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Original study

Fatty acid profile of *m. longissimus dorsi* of Mangalitsa and Moravka pig breeds

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Abstract

The objective of this study was to determine the chemical composition and fatty acid content in *m. longissimus dorsi* (MLD) of two indigenous pig breeds (ML – Swallow-belly Mangalitsa and M – Moravka) reared in free range farm conditions and fed complete mixtures used for commercial meat pig genotypes. The body mass of ML and M pigs at slaughter was,on average, 107.14 and 107.61 kg, respectively. In MLD of M pigs, more total fat was measured compared to ML breed (6.96 % compared to 5.10 %, $P<0.05$). Protein content in MLD of ML pigs was higher by +0.92 % ($P<0.01$) compared to M pigs. Male castrates of M pigs had more fat compared to gilts of the same breed (8.64 compared to 5.29 %), and the 3.35 % difference between mean values was statistically significant ($P<0.05$). The breed of pigs influenced the total saturated fatty acids ($P=0.011$) and mono-unsaturated fatty acid ($P=0.003$) contents, but not the content of polyunsaturated fatty acids ($P=0.325$). In the case of saturated fatty acids in the MLD of ML and M pigs, the most common were C16:0 (25.05 % and 25.53 %) and C18:0 (12.73 % and 14.40 %). The MLD of M pigs contained 1.67 % more stearic acid compared to ML pigs ($P=0.004$). Pigs of ML, compared to M pigs, had more C18:1*cis*-9 (+2.31 %), C16:1 (+0.49 %), C17:1 (+0.10 %) and less C20:1*cis*-11 (–0.25 %). The content of two essential fatty acids, C18:2n-6 and C18:3n-3, did not vary according to breed or sex of pigs ($P>0.05$). The n-6/n-3 ratio was higher than optimal (18.7 for breed ML and 13.7 for M).

Keywords: pig, Mangalitsa, Moravka, meat quality, fatty acids

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Abbreviations: FAME: fatty acid methyl esters, M: Moravka, ML: Swallow-belly Mangalitsa, MLD: *musculus longissimus dorsi*, MUFA: mono-unsaturated fatty acids, PUFA: polyunsaturated fatty acids, SFA: saturated fatty acids

Introduction

Oils and fats are necessary in human nutrition, however, excessive or insufficient intake of fat can have adverse effects on human health. The World Health Organization (WHO/FAO 2003), Tapsell & Probst (2008), Harris *et al*. (2009) and Grenon *et al*. (2012) reported a connection between nutrition and chronic diseases. In human nutrition, 15-30 % of energy should be derived from fat. Less than 10 % should be derived from saturated fatty acids (SFA) since their higher level increases the cholesterol and triglyceride content in the blood. The polyunsaturated fatty acids (PUFA) content should be 6-10 % because of the requirement for essential fatty acids. Preferably, n-6 and n-3 PUFA should provide 5-8 % and 1-2 % of the energy, respectively, but not more than 1 % of the energy should be due to trans fatty acids.The remainder should consist of mono-unsaturated fatty acids (MUFA), especially oleic acid (C18:1*cis*-9). They are less susceptible to oxidation and have a positive effect on human blood cholesterol levels. Increased intake of n-3 fatty acids in relation to n-6 has a positive effect on human health (Simopoulos 2002, Harris *et al*. 2009, Grenon *et al*. 2012). Pork is richer in linoleic acid (C18:2n-6) content which affects the total amount n-6 fatty acid content in pork products (Wood *et al*. 2008). The fatty acid composition/profile of the fatty and muscle tissues of pigs is influenced by numerous factors, including genetic factors (Sellier 1998, Sellier *et al*. 2010, Fernández *et al*. 2003), breed (Parunović *et al*. 2012b, Luković *et al*. 2009, Furman *et al*. 2010), sex, body mass (Žemva *et al*. 2009), age, energy intake, fatty acid composition of the diet, housing system (Hoffman *et al*. 2003, Rey *et al*. 2004, Daza *et al*. 2007, Luković *et al*. 2009, Dannenberger *et al*. 2012). The effect of the housing system on pig traits and subsequently on carcass and meat properties, comprises interaction between the features of the facility, feeding level and pig genotype used in the production system (Araújo *et al*. 2011).

The objective of this study was to determine the chemical composition and fatty acid content in *m. longissimus dorsi* (MLD) of two autochthonous pig breeds (Swallow-belly Mangalitsa and Moravka) reared in farm conditions (a free range system) and fed complete mixtures used in commercial fattening of meat pig genotypes.

Material and methods

Animals and housing

In total, 31 animals, i. e. 16 animals of Swallow-belly Mangalitsa breed (ML) and 15 animals of Moravka breed (M) were studied. Gender representation (castrated male animals and females) within the two groups was approximately the same (8:8 and 7:8 among ML and M pigs, respectively). Animals of both breeds were born and reared on an experimental pig farm at the Institute for Animal Husbandry, Belgrade-Zemun, Serbia. Pigs were kept in farm conditions on a free range system. The surface of the free range was 150 m^2 (110 m^2 open section and 40 m^2 covered section of the range). There was 4.8 m^2 of surface area per animal.

Diets and feeding program

Animals were an average of 129 days old at the beginning of fattening, and weighed around 20 to 22 kg. At the end of fattening, pigs were an average of 344 days old, and weighed 93 to 124 kg. During fattening, pigs were fed two complete mixtures (mixture I; mixture II) consisting of corn silage (62.93 %; 68.76 %), feed flour (15.00 %; 15.00 %), soybean oil meal (14.00 %; 9.10 %), sunflower oil meal (5.00 %; 4.00 %), L-lysine (0.07 %; 0.09 %), mineral feedstuffs (calcium carbonate, mono calcium phosphate and salt: 2.40 %; 2.55 %) and premix-vitamin mineral part (0.50 %; 0.50 %). Mixture I contained,on average 15.5 % of crude proteins and 12.95 MJ/kg ME and it was used to feed the pigs at the start of the study, when they weighed 20 to 22 kg, and up to 60 kg. In the second part of the fattening, when pigs had from 60 to 124 kg of body mass, they were fed with mixture II which contained 13 % of crude proteins and 13.05 MJ/kg ME. Pig feed and water was provided to pigs ad libitum. The time to slaughter of the animals depended on the average body mass of the group, rather than animal age. The body weight of each individual animal was measured on farm. The average body weight of ML and M pigs was 107.14 and 107.61 kg, respectively, this difference was not statistically significant. All pigs in a group were simultaneously delivered to the slaughterhouse. The pigs were transported (approximately 5-10 min) to the experimental slaughterhouse in the morning and left in crates for approximately 4 h.

Samples and chemical analyses

Animals were slaughtered in the Experimental Slaughterhouse of the Institute for Animal Husbandry under conditions stipulated by current regulations. After dissection of left carcass sides, samples (around 300 g) MLD were collected marked/identified and frozen at –20 °C until the start of chemical analyses. Chemical analyses were conducted in the reference laboratory at the Institute of Meat Hygiene and Technology in Belgrade.

Prior to laboratory analyses MLD samples were defrosted, and the tissue was cut into pieces and homogenized in a blender (CombiMax600; Braun GmbH, Kronberg im Taunus, Germany).

The content of water, total fats/lipids protein and ash in homogenized MLD of experimental pigs were each determined according to standard methods (AOAC 1990).

Total lipids, used in the determination of fatty acids, were extracted by rapid solvent extraction using an accelerated solvent extractor (Dionex ASE 200; Dioney Corporation, Sunnyvale, CA, USA). Homogenized MLD, mixed with diatomic soil, was extracted using a mixture of n-hexane and isopropanol (60:40 v/v) in 33 ml extraction cells, at a temperature of 100 °C and under nitrogen pressure of 10.3 MPa. The extract thus obtained was steamed in a nitrogen flow at 50 °C until dry fat remains were obtained (Spirić *et al*. 2010).

Fatty acids as methyl esters were determined on the dry fat remains using capillary gas chromatography with flame-ionization detector. Fatty acids were converted into fatty acid methyl esters (FAME) with tri-methyl sulphonium hydroxide according to SRPS EN ISO 5509:2007. FAME were analysed by gas chromatography with a flame ionization detector (GC-2010; Shimadzu, Kyoto, Japan) on a cyanopropyl-aryl column HP-88 (column length 100 m, inner diameter 0.25 mm, film thickness 0.20 µm). Injector and detector temperatures

were 250 °C and 280 °C, respectively, and 1 µL volumes of FAME were injected. Nitrogen was used as the carrier gas, at a rate of 1.33 ml/min, with split ratio 1:50, and hydrogen and air as detector gases. The column furnace temperature was programed in the range from 120 °C to 230 °C. Total duration of analysis was 50 min 30 s. FAME were identified based on the retention times, by comparing the retention times of the mixture of FAME in a standard, Supelco 37 Component FAME Mix (Sigma-Aldrich, St. Louis, MO, USA) (Spirić *et al*. 2010).

Chromatographic peak areas were corrected by response factors calculated from the ratios between the peak areas and concentrations of the individual FAME in the standard mixture. The response factors ranged from 0.92 for C22:6 to 1.02 for C18:2. Coefficients of variations for response factors calculated for six injections were lower than 5%. In the analysed FAME, long chain n-3 and n-6 PUFAs fatty acids were not detected (<0.05 %).

Statistical analyses

The data obtained was processed using the general linear model (GLM) in the program SAS v. 9.1.3 (SAS Inst., Inc., Cary, NC, USA). The model included breed (B_i), sex of animals (S_j) and interaction $(BS)_{ij}$ as systematic factors:

$$y_{ijk} = \mu + B_i + S_j + (BS)_{ij} + \varepsilon_{ijk} \quad (1)$$

Differences among corrected mean values (LSM) were examined using Student's test. The correlation coefficient was evaluated using the CORR procedure and correlation strength was interpreted based on Roemer-Orphal classification (Latinović 1996).

Results

The average pre-slaughter age of ML pigs was 337.1 and of M pigs was 352.1 days. Therefore, ML pigs were younger (~15 days) than M pigs, but the difference in mean ages was not statistically significant (P=0.203). The pre-slaughter body mass of ML and M pigs was,on average 107.14 ± 2.85 and 107.61 ± 3.06 kg, respectively (Table 1), which was not statistically significantly different (P=0.887). Also, the mean pre-slaughter body mass of castrates and gilts was not different (P=0.957).

The water content in MLD of ML pigs was higher (+1.00 %) compared to that of M pigs, but the difference in mean values was not statistically significant (P>0.05). However, water content varied between animals of different sexes within the breeds (P=0.023, Table 1). Male castrated M pigs had statistically significantly less water in their MLD (–2.82 %, P<0.05) compared to females of the same breed (68.65 compared to 71.47 %) and female ML pigs (–2.64 %) (68.65 compared to 71.29 %).

The lower water content in MLD of M pigs signified that they contained significantly more total fat (6.96 % compared to 5.10 %, P=0.031). Male castrated M pigs had more fat than gilts of the same breed (8.64 compared to 5.29 %), and the difference in mean values of 3.35 % was statistically significant (P<0.05).

The protein content in MLD of ML pigs was higher by +0.92 % compared to M pigs, and this difference in mean values was statistically highly significant (P=0.002).

Pig breed had a statistically significant effect (P=0.011) on the amount of total SFA (∑SFA) in MLD (Table 2). Pigs of M breed had, on average, 41.64 % SFA in their MLD, while ML pig MLD

Table 1
The effect of breed and sex of pigs on variation in the chemical composition of *m. longissimus dorsi*

Trait	LSM±SE		*P*-value		
	ML	M	Breed	Breed×sex	R^2
Fattening					
Pre-slaughter body mass, kg	107.14 ± 2.85	107.61 ± 3.06	0.887	0.957	0.004
Pre-slaughter age, days	337.1 ± 7.83	352.1 ± 8.42	0.203	0.268	0.152
Chemical composition of MLD					
Water, %	71.06 ± 0.46	70.06 ± 0.48	0.149	0.023	0.326
Fat, %	5.10 ± 0.56[a]	6.96 ± 0.59[b]	0.031	0.029	0.375
Proteins, %	22.39 ± 0.18[c]	21.47 ± 0.19[d]	0.002	0.536	0.369
Ash, %	1.09 ± 0.01	1.07 ± 0.01	0.132	0.650	0.127

R^2: coefficient determination; [a,b]Within row, means with different superscripts are significantly different (P<0.05). [c,d]Within row, means with different superscripts are significantly different (*P*<0.01).

Table 2
The effect of breed and sex of pigs on variation of the fatty acid profile of *m. longissimus dorsi*

Trait	LSM ± SE		*P*-value		
	ML	M	Breed	Breed×sex	R^2
ΣSFA	39.45 ± 0.55[a]	41.64 ± 0.57[b]	0.011	0.846	0.237
ΣMUFA	56.41 ± 0.56[c]	53.78 ± 0.58[d]	0.003	0.614	0.319
ΣPUFA	4.10 ± 0.30	4.54 ± 0.31	0.325	0.469	0.010
C14:0	1.33 ± 0.03	1.34 ± 0.03	0.789	0.046	0.225
C16:0	25.05 ± 0.32	25.53 ± 0.34	0.311	0.139	0.165
C16:1	4.19 ± 0.14[a]	3.70 ± 0.15[b]	0.022	0.562	0.222
C17:1	0.34 ± 0.02[a]	0.24 ± 0.03[b]	0.021	0.113	0.304
C18:0	12.73 ± 0.37[c]	14.40 ± 0.39[d]	0.004	0.262	0.355
C18:1*cis*-9	50.82 ± 0.48[c]	48.51 ± 0.50[d]	0.002	0.744	0.322
C18:2n-6	3.92 ± 0.28	4.26 ± 0.29	0.418	0.428	0.094
C18:3n-3	0.21 ± 0.04	0.31 ± 0.04	0.116	0.374	0.157
C20:0	0.23 ± 0.04	0.26 ± 0.05	0.668	0.185	0.143
C20:1*cis*-11	1.07 ± 0.08[a]	1.32 ± 0.08[b]	0.038	0.457	0.208
PUFA/SFA*	0.10 ± 0.01	0.11 ± 0.01	0.672	0.513	0.062

R^2: coefficient determination; [a,b]Within row, means with different superscripts are significantly different (P<0.05). [c,d]Within row, means with different superscripts are significantly different (*P*<0.01). *PUFA/SFA: (C18:2n-6+C18:3n-3) /(C14:0+C16:0+C18:0)

contained 39.45 % of SFA. The difference in mean values for SFA in MLD between the two breeds of pig – 2.19 % – was statistically significant.

The content of MUFA varied under the influence of pig breed (*P*=0.003). Pigs of ML breed had more total MUFA in their MLD compared to pigs of M breed (56.41 compared to 53.78 %).

This difference in corrected mean values of MUFA between fattened breeds (2.63 %) was statistically significant. Male castrate and female ML pigs had higher concentrations of MUFA (56.92 and 55.9 %) compared to both sexes of M pigs (53.56 and 53.91 %).

Among SFA in the MLD of pigs, the most common were C16:0 (palmitic acid, 25.05 % and 25.53 % for ML and M pigs, respectively) and C18:0 (stearic acid, 12.73 % and 14.40 % for ML and M pigs, respectively). Both fatty acids, C14:0 and C20:0, made up 4.0 and 3.8 % of all SFA.

The most common MUFA in the MLD examined was C18:1*cis*-9 (oleic acid). ML pigs had statistically highly significantly (P=0.002) more oleic acid in their MLD than M pigs (50.82 % compared to 48.51 %). However, the content of C18:1*cis*-9 in MLD showed no variations between sexes of the same breed (P=0.744). The second most common MUFA was C16:1 (Table 2). The amount of eicosenoic acid (C20:1*cis*-11) in MLD varied between pig breeds (P=0.038) but showed no statistically significant variations between pigs of different sex/gender and same breed (P=0.457). MLD of M pigs contained 0.25 % more C20:1*cis*-11 than that of ML pigs. C17:1 content was influenced by breed of pigs (P=0.021), so in MLD of ML pigs, more of this acid was determined (+0.10 %) than in M pigs (Table 2). Among PUFAs, the most common was C18:2n-6 (linoleic acid), followed by C18:3n-3 (linolenic acid). Contents of C18:2n-6 and C18:3n-3 in MLD did not vary according to breed or sex of pigs. The ratio between PUFAs (C18:2n-6 and C18:3n-3) and SFA with 14, 16 and 18 carbon atoms (PUFA/SFA) showed no statistically significant variations between breeds, sexes/genders, and neither was it under the influence of pre-slaughter body mass of pigs.

The correlation between total SFA and stearic fatty acid (Table 3) was very strong, positive and statistically very highly significant (r=0.837, P<0.001). With the increase of the stearic fatty acids the content of total MUFA decreased (r= −0.806, P<0.001).

The most common MUFA in MLD was C18:1*cis*-9, and there was a clear correlation between that acid and total MUFA (r=0.973, P<0.001). Of the total PUFA content, C18:2n-6 accounted for 94 %, so the correlation between them was clear (r=0.991, P<0.001).

Table 3
Coefficients of phenotypic correlations between proportions of fatty acids in the *m. longissimus dorsi*

Fatty acid	∑SFA		∑MUFA		∑PUFA	
	r	*P*-value	r	*P*-value	r	*P*-value
C14:0	0.229	0.236	0.236	0.201	0.063	0.735
C16:0	0.637	0.0001	−0.482	0.006	−0.214	0.248
C16:1	−0.732	<0.0001	0.792	<0.0001	−0.301	0.099
C17:1	−0.463	0.008	0.471	0.008	−0.118	0.528
C18:0	0.837	<0.0001	−0.806	<0.0001	0.114	0.524
C18:1*cis*-9	−0.874	<0.0001	0.973	<0.0001	−0.417	0.019
C18:2n-6	−0.089	0.634	−0.353	0.051	0.991	<0.0001
C18:3n-3	0.468	0.012	−0.625	0.0004	0.452	0.016
C20:0	0.341	0.076	−0.416	0.028	0.238	0.223
C20:1*cis*-11	0.183	0.323	0.153	0.412	−0.039	0.835

r: phenotypic correlations

Discussion

Water content in MLD of ML pigs, reported in the literature, ranged from 61.70 to 72.47 % (Parunović *et al*. 2012a, b, Petrović *et al*. 2010, 2012, Holló *et al*. 2003, Gajić & Isakov 2000). One group of researchers have indicated that pigs reared in an outdoor system have higher water content in meat compared to same breed of animals reared in an indoor system (Butko *et al*. 2007, Petrović *et al*. 2012). However, another group of researchers could not demonstrate statistically significant differences (Kim *et al*. 2009, Parunović *et al*. 2012a). In MLD of Swallow-belly Mangalitsa pigs examined in the current study, there was on average, 71.06 % of water, which was higher than water contents reported by Holló *et al*. (2003), Parunović *et al*. (2012a, b) and Petrović *et al*. (2010) for same breed. However, our measured mean water content was similar to results obtained by Petrović *et al*. (2012) for the same pig breed reared in a closed housing system (71.06 % in the current study compared to 70.71 %). Higher average values of water content in MLD were measured by Gajić & Isakov (2000).

Total fat content in MLD of Swallow-belly Mangalitsa pigs in the current study was lower than was reported for the same strain of Mangalitsa pigs by Parunović *et al*. (2012a, b) and Petrović *et al*. (2010). The said authors determined total fat content ranging from 12.1 to 18.2 % in the MLD of Mangalitsa pigs, but the pigs in those studies were reared in the traditional way typical for autochthonous pig breeds (outdoor housing system, pasture fed, the inclusion of roots and other fruits in the diet with supplement of small amounts of corn, up to 0.3 kg/animal/day). Lower fat content (2.93 %, compared to 5.10 % in the current study) has been reported by Gajić & Isakov (2000) in the meat of Mangalitsa pigs originating from Subotica, Serbia. According to Ender *et al*. (2002), Mangalitsa pigs contain 7.50 % intramuscular fat in meat, with a low polyenoic fatty acid percentage and high oleic acid content in intramuscular fat compared to commercial breeds. The fat content in MLD of M pigs in the present study was higher compared to values determined by Senčić *et al*. (2005; 5.90 %) and Butko *et al*. (2007; 4.95 and 5.90 %) for Black Slavonian pigs slaughtered with higher body mass (135 kg). Both breeds (Moravka and Black Slavonian pig) are combination pig breeds (meat-fatty types), however, Moravka is a less numerous breed reared in the Republic of Serbia compared to the Black Slavonian pig which is the number one autochthonous breed in the Republic of Croatia. The lower numbers of pigs enables more strict selection of individual animals for breeding.

The mean value of protein content in MLD of ML pigs in the present study (22.39 %) was higher (from +0.34 to +2.69 %) than the value determined by Petrović *et al*. (2009), Parunović *et al*. (2012a, b), Holló *et al*. (2003) and lower (from −0.41 to −1.48 %) than the value stated by Gajić & Isakov (2000) for Subotica Mangalitsa and Pugliese *et al*. (2005) for Italian local pig breed (cinta senese). The crude protein content in MLD of Moravka pigs (M, 21.47 %) was similar to that found by Petrović *et al*. (2010; 21.61 %) for the same breed and identical to mean value determined by Senčić *et al*. (2011; 21.47 %) for Black Slavonian pigs which had been fed with mixture containing higher protein levels.

Research by Zhang *et al*. (2007) has shown that pig breed has an effect on the content of certain fatty acids and total lipids in MLD. Also, the same researchers have established that castrates have higher contents of SFA and MUFA but lower content of PUFA compared to gilts. Parunović *et al*. (2012b) discovered a significant effect of pig breed on variation of SFA, MUFA

and PUFA in MLD. However, the same authors did not find statistically significant differences in content of total SFA, MUFA and PUFA between the White and Swallow-belly Mangalitsa strains, instead, differences occurred between meat pig breeds and both Mangalitsa strains. Fatty commercial fattener pigs had the most SFA in MLD (38.30 %) compared to Krškopoljske pigs (33.82 %) and other two groups of commercial fatteners (36.20 and 35.53 %), as established by Žemva *et al*. (2009). Luković *et al*. (2009) have established that all SFA and MUFA in intramuscular fat of *m. semimembranosus,* varied under the influence of breed, i.e. lower concentrations were seen in Black Slavonian pigs compared to crosses Black Slavonian with Duroc.Total SFA in MLD varied between strains of Iberian breed and crosses with Duroc from 38.09 % to 41.32 % (Juarez *et al*. 2009). No significant variations of MUFA were found between genotypes, but significant variations were established in PUFA .

In the current study, the content of SFA in MLD of Swallow-belly Mangalitsa was 39.45 %, which was higher than values determined for same breed by Parunović *et al*. (2012a, b; 35.28 and 33.39 %) in conventional housing systems. By comparing the current results with the research conducted by Juarez *et al*. (2009), we can conclude that some strains of Iberian pig had less, and one strain (IB-TO) more SFA (40.42 %) than ML. The SFA and MUFA levels measured in the present study for ML pigs were slightly higher, and for PUFA lower, than levels reported by Holló *et al*. (2003).

Housing system influences the content of SFA, as stated by Kim *et al*. (2009) and Parunović *et al*. (2012a). These authors found lower SFA content in MLD of autochthonous breeds reared in organic production, i.e. in outdoor systems, compared to the conventional system.

The current results are consistent with research by Parunović *et al*. (2012a), who have established that C16:0 is the most common SFA in MLD of Mangalitsa pigs. These authors also noticed that the content of C16:0 was higher in pigs reared in the free range system (24.6 %) compared to conventional system (23.2 %).

Carcass sides of Iberian pig are characterized by high concentration of MUFA in intramuscular fat of MLD, especially when kept in a free range system and fed grass and acorn (59.18 %, Daza *et al*. 2007). Other two groups animals kept in the indoor system, regardless of the feeding system (acorn in confinement and concentrate diet in confinement), showed no difference in MUFA concentration (56.68 and 56.28 %). Results of the research by Sans *et al*. (2004) relating to the quality of fresh meat deriving from Gascon pigs whose rearing is associated with natural resources with addition of acorn and concentrate in limited quantities, have shown that there is more MUFA in MLD (58.27 %). Similar values for MUFA concentration (58.13 %) in MLD of Iberian pigs in free range housing have been established by Rey *et al*. (2004). Our results are consistent with research conducted by Daza *et al*. (2007), since our ML pigs averaged 56.41 % MUFA in MLD.

The PUFA/SFA ratio should be above 0.4, but on the other hand, it is not only a high PUFA content which is important, but also the n-6/n-3 ratio. The British Committee on Medical Aspects of Food and Nutrition Policy (COMA) recommends that PUFA/SFA ratio should be >0.45 and <1.0 (Corino *et al*. 2002). However, it must be considered that higher PUFA content in meat can increase the incidence of softer fat tissue, which is more susceptible to oxidation and rancidity with adverse effects on human health. In our research, the PUFA/SFA ratio was not optimal since it was 0.10 and 0.11 in ML and M pigs, respectively. However, higher values for the PUFA/SFA ratio were measured by Parunović *et al*. (2012a) in MLD of Mangalitsa

reared in free range (0.183) and conventional systems (0.175). The PUFA/SFA ratio in the intramuscular fat of *m. semimembranosus* in Black Slavonian pigs was 0.26 in both rearing systems (outdoor and indoor) (Luković *et al*. 2009). Duroc/Black Slavonian crosses had lower PUFA/SFA ratios (0.15 and 0.21). Generally, it is regarded that the effect of pig breed is greater than the effect of the housing system, especially in regard to total PUFA and n-6/n-3 ratio. However, Kim *et al*. (2009) have found a more favourable PUFA/SFA ratio in MLD in Korean native black pigs reared in organic (0.66) compared to conventional feeding system (0.39). Total PUFA/SFA ratio in *m. longissimus lumborum* was higher in pigs from a free range system (0.64) compared to conventional system (0.46), as shown by Hoffman *et al*. (2003).

In the modern human diet, the balance between n-6/n-3 fatty acids has been disrupted which can lead to various disorders of physiological processes in the organism. However, increased intake of n-3 fatty acids in relation to n-6 has positive effects on human health (Simopoulos 2002, Harris *et al*. 2009, Grenon *et al*. 2012). Increased intake of unsaturated fatty acids is not recommended due to increased oxidation causing damage to cell membranes. There is a deficit in n-3 FA (polyunsaturated fatty acid) in modern human diets, and the n-6/n-3 ratio is 10-20:1 (Istoll 2001 – cited Habeanu *et al*. 2011), vastly greater than the preferred ratio, which is from 1:1 to 5:1.

In the present study, the n-6/n-3 ratio is higher than desirable (18.7:1 for breed ML and 13.7:1 for M). A slightly more favourable ratio was found in the fat tissue of Red Mangalitsa (13.2:1) (Zăhan *et al*. 2010). Values obtained for n-6/n-3 in the present study were lower compared to those determined by Kim *et al*. (2009) in MLD of the Korean native black (25.33:1) and Parunović *et al*. (2012a) for Mangalitsa (37.3:1), reared in conventional conditions.

Parunović *et al*. (2012b) established a negative phenotypic correlation between SFA and MUFA (r=−0.97) and MUFA and PUFA (r=−0.98), and positive between MUFA and PUFA (r=0.90).

One of the factors influencing the fatty acid profile of meat and fat is the composition of the diet. Dietary fats are transformed into carcass fat at a high rate (from 31 to 40 %) depending on the specific fatty acids (Kloareg *et al*. 2007). Feeding of Iberian pigs during fattening is the main factor influencing carcass quality and composition of meat and fat (Daza *et al*. 2006).

The duration of housing of pigs (entire fattening, first or final phase of fattening) in the outdoors (forest, pasture, meadow, etc.), composition and quality of grass, additional nutrition with concentrated feed can all vary. In Serbia, as well as in surrounding neighbouring countries, autochthonous pig breeds are reared in outdoor and indoor systems (farm conditions) and fattened until they reach a final body mass determined by market demand. On one hand, the number of Mangalitsa animals, and especially Moravka pigs, is very small and production is disorganized. For example, Mangalitsa sows are reared in herds of less than 10 to several tens of individuals. Clearly, quantity, quality or continuity in this type of production cannot be ensured. On the other hand, the live weight price of Mangalitsa pigs is approximately 20 % higher than other commercially produced pig meat genotypes. Additionally, meat products derived from autochthonous pig breeds such as Mangalitsa or Moravka command a very high price and are available in modest quantities and only to very small number of consumers – hence their exclusivity has great market appeal. Therefore, further work should be conducted to determine whether the fatty acid profiles of these highly-regarded »boutique« animals could be influenced by factors such as breeding or diet.

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