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Digestible lysine for 63 to 103 day-old barrows of genetic lines selected for lean deposition

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ABSTRACT - Ninety-six barrows from 63 to 103 days of age were used to evaluate the effects of dietary digestible lysine levels on performance and carcass traits of two genetic lines selected for lean deposition. Pigs with initial body weight of 23.800 ± 1.075 kg were allotted in a completely randomized block design, within a 4 × 2 factorial arrangement (four digestible lysine levels: 0.80, 0.90, 1.00, 1.10%, and two genetic lines), with six replicates and two pigs per experimental unit. There was no interaction between genetic and digestible lysine levels. The digestible lysine levels also did not influence performance or carcass traits of pigs; however, average daily lysine intake increased with increasing digestible lysine level in the experimental diets. Pigs from genetic line B had better carcass traits when compared with those from genetic line A. The level of 0.80% digestible lysine corresponding to a daily intake of 16.60 g digestible lysine meets the nutritional requirement of pigs from both genetic lines evaluated, from 63 to 103 days of age.

Key Words: amino acids, carcass, genotype, growing, performance

Introduction

Values of amino acids' digestibility must be taken into account in the formulation of pigs' diet to reduce costs and maximize animals' performance. Thus, studies to determine the digestible amino acid requirements of pigs at specific stages of production are essential to allow optimal expression of their genetic potential for meat deposition.

Lysine is the first limiting amino acid in corn and soybean meal based diets for pigs, and is also one of the main nutrients directly responsible for muscle deposition, due to its constancy in body protein and destination primarily to the deposition of lean tissue. Therefore, the responses of performance and lean gain of pigs may be associated with the level of lysine in the diet (Oliveira et al., 2003).

In experiments to determine the requirement of digestible lysine, it is essential to consider the ratios of the essential amino acids with lysine in the diets to avoid variations in the pigs' performance. When the level of supplementation of an essential amino acid is inadequate, performance may be limited by the amino acid that is deficient in the diet, although the level of dietary lysine is adequate.

As genetic companies constantly offer new strains of pigs with high capacity for meat production, research is needed to determine the digestible lysine requirements of these new strains or performance may be compromised.

Thus, this study was conducted to evaluate levels of digestible lysine in diets for barrows 63 to 103 days of age from two genetic lines selected for meat deposition.

Material and Methods

The experiment was conducted at the Setor de Suinocultura in Departamento de Zootecnia, Universidade Federal de Viçosa, Viçosa, Minas Gerais, during March and April of 2007.

Ninety-six barrows (48 line A and 48 line B) were selected for meat deposition, with initial body weight of 23.800 ± 1,075 kg, allotted in a completely randomized block design, within a 4 × 2 factorial arrangement (four digestible lysine levels and two genetic lines), with six replications and three pigs per experimental unit. Body weight and genetic line were considered as criterion in the blocks formation.

Pigs were housed in pens of 3 m^2, equipped with semi-automatic feeders and drinkers, located in a concrete floor facility, covered with ceramic tiles.

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Experimental diets (Table 1) were formulated to meet the nutritional requirements of pigs in the growth phase, according to the nutritional recommendations of Rostagno et al. (2005), except for digestible lysine. The treatments corresponded to the levels of 0.80, 0.90, 1.00, and 1.10% digestible lysine, obtained from a basal diet supplemented with L-lysine HCl replacing starch.

In all diets, the ratios between the digestible amino acids and lysine were checked to ensure that no essential amino acid was deficient. In the evaluation of amino acid ratios with lysine, those recommended by Rostagno et al. (2005) in the ideal protein were used.

Diets and water were supplied *ad libitum* to pigs throughout the experimental period (63 to 103 days of age). Diets, leftovers and waste were weighed weekly, and pigs were weighed at the beginning and at the end of the experimental period to determine weight gain, feed intake, digestible lysine intake and feed conversion.

At the end of the experiment, to evaluate loin-eye area (LEA) and backfat thickness (BF) of pigs, an ultrasonic apparatus (Aloka SSD 500) was used, and measurements were taken between the tenth and eleventh ribs. AOL and ET were later calculated using the computer program AUSKey System V-5.0. The amount of meat in the carcass was obtained from the formula proposed by Cline et al. (2000):

Meat (kg) = 9.77 + (0.343 × hot carcass weight, kg) – (0.291 × BF mm)

The performance variables (weight gain, feed intake, digestible lysine intake and feed conversion) and carcass traits (loin-eye area, backfat thickness and amount of meat) were analyzed using the procedures for analysis of variance and regression contained in the Sistema para Análises Estatísticas e Genéticas (SAEG), developed at Universidade Federal de Viçosa (UFV, 2000), version 9.0.

Results and Discussion

There was no interaction (P>0.05) between lysine levels and genetic lines for performance and carcass traits.

Regardless of genetic lines, the levels of lysine did not influence (P>0.05) average daily weight gain (ADG) of pigs (Table 2), this result is similar to those obtained by Owen et al. (1994), Gomes et al. (2000) and Abreu et al. (2007), who assessed levels of 0.80 to 1.15% digestible lysine for growing barrows and also found no effect of treatments in the growth rate of pigs.

Table 1 - Percentage and calculated composition of experimental diets

Ingredient	Digestible lysine levels (%)			
	0.80	0.90	1.00	1.10
Corn	67.300	67.300	67.300	67.300
Soybean meal	26.600	26.600	26.600	26.600
Nucleous[1]	4.000	4.000	4.000	4.000
Soybean oil	0.870	0.870	0.870	0.870
Starch	1.170	1.008	0.738	0.433
Growth promoter	0.050	0.050	0.050	0.050
BHT	0.010	0.010	0.010	0.010
L-lysine HCl	0.000	0.129	0.259	0.387
DL-methionine	0.000	0.025	0.088	0.150
L-threonine	0.000	0.008	0.081	0.153
L-tryptophan	0.000	0.000	0.004	0.023
L-valine	0.000	0.000	0.000	0.024
Total	100.00	100.00	100.00	100.00
Calculated nutritional composition[2]				
Crude protein (%)	17.680	17.830	18.040	18.270
Metabolizable energy (kcal/kg)	3200	3200	3200	3200
Digestible lysine (%)	0.800	0.900	1.000	1.100
Digestible tryptophan (%)	0.187	0.187	0.191	0.210
Digestible threonine (%)	0.587	0.595	0.661	0.726
Digestible met + cys (%)	0.524	0.549	0.610	0.671
Digestible isoleucine (%)	0.668	0.668	0.668	0.668
Digestible valine (%)	0.746	0.746	0.746	0.770
Calcium (%)	0.665	0.665	0.665	0.665
Available phosphorus (%)	0.340	0.340	0.340	0.340

[1] Provided per kg of product: vitamin A – 93,000 UI; vitamin D3 – 24,000 UI; vitamin E – 106 mg; vitamin K3 – 53 mg; thiamin – 13.3 mg; pantothenic acid – 173 mg; biotin – 0.42 mg; pyridoxine – 13.3 mg; vitamin B6 HCl – 8.8 mg; folic acid – 520 mg; vitamin B12– 7.000 mg; calcium (minimum) - 112 g; phosphorus (minimum) – 27 g; sodium – 58.5 g; iron – 1,820 mg; zinc – 2,049 mg; copper – 2,126 mg; manganese – 836 mg; iodine – 29.5 mg; fluorite (maximum) – 485 mg; selenium – 8 mg; cobalt – 3.6 mg.

[2] Values estimated based on the digestibility coefficients of amino acids of ingredients, according to Rostagno et al. (2005).

Table 2 - Performance and carcass traits of barrows from two genetic lines fed on diets containing four digestible lysine levels

Variable[1]	Digestible lysine level (%)				Line		CV (%)
	0.80	0.90	1.00	1.10	A	B	
Initial weight (kg)	23.9	23.7	23.8	23.7	24	23.5	2.31
Final weight (kg)	61.7	61.9	61.6	61.9	62.4	61.1	4.43
ADG (g)	944	956	946	954	962	938	7.00
ADFI (g)	2077	2065	2078	2110	2112	2052	6.80
F:G	2.20	2.16	2.20	2.21	2.20	2.19	4.71
ADLI[2]	16.6	18.6	20.8	22.0	20.0	19.4	6.07
LEA	23.3	23.6	23.0	23.6	22.5b	24.25a	9.24
BF (mm)	13.1	13.5	14.2	12.0	14.4a	12.1b	21.67
Amount of meat (kg)	22.1	22.0	21.8	22.6	21.7b	22.6a	4.72

Different letters on the same row are different by F test at 5% probability.
[1] ADG = average daily gain; ADFI = average daily feed intake; F:G = feed conversion; ADLI = average daily lysine intake; LEA = loin-eye area; BF = backfat thickness.
[2] Linear effect (P<0.01).

On the other hand, Fontes et al. (2005), testing lysine levels (0.80, 0.90, 1.00, and 1.20%) in diet for 30 to 60 kg gilts found a linear increase in ADG. Similarly, Souza et al. (2008) in a study with female and castrated male pigs from 60 to 95 days of age assessed dietary lysine levels ranging from 0.85 to 1.15% and found a linear effect of the lysine levels in the ADG of pigs.

The ADG of 950 g obtained in this study was similar to the values 944 and 951 g found by Owen et al. (1994) and Fontes et al. (2000), respectively, and higher than the values of 910, 893 and 757 obtained by Fontes et al. (2005), Haese et al. (2006) and Souza et al. (2008). Besides ambient temperature and pigs' health standard (Williams et al., 1997; LeFloc'h et al., 2004; Trevisi et al., 2009), the inconsistency in the response of ADG in relation to the digestible lysine levels in the diets verified among studies may be due to differences in the genetic potential of pigs for lean gain. According to Stahly et al. (1994), the intensity of ADG response related to the lysine concentration in the diet depends on the genetic potential of pigs.

Confirming these propositions, Gasparoto et al. (2001), in a study to evaluate lysine requirements of pigs from different genetic groups concerning their growth potential, found that the response of ADG to the levels of lysine varied according to the genetics.

According to Yen et al. (1986), the responses of performance and carcass meat deposition in pigs may be associated with the level of dietary lysine due to the requirement in a larger quantity of this amino acid for protein deposition and its high concentration in muscle tissues. Based on these considerations, the fact that in this study pigs of different genetic lines have shown similar (P>0.05) values of ADG may have contributed to the absence of effect in the lysine requirements among them.

There was no effect (P>0.05) of the lysine levels on average daily feed intake (ADFI) nor variation (P>0.05) in this parameter between pigs of different genetic lines, showing that feed intake capacity was not a significant variable to differentiate the two lines.

In a similar way, Donzele et al. (1994), Fontes et al. (2000), Gasparoto et al. (2001), Abreu et al. (2007), Souza et al. (2008) and Fisher et al. (2009) also found no effect of dietary lysine levels on feed intake of growing pigs.

The consistency of results among studies with respect to the effects of lysine level in ADFI is an indication that pigs do not adjust their voluntary intake to meet lysine requirements, contrary to what occurs in the case of tryptophan (Ettle & Ruth, 2004). This proposition is consistent with the data of Owen et al. (1994), who evaluating diets with different lysine concentrations (0.50, 1.1, and 1.60%) fed in the system of free choice found that pigs were not able to regulate their intake due to the lysine concentration in the diets. In the same sense, Edmonds & Baker (1987) stated that excess of lysine and other amino acids did not influence feed intake by pigs. On the other hand, according to Kerr et al. (2003), the imbalance of amino acids in the diet may result in changes in pigs' voluntary consumption. However, in this study, there was no amino acid imbalance as diets were supplemented with industrial amino acids, maintaining the ratios with lysine.

There was effect (P<0.05) of lysine levels in the average daily lysine intake (ADLI), which increased linearly according to the equation: $\hat{Y} = 0.4802 + 21.2818X$ ($r^2 = 0.99$). Several authors, among them, Friesen et al. (1994), Fontes et al. (2000, 2005), Gasparoto et al. (2007), and Abreu et al. (2007) also found a linear increase in lysine intake due to its increasing levels in the diets. The fact that the ADFI of pigs did not vary among lysine levels justifies the direct relationship between the daily intake of lysine and its concentration in the diet.

There was no effect (P>0.05) of lysine level on feed conversion (FC) of pigs (Table 2). These results are consistent with those obtained by Gasparoto et al. (2001) and Haese et al. (2006), who found no variation in the feed efficiency for weight gain when evaluating lysine levels for growing barrows. In contrast, conducting studies to evaluate levels of lysine for growing pigs, Friesen et al. (1994), Smith et al. (1999), Fontes et al. (2000), Abreu et al. (2007) and Souza et al. (2008) observed significant variation in pigs' feed conversion.

The divergence of results between studies may be related to differences in the genetics of pigs used concerning the capacity of protein deposition in the carcass. According to Campbell & Taverner (1998), the selection of pigs to improve feed efficiency has resulted in animals with higher potential for meat gain.

There was no difference (P>0.05) in feed conversion of pigs from the different lines evaluated in this study. Based on these data, one can infer that although genetically different, pigs showed a similar capacity for growth and feed efficiency, thus justifying the fact that no significant interaction occurred between the levels of lysine and the genetic groups of pigs.

In the evaluation of carcass traits, there was no effect (P>0.05) of lysine levelson loin-eye area (LEA) nor on the amount of meat (AM) in the carcasses. These results are similar to those obtained by Smith et al. (1999), who evaluated the effect of lysine with calorie in the diets on the performance and carcass traits of for growing-finishing pigs, and found no effect on loin depth. Similarly, Power et al, (2000) also found no effect of lysine levels on protein deposition in the carcasses of growing gilts.

In contrast, in a study conducted with growing pigs, Friesen et al. (1994) verified significant variation in the values of loin-eye area due to the increased levels of lysine. In the same way, Abreu et al. (2007) found significant effect of lysine levels on carcass protein deposition in castrated male pigs from 30 to 60 kg.

The differences in the results between studies are probably related, among other factors, to differences in pigs' genetics. Assessing the lysine requirement of barrows from two genetic groups in the growth phase, Gasparoto et al. (2001) found that the effect of lysine level in loin depth (LD) varied according to the genetics of pigs.

Although there was no interaction between the levels of lysine and genetic lines, pigs from line B had higher (P<0.05) values of LEA and amount of meat in the carcass compared with those of line A. However, the increases corresponding to 7.70% and 4.20% for LEA and amount of meat in the carcass of pigs from line B, respectively, were not sufficient to alter performance concerning growth rate and feed efficiency. Likewise, no change was observed (P<0.05) in backfat thickness (BF) of pigs with increasing lysine levels, a fact also observed by Gasparotto et al. (2001), who, assessing lysine levels for barrows from two genetic groups in the growth phase, found no effect of treatments in backfat thickness measured at the P_2, regardless of the genetics of pigs. The values obtained are similar to those of Friesen et al. (1994), who observed no significant variation in the values of backfat thickness of pigs due to increased levels of lysine. More recently, Abreu et al. (2007) also found no variation in the percentage or amount of fat deposition in the carcass of barrows from 30 to 60 kg increasing the concentration of dietary lysine.

In contrast with this result, Fontes et al. (2005) observed a reduction in the percentage and amount of fat in the carcass of growing gilts associated with the increase of lysine in the diet. The results of the effects of dietary lysine concentration in the amount of fat in the carcass are not consistent and indicate that this variable is not adequate to establish the requirements of pigs.

The best results for LEA and the amount of meat in the carcass of pigs from line B are compatible with the lower (P<0.05) backfat thickness value of this line. The fact that the line B pigs have shown lower value of BF, but equal ADG value in relation to line A pigs, is consistent with the results of Van Lunem & Coli (1996), who found that by increasing the lysine:energy relation of the diet results in reduction of backfat thickness, with no change in the rate of pigs' growth.

The results of carcass traits evaluated in this study are similar to those obtained by Unruh et al. (1996), who evaluated the influence of genotype, sex and lysine levels on carcass quality of pigs and concluded that lysine had minimal effect on carcass traits.

The level of 0.80% digestible lysine, corresponding to a daily intake of 16.6 g, meets the requirements of pigs of the two genetics lines for performance and carcass traits, characterizing the pigs used in this study as having average genetic potential for meat deposition in the carcass, according to information by Rostagno et al. (2005), which sets the digestible lysine requirement at 16.19 g, for this category of pigs.

Conclusions

The level of 0.80% digestible lysine, corresponding to a daily intake of 16.60 g, meets the nutritional requirements of barrows selected for lean deposition in the phase of 63 to 103 days of age.

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