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Evaluation of Different Digestible Lysine Levels for Male Broilers During the Period of 18 to 40 Days of Age

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ABSTRACT

A total of 1.500 male Cobb 500 broilers were used to determine the optimal digestible lysine level for 18 to 40-day-old broilers. The experimental period started when broilers were 18 days old and had an initial average weight of 737 ± 20 g. A completely randomized experimental design was applied, with five lysine levels, totaling five treatments with 10 replicates of 30 birds each. The experimental diets contained equal energy and protein levels, and 0.86, 0.95, 1.04, 1.13, and 1.22% digestible lysine. The following parameters were evaluated: average body weight at 40 days of age, daily weight gain, daily feed intake, feed conversion ratio, carcass yield and parts yield, and abdominal fat percentage. There was a quadratic effect ($p<0.05$) of digestible lysine levels on average body weight at 40 days of age, daily weight gain, and breast yield, and a cubic effect on feed conversion ratio and abdominal fat. There was no influence of lysine levels of daily feed intake, carcass yield, leg, or wing yields. It was concluded that digestible lysine requirements for male broilers during the evaluated period was 1.22% for performance and 1.04% for carcass yield.

INTRODUCTION

Genetic improvement is constantly applied in modern poultry production, and therefore broiler nutritional requirements need to be regularly updated in order to allow them to express their full genetic potential. In particular, protein inclusion in feed formulation has greatly developed during the last few years. Previously based on crude protein and total amino acids, feed formulation now applies the concept of ideal protein and digestible amino acids.

The application of the ideal protein concept allows reducing crude protein because diets contain a precise balance of essential amino acids formulated to supply the birds' nutritional requirements for maintenance and protein accretion. Moreover, the energy that is required to excrete excessive nitrogen is spared. Therefore, there is a reduction in production costs, better performance, and less environmental pollution due to lower nitrogen excretion.

Lysine is the second limiting amino acid in broiler diets. It is used as reference in the concept of ideal protein because it is strictly essential, i.e., it does not have any endogenous synthesis route. Also, there are several studies on its digestibility in many feedstuffs and on its requirements at all production phases, and the laboratory analysis to determine its content in feedstuffs, feeds, and animal tissues is accurate, and relatively simple. Moreover, its supplementation to diets is not expensive.

Several factors may affect lysine requirements, such as genetic strain, age, sex, thermal environment, stress, dietary protein and metabolizable

energy contents, and especially the feedstuffs included in feed formulation (Conhalato, 1998).

The objective of the present study was to determine the optimal digestible lysine levels for male broilers during the period of 18 to 40 days of age.

MATERIALS AND METHODS

The experiment was carried out in the experimental poultry house of a broiler company located in the state of Santa Catarina, Brazil. A total of 1,500 male Cobb 500 broilers, weighing 45.3 ± 2.5 g at housing, were used. A completely randomized experimental design was applied, with five lysine levels, totaling five treatments with 10 replicates of 30 birds each, distributed in 5.5-m^2 pens.

The sides of the experimental house were equipped with mesh and curtains, and the concrete floor was covered with reused wood-shavings litter. Feed and water were supplied *ad libitum* in tube feeders and nipple drinkers. Natural lighting was adopted. Gas brooders were used. Until 17 days of age, all birds were submitted to the feeding program and fed the nutritional levels recommended by the genetic company's manual.

The experiment started when broilers were 18 days old. Birds which body weight was ± 10% of flock average body weight were selected for the experiment (initial weight: 737 ± 20 g).

Diets were supplied as mash, and were based on corn and soybean meal, and supplemented with methionine, threonine, tryptophan, valine, isoleucine, and arginine. Diets contained equal energy and protein levels, and were formulated based on the ideal protein concept in order to prevent any amino acid limitation, except for lysine. The ingredient composition of the experimental diets is shown in Table 1.

Table 1 – Ingredient composition of the experimental diets.

Ingredients	Treatment 1	Treatment 5
Corn	623.350	624.550
Soybean meal 46%	295.100	298.000
Soybean soapstock	31.800	31.900
Phosphate 18%	13.000	13.000
Calcitic limestone	9.000	9.000
L-glutamic acid	9.000	
DL-methionine	4.100	4.050
Ground salt	4.000	3.200
L-threonine 98.5%	2.000	1.950
Mineral premix	2.000	2.000
L-valine	1.400	1.400
L-arginine 98.5%	1.400	1.400
L-isoleucine 98.5%	1.250	1.200
Vitamin premix	1.000	1.000
Sodium bicarbonate + potassium carbonate	0.800	2.250
Choline chloride 60%	0.500	0.500
L-tryptophan 98%	0.300	0.300
L-lysine 78.8%		4.300
Total	1000.000	1000.000

L-lysine (78.8%) was supplemented at the expense of L-glutamic acid, and the experimental diets therefore contained 0.86, 0.95, 1.04, 1.13, and 1.22% digestible lysine.

Two basal diets were manufactured: Treatment 1 (T1), containing 0.86% lysine and Treatment 5 (T5), containing 1.22% lysine, which were mixed to obtain the remaining treatments: Treatment 2 - 5% T1 + 25% T5, Treatment 3 - 50% T1 + 50% T5, Treatment 4 - 25% T1 + 75% T5. The nutritional content of the experimental diets are described in Table 2.

Birds, feed supply and feed residues were weekly weighed. Based on these measurements, the following

Table 2 – Nutritional levels of the experimental diets.

Nutritional levels	T1	T2	T3	T4	T5
Crude protein (%)	20.00	20.00	20.00	20.00	20.00
Metabolizable energy (kcal/kg)	3200	3200	3200	3200	3200
Calcium (%)	0.950	0.950	0.950	0.950	0.950
Available phosphorus (%)	0.440	0.440	0.440	0.440	0.440
Sodium (%)	0.190	0.190	0.190	0.190	0.190
Choline (ppm)	1400	1400	1400	1400	1400
Digestible lysine (%)	100	100	100	100	100
Digestible methionine (%)	76	69	63	58	54
Digestible methionine + cystine (%)	108	98	89	82	76
Digestible threonine (%)	93	84	77	71	66
Digestible tryptophan (%)	26	23	21	19	18
Digestible arginine (%)	148	134	123	113	105
Digestible valine (%)	107	97	88	81	75
Digestible isoleucine (%)	99	89	82	75	70

parameters were evaluated: average body weight (BW) on day 40, daily weight gain (DWG), daily feed intake (DFI), and feed conversion ratio (FCR). Daily feed intake was calculated as the difference between feed supply and feed residues, which were weighed at the beginning and end of the experimental period, divided by the number of days of feed supply. Birds were weighed at the beginning and end of the experimental period, divided by the number of days of the experimental period to determine daily weight gain. Feed conversion ratio was calculated by dividing accumulated feed intake by weight gain during the period, adjusted by feed residue weight and dead bird weight.

Mortality and flock health status (birds with abnormal development were removed) were daily monitored and recorded.

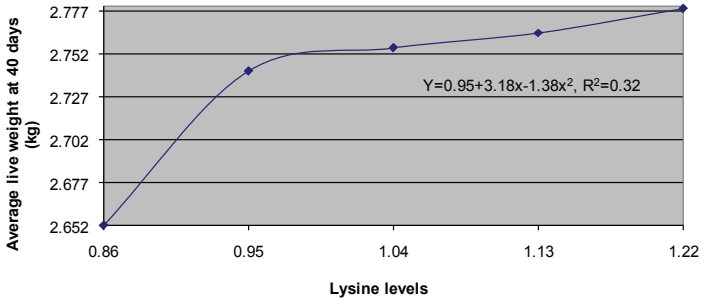
At the end of the experimental period, when birds were 40 days old, two birds representing ± 10% average body weight of each experimental unit were selected, totaling 100 birds or 10 birds per treatment. These birds were identified, submitted to 6-h feed fasting to empty the gastrointestinal tract, individually weighed, and slaughtered according to humane slaughter methods. After bleeding, plucking, manual evisceration, and head removal, carcasses were weighed. Carcass yield (CY) was calculated as empty carcass weight relative to live weight after fasting. Carcasses were then cut up by a single trained person and parts were individually weighed. Breast yield (BY), leg (thighs + drumstick) yield (LY), wing yield (WY), and abdominal fat (AF) were calculated relative to empty carcass weight.

Data were analyzed using the Statistical Analysis System package (SAS Institute Inc., 2008) after testing the residue normality by the test of Shapiro-Wilk (PROC UNIVARIATE). Performance and carcass yield data were submitted to analysis of variance using the MIXED procedure, which separated effects of treatment as causes of variation. The effect of treatment (dietary lysine levels) was evaluated using polynomial regression, separating the effects as linear, quadratic, cubic, and deviation of the cubic effect.

RESULTS AND DISCUSSION

During the period of 18-40 days of age, there was a quadratic effect ($p<0.05$) of digestible lysine levels on average body weight at 40 days of age (BW) and daily weight gain (DWG), and a cubic effect on feed conversion ratio (FCR), as shown in Table 3, and Figures 1, 2, and 3, respectively.

Figures 1 – Average body weight of male broilers at 40 days of age.



Figures 2 – Daily weight gain of male broilers between 18 and 40 days of age.

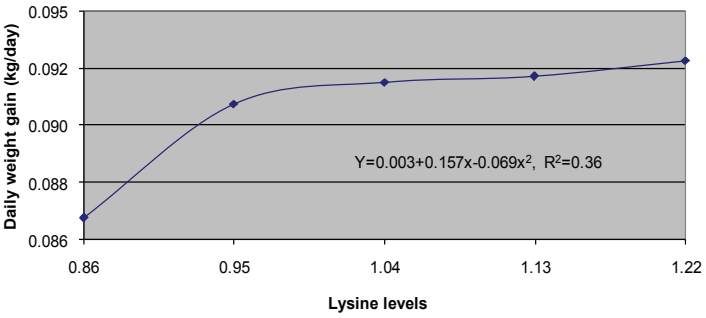
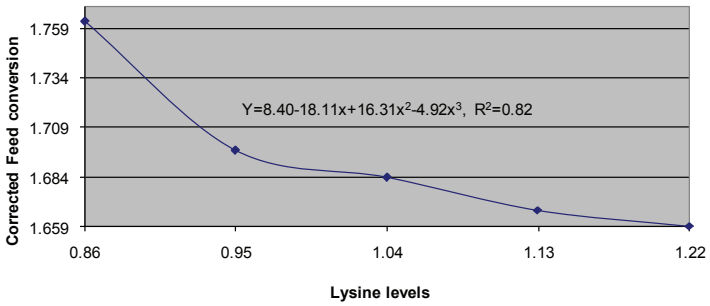


Table 3 – Performance of male broilers during the period of 18 to 40 days of age.

	Lysine levels					
Parameters	0.86	0.95	1.04	1.13	1.22	CV
BW 18 days	0.7385	0.7375	0.7349	0.7378	0.7360	1.3866
BW 40 days	2.6522	2.7422	2.7557	2.7647	2.7785	2.8237
DWG 18-40 days	0.0869	0.0911	0.0919	0.0921	0.0927	3.7465
DFI 18-40 days	0.1547	0.1553	0.1549	0.1560	0.1578	2.9717
FCR 18-40 days	1.7626	1.6976	1.6838	1.6674	1.6592	2.4067

Figures 3 – Feed conversion ratio of male broilers between 18 and 40 days of age.

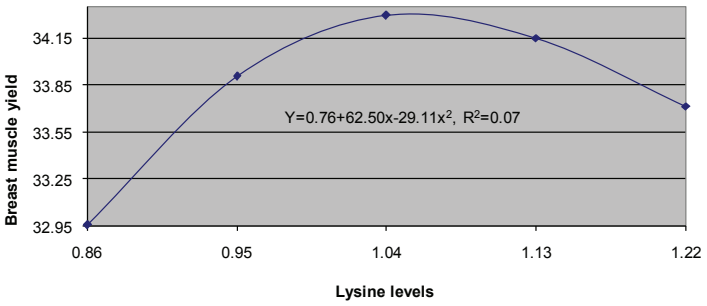


The heaviest body weight at 40 days of age, highest daily weight gain, and best feed conversion ratio were obtained in broilers fed 1.22% digestible lysine. Rostagno *et al*. (2011) recommended 1.131% digestible lysine and 19.8% crude protein dietary levels for high-performance male broilers during the period of 22 to 33 days of age, and 1.060% digestible lysine and 18.4% crude protein for the period of 34 to 42 days of age.

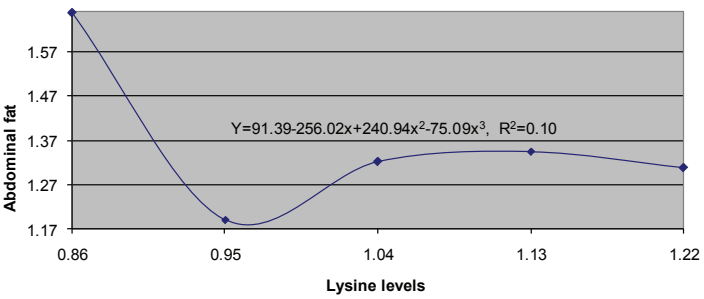
There was no influence of lysine levels of daily feed intake (DFI) carcass yield (CY), leg yield (LY), or wing yields (WY). Viola *et al*. (2009), evaluating different digestible lysine levels for male Cobb broilers, also did not find any effects on feed intake, and demonstrated that there was no compensatory intake of broilers fed limiting digestible lysine levels, consistent with the findings of Labadan *et al*. (2001) and Corzo *et al*. (2002).

There was a quadratic effect on breast yield (BY) and a cubic effect on abdominal fat (AF), as shown in Table 4 and Figures 4 and 5, respectively.

Figures 4 – Breast yield of male broilers fed different digestible lysine levels between 18 and 40 days of age.



Figures 5 – Abdominal fat yield of male broilers fed different digestible lysine levels between 18 and 40 days of age.



The greatest breast yield was obtained when 1.04% digestible lysine was fed, and the lowest abdominal fat content with 0.95% digestible lysine. This greater breast yield is due to the fact that lysine is used for body protein accretion, and in the specific case of the breast muscle, lysine is better utilized due to its type of muscle fibers (Leclercq, 1998).

The supplementation of the diet with amino acids improves carcass quality (Fancher & Jensen, 1989), particularly breast yield. However, amino acids in excess of the requirements for protein synthesis need to be broken down. The resulting nitrogen is excreted in the urine and the carbon skeleton can be used for glucose synthesis, converted in fat or in CO_2 and H_2O (Scott *et al*, 1982), thereby increasing energy metabolism.

Abdominal fat percentage is a good estimate of carcass fat percentage due to the high correlation (0.75) between them. Abdominal fat can be reduced due to lower availability of excessive energy for storage as a result of energy utilization for meat deposition in the carcass.

According to Viola *et al*. (2009), several authors obtained higher weight gain and better feed conversion ratio as digestible lysine supplementation levels increased in the diet of 21- to 40-d-old broilers (Emmert *et al*., 1999, Mack *et al*., 1999). Mack *et al*. (1999) estimated considerably higher digestible lysine requirements for feed conversion ratio (1.16%) and weight gain compared with that for breast weight gain (0.87%). Corzo *et al*. (2002) observed that feed conversion ratio linearly improved when dietary lysine

Table 4 – Carcass yield of 40-d-old male broilers fed different digestible lysine levels between 18 and 40 days of age.

	Lysine levels					
Parameters	0.86	0.95	1.04	1.13	1.22	CV
CY	80.2243	80.6635	80.7264	80.3745	80.4786	1.7452
BY	32.9593	33.9054	34.2981	34.1526	33.7163	5.3660
LY	27.3235	26.6030	26.7192	26.7677	26.8451	4.1392
WY	10.4456	10.2653	10.1232	10.1764	10.7722	5.9905
AF	1.6574	1.1909	1.3211	1.3448	1.3077	34.3958

levels increased from 0.75 to 1.15% even after 42 days of age.

Leclercq (1998) and Mack *et al*. (1999) noted that the optimal digestible lysine level is different for each evaluated parameter and should be determined in the formulation according to the parameter desired at field level. According to Leclercq (1998), lysine requirement for maximum weight gain is lower than that for breast meat yield, which is lower than for feed conversion ratio, whereas for reducing abdominal fat deposition is the highest. This relation was not observed in the present study, as digestible lysine levels for weight gain and feed conversion ratio were equal and higher than for breast yield, which in turn was higher than for abdominal fat deposition.

CONCLUSIONS

Under the conditions described in the present study, digestible lysine requirements for male broilers during the period of 18 to 40 days of age was 1.22% for performance and 1.04% for carcass yield.

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