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Digestible Lysine on Live Performance of Chicken Type Naked Neck During the Starter Phase

■Author(s)

Oliveira RG de[I]
Pinheiro SRF[II]
Castro MR de[II]
Vieira DJ[II]
Pires AV[II]
Abreu LRA de[II]

[I] Department of Animal Science, Federal University of the Jequitinhonha and Mucuri Valleys, 39100-000, Diamantina, Minas Gerais, Brazil.
[II] Department of Animal Science, Federal University of the Jequitinhonha and Mucuri Valleys, 39100-000, Diamantina, Minas Gerais, Brazil.

■Mail Address

Corresponding author e-mail address
Sandra Regina Freitas Pinheiro
Department of Animal Science, Federal University of the Jequitinhonha and Mucuri Valleys, 39100-000, Diamantina, Minas Gerais, Brazil.
Email: sandrafreitaspinheiro@gmail.com

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ABSTRACT

The poultry market has changed due to a higher consumer interest on products with differentiated organoleptic characteristics, making of free-range broiler production a promising activity. This experiment was conducted to determine the digestible lysine requirements of Redbro Cou Nu male and female chickens during the starter phase (one to 21 days of age). Six hundred and thirty Redbro Cou Nu broilers were distributed into 30 pens (21 chickens/pen) according to a randomized complete design in a 5 x 2 factorial arrangement, consisting of five levels of digestible lysine and two sexes, with three replicates (pens) per treatments. Diets with increasing digestible lysine levels (8.1, 9.5, 10.9, 12.3 and 13.7 g of digestible lysine per kg of diet) were offered *ad libitum*. The following performance traits were evaluated at the end of the experiment (d 21): feed intake, lysine intake, body weight gain, and feed conversion ratio. No interaction between dietary lysine level and sex was observed for the evaluated traits. The effect of sex was only detected on body weight gain, while effects of dietary lysine level were only detected on the feed intake. Males presented higher body weight gain than females. Lysine intake and body weight gain increased, and feed conversion ratio decreased as the level of dietary lysine increased. The best feed conversion ratio was obtained when birds were fed 12.95 g of digestible lysine per kg of diet.

INTRODUCTION

The rearing of free-range broilers for meat production, which provides better animal welfare, food safety, sensory meat quality, and environmental care, is a promising alternative in poultry production. Although the demand for free-range broilers has increased (Cunha Filho, 2014), the nutritional requirements for these birds are very little studied compared with industrial broilers. In order to obtain the maximum efficiency in the production of free-range broiler chickens, a feeding program needs to be established for feed formulation (Pinheiro *et al.*, 2011a).

The main ingredients used in poultry feed formulation are corn and soybeans, which amino acid profile is not always adequate to supply birds' needs. Excessive protein supply or imbalance among amino acids may compromise the performance of broiler chickens may cause an excessive load of amino acids in the bloodstream, requiring extra energy expenditure to metabolize and excrete nitrogen as uric acid (Oliveira Neto & Oliveira, 2009).

Therefore, determining the amino acid requirements to obtain optimum growth and carcass yield is extremely important for the success of poultry production. Hence, the objective of this work was to evaluate the effect of increasing levels of dietary digestible lysine on

the performance of male and female Redbro Cou Nu chickens during the starter phase (1 to 21 days of age).

MATERIAL AND METHODS

This experiment was approved (protocol #003/2012) by the Animal Use Ethics Committee and carried out in October of 2012 at the Poultry Sector of the Department of Animal Science at Federal University of the Jequitinhonha and Mucuri Valleys, in Diamantina city, Minas Gerais state, Brazil.

Chicks were housed in 30 pens located inside a poultry house with fiber cement roof, 2.5-cm ceiling height, open sides with galvanized-iron screens fitted with raffia curtains, and concrete floor (4 m^2) with wood-shavings litter (~ 5 cm thick), was equipped with feeders and drinkers. A total of 630 one-d-old naked neck chickens with red plumage, yellow skin and legs, of the Redbro Cou Nu strain, with 36 g initial average weight, were allocated in the 30 pens. A completely randomized design with a 5 x 2 factorial arrangement was applied, consisting of dietary digestible lysine level and sex as main factors, with three replicates of 21 chickens/pen.

Diets were basically formulated with corn, soybean meal, and crystalline amino acids (methionine, threonine, tryptophan, valine, isoleucine and arginine) to meet the nutritional requirements of chickens (Table 1). The calculations described by Pinheiro *et al.* (2011b,c) were used to meet phosphorus and calcium

Table 1 – Composition of the experimental diets (%) fed to Redbro Cou Nu chickens during the starter phase (one to 21 days).

Ingredients	Digestible lysine (g/kg of diet)				
	8.100	9.500	10.900	12.300	13.700
Ground corn	65.662	65.662	65.662	65.662	65.662
Soybean meal (45%)	26.663	26.663	26.663	26.663	26.663
Dicalcium phosphate	1.529	1.529	1.529	1.529	1.529
Soybean oil	0.100	0.100	0.100	0.100	0.100
Limestone	1.269	1.269	1.269	1.269	1.269
Salt	0.495	0.495	0.495	0.495	0.495
Mineral premix [1]	0.050	0.050	0.050	0.050	0.050
Vitamin premix [2]	0.100	0.100	0.100	0.100	0.100
Corn starch	0.100	0.600	0.700	0.900	1.669
L-Glutamic (99%)	3.899	3.130	2.432	1.521	0.039
L-Lysine HCl (79%)	0.000	0.141	0.281	0.421	0.561
DL-Methionine (99%)	0.093	0.197	0.299	0.402	0.504
L-Tryptophan (99%)	0.000	0.000	0.000	0.022	0.046
L-Threonine (99%)	0.000	0.024	0.114	0.207	0.300
L-Valine (99%)	0.000	0.000	0.097	0.205	0.313
L-Isoleucine (99%)	0.000	0.000	0.061	0.155	0.249
L-Arginine (99%)	0.000	0.000	0.109	0.260	0.412
Choline chloride (60%)	0.040	0.040	0.040	0.040	0.040
Total	100.000	100.000	100.000	100.000	100.000
	Calculated Composition				
Crude protein (%)	19.500	19.270	19.440	19.630	19.500
Metabolizable energy (kcal/kg)	2952	2958	2966	2975	2989
Calcium (%)	0.950	0.950	0.950	0.950	0.950
Available phosphorus (%)	0.394	0.394	0.394	0.394	0.394
Sodium (%)	0.215	0.215	0.215	0.215	0.215
Digestible lysine (%)	0.810	0.951	1.090	1.230	1.370
Digestible methionine+cystine (%)	0.583	0.685	0.785	0.886	0.986
Digestible methionine (%)	0.338	0.441	0.542	0.644	0.746
Digestible threonine (%)	0.596	0.619	0.708	0.799	0.890
Digestible tryptophan (%)	0.188	0.188	0.188	0.209	0.233
Digestible valine (%)	0.742	0.742	0.839	0.947	1.055
Digestible isoleucine (%)	0.670	0.670	0.730	0.824	0.918
Digestible arginine (%)	1.069	1.069	1.177	1.328	1.480

[1] per kilogram of product: manganese, 75.000 mg, iron, 50.000 mg, zinc, 70.000 mg, copper, 8.500 mg, cobalt, 200 mg, iodine, 1.500 mg, and vehicle qsp 1.000 g.

[2] per kilogram of product: Vitamin A - 12 million IU, vit. D3 – 2.200.000 IU, vit. E - 30 g, vit. B1 - 2.2 g, vit. B2 - 6 g, vit. B6 - 3.3 g, vit. B12 - 0.016 mcg, pantothenic acid - 13 g, vit. K ¬ 3 to 2.5 g, folic acid - 1g, antioxidant - 100.000 mg, and vehicle qsp - 1.000 g.

requirements. Other nutritional requirements were met according to the calculations of Rostagno *et al.* (2011) for diets to provide the ideal ratio between amino acids and lysine and broilers with regular performance. The increasing levels of digestible lysine tested were 8.1, 9.5, 10.9, 12.3, and 13.7 g of digestible lysine per kg of diet. L-lysine HCl was added to the diets at the expense of cornstarch and glutamic acid.

Throughout the experimental period, the birds received feed and water *ad libitum*. The following performance traits were evaluated at the end of the experiment: feed intake (g/chicken), lysine intake (g/chicken), body weight gain (g/chicken), and feed conversion ratio (g feed intake/g weight gain). In addition, average maximum and minimum house temperatures were daily recorded at 8 am and 6 pm. No lighting program was applied; chickens were exposed only to natural light.

Data were submitted to analysis of variance using the GLM procedure of the Statistical Analysis System (SAS, 2008) to verify possible main effects of the studied factors and their interactions. Means were compared by the F test at 5% probability level. When a significant (P<0.05) main effect of dietary lysine level was detected in the analysis of variance, a regression analysis was then performed using the REG procedure of the SAS. In order to check the best data fit, the sum of squared deviations, the significance of the F test, and the coefficient of determination were considered. In order to determine the best dietary level of lysine for the traits evaluated both linear and quadratic equations were tested.

RESULTS AND DISCUSSION

The average maximum and minimum temperatures were 37.1 and 23.5°C, respectively. According to Macari *et al. (*2004) and Abreu *et al.* (2007), the ideal room temperature to provide thermal comfort for broiler chickens should be 30-32° C in first week of age, 28-30° C in the second week, 26-27° C in the third week, 23-26° C in the fourth week, 20-23° C in the fifth week, and 20° C in the sixth and seventh weeks. Some studies have demonstrated that naked-neck broiler chickens have a higher resistance to high temperatures, because they are able to dissipate more heat in function of a reduction of up to 40% in the number of feathers and, therefore, should be chosen for hot climates (Silva *et al.*, 2001; Fukayama *et al.*, 2005).

There was no significant interaction (P≥0.05) between dietary lysine level and sex for the traits studied in this experiment (Table 2). However, a main effect of sex was only detected (P<0.01) for the body weight gain. Dietary digestible lysine levels did not influence (P≥0.05) feed intake, but affected (P<0.01) lysine intake, body weight gain, and feed conversion ratio.

Because there were no differences (P≥0.05) in feed intake due to increasing levels of dietary digestible lysine levels (Table 2), it is possible to assert that the ideal ratio between essential amino acids and lysine was maintained in the experimental diets, which were formulated according to ideal protein concept. These

Table 2 – Effect of dietary digestible lysine level and sex on the feed intake, lysine intake, body weight gain, and feed conversion ratio (FCR) of Redbro Cou Nu chickens from 1 to 21 days of age.

Parameter	Sex (S)	Digestible lysine (g/kg diet)					Mean	CV (%)	p value		
		8.10	9.50	10.90	12.30	13.70			LYS	S	LYS × S
Feed intake, g	Male	710	720	669	733	731	713	3.6	0.33	0.16	0.72
	Female	680	725	668	713	708	699				
	Mean	695	722	668	723	719	-				
Lysine intake, g	Male	5.75	6.84	7.29	9.01	10.02	7.78	3.8	<0.01	0.17	0.76
	Female	5.51	6.89	7.28	8.77	9.69	7.63				
	Mean	5.63	6.86	7.28	8.89	9.85	-				
Body weight gain, g	Male	393	420	420	469	461	432[a]	3.3	<0.01	<0.01	0.19
	Female	368	431	400	444	445	418[b]				
	Mean	380	425	410	456	453	-				
FCR, g:g	Male	1.81	1.71	1.59	1.60	1.59	1.66	2.3	<0.01	0.19	0.21
	Female	1.85	1.68	1.67	1.61	1.59	1.68				
	Mean	1.83	1.70	1.63	1.60	1.59	-				

CV = coefficient of variation; LYS= lysine; S= sex. Means followed by different letters in the same column are different by the test F at 5% probability level (p<0.05)

results also demonstrate that the supply of all amino acids was adequate.

Likewise, in other studies, dietary digestible lysine levels did not influence the feed intake of naked-neck chickens between 1 and 28 days of age (Nascimento *et al.*, 2009) or of Cobb chickens between 8 and 21 days of age (Haese *et al.*, 2012). On the other hand, feed intake and final body weight reductions were observed in naked-neck chickens between 1 and 28 days of age when dietary digestible lysine levels increased (Oliveira *et al.*, 2013). According to the authors, these findings were observed because of the imbalance among the amino acids in the diets.

As expected, lysine intake (LI) linearly increased ($P<0.01$) as dietary digestible lysine levels increased (Table 2). This increase in LI may be attributed to the increase of digestible lysine levels in the diet, because feed intake was not affected. The following equation predicted lysine intake: LI = –0.42202 + 7.44780*LYS ($R^2 = 0.95$). A linear increase of LI as a function of increasing levels of dietary lysine was also observed in previous studies (Siqueira *et al.*, 2007; Haese *et al.*, 2012 and Oliveira *et al*., 2013).

The increasing dietary digestible lysine levels also caused a linear increase ($P<0.01$) in body weight gain (BWG) in naked-neck chickens (Table 2). The linear equation estimated to predict the BWG was: BWG = 0.2877 + 0.1258*Lys ($R^2 = 0.60$). The increase in BWG due to increasing dietary digestible lysine levels may be explained by a higher absorption of digestible lysine, resulting in higher protein deposition in the muscle. Higher BWG between 1 and 21 days of age was also verified in broiler chickens fed higher levels of dietary lysine (Barboza *et al.*, 2000; Cella *et al.*, 2009).

There also was an effect of sex ($P<0.01$) on the BWG of these chickens (Table 2). Males presented higher ($P<0.01$) BWG compared with females. This result may be attributed to the lower maintenance and gain requirements of males in relation to those of females (Hurwitz *et al.*, 1978; Longo *et al.*, 2006). Similar response pattern was also verified in Hubbard chickens between 1 and 21 days of age in a previous study (Barboza *et al.*, 2000).

The feed conversion ratio (FCR) of Redbro Cou Nu chickens was only influenced ($P<0.01$) by dietary digestible lysine levels (Table 2). Feed conversion ratio data fitted either a decreasing linear equation (FCR = 2.1206 – 0.4126*LYS; $R^2 = 0.73$) or a quadratic equation (FCR = 3.2829 – 2.6169*LYS + 1.0099*LYS^2, $R^2 = 0.85$). A lower FCR was estimated in the quadratic equation when the birds were fed 12.95 g of lysine per kg of diet. At this level of dietary lysine, the estimated lysine intake was 9.22 g. On the other hand, the recommendations for Redbro Cou Nu chickens suggest 1% total dietary lysine (Globoaves, 2011). However, according to Nascimento *et al.* (2009), higher lysine intakes could promote higher muscle deposition and lower carcass fat accumulation, resulting in better FCR in chickens. Lower FCR for males and females broiler chickens were previously estimated at dietary lysine levels of 1.22 and 1.24%, respectively (Bernal *et al.*, 2014).

According to the performance results obtained in the present study, the level of 12.95 g of digestible lysine per kg of diet at an estimated lysine intake of 9.22 g is recommended for Redbro Cou Nu broilers during the starter phase (one to 21 days of age).

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