RESEARCH ARTICLE Agricultural Science Digest, Volume 39 Issue 4: 341-346 (October-December 2019)

Comparative Evaluation of Growth Performance among Broilers Supplemented with Synthetic Lysine Amino Acid from 0-28 Days

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10.18805/ag.D-154

ABSTRACT

Different levels of synthetic lysine amino acid were supplemented to 240 starter broiler chicks randomly distributed to 12 groups of each 20-day chicks and allocated to four treatment diets in a Completely Randomized Design (CRD). T1 (Control) basal diet (0% synthetic lysine); T2 (0.15% synthetic lysine); T3 (0.3% synthetic lysine) and T4 (0.45% synthetic lysine). There was no significant difference (P>0.05) observed between treatments in dry matter, metabolizable energy, crude protein intake, body weight and death rate of the chicks. In conclusion, there were no significant changes for all parameters and further amino acid analysis of the feedstuffs is required and extra addition above 0.45% synthetic lysine of T4 need to be added in this experiment which numerically improved the chick's performance. Further experiments were recommended to evaluate the levels of lysine amino acid in the feedstuffs and its inclusion level in to the diet of modern broiler strains.

Key words: Broiler, Diet, Growth, Hubbard, Lysine, Starter.

INTRODUCTION

Poultry production remains the widest spread of all livestock enterprises and constitutes an important pillar of food and nutrition security improvement as well as socio-cultural and economic development in the world Alabi *et al*. (2017). It is a major meat and egg contributor and important source of nutrients for people in many developing countries Dowarah (2013) and Marangoni *et al*. (2015) and Bruyn (2015). Which encompasses both extensive and small-scale intensive management systems, is practiced by many households in low-income food-deficit countries. Despite low production levels and potentially high losses due to disease, predation and theft, scavenging systems offer the advantage of requiring minimal land, labour and capital inputs. Human undernutrition remains a major public health challenge globally, contributing to over 3 million preventable maternal and child deaths each year. Animal source foods, including poultry meat and organs. Dietary protein is the most expensive component of a broiler diet and methionine and lysine amino acids are the first and second most critical importance in commercial poultry diets Ruan *et al*. (2018), Mohammad and Sami (2014) and Nasr and Parviz (2015). Essential amino acids' including lysine is a limiting amino acid in crop grains and vegetable protein source feedstuffs in the chicken rations globally Basavanta *et al*. (2016).

Animal protein source ingredients are also not widely available and expected to be less to meet the requirement of essential broiler amino acids especially lysine amino acid for chicken existing with different agro-ecological zones and environmental conditions Cristina *et al*. (2018) and Hossain *et al*. (2017). In addition, the amino acid profile of the local feedstuffs is not well done in the laboratory and simple addition and supplementation of such amino acids are based on the NRC (1994) table value recommendation. Therefore, this experiment was conducted to evaluate the growth performance and mortality rate of Hubbard broiler chickens supplemented with graded levels of synthetic lysine amino acid.

MATERIALS AND METHODS

Feed Ingredients and Experimental Rations

Four ingredients [white maize, soybean meal, wheat short, and Niger seed cake (NSC)], vitamin premix, limestone, salt (NaCl) and synthetic lysine (sLys) amino acid were used for formulating rations. The chemical composition of feed ingredients was analyzed in the laboratory (Table 1) and proportion of ingredients and chemical composition of formulated experimental diets were shown (Table 2). Four similar Metabolizable and Protein (3000 kcal/kg ME and 22% CP) rations were mixed and balanced based on the chemical composition of feed ingredients. In addition, all treatment diets contained equal amounts of vitamin premixes, limestone and salt.

Design and experimental diets

Completely randomized design (CRD) was used with four treatments diets having various compositions of synthetic lysine (sLys) with three replications for each treatment. 240 Hubbard Classic commercial day-old broiler chicks were

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How to cite this article: M. Melaku, M. Urge and G. Animut (2019). Comparative Evaluation of Growth Performance among Broilers Supplemented with Synthetic Lysine Amino Acid from 0-28 Days. Agricultural Science Digest. 39(4): 341-346.

Source of support: Haramaya University for hosting and Ministry of Education for financing the research work is highly acknowledged.

Conflict of interest: None

Submitted: 07-05-2019 **Accepted:** 18-07-2019 **Published:** 09-12-2019

Table 1: Chemical composition of the ingredients and supplements used for ration formulation.

Ingredients	Nutrients (% DM)					
	DM (%)	CP	EE	CF	Ash	ME (Kcal/kg DM)
Maize	90.88	9.65	6.73	5.72	3.98	3647.36
Soybean meal	94.45	38.87	8.05	7.69	7.85	3386.54
Wheat short	90.74	15.4	5.08	8.09	4.84	3312.29
Noug seed cake	93.68	29.8	5.11	17.96	7.84	2316.06
Vitamin Premix	-	-	-	-	-	-
Limestone (CaCo3)	-	-	-	-	-	-
Lysine	-	-	-	-	-	-
Salt	-	-	-	-	-	-

DM=dry matter; CP= crude protein; CF= crude fiber; EE= ether extract; ME (Kcal/kgDM) = Metabolizable Energy kilocalorie per kilogram of dry matter.

Table 2: Proportion of ingredients and Chemical composition of formulated experimental diets.

Ingredients (%)	Treatment of diets			
	T1	T2	T3	T4
White Maize	38.5	38.67	38.7	38.43
Soybean meal	25.5	25.6	25.6	25.7
Wheat short	15.0	14.6	14.5	14.6
Niger seed cake	18.5	18.5	18.4	18.4
Calcium carbonate (limestone)	1	1	1	1
Broiler starter vitamin premix	1	1	1	1
Salt (NaCl)	0.5	0.5	0.5	0.5
Level of synthetic lysine (sLys) added	-	0.15	0.3	0.45
Chemical composition of formulated experimental diets				
Dry Matter (DM)	92.46	92.21	91.71	92.06
Crude Protein (CP)	21.38	21.44	21.52	21.85
Crude Fiber (CF)	9.02	8.92	8.77	8.65
Ether Extract (EE)	6.37	6.28	6.15	6.42
Ash	8.4	8.29	8.54	8.97
Metabolizable Energy (ME in Kcal/kgDM)	3154.73	3163.19	3159.22	3167.01

randomly assigned into 12 groups of 20 chicks for each. The amino acid profile such as lysine content of the main feedstuffs (such as white corn, wheat short, soya bean meal and Nugeseed cake) was taken from NRC (1994) table values and other literature especially for Nugeseed (*Niger seed*) cake. Thus, white corn (maize)=1.17g/kg, SBM=5.38g/kg, wheat short=1.58 and Nugeseed cake (*Niger cake*) =0.87g/kg. The natural lysine content of the diets was 0.9% which lacked 0.3% from the NRC recommendation (1.2%). Therefore, the deficiency was 0.3% lysine in the ration. So, the treatment diets were T1 (control diet); T2= (control diet + 0.15% sLys), T3= (control diet + 0.3% sLys); T4= (control diet + 0.45% sLys).

Chicken and their management

The experiment was conducted at Haramaya University poultry farm in Ethiopia. The chicks were kept in separate wire-mesh partitioned pens of 1.5 X 1.65 m on concrete floor housing system that was covered with sawdust litter material of 10cm depth. The chicken pens, water and feed troughs were thoroughly cleaned, disinfected by HI-7 (1L/330L water) and sprayed against external parasites before two weeks of placing chicks in the house for each chicken pens. Each pen was equipped by 500-watt infrared heat lamp for as a source of heat and light. No additional heat was provided for the chickens rather than the normal room temperature. The chicks were given feed at the morning (8:00 AM), afternoon (4:00 PM) *ad libitum* and pipe water during the study period. Leftovers of each replication were measured daily in the morning and given feed for each group. Vaccinations such as HB1 and Lasota were given against New Castle Disease at the first and 21st days of age of chicks.

Measurements: Chemical Analysis

The chemical compositions of the ingredients were determined by the proximate method of analysis of AOAC (2016). *Kjeldahl* procedure was used to determine the nitrogen (N) content of the feed and crude protein (CP) was estimated as *"N x 6.25"*. Metabolizable energy (ME) content of the treatment diets was determined by Wiseman (1987) formula as follows:

ME (kcal/kg DM) = 3951 + 54.4 EE – 88.7 CF – 40.8 ash

Dry matter, Metabolizable and Crude Protein intake

The total or daily DM, ME and CP intake of the chicks were calculated by the following formula:

(Dry matter intake) =
[(Offered feed x DM %) - (collected refusal x DM %)]

Mean daily DM intake (in g) =

$$\frac{\text{(Offered feed x DM \%) - (collected ort x DM \%)}}{\text{(No. of days x No. of chicks)}}$$

Daily ME intake (Kcal/Kg DM)=
(daily DM intake x ME content of the ration

Daily CP intake (CP/Kg DM)=
(daily DM intake x CP content of the ration

Body weight gain

The initial body weight of the chicks was taken after 30 hours of hatching. They weighed in a group per pen on weekly basis and average daily body weight gain (ADBWG) of the chicks were calculated for each replication through the following formula.

(ADBWG) =

$$\frac{\text{(Mean of final body Weight-Mean of initial body weight)}}{\text{Number of experimental days (28 days)}}$$

Dry matter conversion ratio (DMCR)

The mean dry matter conversion ratio was computed as the proportion of average daily dry matter intake (ADDMI) to average daily body weight gain (ADBWG) by using the formula as followed.

(DMCR) =

$$\frac{\text{(Average daily dry matter intake (ADDMI in g)}}{\text{(Average daily body weight gain (ADBWG in g)}}$$

Mortality

After the beginning of the study any death occurred was documented as mortality and expressed as % mortality at the end of the experiment.

Data Analysis

The General Linear Model Procedure of SAS (2002) was used for the analysis of data collected during this experiment for the effect of diets containing different levels of lysine. Least significant difference (LSD) was employed to separate them when the treatment effect was significant. The following model was used for analyzing the data.

$$Yij = \mu + ti + eij$$

Where
Yij = individual observation, μ = overall mean, ti = treatment effect and eij = random error.

RESULTS AND DISCUSSION

Dry matter, metabolizable energy and crude protein Intake

The total and daily dry matter intake (DDMI) showed non-significant difference (P>0.05) between treatments throughout the experimental period (Table 3). Since it might be due to the similarity of dry matter intake, the protein and energy intake of the chicks was similar. There was an increment in numerical changes even though the result was non-significant as shown in Figure (1). Most findings stated that the intake and conversion efficiency was increased as the level of lysine intake increased. As shown in table (3) the amount of dry matter intake in T4 was less than T3. This might be due to loss of feed ingredients by the chick's leg and that was associated with the higher the older age, the difficulty to control the wastage of rations. In addition, higher feed intake was observed by Hubbard broiler chickens since genotype, environmental conditions and season have also effects as mentioned by Singh *et al*. (2018).

The result was also agreed with Martinez-Amezcua (1988), who stated that increasing the amount of lysine from 1.1 to 1.2% did not improve dry matter intake for 1-35 days old chicks. Further supply of amino acids is required by the body to meet their metabolic needs as mentioned by Matthews (2009) but greater than the required which reduced

Table 3: DM, ME and CP intake of chicks fed diets having various proportion of synthetic lysine.

Intake of chicks	Treatments				SEM	SL
	T1	T2	T3	T4		
Total DM (g/b)	1351.67	1362.32	1380.55	1368.70	14.88	NS
Daily DM (g/b)	48.27	48.65	49.30	48.88	0.53	NS
ME (Kcal/Kg DM)	152.29	153.90	155.76	154.81	1.68	NS
CP (g/b/d)	10.32	10.43	10.61	10.68	0.12	NS

DM=dry matter; ME=metabolizable energy; CP=crude protein; NS (P>0.05) =not significant; sLys=synthetic lysine Amino Acid, SEM= standard error of mean, SL=significance level.

Table 4: Effect of supplementing different levels of synthetic lysine on DMCR, Body weight gain and Mortality percentage.

Body weight and mortality of chicks	Treatments				SEM	SL
	T1	T2	T3	T4		
Initial Body Weight (g/b)	46.50	46.66	46.40	47.16	0.31	NS
Final Body Weight (g/b)	794.17	799.28	807.05	842.88	9.7	NS
Total BWG (g/b)	747.67	752.62	760.65	795.71	9.6	NS
Average Daily Weight Gain (g/b)	26.70	26.87	27.16	28.41	0.34	NS
DMCR	1.81	1.81	1.81	1.722	0.03	NS
Mortality%	3.59	3.09	2.76	2.12	0.40	NS

BWG=body weight gain, DMCR=dry matter conversion ration; NS=non- significant, SEM= standard error of mean, SL=significance level.

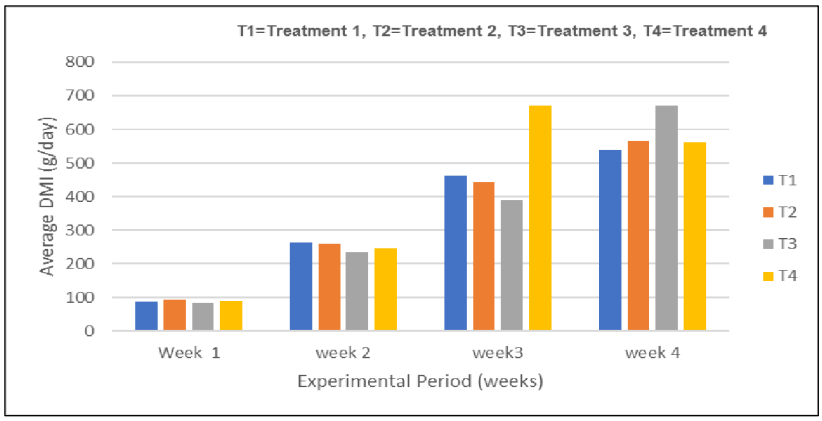

Fig 1: DM intake of chicks given with various proportion of synthetic lysine.

feed intake and harm appropriate nutrient stability. This finding disagreed with Mendes *et al*. (1997) who noted that lower feed consumption was observed when the amount of lysine in the feed increased. Similarly, Abudabos and Aljumaah (2010) noted no significant difference in feed intake between broiler chicks supplemented with synthetic lysine amino acid at a level of 1.0-1.3% up to 42 days of age. According to Panda *et al*. (2011) the significant improvement in dry matter intake when the lysine level raised to 1.2%, but dry matter intake decreased when the quantity of sLys raised to 1.3%. The increased of dry matter intake of chicks with age was due to the increased of the body size of chicks and to meet the demand of nutrients for maintenance and growth, there was a more diet consumption.

Body weight gain

The weight of chicks at different times throughout the experimental days was described in Table (4). The initial average body weight of birds in this finding was higher than the findings showed by Tadelle *et al*. (2003) and Zena (2011) for similar breed lines. This might be because of the initial body weight of the birds was recorded after 30 hours of hatching and feeding.

Absence of significant differences between treatments through different body weight parameters and thus, the response of weight gain obtained from feeding synthetic lysine at T4 of the deficiency of the diet in lysine amino acid was not significantly improved compared to the one supplemented with T3. This research output showed that 0.3% or 0.45% synthetic lysine inclusion would not allow chicks to bring highest body weight gain. This result was agreed with Corzo and Kidd (2004) who stated that the performance of chicks seemed not to be varied with raising levels of lysine at starter age of the chicks but significant weight gain was observed more during the finisher age of the chick's. Similarly, the increment of body weight from T1-T4 was also supported by Melaku *et al*. (2015) who stated that the increasing level of lysine may not be observed at the starter age of birds.

In general, body weight increased at least figuratively with an addition of synthetic lysine and the maximum and minimum mean value was documented in T4 and T1, respectively. Panda *et al.* (2011) stated that weight gain raised and DMCR reduced linearly as lysine raised up to 1.4%. As mentioned by Tesseraud *et al*. (2003), this is due to the increment of the amino acid concentration, that is known to stimulate the synthesis of insulin-like growth factor-I. Furthermore, lysine amino acid is recognized in increasing the nutrient digestibility and utilization which was similarly stated by Selle *et al*. (2007). At marginal level of lysine inclusion, growth and body weight was influenced because of apparent depigmentation and lowered hemoglobin and hematocrit in birds and lysine is the greatest indispensable amino acid for growth and lowers body weight gain as described by Nasr and Kheiri (2012). It is required for appropriate collagen formation of bones, cartilage, ligaments, and tendons and production of antibodies, hormones and enzymes Liao *et al*. (2015) and Kong and Adeola (2014). Therefore, this research finding supported the results of Saima *et al*. (2010). The protein and essential amino acids requirement for broilers proposed by NRC (1994) were unable to accommodate the terms of production for modern strains of birds.

Dry Matter Conversion Ratio (DMCR)

As indicated in Table (4), no significant difference ($P>0.05$) was observed between treatments. However, T4 group numerically enhanced body weight of birds. As mentioned by Dozier *et al*. (2008) maximal feed efficiency needs a higher dietary level of lysine than the required body weight gain. Safamehr *et al*. (2008) also noted that 1.2% lysine recommendations sited by NRC (1994) is not enough to satisfy the needs of recent breeds of broilers chicks which have higher growth and genetic potential. In addition, there was an indication that greater level of lysine amino acid supplementation is essential to bring improved feed efficiency which was supported by Coto *et al.* (2009) who stated that chicks given feeds supplemented with 1.1% lysine have a significantly reduce dry matter conversion ratio than chicks fed 1.3% and 1.5% lysine. Similarly, there was non-significant difference in feed conversion among treatments since the lysine level for optimum dry matter conversion ratio was described to be greater than that of the required for maximum weight gain which was supported by Labadan *et al*. (2001).

Mortality

Mortality of chicken was related with the weather condition and the stress due to transportation but not due to the supplementation of synthetic lysine amino acid. According to the findings of Rezaei *et al*. (2004) who stated the national research council (NRC) requirement for lysine is too low for the period of 3 to 6 weeks of age and had absence of significant result on mortality of birds. Similar results were mentioned by Zampiga *et al*. (2018) who showed that there was no significant effect on the mortality percentage of chicks supplemented with dietary arginine to lysine in each feeding phase as well as in the overall period of the trial.

CONCLUSION

It can be concluded that the nutrient needs of broiler chicks proposed by NRC (1994) should have to be amended and the amino acid profile of the different ingredients in hot climate areas of the world should be assessed for addition of lysine levels in chick's supplementation to enhance their performance. In addition, flow up experiment is recommended to evaluate levels of synthetic lysine and other essential amino acids, to establish optimum and profitable levels of critical amino acids.

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ISSN: 0976-0547 (Online), 0253-150X (Print), Naas Rating: 4.21