic acid and vitamin B12 combination on laying performance of Bovans White laying hen layers fed high level of methionine gave higher egg production. The result was disagreed with who reported fed diets containing either 0.32 or 0.27% methionine to single comb white leghorn (SCWL) hens did not detect any change in hen productivity. The results of the current study indicated that, reducing the methionine and lysine level in layers ration below the standard level i. e. 0.3% and 0.7%, respectively resulted in low laying performance and lysine seems more limiting amino acid on HDEP and HHEP than methionine.

Egg weight and egg mass

The egg weight in the present study is similar with Higher fertility was obtained in eggs collected from hens fed T5 diet fortified with standard level of Met and Lys combination, but eggs from birds in T3 and T4 and T6 resulted in statistically similar fertility and T6 is not different from T5. The current study indicated that birds fed diet consisting standard level of sole Lys (T3) or Met (T4) or their combination at one unit below the standard level significantly reduced fertility as compared to those birds fed diet fortified with standard level of Met and Lys inclusions (T5). The amino acid at level greater than standard level did not seem to improve fertility. Therefore, T5 diet fortified with standard level of Met and Lys combination is preferable for better fertility of egg than the rest treatments. Fertility result of T5 is similar with that recorded by Aregaw (2010; 87.44±2.1) for consumed similar diet at the same farm

Hatchability based on fertile egg indicated that eggs of birds of T5 diet fortified with standard level of Met and Lys combination and T6 diet fortified with one unit above standard level of Met and Lys combination resulted in higher hatchability percentage than the rest treatments. Eggs from birds in T2, T3 and T4 resulted in similar hatchability percentage compared to T1. The fact that eggs from birds in T5 and T6 resulted in improved hatchability percentage imply that appropriate supplementation of synthetic amino acids is important to improve hatchability. This result was in agreement with that of who reported that addition of 0.1 and 0.15 % of methionine with basal diet of corn soybean meal in to play moth rock improved hatchability of fertile eggs groups whereas, 0.05% did not seem to influence hatchability. reported that average percent hatchability of fertile eggs of Lohmann silver hen fed on a basal diet to which standaed level of Met and Lys added was 86.54±4.17. The result of the current study confirmed that the variation in hatchability can arise due to the amount of methionine and lysine in the diet. confirmed that feeding the breeding hen, with adequate micronutrients is essential since the amount of this nutrients carried in to the egg can significantly influence hatchability.

Embryo Mortality

Embryonic mortality at early, mid, late and pip were not significantly varied among the control and the amino acid supplemented treatments. The absence of significant difference in embryo mortality of the current study implicated that the cause to embryo mortality must not be the difference in dietary treatments particularly methionine and lysine, but the cause might be management aspects in the egg storage and incubation. The rate of development and vitality of embryo depend on egg storage, temperature, humidity and ventilation of incubator and on maternal age the non-significant difference in embryo mortality of the current study agreed with the previous result reported by on the same breed [7].

However, inclusion of different levels of methionine and lysine significantly ($p<0.01$) affected egg mass. Birds in T2 groups that consumed one unit below the standard Met and Lys level and T1 the control group resulted in lower egg mass compared to the other treatments, because of decreased egg production (HDEP). The result was in agreement with the findings of who reported that increased methionine and met + syst level increased egg mass. Furthermore, reported that egg mass increased with methionine supplementation. In contrast, did not found significant effect of Met+Cys levels on egg mass. In general, the present study showed that decreasing the methionine and lysine level below 0.3% and 0.7% respectively resulted in low egg mass performance.

Feed conversion ratio

The inclusion of varying levels of Methionine and Lysine on feed conversion ratio (FCR) is presented in . There was significant ($p<0.01$) difference in feed conversion ratio between treatments. Birds in T2 lowest inclusion of Met and Lys combination and T1 the control group resulted in highest FCR than the other treatments. Birds in T3, T4, T5 and T6 showed no statistically significance difference among them and resulted in lower FCR than T1 and T2. The explanation for the improved feed efficiency with increasing the amino acids level might be attributed to the fact that the ration consisted balanced amino acids and therefore, animals are satisfied their need at relatively lower intake, but those with lower inclusion and control group consume more in an attempt to satisfy their need which leads to poor feed conversion ratio, that is they consume more feed per output. This result was in agreement with who reported that feed conversion efficiency was improved as the level of methionine and total sulfur amino acids is increased. On the contrary, reported that, both methionine and folic acid levels up to 0.4% and 20 mg/kg respectively did not significantly affected FCR. In general, the result of the present study indicated that FCR is highly influenced by different levels of lysine and methionine inclusions in layers feed in which low level of inclusion of those essential amino acids negatively affect FCR in layers [8]

Fertility and hatchability of eggs

The results of fertility and hatchability are presented in (Table-7). There is significant ($p<0.01$) difference in mean fertility of eggs among treatments. Fertility of eggs of birds fed ration in T2 diet containing lower level of lys and met combination was similar with that of eggs of birds fed the control diet (T1) both of which had low fertility of eggs than the rest treatments.

Higher fertility was obtained in eggs collected from hens fed T5 diet fortified with standard level of Met and Lys combination, but eggs from birds in T3 and T4 and T6 resulted in statistically similar fertility and T6 is not different from T5. The current study indicated that birds fed diet consisting standard level of sole Lys (T3) or Met (T4) or their combination at one unit below the standard level significantly reduced fertility as compared to those birds fed diet fortified with standard level of Met and Lys inclusions (T5). The amino acid at level greater than standard level did not seem to improve fertility. Therefore, T5 diet fortified with standard level of Met and Lys combination is preferable for better fertility of egg than the rest treatments. Fertility result of T5 is similar with that recorded by Aregaw (2010; 87.44±2.1) for consumed similar diet at the same farm.

Hatchability based on fertile egg indicated that eggs of birds of T5 diet fortified with standard level of Met and Lys combination and T6 (diet fortified with one unit above standard level of Met and Lys combination resulted in higher hatchability percentage than the rest treatments. Eggs from birds in T2, T3 and T4 resulted in similar hatchability percentage compared to T1. The fact that eggs from birds in T5 and T6 resulted in improved hatchability percentage imply that appropriate supplementation of synthetic amino acids is important to improve hatchability. This result was in agreement with that of who reported that addition of 0.1 and 0.15 % of methionine with basal diet of corn soybean meal in to play moth rock improved hatchability of fertile eggs groups whereas, 0.05% did not seem to influence hatchability. reported that average percent hatchability of fertile eggs of Lohmann silver hen fed on a basal diet to which standaed level of Met and Lys added was 86.54±4.17. The result of the current study confirmed that the variation in hatchability can arise due to the amount of methionine and lysine in the diet. Confirmed that feeding the breeding hen, with adequate micronutrients is essential since the amount of this nutrients carried in to the egg can significantly influence hatchability [9].

Embryo mortality

Embryonic mortality is presented in Embryonic mortality at early, mid, late and pip were not significantly varied among the control and the amino acid supplemented treatments. The absence of significant difference in embryo mortality of the current study implicated that the cause to embryo mortality must not be the difference in dietary treatments particularly methionine and lysine, but the cause might be management aspects in the egg storage and incubation. The rate of development and vitality of embryo depend on egg storage, temperature, humidity and ventilation of incubator and on maternal age. The non significant difference in embryo mortality of the current study agreed with the previous result reported on the same breed [10].

Weight loss of eggs during storage and incubation

Weight loss of egg during storage and incubation is presented in. There was no significant (P>0.05) difference in weight loss of eggs during storage between treatments. reported that the total Lohmann silver eggs weight loss during storage was 3.28±1.2. In the present study significant (P<0.01) difference was observed in weight loss of eggs during incubation. As compared to other treatments, numerically higher loss of weight during incubation was recorded in T5 and lower weight loss was recorded in the control group. A possible explanation for the difference in egg weight loss among the treatments of the current study might be their hatchability difference as the variation in hatchability can arise due to the amount of methionine and lysine in the diet and more hatched eggs loose more weight than less hatched one. Different researchers have concluded from their research that the best hatchability are obtained when eggs loss 12% of their fresh weight from the time of lay to the time of embryo pipes the shell and hatchability decreases for eggs loosing less than 10% or greater than 15% of their fresh egg weight. Reported that low hatchability of eggs from RIR might be due to the higher loss of weight during incubation as a result of loss of excess water through the pores.

Chick quality

Mean values of chick quality parameters are observed in (Table-10). There was significant (P<0.01) difference in chick quality between treatments and better chick quality was obtained from eggs hatched from T3, T4, T5 and T6. Low percentages of good quality chicks were observed in T2 and the control group. The result of this study revealed that as different levels of lysine and methionine affect hatchability of egg, they also have an impact on the quality and viability of chicks which contrast the previous idea that only poor hatchery management is the reason to poor quality chicks. Poor incubation condition results in low hatchability and poor chick viability [11].

Egg quality parameters

Egg shell weight and thickness: The mean eggshell thickness and weight resulting from feeding the six treatment rations is shown in. The results showed that there was no significant (P>0.05) difference between dietary treatments in egg shell thickness and egg shell weight. These results agreed with the results reported by in which supplementation of the diets with methionine, lysine and /or vitamin C, or combinations of these nutrients had no significant (P>0.05) effects in egg shell thickness and shell weight. Similar result was also reported by that a reduction in the methionine level from 0.36 to 0.31% in Lohmann brown hen diet did not affected eggshell quality. The result disagreed with who reported that reducing dietary methionine from 0.30 to 0.26% in Single comb white leghorn hen from 38 to 70 weeks of age reduced egg size and improved eggshell quality without affecting egg production [12]

Albumen height and weight

The result on albumen height and weight are given in. Albumen height resulted in a significant (P<0.05) difference between treatments. The eggs of birds consumed T4 ration (diet fortified with sole Met) recorded significantly (P<0.05) lower albumen height than the control group (T1). But there was no statistical significance (P≥0.05) difference in albumen height between T2, T3, T4, T5, and T6 . Another important finding was also that albumen weight resulted in a significant (P<0.05) difference between treatments in which the eggs of group of birds in T2 diet supplemented with one unit below the standard level and the control group resulted in higher albumen weight than the rest treatments. Aregaw (2010) on the study conducted on the same farm and breed reported that albumen height and weight of Lohmann silver chicken eggs were 8.56 ± 0.4 mm and 38.8 ± 1.3 g. The result of the current study was similar with who reported that the percentage of albumen in eggs from commercial laying hens was not affected by Met+Cys levels (0.52 and 0.8%) or by lysine levels 800 to 900 mg/day.

The current study was not consistent with those of Hussein and Harms in which Arbor Acres hens that received the Tryptophan or Lysine deficient diets in which albumen weight was significantly reduced. Likewise, the hens produced eggs with reduced albumen weight when receiving diets deficient in Methionine and Tryptophan. With similar findings, reported that a reduction in the methionine content of the diet reduced both albumen and yolk weight. The result of the current study implicated that reduced amount of methionine and lysine inclusion and those treatments without supplementation of synthetic amino acids (T1) performs better albumen weight as well as height in layers egg than supplementing the diet with higher amount of the synthetic amino acid. Therefore layers diet with reduced methionine and lysine would not affect the albumen content of egg. Kuchinski and harms, reported that the amino acid content of albumen is not changed when hens eat an amino acid-deficient diet.

Haugh unit

The Haugh unit (HU) values are in (Table-11). The haugh unit measured resulted in a significant (P < 0.01) difference between the treatments. The haugh unit measurement of birds in T2, T3, and T4 was similar with that of the birds in the control diet (T1), but birds in T5 and T6 resulted in a significantly (P < 0.01) higher HU as compared to the other treatments. The finding of the current study disagree with who reported that Bovan Nera layers fed diets with methionine, lysine and / or vitamin C, or combinations of these nutrients had no effect on haugh unit measurement between treatments. Similar result was reported by that a reduction in MET content of the diet from 0.30 to 0.26% did not influence any internal or external quality trait of the eggs. In general the haugh unit of all treatments in the present study achived the best standard haugh unit measurement.

Conclusion

An experiment on the effect of inclusion of different levels of methionine and lysine on egg production, quality, fertility and hatchability was carried to evaluate the effect on subsequent performance of Lohmann silver layers. 360 laying hens and 54 cocks of mature Lohmann silver breeds of similar age and weight group were used for this study. The birds were randomly allocated into six treatment groups of 60 birds in each treatment with three replications consisting of 20 layers each and three cocks. The birds were kept in deep litter floor housing covered with teff straw litter material. The treatment rations were T1: Standard layers diet without Met or Lys, T2=0.6% Lys and 0.2% Met, T3=Only 0.7% Lys, T4=Only 0.3% Met, T5=0.7% Lys and 0.3% Met, T6=0.8% Lys and 0.4% Met.

The experiment was lasted for a period of 12 weeks. The parameters considered included: DMI, body weight, mean mortality, HDEP, HHEP, FCR, average egg mass, average egg weight, shell thickness and weight, albumen height and weight, haugh unit, Yolk diameter, height, index and color, Weight loss of egg during storage and incubation, Embryo mortality, chicks quality and economic considerations

The design of the experiment was CRD and data were analyzed using General Linear Model (GLM) of the SAS software. Mean separation among treatments were carried out using Duncan's Multiple Range Test.

The results of laboratory chemical analysis showed that the CP content of the experimental rations were 16.6, 16.9, 17.2, 17.6, 18.4 and 19.8%, respectively of T1, T2, T3, T4, T5 and T6, respectively and ME values of the experimental rations were 2876.9, 2901.4, 2864.0, 2882.2, 2853.8 and 2857.5 kcal/kg DM, respectively. The statistical analysis showed that there were significant ($P>0.01$) difference in average daily DM intake, %HDEP, %HHEP, Average egg mass, FCR, %fertility, %hatchability, Weight loss of egg during storage, % quality chick, albumen height, albumen weight, haugh unit, yolk weight, egg price, feed cost, ESFCR, FCPEM, and net return between treatments and control group.

Birds in T2 and the control group (T1) resulted in lower dry matter intake (g/d/hen) than the rest treatments. However, the average DMI of T3, T4, T5 and T6 were statistically similar however; T3 resulted in higher DMI than the other treatments. Birds in T2 and T1 recorded lower HDEP, HHEP, egg mass and FCR. Even though T3, T4, T5 and T6 had statistically similar results, T6 and T3 resulted in numerically higher HDEP, HHEP, egg mass and FCR than T4 and T5, respectively. Fertility of eggs of birds in T2 was similar with that of eggs of birds of the control diet (T1) resulted in low fertility of eggs than the rest treatments. Higher fertility was resulted in eggs of T5 but eggs of birds T3, T4, and T6 resulted in statistically similar fertility. Hatchability based on fertile eggs of birds in T5 and T6 resulted in higher than the rest treatments. Eggs from birds in T1, T2, T3 and T4 resulted in lower hatchability percentage compared to T5 and T6 with no significant different among them.

As compared to other treatments T5 has higher loss of weight during incubation. Better quality chick was resulted from eggs hatched of T3, T4, T5 and T6. Here, low percentages of good quality chicks were observed under T2 and the control group. The eggs of birds in T2 and the control group (T1) resulted in higher albumen height and weight than the rest of treatments. But birds in T5 and T6 resulted in a higher HU as compared to the other treatments. Birds in T3 and T6 resulted in numerically higher yolk weight than the rest of treatments, even though there was no statistical difference in yolk weight between T1, T3, T4, T5 and T6. Concerning economic consideration T2 resulted in lower net return similar to the control group (T1). However T3, T4, T5 and T6 resulted in net return than the rest treatment groups. T3 recorded with higher net return and marginal rate of return. The statistical analysis showed that there were no significant ($P>0.05$) difference in body weight change, mean percent mortality, average egg weight, embryo mortality, weight loss of egg during storage, shell weight and thickness, yolk diameter, height index and color between treatments and the control group.

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