EFFECT OF LEAN MEAT PROPORTION AND GENDER ON AMINO ACID CONTENT IN PORK

Okrouhlá M., Stupka R., Čítek J., Šprysl M., Brzobohatý L., Vehovský K., Kluzáková E.

Czech University of Life Sciences, Prague, Czech Republic

Abstract

The aim of this research was to evaluate the effect of lean meat proportion and gender on amino acid content in carcass parts loin and ham. A total of 116 finishing hybrid pigs commonly used in the Czech Republic were fattened. The pigs were divided into 6 groups according to three lean meat proportion criterion (more than 60.0%, 55.0 – 59.9% and 50.0 – 54.9%) and according to gender (barrows and gilts). The amino acids in the carcass part musculus longissimus lumborum et thoracis (MLLT) expect nonessential amino acid proline were not influenced by lean meat proportion and gender. Higher ($P < 0.05$) share of proline in MLLT had gilts with lean meat proportion 55.0 – 59.9% contrary to barrows with same lean meat proportion. Significantly ($P < 0.05$) the highest values of amino acids threonine (7.15%), phenylalanine (1.88%) and serine (6.28%) were detected in the carcass portion musculus semimembranosus (MS) in gilts with lean meat proportion more than 60.0% contrary to gilts from other two treatments. In addition, the values of valine, phenylalanine, serine, proline in barrows and threonine, valine, isoleucine, phenylalanine, aspartic acid, serine, glycine and alanine in gilts in MS increased with an increasing lean meat proportion.

Key Words: Pig; lean meat proportion; gender; amino acids.

Amino acids (AA) are building blocks for tissue proteins and essential substrates for the synthesis of many low-molecular-weight substances (e.g., NO, polyamines, glutathione, creatine, carnitine, carnosine, thyroid hormones, serotonin, melanin, melatonin, and heme) with enormous physiological importance (Wu, 2009). Based on the growth or nitrogen balance of animals, AA have been traditionally classified as nutritionally ‘‘essential’’ or ‘‘nonessential’’. The concentration for each amino acid is important for its contribution to taste (Kato, et al., 1989). In fact, it has been established that oxidative muscles are tastier than glycolytic ones (Valin, et al., 1982) and this has been partly attributed to the content of free amino acids and dipeptides (Cornet and Bousset, 1990). Also Aristoy and Toldrá (1998) evaluated the free amino acids and dipeptides in pork meat, namely in the muscles of diverse metabolic types (*masseters, trapezius, semimembranosus* and *longissimus dorsi*). The objective of this study was to determine the influence of the attained lean meat proportion and gender on the amino acids composition of pork.

Material and Methods

Animals

The experiment was performed at the pig breeding test station in Ploskov at Lány. A total of 116 slaughter pigs of a final hybrid combination bred in the Czech Republic were used for this purpose. All of the pigs were penned pairs and divided according to sex (gilts, barrows). The pigs were placed in the experiment at an average live weight of 23.6 kg (the same age and well-balanced sex ratio - barrows /gilts) and at an average age of 65 to 70 days after the date of birth.

Diet

Feeding was provided by means of a full feed mixture (FFM) which contained three components (wheat, barley, soybean extracted meal) and premix. The pigs were slaughtered and subjected to carcass analysis after reaching an overall average live weight of 111.6 kg at the age of 168-171 days after birth. The pigs were then commercialized in a slaughterhouse by the SEUROP system. The lean meat proportion of the pigs was evaluated by the ZP method [Pulkrábek (2001), Pulkrábek et al. (2004)] and further subjected to carcass analysis. 116 finishing pigs were divided into 3 groups according to the lean meat proportion and gender (Table1).

Amino acid analysis

The right half-carcass was dissected into individual parts. Samples were taken from the loin (*musculus longissimus lumborum et thoracis)* and ham (*musculus semimembranosus).* Representative ones were homogenized and subjected to chemical analyses to determine the content of amino acid (analysis of the hydrolysis product with an automatic analyzer AAA 400 and evaluation by the ChromuLan programme).

Statistical analyses

The results of the experiment were evaluated with the statistical program SAS® Propriety Software Release 6.04 (2001) using analysis of variance (ANOVA). The differences between the individual traits were tested *via* a GLM procedure.

Results and Discussion

The amino acid content in relation to proportion of lean meat and gender are showed in Table 2 and 3. As is evident from Table 2, the values of selected amino acids in carcass part loin in the group with 60.0% or more of lean meat share were higher (except phenylalanine and glutamic acid) in gilts than barrows. Also, group with 55.0 to 59.9% of lean meat share showed in most of amino acids (except phenylalanine) higher values in gilts than barrows. Conversely, barrows from the group with 50.0 to 54.9% of lean meat had higher

values of most amino acids contrary to gilts. Barrows showed in the content of amino acids such as threonine, valine, isoleucine, lysine, aspartic acid, serine and proline a decreasing trend with an increase of the lean meat proportion. A decreasing trend was found also in gilts in the amino acid lysine. In contrast, content of phenylalanine, arginine, serine, glycine and alanine increased with increase of lean meat share in gilts.

The results of the measurement of amino acid content in carcass parts ham (Table 3) show that the group with 60.0% and more of lean meat had higher levels of threonine, leucine, lysine, glutamic acid, glycine and alanine in barrows than gilts. In the group with 55.0 to 59.9% of lean meat, the values were higher only in threonine, phenylalanine, arginine and aspartic acid. Conversely, in the group from 50.0 to 54.9% of lean meat, the most of amino acids showed higher values in barrows. In barrows/gilts, content of amino acids (valine, phenylalanine, serine, proline, threonine, valine, isoleucine, phenylalanine, aspartic acid, serine, glycine and alanine) grew with an increasing percentage of lean meat. Conversely, in amino acid arginine in barrows, decreasing trend was demonstrated with increasing proportion of lean meat.

Concerning the statistical evaluation of differences between the groups, the values of proline in MLLT and threonine, phenylalanine and serine in the MS were highly significant (*P*£0.05; *P*£0.01).

Jiang et al. (2011) found in the two breeds, nine essential amino acids (EAAs), which had higher EAA percentages (49.55% in the Dahe pigs and 49.60% in the Dawu pigs, respectively) compared with the total amino acid contents. The EAAs at the highest concentration in pig meat were lysine and leucine. Okrouhlá et al. (2006) reported that the highest content of essential and semi-essential amino acids was determined in lysine (9.71% to 10.54%), leucine (8.18% to 9.21%) and arginine (7.28% to 7.88%). However, Belitz et al. (2001) reported values of 7.8% to 8.1% for lysine and 7.5% to 7.6% for leucine. In this study, the lowest content among the EAAs was measured in methionine, whereas Okrouhlá et al. (2006) reported that phenylalanine showed the lowest content among the EAAs.

Cornet and Bousset (1990) pursued the free amino acids and dipeptides in pigs namely in the muscle *masseter*, *trapezius* and MLLT. The upper-most content of aspartic acid, glutamine and taurine was in muscle *masseter*. The muscle MLLT showed out the upper-most content of ß-alanine and carnosine. The muscle *trapezius* embodied the medium content of the above mentioned amino acids. According to Schneiderová (1990), boars have ability of higher storage of proteins due to sexual hormones, and thereby increase of lean meat, so that they are superior to gilts and barrows in a amount and share of lean meat.

Table 1. Dividing hogs according to the lean meat proportion and gender

Lean meat proportion (%)	Barrows	Gilts	Total
more than 60.0	12	23	35
55.0 - 59.9	25	26	51
50.0 - 54.9	19	11	30

Table 2. Content of amino acids in loin according to the lean meat proportion and gender

Lean meat proportion (%)	more than 60.0		55.0 - 59.9		50.0 - 54.9	
	Barrows	Gilts	Barrows	Gilts	Barrows	Gilts
	$\bar{x}$ ± SD	$\bar{x}$ ± SD	$\bar{x}$ ± SD	$\bar{x}$ ± SD	$\bar{x}$ ± SD	$\bar{x}$ ± SD
Essential and semi-essential amino acids (%)						
Threonine	5.69 ± 0.35	6.52 ± 0.33	6.27 ± 0.19	6.41 ± 0.24	6.72 ± 0.49	6.13 ± 0.59
Valine	5.47 ± 0.39	6.16 ± 0.33	6.04 ± 0.17	6.28 ± 0.22	6.47 ± 0.47	5.10 ± 1.04
Isoleucine	4.98 ± 0.35	5.61 ± 0.31	5.59 ± 0.17	5.78 ± 0.22	6.20 ± 0.58	5.40 ± 0.49
Leucine	8.75 ± 0.57	8.87 ± 0.56	8.84 ± 0.32	8.96 ± 0.42	8.19 ± 0.46	8.53 ± 0.86
Phenylalanine	1.44 ± 0.16	1.40 ± 0.08	1.24 ± 0.04	1.21 ± 0.09	1.39 ± 0.10	1.09 ± 0.15
Lysine	9.74 ± 0.71	9.92 ± 0.62	10.00 ± 0.39	10.41 ± 0.59	10.68 ± 0.55	10.45 ± 0.91
Arginine	8.39 ± 0.53	9.82 ± 0.54	9.55 ± 0.32	9.68 ± 0.40	9.12 ± 0.72	9.26 ± 0.47
∑ EAA	**44.46**	**48.30**	**47.53**	**48.73**	**48.77**	**45.96**
Nonessential amino acids (%)						
Aspartic acid	11.25 ± 0.81	11.84 ± 0.71	11.67 ± 0.38	12.35 ± 0.40	12.58 ± 0.50	11.76 ± 0.91
Serine	5.18 ± 0.30	5.86 ± 0.29	5.66 ± 0.18	5.75 ± 0.21	6.07 ± 0.41	5.54 ± 0.53
Glutamic acid	12.25 ± 1.00	12.21 ± 0.89	12.34 ± 0.53	12.40 ± 0.75	12.03 ± 0.65	12.13 ± 1.45
Proline	4.15 ± 0.30	4.83 ± 0.35	4.68^{α} ± 0.30	5.68^{α} ± 0.28	5.46 ± 0.40	5.41 ± 0.39
Glycine	5.11 ± 0.34	5.93 ± 0.31	5.62 ± 0.18	5.65 ± 0.21	5.77 ± 0.27	5.58 ± 0.47
Alanine	7.10 ± 0.43	8.03 ± 0.40	7.78 ± 0.24	7.86 ± 0.29	7.79 ± 0.30	7.64 ± 0.64
∑ NEAA	**45.04**	**48.70**	**47.75**	**49.69**	**49.70**	**48.06**

$\bar{x}$ = mean, SD = standard error of the mean; ∑ EAA = sum of the essential and semi-essential amino acids; ∑ NEAA = sum of the nonessential amino acids; $\alpha \leq 0,05$.

Table 3. Content of amino acids in ham according to the lean meat proportion and gender

Lean meat proportion (%)	more than 60.0		55.0 - 59.9		50.0 - 54.9	
	Barrows	Gilts	Barrows	Gilts	Barrows	Gilts
	$\bar{x}$ ± SD	$\bar{x}$ ± SD	$\bar{x}$ ± SD	$\bar{x}$ ± SD	$\bar{x}$ ± SD	$\bar{x}$ ± SD
Essential and semi-essential amino acids (%)						
Threonine	7.22 ± 0.93	$7.15^{\alpha\beta}$ ± 0.46	6.08 ± 0.29	6.04^{α} ± 0.34	6.34 ± 0.56	5.39^{β} ± 0.42
Valine	6.49 ± 0.72	6.71 ± 0.45	6.02 ± 0.28	6.18 ± 0.25	5.94 ± 0.40	5.42 ± 0.55
Isoleucine	5.68 ± 0.55	5.97 ± 0.43	5.42 ± 0.24	5.71 ± 0.20	5.43 ± 0.31	4.86 ± 0.62
Leucine	9.53 ± 1.36	8.58 ± 0.72	9.26 ± 0.46	9.87 ± 0.41	9.52 ± 0.63	9.00 ± 0.68
Phenylalanine	1.70 ± 0.23	$1.88^{a\alpha}$ ± 0.18	1.47 ± 0.10	1.36^{a} ± 0.09	1.38 ± 0.11	1.22^{α} ± 0.09
Lysine	11.13 ± 1.34	10.80 ± 0.48	10.05 ± 0.54	10.81 ± 0.45	10.13 ± 0.51	10.11 ± 0.79
Arginine	8.11 ± 1.29	8.31 ± 0.82	8.99 ± 0.49	8.63 ± 0.69	9.27 ± 0.59	8.20 ± 1.23
∑ EAA	**49.86**	**49.40**	**47.29**	**48.60**	**48.01**	**44.20**
Nonessential amino acids (%)						
Aspartic acid	10.48 ± 2.11	10.90 ± 0.76	10.16 ± 0.59	10.09 ± 0.42	10.77 ± 1.15	9.95 ± 0.89
Serine	6.21 ± 0.73	6.28^{α} ± 0.41	5.52 ± 0.25	5.52 ± 0.28	5.51 ± 0.41	4.91^{α} ± 0.36
Glutamic acid	11.68 ± 3.28	11.10 ± 1.54	12.28 ± 0.84	12.79 ± 0.87	11.25 ± 1.90	11.80 ± 1.06
Proline	5.31 ± 0.60	5.41 ± 0.39	4.97 ± 0.23	5.51 ± 0.34	4.83 ± 0.21	4.82 ± 0.81
Glycine	6.77 ± 0.86	6.70 ± 0.41	5.73 ± 0.29	5.92 ± 0.27	5.85 ± 0.46	5.60 ± 0.30
Alanine	9.00 ± 1.25	8.96 ± 0.53	7.62 ± 0.35	7.76 ± 0.34	7.81 ± 0.70	7.45 ± 0.42
∑ NEAA	**49.45**	**49.35**	**46.28**	**47.59**	**46.02**	**44.53**

$\bar{x}$ = mean, SD = standard error of the mean; ∑ EAA = sum of the essential and semi-essential amino acids; ∑ NEAA = sum of the nonessential amino acids; a£0,01; αβ£0,05.

Conclusion

Amino acid content in MLLT was not influenced by lean meat share and gender (expect proline). Whereas, content of threonine, phenylalanine and serine in MS of gilts increased with increasing lean meat proportion.

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Corresponding Address:
Ing. Monika Okrouhlá, Ph.D.
Faculty of Agrobiology, Food and Natural Resources
Czech University of Life Sciences Prague
Kamýcká 129, 165 21, Praha 6 - Suchdol, Czech Republic
E-mail: okrouhla@af.czu.cz

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