Vol. 13(43), pp. 2408-2413, 25 October, 2018
DOI: 10.5897/AJAR2018.13393
Article Number: F9BBD0059019
ISSN: 1991-637X

http://www.academicjournals.org/AJAR

ACADEMIC JOURNALS
expand your knowledge

African Journal of Agricultural Research

Full Length Research Paper

The influence of essential amino acid in the chick's diet interferes in the weight gain

Aurelio Ferreira Borges[1*] and Maria dos Anjos Cunha Silva Borges[2]

[1]Department of Animal Nutrition, Federal Institute of Education in Rondonia State, Brazil.
[2]Department of Education, Technological University of Ipe in Mato Grosso State, Brazil.

Received 15 July, 2018; Accepted 7 September, 2018

One of the attributes of amino acid lysine is to manufacture muscle protein, as it is a physiologically essential amino acid for immunity, development and production in birds. This study evaluates the influence of several levels of the essential amino acid lysine for chicks, with age of about 504 hours, maintained at a temperature of approximately 29 degrees Celsius. The basal diet contained 21.0% crude protein and 3,000 kcal of energy of biological transformations/kg. This formula was supplemented with levorotatory-lysine acid monohydrochloride, resulting in diets with 1.040 to 1.280% of total lysine for five experimental treatments. The treatments were found to have a mathematical expression squared influence on animals' weight gain, conversion of diet, total liver mass and protein synthesis index. The effect of the five experimental treatments was not observed in diet consumption, fat synthesis index, absolute weights of intestines and heart, and percentage of liver mass. It was concluded that the total lysine requirements for chicks aged up to 504 h were 1.240%.

Key words: Thermal environment, dietary lysine, growth performance, rearing setting.

INTRODUCTION

According to Zaboli et al. (2016), temperature control in sheds for slaughter chickens may induce thermo tolerance, possibly by modifying physiological parameters during the first days of chronic heat stress. This is due to the importance of cardiovascular and respiratory systems in the thermoregulation of these birds. In the respiratory system of the bird, blood circulation can weaken control of body temperature in a housing environment that is not stable. There is also the potential challenge, given that due to the challenges posed by environmental degradation, the global temperature will increase approximately from 0.7 to 2.6°C of at least more than 52 years or more.

In the tropical regions of Brazil State, temperature variation in the range of 34 to 45°C can occur between the months of August and May. This promotes a significant reduction in the performance of chicks. The growth of these modern birds over the years, owing to continued genetic progress and the economic growth of the poultry industry in hot climates, requires ways to mitigate thermal stress. Therefore, unequal approaches, such as sheds controlled by the artificial climate, the low population density, nutritional screening of chicks, and the decrease in weight gain have been experienced. However, many of these practices are overestimated and inefficient (Zaboli et al., 2016; Borges, 2017).

High amounts of heat of tropical origin still reduce the weight of digestive and respiratory organs in chicks, to decrease the percentage metabolic rates in birds.

This promotes the reduction of metabolic heat

*Corresponding author. E-mail: aferreiraborges@yahoo.com.br.

production (Lara and Rostagno, 2013; Mehaisen et al., 2017). High temperatures can be reduced with Levorotatory-Lysine Acid Monohydrochloride supplementation, without modifying the performance of chicks. Consequently, by ratifying the different responses related to the effect of high temperatures, it is evident that the requirements of chicks are modified not only according to genetics, but also as a consequence of the thermal environment to which these animals are placed, in the different stages of development (Belloir et al., 2017).

This author adds that the dietary level of rations for chicks raised at elevated temperatures may be reduced by the addition of lysine-levorotatory acid monohydrochloride without any changes in body development. Therefore, the reason for the various responses to the phenomenon of high temperatures means that the diets of chicks can be modified not only in relation to genetics but also in the thermal adaptation in which these animals are reared.

The amino acid lysine-levorotatory acid mono-hydrochloride in the diet has an essential function in protein turnover in musculature of chicks, as it promotes protein synthesis. The deficiency of this amino acid promotes compact protein synthesis, especially in the pectoralis major muscle, which is more sensitive to this amino acid than to the wings and thigh muscles. Lysine has been described as influencing the muscular development of the carcass, since it improves the performance of the musculature and decreases the fat of the carcass (Cruz et al., 2016).

Glutamate indexes found in the muscle of birds are influenced by the natural process of lysine decomposition. The results of the decomposition of lysine, piperidine carboxylic acid, DL-α-Aminoadipic Acid and saccharopine dehydrogenase were increased in broiler diets by about 150%. These results suggest that the short-term diet rich in lysine-levorotatory acid monohydrochloride can improve the meat flavor of broilers in various environmental situations (Watanabe et al., 2015). Nutritional protein for chicks is the high-priced dietary nutrient in the market, yet the use of amino acids consisting of crystals offers several advantages. Its use provides reductions in crude protein concentrations in the diet and the ejection of this nitrogen into the environment, which favors the reduction of environmental pollution. Most broiler diets are formulated with all essential amino acids, where they are fed in optimal proportions to the lysine concentration in the diet (Franco et al., 2017).

The Lysine-levorotatory acid monohydrochloride from vegetable fermentation, such as sugarcane, was as efficient as the lysine offered in the consumer market, potentially being offered in commercial dimensions (Tabassum et al., 2015). Lysine is the amino acid used as an example in chicks because it is used in the production of proteins. It means that it is the first most limiting amino acid in diets for these birds (Belloir et al., 2017).

When chicks are kept in warm environment, there is reduction in the size of the heart, liver and small intestine, to compensate for the heat load to be dissipated in the environment (Borges, 2017). Chicks up to 504 h old, raised in a heat stress environment, represented by a temperature of approximately 29 °C, have lower weights of metabolically active tissues (heart, liver and intestine). The author adds that abdominal fat deposition, noble cut yield and slaughter carcass weight are influenced by the ambient temperature. The objective of this article is to evaluate the effects of several levels of lysine for chicks up to 504 h of age, when maintained in representative heat stress at approximately 29°C; thus simulating the natural conditions in Brazil State. The research problem arises from the question: what are the effects of different level of lysine in the diets of chicks up to 504 hours of age, when kept in heat stress representative of natural conditions in Brazil State? The overall conclusion of the study is that the levels of amino acid lysine on the diet on absolute (dg) and relative weight of the heart, liver, gizzard, intestine and carcass of chicks subjected to a temperature of approximately 29°C, which were slaughtered within 504 hours of age.

MATERIALS AND METHODS

Chicks

Experimentation with chicks was carried out in a climatic chambers at a Laboratory of Climatic Effects and Environmental Factors on cutting chicks in Brazil State. In all, 400 male chicks were used, with a mean initial weight of 350 ± 1.5 dg, and received the vaccines against neurolymphomatosis and Newcastle diseases. The choice of male chicks was justified by the greater absolute weight of breast and legs meat compared to females, in order to verify the tendency of rations to influence increases in the deposition of breast meat and thighs. The chicks remained at 24 to 504 h of life in the experiment under conditions of heat stress at the temperature of approximately 29°C. The statistical model of the experiment it was totally random, consisting of five treatments and eight replicates per treatment. Ten chicks were housed in each replicate.

Feeding regime in the experiment

The experimental recommendations used the spreadsheet with the set of digestibility values developed by Ajinomoto Heartland Llc (2014). In experimental diets, the animals ingested the same amount of protein and energy several times a day; that is, with diets of the same number of calories and proteins, formulated with corn, roasted soybean meal and corn gluten. They were formulated to meet the nutritional requirements, phosphorus, protein, amino acids, energy and calcium, with the exception of lysine. The basal diet was supplemented with 78.40% of Levorotatory-Lysine Acid Monohydrochloride, resulting in diets with 1.040 to 1.280% total lysine. The total amino acid values of the nutritional components of the basal diet were corrected for digestible amino acids.

Planned experimentation

The 15 metal troughs, each with an area of 72.0 dm^2, received the chicks. Each compartment is a representative of an experimental unit. The objective of this study was to estimate the range indicating representative thermal stress at a temperature of approximately

Table 1. The heat and the water vapor in the experimental unit.

Stage (h)	Atmosphere (°C)	Qualified atmosphere wetness	BGMC
24	33.21±0.211	53.41±1.791	82.11±0.271
48	32.41±0.721	56.31±2.440	81.51±0.831
72	31.50±0.781	57.31±1.741	80.31±1.090
96	30.51±0.501	54.90±2.210	78.71±0.441
120	30.21±0.210	55.81±1.960	78.51±0.181
144	29.50±0.241	55.51±4.020	77.51±0.761
168-504	29.10±0.391	59.71±3.160	77.40±0.591

29°C for the initial phase of 504 h-old chicks during the artificial warm-up period. The heat and the water vapor in the experimental unit were monitored by a minimum and maximum dry rounded temperature evaluator and humid and black rounded globe. The thermometers were seated at an intermediate height relative to the central battery compartment. Temperatures were recorded daily on two occasions, at 8:30 and 6:30 p.m., performed throughout the experimental period.

The thermal environment was demonstrated in terms of the black globe moisture code (BGMC) and calculated by the following equation: BGMC = Bgt + 0.36 Dpt - 330.08, where Bgt is the black globe temperature in degrees Kelvin and Dpt is the dew point temperature in Kelvin degrees (Table 1). The diet and water were freely offered; the water was changed once a day to avoid temperature rise. An uninterrupted flow chart of 24 h of artificial light was used throughout the experimental occasion. The variables that were evaluated were: total lysine intake, diet conversion, carcass performance, protein placement, full weight and percentage of primary thigh and thigh cuts, breast weight gain and amount of feed consumed. The weight yield of the chicks that were cushioned was obtained by distinguishing between the weight at the end and the beginning of the experiment. The feed conversion was evaluated for the period of 24 to 504 h, based on information on dietary intake and weight gain. The calculation of the food intake during the experimental period was acquired using the difference between the counting of foods provided and despised by the animals and the remnants of the diets supplied. The diets were weighed at the beginning and at the end of the experiment (Alhotan and Pesti, 2016).

Evaluation of the physical formation and constitution of crude protein in carcass of the chicks

Four chicks of each replicate were chosen to be slaughtered, considering the mean weight of the experimental unit, and the weight deviation to + 5% and to - 5%. Then the chicks were slaughtered and plucked, the mass of gutted skeletons was determined. Following, the fatty acids of the chest were excluded and the mass determined. Two whole skeletons, including head and foot, of each repetition were sprayed in 16 minutes, one at a time, on a commercial horsepower with 1,78 rotations per minute (RPM); and after homogenization a sample was collected. The chicks were weighed after 12.5 h of fasting and then at the end of the experiment.

Considering the high fat content of the carcasses, the carcass fragments were oven dried at ± 60°C for 73 h and the fat removed in the extractor for 4 h. After this, the samples were ground and placed in chalices for further evaluation. Crude protein evaluations were performed in an animal nutrition laboratory. An additional set of chicks of 24 to 504 h of age were slaughtered to determine the body composition of the animals at the beginning of the experiment. Protein deposition in the animal skeleton was measured by the difference between estimates of carcass composition between 24 and 504 h of age of the chicks.

Evaluations using experimental statistics

The numerical data capture for analysis was developed with the scientific support of the computer program, Statistical and Genetic Analysis (SGA). The approximate calculations of total determination of lysine were determined with the aid of the linear or quadratic regression models and the Linear Response Plateau (LRP), observing the adaptation with smaller error.

RESULTS AND DISCUSSION

The animals received diverse stages of lysine in the diet and were kept in a high temperature environment (29.10°C). The results of performance, specified by feedstuff eating and feed transformation, mass increase, entire lysine ingesting, protein and fat statement rates in the slaughter chick's carcass of 24 to 504 h grow old were obtained (Table 2). The Levorotatory-Lysine Acid Monohydrochloride indexes of the diet influenced the gain in animals' weight of the chicks, increasing in quadratic equation form until it gets to 1.20% indexes (Table 3); corresponding to an estimated consumption of 99.01 dg of the total lysine.

Due to the increased use of Levorotatory-Lysine Acid Monohydrochloride, no effect of lysine levels on feedstuff eating (FE) was observed. These results were similar to those obtained by those who, grow old working in high temperature conditions, did not find the effect of the stages of Levorotatory-Lysine Acid Monohydrochloride in relation to the initial consumption of chicks. However, it is different from the one pointed out by those who observed a significant modification in the consumption of chick's ration of 24 to 504 h and subjected to warmth pressure. Dietary lysine result ($p < 0.01$) in the feed conversion (FC) was verified for the chicks, which varied in the quadratic form and improved to 1.24% level, corresponding to an estimated consumption of lysine of 100.7 dg (Table 4).

Considering report that male chicks at 37°C up to 504 h of age does not require a higher level of lysine in the feed than those kept at 24°C, it is inferred that the variation of the results of this work can possibly be associated with differences in experimental environmental

Table 2. Entire consumption of lysine and aliquots of fat and protein account in the skeleton of male chicks of 24 to 504 h.

Parameter	Total lysine level (%)					RSD
	1.04	1.10	1.16	1.22	1.28	
Weight gain (dg)	5,390	5,700	5,890	5,720	5,790	0.0479
Feed intake (dg)	8,070	8,250	8,460	8,180	8,220	0.0452
Feed: gain ratio	1.50	1.45	1.43	1.43	1.42	0.0148
Total lysine intake (dg)	85	91	98	99	106	0.0461
Carcass deposition rate						
Fat (dg)	440	460	470	430	460	0.0555
Protein (dg)	950	1,000	1,070	1,020	1,070	0.0449

RSD = Relative Standard Deviation.

Table 3. Gain in animals' weight (dg) of chicks from 24 to 504 h old, underneath 29.1°C.

Weight gain	Lysine complete in diets (%)	Lysine complete doss (%)	Mathematical expression squared
5,390	1.04		
5,700	1.10	1.20	$\hat{Y}$= -1853.67 + 4067 X - 1695.88 X^2 r^2 = 0.77
5,890	1.16		
5,720	1.22		

Table 4. Lysine starting point in the ration for chicks of 24 to 504 hours of age, at a 29.10°C.

Feed: gain ratio	Lysine complete in diets (%)	Lysine complete doss (%)	Mathematical expression squared
1.50	1.04		
1.45	1.10		
1.43	1.16	1.24	$\hat{Y}$= 4.10087– 4.31539 X + 1.73764 X^2 r^2 = 0.96
1.43	1.22		
1.42	1.28		

Table 5. Lysine factor and coefficient of protein constitution of chicks from 24 to 504 h of phase, below 29.10°C.

Deposition rate (dg/day)	Total lysine of ration (%)	Ideal total lysine (%)	Quadratic equation
950	1.04		
1,000	1.10		
1,070	1.16	1.26	$\hat{Y}$= - 256.843+577.436 X –229.628 X^2 r^2 = 0.71
1,020	1.22		
1,070	1.28		

conditions. Cemin et. al. (2017) explains that the requirements of the fundamental amino acids add up with the addition of protein. This suggests that, deamination and excretion of excess protein nitrogen may contribute to the excretion of the first limiting amino acid of lysine. This fact would increase your requirement. The performance results evidenced that early-stage chicks require a higher lysine level to achieve a better FC ratio than a higher gain. The action of the lysine amino acid coefficients in the diet ($p<0.01$) on the protein deposition rate (dg/daytime) of chicks from 24 to 540 h of age was verified. The coefficients of the amino acid lysine of the diet prompted the protein clarification aliquot (PCA) ($p<0.08$), which was quadratically added until the coefficient corresponds to 1.26% (Table 5). These results are similar to those obtained by those who verified the efficiency of the coefficients of the amino acid lysine in the PCA in a thermo-neutral environment. It can be inferred that, the requirement of total lysine for protein deposition (1.26%) was higher than that required for weight gain (1.20%).

Table 6. Complete (dg) and relation masses of heart, liver, gizzard and intestine of 504 hours old of chicks subjected to 29.10°C.

Parameter	Total lysine level (%)					RSD (%)
	1.04	1.10	1.16	1.22	1.28	
			Absolute weight(dg)			
Heart	40	40	50	40	40	13.96
Liver	140	150	160	150	150	11.42
Intestine	240	260	250	250	250	13.04
			Relative weight (%)			
Heart	0.95	0.95	0.97	0.95	0.97	15.34
Liver	3.33	3.23	3.30	3.38	3.24	11.45
Intestine	5.53	5.61	5.38	5.42	5.47	11.96

Table 7. Since liver weight until mathematical expression squared to chicks subjected to high temperature in 29.10°C.

Liver weight (dg)	Lysine complete in diets (%)	Lysine complete doss (%)	Mathematical expression squared
33.3	1.04		
32.3	1.10		$\hat{Y} = -88.6843 + 178.405\,X - 76.3782\,X^2$
33.0	1.16	1.17	$r^2 = 1.00$
33.8	1.22		
32.4	1.28		

r^2 = is portion statistical model adjustment to the detected values. The r^2 varies between 0 and 1, indicating how much the model explains the observed values. The higher the r^2, the better it fits the sample.

It was verified that, in absolute values (dg), the 1.16% lysine factor harmonized the ascending fat building (FB) effects. Considering the constitution of the carcass, the consequence ($p>0.10$) of the coefficients of the lysine amino acid of the ration on the FB was not emphasized. These results defers from those achieved by those who found a mathematical expression squared result of the lysine coefficients in the FB of chicks between 24 to 504 h of age, when they worked in a thermo-neutral atmosphere. The absolute (dg) and relative (expressed as percentage of carcass) weights of heart, liver, gizzard and intestine of 24 h old of chicks subjected to high temperature in 29.10°C. The total lysine coefficients of the diets did not influence the integral and rational weights of the organs constituted by the small and large intestines and the heart (Table 6). Absolute liver weight of the chicks varied in a quadratic form, being the highest weight found in the level of 1.17% lysine (Table 7). The increase in absolute liver weight occurred due to the increase in the body weight of the birds, since the relative weight of the liver did not vary between treatments.

Conclusion

In this study, it was found that the coefficients of the essential amino acid lysine present in the diet influenced the yield of chicks weight gain. This yield by weight increased in a quadratic fashion up to 1.20% coefficient. This corresponds to the estimated consumption of 99.1 dg of the total amino acid lysine of the feed. The effect of the lysine coefficients of the diet is confirmed for the feed conversion, which occurs in the form of a quadratic mathematical equation. There is feed efficiency for feed conversion up to the coefficient 1.24%, which corresponds to the estimated lysine consumption of 100.7 dg. It is verified that the effect in the form of a quadratic equation of the lysine coefficients in the diet ($p<0.01$) on the rate of protein deposition in dg/day, occurs with feed efficiency of about 1.26% coefficient. The conclusion is that there was absolute (g) and relative (expressed as percentage of carcass) weights gain in gizzard, liver, heart and intestine of 504 h old chicks subjected to high temperature (29.10°C). At least in the subject of the lysine coefficients here tested, the consequence of the total lysine coefficients of the diets on the integral and unrestricted weight of the intestine and the heart was not highlighted in this paper. The absolute liver weight of the birds varied in a quadratic manner, with the highest weight found at 1.17% lysine level. The increase of the absolute weight of the liver occurs due to the increase of the body weight of the birds, since the percentage mass related to the liver does not vary in experiments.

CONFLICT OF INTERESTS

The author has not declared any conflict of interests.

ACKNOWLEDGMENTS

The authors thank the “National Council for Scientific and Technological Development – CNPq”, for financial support to this research.

REFERENCES

Ajinomoto Heartland Llc. (2014). True digestibility of essential amino acids for poultry. Ajinomoto Heartland LLC, Chicago, IL. Accessed February 2018. http://aaa.lysine.com/AATable/Ingredients.aspx.

Alhotan RA, Pesti GM (2016). Quantitative estimates of the optimal balance between digestible lysine and the true protein contents of broiler feeds. British Poultry Science 57(4):538-550.

Belloir P, Méda B, Lambert W, Corrent E, Juin H, Lessire M, Tesseraud S (2017).Reducing the CP content in broiler feeds: impact on animal performance, meat quality and nitrogen utilization. Animal 2:1-9.

Borges AF (2017). Levels of the amino-acid lysine in rations for broilers. African Journal of Agricultural Research 12(28):2365-2371.

Cemin HS, Vieira SL, Stefanello C, Kipper M, Kindlein L, Helmbrecht A (2017). Digestible lysine requirements of male broilers from 1 to 42 days of age reassessed. PLoS One 12(6):e0179665.

Cruz RF, Vieira SL, Kindlein L, Kipper M, Cemin HS, Rauber SM (2016). Occurrence of white striping and wooden breast in broilers fed grower and finisher diets with increasing lysine levels. Poultry Science 1:96(2): 501-510.

Franco SM, Tavernari FC, Maia RC, Barros VR, Albino LF, Rostagno HS, Lelis GR, Calderano AA, Dilger RN (2017). Estimation of optimal ratios of digestible phenylalanine + tyrosine, histidine, and leucine to digestible lysine for performance and breast yield in broilers. Poultry Science 96(4):829-837.

Lara LJ, Rostagno MH (2013). Impact of Heat Stress on Poultry Production. Animals. An Open Access Journal from MDPI 3(2):356-369.

Mehaisen GMK, Ibrahim RM, Desoky AA, Safaa HM, El-Sayed OA, Abass AO (2017). The importance of propolis in alleviating the negative physiological effects of heat stress in quail chicks. PLoS ONE 12(10):e0186907.

Tabassum A, Hashmi AS, Masood F, Iqbal MA, Tayyab M, Nawab A, Nadeem A, Sadeghi Z, Mahmood A (2015). Report: Bioconversion of agriculture waste to lysine with UV mutated strain of brevibacterium flavum and its biological evaluation in broiler chicks. Pakistan Journal of pharmaceutical sciences 28(4):1401-1408.

Watanabe G, Kobayashi H, Shibata M, Kubota M, Kadowaki M, Fujimura S. (2015). Regulation of free glutamate content in meat by dietary lysine in broilers. Animal Science Journal 86(4):435-442.

Zaboli GR, Rahimi S, Shariatmadari F, Torshizi MA, Baghbanzadeh A, Mehri M (2016). Thermal manipulation during Pre and Post-Hatch on thermotolerance of male broiler chickens exposed to chronic heat stress. Poultry Science 96(2):478-485.