Acta fytotechn zootechn, 23, 2020(3): 167–173
http://www.acta.fapz.uniag.sk

Original Paper

Amino acid, fatty acid and chemical composition of meat and fat from entire males, castrates and gilts

Ivan Bahelka[1], Ondřej Bučko[2]*, Katarína Hozáková[2], Roman Stupka[1],
Jaroslav Čítek[1], Emília Hanusová[3], Martina Gondeková[3]
[1]*Czech University of Life Sciences, Faculty of Agrobiology, Food and Natural Resources, Prague, Czech Republic*
[2] *Slovak Agricultural University Nitra, Faculty of Agrobiology and Food Resources, Slovakia*
[3]*Research Institute for Animal Production, National Agricultural and Food Centre, Lužianky, Slovakia*

Article Details: Received: 2020-04-28 | Accepted: 2020-05-25 | Available online: 2020-09-30

https://doi.org/10.15414/afz.2020.23.03.167-173

Forty-two pigs, entire males, surgical castrates and gilts, was randomly selected for the experiment. After reaching the average live weight of 105 kg, pigs were slaughtered. Significant differences (P <0.05) in contents of water and crude fat in muscle between entire males and castrates (74.44 vs 73.93%, 2.52 vs 3.14%), resp. of cholesterol between entire males, gilts and castrates (0.31, 0.33 vs 0.41%) were found. Significantly higher contents (P <0.05) of almost the all amino acids in entire males and gilts compared to castrates were observed. In muscle, castrates had more eicosanoic fatty acid than entire males, and vaccenic than gilts whilst gilts and entire males had higher content of linolenic acid than castrates (P <0.05). In adipose tissue, entire males had lower content (P <0.05) of myristic, stearic, palmitic, and total saturated fatty acids than castrates or both castrates and gilts (1.39 vs 1.45%, 14.88 vs 16.90%, 25.41 vs 26.83 and 26.27%, 43.40 vs 46.70 and 45.53%). At the same time, they showed greater amounts of oleic (36.71 vs 34.95%), total monounsaturated (43.58 vs 41.35%), linoleic (10.29 vs 9.45 and 9.56%), linolenic (0.65 vs 0.59%), total polyunsaturated (12.06 vs 11.06%), n-6 (10.69 vs 9.83%) and n-3 (0.78 vs 0.71 and 0.72%) fatty acids than castrates or both castrates and gilts. Also, PUFA/SFA ratio was more desirable in entire males than those of castrates and/or gilts (0.28 vs 0.24 and 0.25). Based on these results, meat and adipose fat from entire males seems to be more beneficial from the human health point of view.

Keywords: pigs, amino and fatty acids, chemical composition, pork quality

1 Introduction

At present, a production of high quality meat including pig meat is in the spotlight of pork producers and meat processors since consumers have been becoming more demanding on quality of meat and meat products. Therefore, not only growth performance and carcass value of pigs are the aims of modern pig production, but also meat quality parameters including quality of fat tissue.

The aspects of pork quality are becoming increasingly important in regard to the expected stopping of surgical castration of piglets within EU countries in the near future on the base of meeting the pig stakeholders which was held in 2010 (EC Declaration, 2010). It is widely known that castration prevents the expression of boar taint in pork (Font i Furnols et al., 2003; Bonneau and Squires, 2004) but presently it has became the subject of heavy criticism from the animal welfare point of view. One alternative to surgical castration that has a chance to be widely used in practice is entire males rearing. The advantages of boars over barrows and gilts in growth intensity, feed conversion and carcass quality are well known (Dostálová and Koucký, 2008; Pauly et al., 2008; Škrlep et al., 2012). However, apart from the problem of boar taint, a very little research has been conducted on the quality of amino acid and fatty acid composition of pork from entire males. Generally, amino acids play an important role in nutrition as some of them are essential not only for animals but also for human (Okrouhlá et al., 2006). Total intramuscular fat content and fatty acid composition affect the eating quality traits such as tenderness,

***Corresponding Author:** Ondřej Bučko, Slovak University of Agriculture in Nitra, Faculty of Agrobiology and Food Resources, Department of Animal Husbandry, Tr. Andreja Hlinku 2, 949 76 Nitra, Slovakia. E-mail: ondrej.bucko@uniag.sk

juiciness and flavour (Font i Furnols et al., 2008; Aluwé et al., 2013; Liu et al., 2017). Several studies in the past have been concentrated on fatty acid composition in adipose tissue (e.g. belly, backfat) but recently, there is more emphasis on fatty acid composition in muscles because of their importance for human health.

The objectives of the present study were to determine the meat quality traits, amino acid and fatty acid composition of muscle and fat tissue of entire males and to compare it with castrated males and gilts.

2 Materials and methods

2.1 Animal care

Animal care was done in accordance with Act on animal veterinary care No. 39/2007 of Slovak Republic and approved by Animal Care Committee of the Research Institute for Animal Production.

2.2 Animals and diet

Forty-two pigs, entire males (EM), surgical castrates (SC) and gilts (G), each of 14, was randomly selected for the experiment. Pigs were crosses of Landrace (L) sows and Yorkshire × Landrace (YxL) boars. From seven litters was always selected 6 sibs (2 EM, 2 SC and 2 G). Male pigs (SC) were castrated until 7 days of age. They were housed in test station at 22–26 ±0.64 kg live weight because of acclimation to new space and feed. Pigs were housed in pairs in pen according to gender. They were fed by commercial diet (Table 1) according to nutrient requirements for growing-finishing pigs and actual growth curves during whole test period (from 30 to 105 kg live weight) and have free access to water. Test started at 30 ±0.82 kg live weight of pigs.

Table 1 Composition and nutrient content of the diet

Ingredients	g kg^{-1}
Barley	330
Corn	150
Wheat	120
Wheat bran	80
Rapeseed meal	60
Soybean meal	80
Animal fat	5
Premix	10
Ground limestone	12
Feed salt	4
Monocalcium phosphate	8
Analysed composition	
Dry mater	899.2
Organic matter (in 1000g DM)	958.3
Crude protein	149.8
Crude fiber	47.7
Crude fat	23.5
Nitrogen-free extractes	737,3
Ash	41.7
Lysine (in DM)	7.0
Metionine + Cysteine (in DM)	5.3
Metabolisable energy (MJ kg^{-1})	14.8

DM – dry matter, Premix – Fe 40,000 mg, Cu – 5,000 mg, Mn – 16,500 mg, Zn – 40,000 mg, Se – 90 mg, I – 300 mg, Co – 300 mg, vitamin A – 3,000,000 m.j., D_3 – 375,000 m.j., E – 9,000 mg, K_3 – 525 mg, B_1 – 600 mg, B_2 – 1,350 mg, B_6 – 600 mg, B_{12} – 10 mg, calcium pantothenate – 5,250 mg, Niacinamide – 4,500 mg, cholinchloride – 45,000 mg, folic acid – 75 mg

2.3 Slaughtering, sampling and analysis

After reaching the average slaughter weight of 105 ± 4.26 kg, pigs were slaughtered at the experimental slaughter house of the Research Institute for Animal Production (RIAP) situated approximately 200 m from the test stable. During the experiment, two pigs (1 EM and 1 SC) were excluded because of health reasons.

A slaughter was done according to standard procedure, e.g. electrical stunning, vertical exsanguination, vapor scalding and evisceration. After that, carcasses were chilled 24 hours at air temperature of 2 °C to 4 °C, and air velocity 0.5 to 1.0 m s^{-1} started approximately 60 min post mortem. The second day after slaughter, the dissection of the right half of carcasses was done. Subsequently, samples from neck (at level of 5th thoracic vertebra) and from adipose tissue (over the neck, each of approx. 200 g) were taken and transported to the Chemical laboratory of the Slovak Agricultural University for basic chemical composition, cholesterol content as well as amino and fatty acid composition. Each sample was homogenized (50 g) and subsequently analyzed by the Fourier Transform Infrared (FTIR) method (Carbonaro and Nucara, 2010) using the device Nicolet 6700 (IET Ltd., Illinois, USA).

2.4 Statistical analysis

Statistical package (SAS Institute Inc., Cary, N.C., USA, 2009, version 9.2) was employed in the analysis. Basic statistics for all the variables of castration/sex treatment groups was calculated using MEANS procedure. Differences between groups were analysed using GLM procedure. Castration/sex treatment was included in the model as fixed effect. All data are presented as Least

Squares Means (LSM) with standard errors of the mean (SEM). The model used was:

$$y_i = \mu + B_i + e_i$$

where:
y_i – characteristic of trait selected
μ – intercept
B_i – effect of sex/castration (i = EM, SC, G)
e_i – random error

Comparison of LSM values was performed using Tukey´s test. Significance of differences was declared at P <0.05.

3 Results and discussion

3.1 Chemical composition and cholesterol content of muscle

Chemical composition of meat from boars, castrates and gilts is presented in the Table 2. Entire males had lower content of crude fat and cholesterol (also gilts) than castrates (2.52 vs. 3.14%, 0.31 vs. 0.41, P <0.05). On the other hand, content of total water was higher in entire males than castrates (74.40 vs 73.93%, P <0.05).

3.2 Amino acid and fatty acid composition of muscle and fat tissue

Differences between entire males, castrates and gilts were observed in amino acid composition of meat (Table 3). The content of essential amino acids in the meat of boars and gilts was very similar and higher (P <0.05) with exception of cysteine (both boars and gilts) and histidine (gilts) than in meat of castrates.

A comparison of fatty acid composition of pork from entire males, castrates and gilts (Table 4) showed higher content (P <0.05) of linolenic fatty acid in boars and gilts compared to barrows (2.06 and 2.04 vs 1.92%). On the other hand, castrates had higher content of vaccenic fatty acid than gilts (4.46 vs. 4.38%, P <0.05) and eicosanoic acid compared to entire males (0.67 vs 0.60%, P <0.05).

Completely different composition of fatty acids was observed in fat tissue of entire males, castrates and gilts (Table 5). Differences (P <0.05) between boars and barrows were found in all the observed parameters except for n6/n3 fatty acids ratio. Values of five components were different also between males and gilts. The content of n-3 fatty acids and linoleic fatty acid was higher in boars than in other two groups (0.78 vs 0.71 and 0.72, 10.29 vs 9.45 and 9.56, P <0.05). Boars reached higher

Table 2 Chemical composition and cholesterol content (LSM ±SEM) of pork from entire males, surgical castrates and gilts

Item	EM	SC	G
Crude protein (%)	22.24 ±0.15	21.98 ±0.20	21.97 ±0.23
Crude fat (%)	2.52 ±0.12^{a}	3.14 ±0.10^{b}	2.87 ±0.23^{ab}
Cholesterol (%)	0.31 ±0.02^{a}	0.41 ±0.01^{b}	0.33 ±0.03^{a}
Water (%)	74.40 ±0.13^{a}	73.93 ±0.12^{b}	74.09 ±0.18^{ab}

a, b – values with different letters within rows are significantly different (P <0.05), EM – entire males; SC – surgical castrates; G – gilts

Table 3 Amino acid composition of muscle (LSM ± SEM) from entire males, surgical castrates and gilts

Item	EM	SC	G
Arginine (%)	1.61 ±0.03^{a}	1.49 ±0.02^{b}	1.59 ±0.02^{a}
Cysteine (%)	0.37 ±0.00	0.36 ±0.00	0.37 ±0.00
Phenylalanine (%)	1.06 ±0.02^{a}	0.98 ±0.01^{b}	1.05 ±0.01^{a}
Histidine (%)	1.21 ±0.02^{a}	1.11 ±0.02^{b}	1.18 ±0.02^{ab}
Isoleucine (%)	0.97 ±0.02^{a}	0.89 ±0.02^{b}	0.95 ±0.01^{a}
Leucine (%)	2.06 ±0.04^{a}	1.92 ±0.03^{b}	2.04 ±0.03^{a}
Lysine (%)	2.15 ±0.04^{a}	2.00 ±0.03^{b}	2.14 ±0.03^{a}
Methionine (%)	0.75 ±0.01^{a}	0.71 ±0.01^{b}	0.75 ±0.01^{a}
Threonine (%)	1.19 ±0.02^{a}	1.12 ±0.01^{b}	1.18 ±0.02^{a}
Valine (%)	1.09 ±0.02^{a}	1.02 ±0.01^{b}	1.08 ±0.01^{a}

a, b – values with different letters within rows are significantly different (P <0.05), EM – entire males; SC – surgical castrates; G – gilts

Table 4 Fatty acid composition of muscle (LSM ±SEM) from entire males, surgical castrates and gilts

Item	EM	SC	G
Lauric C12:0	0.03 ±0.00	0.04 ±0.00	0.03 ±0.00
Myristic C14:0	1.24 ±0.00	1.25 ±0.01	1.24 ±0.01
Palmitic C16:0	24.40 ±0.04	24.35 ±0.05	24.46 ±0.04
Heptadecanoic C17:0	0.32 ±0.01	0.31 ±0.01	0.32 ±0.01
Stearic C18:0	11.29 ±0.08	11.26 ±0.04	11.31 ±0.06
SUM SFA	39.54 ±0.40	38.57 ±0.34	39.37 ±0.39
Oleic C18:1 n-9	42.02 ±0.65	43.80 ±0.41	42.63 ±0.52
Eicosanoic C20:1	0.60 ±0.02^{a}	0.67 ±0.01^{b}	0.62 ±0.02^{ab}
Vaccenic C18:1 11c 15t	4.40 ±0.02^{ab}	4.46 ±0.02^{a}	4.38 ±0.03^{b}
SUM MUFA	47.45 ±0.46	49.18±0.39	47.85 ±0.36
Arachidonoic C20:4 n-6	1.40 ±0.07	1.44 ±0.09	1.34 ±0.05
Conjugated linoleic C18:2,9c,11t	0.13 ±0.00	0.13 ±0.00	0.13 ±0.00
Docosahexaenoic C22:6 n-3	0.04 ±0.00	0.04 ±0.00	0.04 ±0.00
Docosapentaenoic C22:5 n-3	0.14 ±0.00	0.14 ±0.00	0.14 ±0.00
Eicosapentaenoic C20:5	0.10 ±0.00	0.09 ±0.00	0.09 ±0.00
Linolenic C18:3 n-3	2.06 ±0.04^{a}	1.92 ±0.03^{b}	2.04 ±0.03^{a}
Linoleic C18:2 n-6	8.36 ±0.86	8.33 ±1.04	8.60 ±0.92
SUM PUFA	12.45 ±0.43	12.24 ±0.29	12.48 ±0.22
n3 FA	2.30 ±0.01	2.13 ±0.02	2.26 ±0.01
n6 FA	9.94 ±0.45	9.90 ±0.29	10.03 ±0.30
n-6/n-3	4.35 ±2.92	4.63 ±2.17	4.45 ±2.56
PUFA/SFA	0.33 ±0.04	0.31 ±0.03	0.32 ±0.02

a,b – values with different letters within rows are significantly different (P <0.05), EM – entire males; SC – surgical castrates; G – gilts; FA – fatty acids; SFA – saturated fatty acids; MUFA – monounsaturated fatty acids; PUFA – polyunsaturated fatty acids, Fatty acids are analysed as % of FAME – fatty acid methyl ester

content of n-6 fatty acids, oleic, linolenic fatty acid, total monounsaturated (MUFA) and polyunsaturated fatty acids (PUFA) compared to castrates (10.69 vs 9.83%, 36.71 vs 34.95%, 0.65 vs 0.59%, 43.58 vs 41.35% and 12.06 vs 11.06%, P <0.05). Contrary, content of myristic, palmitic, stearic fatty acid and total saturated fatty acids (SFA) of entire males was lower than that of castrates (1.39 vs 1.45%, 14.88 vs 16.90%, P <0.05) or both castrates and gilts (25.41 vs 26.83% and 26.27, 43.40 vs 46.70 and 45.53%, P <0.05).

3.3 Chemical composition and cholesterol content of muscle

Chemical composition of pork showed differences (P <0.05) between three groups of pigs. Whilst crude protein content in pork was not different among groups (P ≥0.05), other three parameters were (P <0.05). Water content was the highest in boars meat and different from that of castrates. Similar observations were reported in other studies (Cai et al., 2010). On the other hand, Jaturasitha et al. (2006) did not find any differences between boars, barrows and gilts. Related to crude fat, entire males had the lowest content compared to castrates (P <0.05). This result is supported by another findings (Jaturasitha et al., 2006; Cai et al., 2010; Van der Broeke et al., 2016; Font i Furnols et al., 2019). It is well-documented that castration affects the chemical composition of meat, especially it decreases water content and increases fat content (Latorre et al., 2004) due to changes in the hormone profile. Cholesterol content in our study corresponded with total crude fat content. Again, it was higher (P <0.05) in barrow´s meat compared to entire males and gilts. As known, elevated cholesterol is one of the major risk factors for cardiovascular disease. From this point of view, the consumption of boar´s meat seems to be more beneficial compared to meat from castrates and gilts.

Table 5 Fatty acid composition of fat tissue (LSM ± SEM) from entire males, surgical castrates and gilts

Item	EM	SC	G
Myristic C14:0	1.39 ±0.04[a]	1.45 ±0.03[b]	1.40 ±0.07[ab]
Palmitic C16:0	25.41 ±1.14[a]	26.83 ±0.45[b]	26.27 ±0.83[b]
Stearic C18:0	14.88 ±1.44[a]	16.90 ±1.00[b]	15.98 ±1.16[ab]
SUM SFA	43.40 ±2.40[a]	46.70 ±1.28[b]	45.53 ±1.93[b]
Oleic C18:1 n-9	36.71 ±1.22[a]	34.95 ±0.99[b]	36.05 ±1.55[ab]
SUM MUFA	43.58 ±1.58[a]	41.35 ±1.33[b]	42.61 ±1.81[ab]
Linoleic C18:2 n-6	10.29 ±0.95[a]	9.45 ±0.43[b]	9.56 ±0.75[b]
Linolenic C18:3 n-3	0.65 ±0.08[a]	0.59 ±0.03[b]	0.60 ±0.06[ab]
SUM PUFA	12.06 ±1.17[a]	11.06 ±0.54[b]	11.22 ±0.94[ab]
n6 FA	10.69 ±1.05[a]	9.83 ±0.52[b]	9.98 ±0.88[ab]
n3 FA	0.78 ±0.08[a]	0.71 ±0.03[b]	0.72 ±0.05[b]
PUFA/SFA	0.28 ±0.04[a]	0.24 ±0.01[b]	0.25 ±0.03[b]
n-6/n-3	13.78 ±0.31	13.87 ±0.18	13.87 ±0.24

a, b – values with different letters within rows are significantly different (P <0.05), EM – entire males; SC – surgical castrates; G – gilts; FA – fatty acids; SFA – saturated fatty acids; MUFA – monounsaturated fatty acids; PUFA – polyunsaturated fatty acids, Fatty acids are analysed as % of FAME – fatty acid methyl ester

3.4 Amino acid and fatty acid composition of muscle and fat tissue

The values of all the amino acids were the highest in entire males and the lowest in castrates. Differences between these two groups were significant (P <0.05) except for cysteine. The values of gilts were close to those of entire males and different (P <0.05) compared to castrates with exception of cysteine and histidine. Cai et al. (2010) reported completely opposite results when compared boars and castrates. All the values except for histidine were higher (P <0.05) in castrates than boars. Higher contents of amino acids of boars compared to barrows in our study can be due to different metabolism of proteins and amino acids. This is influenced by sex hormones such as testosterone, androstenone etc., causing anabolic effect" (higher deposition of amino acids in muscles) in entire males. Zhu et al. (2007) also reported higher amino acid content in entire males. Surgical castration removes the effect of sex steroids, thereby altering metabolism in favour of accumulating an increased amount of adipose tissue in castrates. Moreover, it is obvious that amino acid deposition is also affected by nutrition of pigs as it is documented in several studies suggested higher requirements and higher potential for lean meat (amino acid) deposition for entire males than barrows (Grandhi and Nyachoti, 2002; Purchas et al., 2009).

We observed differences (P <0.05) in fatty acid composition of muscle and back fat among pigs. Barrows had higher content of eicosanoic acid in meat than entire males and of vaccenic acid than gilts. On the other hand, boars and gilts had higher content of linolenic fatty acid. The same results in amount of linolenic fatty acids were observed by Grela et al. (2013). Cai et al. (2010) also reported higher content of PUFA (linoleic, linolenic, arachidonic and eicosapentaenoic fatty acid) in meat of boars compared to barrows. In contrast, they found higher content of saturated fatty acids (SFA) in barrows than boars with exception of stearic and lauric fatty acid. However, in our experiment were percentages of SFA in muscle in all three groups at the same level. Some studies suggest that high SFA and low PUFA content in meat of castrates compared to gilts or boars was due to high intramuscular and subcutaneous fat which was favoured by castration (De Smet et al., 2004; Alonso et al., 2009). These authors concluded that high PUFA contents in gilts have been found in total lipids or triacylglycerols. Another reason of differences in fatty acid composition between sex of pigs may be in different activities of enzymes acting in metabolism and accumulation of fatty acids. Hallenstvedt et al. (2010) found that in pigs with same backfat thickness, gilts had more MUFA and less SFA and PUFA in meat than entire males. The reason may be in higher delta-9-desaturase activity found in female pigs.

Proportion of linoleic fatty acid in pig adipose tissue decreases as fat deposition continues and represents the index of fatness. A strong correlation was observed between content of PUFA linoleic and SFA stearic to firmness/hardness of fat (Wood and Enser, 2008). High linoleic and low stearic acid indicated softer fat,

especially in leaner carcasses (as entire males). As shown in Table 6, content of linolenic fatty acid and total PUFA was higher in boars compared to castrates and of linoleic acid compared to both castrates and gilts. This agrees with other studies (Jaturasitha et al., 2006; Razmaité et al., 2008; Pauly et al., 2009). Saturated (except for stearic acid) and monounsaturated fatty acids can improve the sensory properties of meat such as tenderness, juiciness and flavour. On the other hand, too high content of SFA may increase the risk of heart disease by raising plasma low-density cholesterol (Fernandez and West, 2005; Cutrignelli et al., 2008). Content of SFA, especially myristic, stearic and palmitic acid was significantly higher in castrates or both castrates and gilts than in entire males. The same results were reported by Pauly et al. (2009) and Mackay et al. (2013). Higher content of PUFA and lower of SFA (expressed as PUFA/SFA ratio) is beneficial from the human health point of view. Desirable contents of PUFA, SFA and higher PUFA/SFA ratio in entire males than castrates or both castrates and gilts were observed in our study. These results confirmed the findings of another authors (Jaturasitha et al., 2006; Razmaité et al., 2008; Pauly et al., 2009; Cai et al., 2010; Grela et al., 2013). The investigation has proved that oleic fatty acid (C18:1) can also reduce the risk of cardiovascular diseases (Hoffman et al., 2007). The content of this fatty acid was higher (P <0.05) in entire males than that of barrows. However, other studies did not find any differences between boars and castrates (Jaturasitha et al., 2006; Pauly et al., 2009) or even though higher content of oleic fatty acid in castrates and gilts than in boars (Grela et al., 2013).

A lot of studies have been investigated in order to explain the reason of fatty acid differences in subcutaneous fat among entire male, castrated or female pigs (Thorling and Hansen, 1995; Smith et al., 2003; Chen et al., 2007; Mackay et al., 2013). Wood et al. (1989) concluded that the main reason of these differences between gilts and entire males was backfat thickness. However, fatty acids composition could also be affected by steroid hormones. Thorling and Hansen (1995) found that castrated rats administrated by female hormone oestrogen had the same fatty acid composition as females. Some authors suggest effect of different enzyme activities in subcutaneous adipose tissue (stearoyl-CoA, delta-9-desaturase) on fatty acid composition. Mackay et al. (2013) found considerable protein expression of FAS (fatty acid synthase – one of the key enzymes catalyzing the biosynthesis of SFA) on SFA content in barrows compared to boars (also Roy et al., 2005). Mechanism of action of physical castration on FAS expression is still unknown but one possibility may be the reduction of sex hormones after castration which affects binding of transcription factors required for regulation of the FAS expression.

The values of n6/n3 PUFA ratio in our study were at the same level in all three groups. Another studies reported lower values of n6/n3 ratio in entire males than in castrates and gilts (Grela et al., 2013) or vice versa higher in boars than in barrows (Razmaité et al., 2008; Cai et al., 2010).

4 Conclusion

Entire males and gilts had higher contents of almost all the essential amino acids than barrows. Minor differences were found in fatty acid composition of muscle between three groups. Content of eicosanoic fatty acid of boars was lower than that of castrates. Contrary, boars and gilts had higher content of linolenic fatty acid. However, avoiding castration related in considerable changes in fatty acid profile of fat tissue of entire males compared to castrates (and some cases also to gilts). Less saturated fatty acids, more monounsaturated and polyunsaturated fatty acids, n-6 and n-3 fatty acids as well as better PUFA/SFA ratio were found in entire males. These findings together with less content of intramuscular fat and cholesterol in meat from entire males seems to be more beneficial from the human health point of view. If a ban on the surgical castration enters into force, entire males raising seems to be a good alternative for pork producers instead of current production of castrates. However, it will be possible provided that boar taint will not be a problem for pork processing industry and consumer acceptability of meat from entire male pigs.

Acknowledgements

We would like to thank J. Zeleňáková for her technical support at the laboratory analyses.

References

ALONSO, V. et al. (2009). Effect of crossbreeding and gender on meat quality and fatty acid composition in pork. *Meat Science*, 81(1), 209–217. https://doi.org/10.1016/j.meatsci.2008.07.021

ALUWÉ, M. et al. (2013). Effect of surgical castration, immunocastration and chicory-diet on the meat quality and palatability of boars. *Meat Science*, 94(3), 402–407. https://doi.org/10.1016/j.meatsci.2013.02.015

BONNEAU, M. and SQUIRES, E. (2004). Boar taint. Causes and measurement. In *Encyclopedia of meat sciences*. Oxford: Elsevier.

CAI, Z. et al. (2010). Comparison of muscle amino acid and fatty acid composition of castrated and uncastrated male pigs at different slaughter ages. *Italian Journal of Animal Science*, 9(2), 173–178. https://doi.org/10.4081/ijas.2010.e33

CARBONARO, M. and NUCARA, A. (2010). Secondary structure of food proteins by Fourier transform spectroscopy in the mid-infrared region. *Amino Acids*, 38, 679–690. https://doi.org/10.1007/s00726-009-0274-3

CHEN, G. et al. (2007). Regulation of CYP2A6 protein expression by skatole, indole and testicular steroids in primary cultured hepatocytes. *Drug Metabolism and Disposition*, 36, 56–61.

CUTRIGNELLI, M. et al. (2008). Effects of two protein sources and energy level of diet on the performance of young Marchigiana bulls. 2. Meat quality. *Italian Journal of Animal Science*, 7, 271–285.

DE SMET, S. et al. (2004). Meat fatty acid composition as affected by fatness and genetic factors: A review. *Animal Research*, 53, 81–98.

DOSTÁLOVÁ, A. and KOUCKÝ, M. (2008) Methods: Fattening of entire males under condition of ecological agriculture – Metodika: Výkrm kanečků v podmínkách ekologického Zemědělství. Praha-Uhříněves: Výzkumný ústav živočišné výroby (in Czech).

EC Declaration. (2010). European declaration on alternatives to surgical castration of pigs. Retrieved November 12, 2010 from http://ec.europa.eu/food/animal/farm/initiatives.en.htm

FERNANDEZ, M. and WEST, K. (2005). Mechanisms by which dietary fatty acids modulate plasma lipids. *Journal of Nutrition*, 135(9), 2075–2078. https://doi.org/10.1093/jn/135.9.2075

FONT I FURNOLS, M. et al. (2003). Acceptability of boar meat by consumers depending on their age, gender, culinary habits, sensitivity and appreciation of androstenone smell. *Meat Science*, 64(4), 433–440. https://doi.org/10.1016/S0309-1740(02)00212-7

FONT I FURNOLS, M. et al. (2008). Consumer´s sensory acceptability of pork from immunocastrated male pigs. *Meat Science*, 80, 1013–1018.

FONT I FURNOLS, M. et al. (2019). Intramuscular fat content in different muscles, locations, weights and genotype-sexes and its prediction in live pigs with computed tomography. *Animal*, 13(3), 666–674. https://doi.org/10.1017/S1751731118002021

GRANDHI, R. and NYACHOTI, C. (2002). Effect of true ileal digestible dietary methionine to lysine ratios on growth performance and carcass merit of boars, gilts and barrows selected for low backfat. *Canadian Journal of Animal Science*, 82, 399–407.

GRELA, E. et al. (2013). Performance, pork quality and fatty acid composition of entire males, surgically castrated or immunocastrated males, and female pigs reared under organic system. *Polish Journal of Veterinary Science*, 16, 107–114.

HALLENSTVEDT, E. et al. (2010). Fish oil in feeds for entire male and female pigs: Changes in muscle fatty acid composition and stability of sensory quality. *Meat Science*, 85(1), 182–190. https://doi.org/10.1016/j.meatsci.2009.12.023

HOFFMAN, L. et al. (2007). Meat quality characteristics of springbok (*Antidorcas marsupialis*). 3. Fatty acid composition as influenced by age, gender and production region. *Meat Science*, 76(4), 768–773. https://doi.org/10.1016/j.meatsci.2007.02.019

JATURASITHA, S. et al. (2006). The effect of gender of finishing pigs slaughtered at 110 kilograms on performance, and carcass and meat quality. *Science Asia*, 32, 297–305.

LATORRE, M. et al. (2004). The effects of gender and slaughter weight on the growth performance, carcass traits, and meat quality characteristics of heavy pigs. *Journal of Animal Science*, 82(2), 526–533. https://doi.org/10.2527/2004.822526x

LIU, X. et al. (2017). Fatty acid composition and its association with chemical and sensory analysis of boar taint. *Food Chemistry*, 231, 301–308. https://doi.org/10.1016/j.foodchem.2017.03.112

MACKAY, J. et al. (2013). Fatty acid composition and lipogenic enzyme protein expression in subcutaneous adipose tissue of male pigs vaccinated against boar taint, barrows, and entire boars. *Journal of Animal Science*, 91, 395–404. https://doi.org/10.2527/jas.2011-4685

OKROUHLÁ, M. et al. (2006). Amino acid composition of pig meat in relation to live weight and sex. *Czech Journal of Animal Science*, 51, 529–534.

PAULY, C. et al. (2008). Performances, meat quality and boar taint of castrates and entire male pigs fed a standard and a raw potato starch-enriched diet. *Animal*, 2(11), 1707–1715. https://doi.org/10.1017/S1751731108002826

PAULY, C. et al. (2009). Growth performance, carcass characteristics and meat quality of group-penned surgically castrated, immunocastrated (Improvac®) and entire male pigs and individually penned entire male pigs. *Animal*, 3(7), 1057–1066. https://doi.org/10.1017/S1751731109004418

PURCHAS, R. et al. (2009). Chemical composition characteristics of the longissimus and semimembranosus muscles for pigs from New Zealand and Singapore. *Meat Science*, 81(3), 540–548. https://doi.org/10.1016/j.meatsci.2008.10.008

RAZMAITÉ, V. et al. (2008). Pork fat composition of male hybrids from Lithuanian Indigenous Wattle pigs and Wild boar intercross. *Food Science and Technology International*, 14, 251–257.

ROY, R. et al. (2005). Genomic structure and alternative transcript of bovine fatty acid synthase gene (FASN): Comparative analyses of the FASN gene between monogastric and ruminant species. *Cytogenetic and Genome Research*, 111(1), 65–73. https://doi.org/10.1159/000085672

SMITH, S. et al. (2003). Structural and functional organization of the animal fatty acid synthase. *Progress in Lipid Research*, 42, 289–317.

ŠKRLEP, M. et al. (2012). Effect of immunocastration in group-housed commercial fattening pigs on reproductive organs, malodorous compounds, carcass and meat quality. *Czech Journal of Animal Science*, 57(6), 290–299.

THORLING, E.B. and HANSEN, H.S. (1995). Age-related changes in the percentage of oleate in adipose tissue of male and female Fischer rats. *Biochimica et Biophysica Acta – Lipids and Lipid Metabolism*, 1258, 195–198.

VAN DER BROEKE, A. et al. (2016). The effect of GnRH vaccination on performance, carcass, and meat quality and hormonal regulation in boars, barrows, and gilts. *Journal of Animal Science*, 94(7), 7, 2811–2820. https://doi.org/10.2527/jas.2015-0173

WOOD, J.D. et al. (1989). Backfat composition in pigs: Differences between fat thickness groups and sexes. *Livestock Production Science*, 22, 351–362.

WOOD, J. and ENSER, M. (2008). Factors influencing fatty acids in meat and the role of antioxidants in improving meat quality. *British Journal of Nutrition*, 78, S49–S60.

ZHU, H. et al. (2007). The comparison analysis of the boar meat and pork in nourishment composition. *Acta Agriculturae Boreali-Occidentalis Sinica*, 4, 828–865.