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Cholesterol content and fatty acids composition of Mangalitsa pork meat

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Abstract

The aim of this study was to examine variability in cholesterol content and fatty acid composition in *musculuslongissimus (MLLT)* of various genotypes of pigs.Out of 30 male castrated animals used in the trial, 20 were Mangalitsa pigs (Swallow Belly - SBM and White - WM) while 10 were of the Swedish Landrace breed – SL. The representative of pig meat breeds, SL had significantly less cholesterol in *MLLT* compared to SBM and WM pigs. The total monounsaturated fatty acids (MUFA) and unsaturated fatty acids (USFA) content was higher in SBM and WM than in SL pigs ($p< 0.001$).

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*Keywords:*Mangalitsa; meat quality; cholesterol; fatty acids; various genotypes

1. Introduction

In recent years, much information has been published in connection with the fatty acid composition and cholesterol content of the meat and back fat of the Mangalitsa pig[1,2,3]. Cholesterol content in *m. longissimus*of pigs varies from 58 to 73 mg/100 g of fresh tissue. However, lipid fraction of muscle content varies from 37 to 43% of

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saturated fatty acids, as well as from 59 to 63% of unsaturated fatty acids, including 9 to 12% polyunsaturated fatty acids[4,5].Hungarian researchers studied the fatty acid and cholesterol content of fatty tissues in Mangalitsa and Mangalitsa crosses with other breeds. They established that the unsaturated fatty acids content surpassed 60% in the Mangalitsa pig fat and almost reached the same percentage in the crosses[6,7]. Differences in cholesterol content, detected in different breeds, were insignificant[6].

The aim of this study was to examine variability in cholesterol content and fatty acid composition in *musculuslongissimus (MLLT)* of various genotypes of pigs.

2. Materials and methods

2.1. Animals and samples

Out of thirty male castrated animals used in the trial, twenty (2x10) were Mangalitsa pigs (Swallow Belly - SBM and White - WM) while ten were of the Swedish Landrace breed - SL. The experimental pigs were reared in late spring and early summer. Animals were kept in their natural habitat within the same area. Throughout the investigation, both the Mangalitsa and SL pigs were fed ad libitum diets of identical composition, provided from self-feeders. When the livestock weighed between 60 and 120 kg, they were fed an animal feed, created according to the following recipe: maize 70%, meal 14%, soybean meal 9%, sunflower meal 4%, chalk 1%, dicalcium phosphate 1%, salt 1%.

At the end of the trial, pigs were transported to a nearby commercial abattoir. Animals were conventionally slaughtered according to standard commercial procedures after electrical stunning (250 V AC, ear to ear for 3-5 s) and sticking within 30 s. During routine carcass splitting and cutting, samples of *MLLT* were taken between the 13th and 14th thoracic vertebra and stored in a freezer for further analyses. Prior to laboratory analysis, all the samples were vacuum packaged and kept frozen at approximately – 20ºC.

2.2. *Analytical measurements*

Cholesterol content was determined using HPLC/PDA, on the apparatus HPLC Waters 2695 Separation module, with Waters 2996 Photodiode array detector, as defined by the method of Maraschielloet al.[8].

Fatty acids as methyl esters were detected by capillary gas chromatography with a flame ionization detector. A predetermined quantity of lipid extracts, obtained by the rapid extraction method, was dissolved in tert-butyl methyl ether. Fatty acids were converted to fatty acids methyl esters (FAME) with trimethylsulfonium hydroxide, according to the SRPS EN ISO 5509:2007 method. FAMEs were analysed with GC-FID Shimadzu 2010 device (Kyoto, Japan) on cyanopropyl-aryl column HP-88 (column length 100, internal diameter 0.25 mm, film thickness 0.20 μm)[9].

2.3. Statistical analysis

The experimental data was statistically processed and analyzed by ANOVA and the least squares method (LSM) by applying the GLM procedure of the SAS 9.1.3 program package (SAS Inst. Inc. 2002-2003). The breed was introduced into the model as an independent variable while the mass of freshly slaughtered pig carcass sides was a dependent variable. When means were significantly different, Tukey's test was applied to compare the mean values of the genotypes.

3. Results and discussion

3.1. Cholesterol content

In our research, the type of genotype had a significant effect ($p < 0.001$) on cholesterol content in *MLLT* of examined pigs (Table 1). Cholesterol content in *MLLT* was the lowest in SL pigs. The total cholesterol concentration in *MLLT* of SBM and WM pigs ranged from a minimum of 52.54 mg/100 g to a maximum of 76.93 mg/100 g, while

the level of cholesterol concentration of SL pigs ranged from a minimum of 38.60 mg/100 g to a maximum of 55.12 mg/100 g. No statistically significant differences in cholesterol content in SBM and WM were established. A previous studies reported low levels of cholesterol in *MLLT* with 59 mg/100 g[10] and 57 mg/100 g[11]. Similarly, Bohac and Rhee[12]reported cholesterol content of 55.9 mg/100 g, 53.1 mg/100 g, and 59.7 mg/100 g for *MLLT*. In a similar study, Parunovićet al.[2]reported that the average cholesterol content in meat of WM was 63.38 mg and it varied from 52.00 to 76.93 mg/100 g. The average cholesterol content in 100 g of *MLLT* of WM fattener pigs was 14.78 mg higher than in the meat of SL and 1.15 mg higher than in the meat of SBM[2].

3.2. Fatty acid composition

The fatty acid composition and cholesterol content of *MLLT* from the examined pigs are shown in Table 1. In general,palmitic acid (C16:0) was the most abundant saturated fatty acid (SFA), oleic acid (C18:1 *cis*-9) the most abundant monounsaturated fatty acid (MUFA), and linoleic acid (C18:2 *n*-6) the most abundant polyunsaturated fatty acid (PUFA) in the *MLLT* of the examined pigs. SFA and PUFA were found in significantly higher percentages in *MLLT* of SL pigs (43.37% and 11.47%, respectively) than in SBM and WM pigs ($p< 0.001$). In contrast, MUFA and unsaturated fatty acids (USFA) were found in significantly higher percentages in *MLLT* of SBM and WM than in SL pigs ($p < 0.001$). Zăhan et al.[13]showed Mangalitsa pigs contained high levels of palmitic and stearic (SFA), oleic (MUFA) and linoleic (PUFA) fatty acids.

Table 1. Comparison of the least squares means ± (SEM) for the fatty acids composition of *MLLT* traitsand level of significance differences.

Trait	Swallow-Belly Mangalitsa SBM (n^1 = 10)	White Mangalitsa WM (n = 10)	Swedish Landrace SL (n = 10)	Significance[2] p
SFA	35.26 ± 0.53 ^{b}	33.76 ± 0.53 ^{b}	43.37 ± 0.56 ^{a}	***
MUFA	55.09 ± 1.04 ^{b}	57.96 ± 1.05 ^{b}	44.86 ± 1.11 ^{a}	***
PUFA	7.01 ± 0.77 ^{b}	5.21 ± 0.77 ^{b}	11.47 ± 0.81 ^{a}	***
USFA	62.10 ± 0.45 ^{b}	63.17 ± 0.45 ^{b}	56.33 ± 0.48 ^{a}	***
Total *n*-3 PUFA	0.57 ± 0.05 ^{b}	0.19 ± 0.05 ^{a}	0.20 ± 0.05 ^{a}	***
Total *n*-6 PUFA	6.23 ± 0.51 ^{a}	4.80 ± 0.51 ^{a}	9.63 ± 0.54 ^{b}	***
MUFA/PUFA	8.32 ± 0.60 ^{c}	11.45 ± 0.60 ^{b}	4.51 ± 0.64 ^{a}	***
MUFA/SFA	1.56 ± 0.04 ^{c}	1.72 ± 0.04 ^{b}	1.04 ± 0.04 ^{a}	***
PUFA/SFA	0.20 ± 0.01 ^{b}	0.15 ± 0.01 ^{b}	0.33 ± 0.02 ^{a}	***
n-6/*n*-3 PUFA	14.05 ± 2.99 ^{b}	34.01 ± 2.99 ^{a}	45.63 ± 3.17 ^{a}	***
Cholesterol,mg/100g	62.18 ± 1.11 ^{b}	62.79 ± 2.64 ^{b}	47.35 ± 1.90 ^{a}	***

[1] n = number of samples; [2]NS - not significant ($p \geq 0.05$); *: Statistical significance at the level of $p < 0.05$; **: Statistical significance at the level of $p<0.01$; ***: Statistical significance at the level of $p<0.001$; Content of SFA, MUFA, PUFA; $^{a-c}$Means within a row with different superscripts differ ($p<0.05$).

Total MUFA to SFA ratios of the *MLLT* differed significantly ($p < 0.001$), with a higher MUFA/SFA ratio for the Mangalitsa pigs, compared to that of the SL pigs.

Genotype significantly affected total SFA content in *MLLT* ($p < 0.001$), with SL producing higher levels than Mangalitsa pigs. The average value of SFA (43.37%) in SL pigs was higher than in WM and SBM pigs (Table 1). SL pigs showed higher PUFA content in *MLLT* than Mangalitsa pigs. These differences were mainly produced by higher total *n*-6 PUFA content in *MLLT* of SL pigs ($p < 0.001$). However, SBM had a higher level of total *n*-3 PUFA ($p < 0.001$) than SL and WM pigs. These led to significantly lower *n*-6/*n*-3 ratios in *MLLT* of SBM pigs ($p < 0.001$). It is clear that the housing system and/or diet of Mangalitsa pigs can significantly affect this ratio. For example, Parunovićet al.[3] found that the free-range Mangalitsa pigs showed a higher PUFA content in the *MLLT* than pigs reared indoors and fed conventionally. These differences were produced mainly by an almost four times higher total *n*-3 PUFA content in the *MLLT* of the free-range pigs ($p < 0.001$), and also by slightly higher levels of total *n*-6

PUFA ($p > 0.05$). These led to significantly lower *n*-6/*n*-3 ratios in the *MLLT* of the pigs reared outdoors and fed on acorns and free pasture ($p < 0.001$).

4. Conclusion

The results of our research led us to note differences between pig genotypes, especially between their cholesterol content and fatty acids composition in *MLTT*. The SL, representative of pig meat breeds, had significantly less cholesterol in *MLTT* compared to SBM and WM. However, differences in the content of saturated and unsaturated fatty acids were more expressed and distinct. A higher percentage of unsaturated fatty acids, which are purportedly less harmful to human health, were measured in WM and SBM breeds, whereas the percentage of saturated fatty acids was proven to be significantly higher in SL pigs.

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References

1. Petrovic M, RadovicC, Parunovic N, Radojkovic D, Savic R.Composition of carcass sides and quality of meat from swallow belly mangalitsa reared in two systems.*Biotechnol Anim Husb* 2012;**28**(2):303–11.
2. Parunovic N, Petrovic M, Matekalo-Sverak V, Radojkovic D, Vranic D,RadovicC. Cholesterol and total fatty acid content in *m. longissimusdorsi*of Mangalitsa and Swedish Landrace. *ActaAlimentaria*2012a;**41**(2):161–71.
3. Parunovic N, Petrovic M, Matekalo-Sverak V, Trbovic D, Mijatovic M, RadovicC.Fatty acid profile and cholesterol content of *m. longissimus*of free-range and conventionally reared Mangalitsa pigs.*S Afr J AnimSci* 2012b;**42**:101–13.
4. Migdał W, Koziec K, Koczanowski J, Tuz R, Borowiec F, Furgał K, Gardzińska A. Tissue traits of cross-breed fatteners. *Medycyna Wet* 1999;**55**:403–07.
5. Jacyno E, Pietruszka A, Kołodziej A, Czarnecki R.Content of lipid components in *m longissimusdorsi*of progeny of the boars descending from reciprocal crossing of the Pietrain and Durocbredss. *Arch Tierz* 2002;**45**:237–45.
6. Csapó J, Húsvéth F, Csapóné-Kiss Z, Horn P, Házas Z, Vargáné-Visi É, Bõcs K.Fatty acid and cholesterol composition of the lard of different genotypes of swine. *Acta Agraria Kaposvariensis* 1999;**3**(3):1–13.
7. Csapó J, Vargá-Visi É, Csapó-Kiss ZS, Csokona É.Fatty acid composition and cholesterol content of the fat of pigs of various genotypes. *Acta Agraria Kaposvariensis*2002;**6**(2):107–13.
8. Maraschiello C, Diaz I, Regueiro JAG. Determination of cholesterol in fat and muscle of pig by HPLC and capillary gas chromatography with solvent venting injection. *J High ResolutChromatogr*1996;**19**:165–68.
9. Spiric A, Trbovic D, Vranic D, Djinovic J, Petronijevic R, Matekalo-Sverak V.Statistical evaluation of fatty acid profile and cholesterol content in fish (common carp) lipids obtained by different sample preparation procedures. *Anal ChimActa*2010;**672**:66–71.
10. Moss M, Holden JM, Ono K, Cross R, Slover H, Berry B, Lanza E, Thompson R, Wolf W, Vanderslice J, Johnson H, Stewart K.Nutrient composition of fresh retail pork. *J Food Sci*1983;**48**:1767–71.
11. Dorado M, Martin Gomez EM, Jimenez-Colmenero F, Masoud TA.Cholestrol and fat contents of spanish commercial pork cuts. *Meat Sci*1999;**51**:321–23.
12. Bohac CE, Rhee KS.Influence of animal diet and muscle location on cholesterol content of beef and pork muscles. *Meat Sci* 1988;**23**:71–5.
13. Zăhan M, Miclea V, Hettig A, Miclea I, Raica P, Roman I.. The use of molecular and biochemical markers in Mangalitsa breed characterization. *Bulletin UASVM. Animal Science and Biotechnologies* 2010;**67**(1-2):452–55.