Porcine Research

Comparison between Mangalitsa and Mangalitsa x Duroc hybrids meat quality

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Abstract. Quality of pork is important in food industry and in health of the population due to protein and fat structure, which is correlated with genotype and food intake. The aim of this study was to establish the difference between meat quality of Mangalitsa pure breed and Mangalitsa x Duroc hybrids, based on the carcass traits and chemical composition. The main parameters were dry matter, intramuscular fat, crude protein and fatty acids level in muscle tissues (*Longissimus dorsis* and *Psoas major*). Our results indicated that Mangalitsa x Duroc hybrids provide better parameters of carcass traits in comparison with Mangalitsa pure breed. Concerning the chemical composition, better values of monounsaturated fatty acids (MUFA), polyunsaturated fatty acids (PUFA), PUFA/SFA ratio (P/S) and n-6/n-3 PUFA were observed in the case of Mangalitsa meat. We also calculated health related lipid indices including hypocholesterolemic/Hypercholesterolemic ratio (h/H), atherogenic index (AI) and thrombogenic index (TI) in order to establish the differences between Mangalitsa and Mangalitsa x Duroc hybrids meat quality. In conclusion, Mangalitsa provide better meat quality, but Mangalitsa x Duroc hybrids could be an alternative way to produce good quality of pork.
Key Words: *Sus scrofa*, swine hybrid, meat traits, fatty acids, intramuscular fat.

Introduction. Due to the well balanced nutritional content, meat is an essential component of human diet, its consumption being a marker in the living standard of a population. Because of its sources of nutrients, vitamins and mineral salts, as well as amino acidic balance superior to lots of plant proteins, pork represents the third part of total meat consumption. Along with the increase of the standard of life, the consumers became interested in nutritional values of food. In the last decades, human medicine highlighted the close relationship between fat consumption and cardiovascular diseases. On the other hand, a healthy diet does not mean a fatless one at all, but the right choice of it. Intramuscular fat and fatty acid contents are important components that influence meat quality and play an essential role in its nutritional value (Wood et al 2008). In the last years, effects of dietetic lipids on chronic diseases draw the attention of scientist (Givens et al 2009). Mangalitsa meat is considered a healthy diet for human consumption due to low cholesterol level and higher levels of copper, zinc and vitamins (especially from B complex) than those of commercial pork (Lugasi et al 2006). On the other hand, the main commercial breeds in Romania include Large White, Landrace, Pietrain and Duroc (Petrescu-Mag et al 2017).

From this regard, the choice of the scientists towards local breeds from fatty pig types and their hybrids with commercial ones in order to obtain better meat production with higher quality by increasing the level of unsaturated fatty acids is obvious.

The aim of the present study was to perform a comparison study between Mangalitsa and Mangalitsa x Duroc hybrids meat quality in terms of dry matter, intramuscular fat, crude protein and fatty acids level in muscle tissues (*Longissimus dorsis* and *Psoas major*).

Material and Method. Research was conducted on a population of red Mangalitsa pure breed and red Mangalitsa x Duroc hybrids kept at Agricultural Research and Development Station from Turda, Romania (Figure 1). Three pigs from each group were slaughtered and samples of muscle tissues were taken from *L. dorsis* and *P. major*. For the percentage of dry matter (drying method at temperature of 105°C to constant mass), crude protein (total proteins per Kjeldahl) and intramuscular fat (extraction with ether per Soxlhet) the standard methods were used.

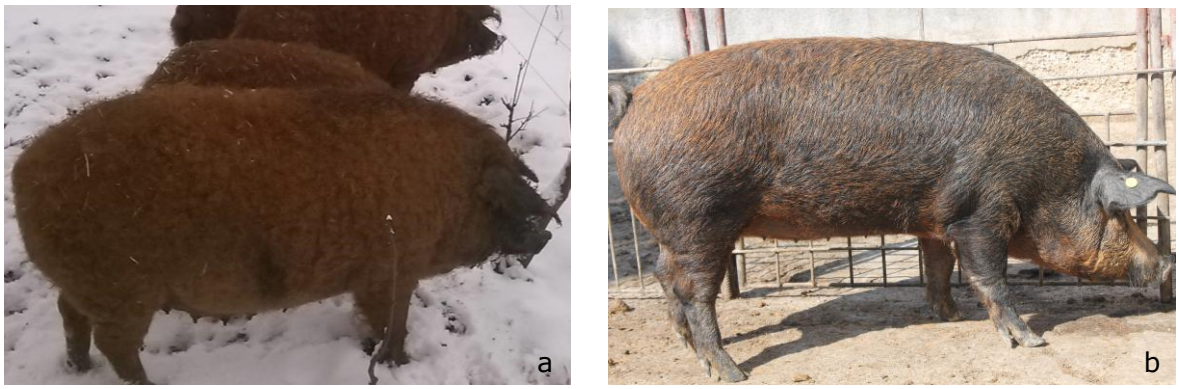

Figure 1. Mangalitsa (a) and Mangalitsa x Duroc hybrid (b) (original).

Fatty acid determination the samples were analyzed by gas chromatography. Peak areas of identified fatty acids were used to determine the relative percentage fatty acid composition of the total fatty acids. The percentage of saturated fatty acids (SFA – C12:0, C14:0, C16:0, C18:0, C20:0 and 22:0), monounsaturated fatty acids (MUFA – C14:1, C16:1 n-9, C16:1 n-7, C18:1 n-9, C18:1 n-7 and C20:1 n-9) and polyunsaturated fatty acid (PUFA – C18:2 n-6, C20:3 n-3 and C20:4 n-6) were calculated. The PUFA/SFA (P/S) and n-6/n-3 PUFA were calculated. The hypocholesterolemic/Hypercholesterolemic ratio (h/H) was calculated using the formula (Fernandez et al 2007):
h/H = [(sum of C18:1 n9, C18:1 n7, C18:2 n6, C20:3 n3 and C20:4 n6)/(sum of C14:0 and C16:0)

The atherogenic (AI) the thrombogenic index (TI) was calculated as follows (Ulbricht & Southgate 1991):
AI = (C12:0 + 4 × C14:0 + C16:0) / (MUFA + PUFA) and
TI = (C14:0 + C16:0 + C18:0) / (0.5 × MUFA + 0.5 × n-6 PUFA + 3 × n-3 PUFA + n-3/n-6 PUFA).

The results were statistically analyzed by Student's test, using GraphPad Prism.

Results and Discussion. The results of biochemical analysis showed higher value of dry matter and protein of Mangalitsa x Duroc hybrids than in the case of Red Mangalitsa pure breed (Table 1).

Table 1

Biochemical composition of Mangalitsa and Mangalitsa x Duroc hybrids meat

Traits	*Mangalitsa (n = 6)*	*Mangalitsa x Duroc (n = 6)*	*p value*
Dry matter (%)	29.58±0.18	31.73±0.53	<0.01
Fat (%)	5.32±0.31	4.84±0.42	Ns
Protein (%)	19.51±0.29	20.40±0.26	<0.05
Fat/protein ratio	0.27±0.02	0.24±0.02	Ns

n – number of samples, Ns – non significant.

As it was supposed we observed a higher percent of fat in Mangalitsa meat, without significant differences from statistical point of view. Even the fat/protein ratio showed similar values between the experimental variants. These results indicate that concerning

biochemical composition the quality of Mangalitsa and hybrids meat is similar. In comparison with these results, other researchers showed higher values on Mangalitsa intramuscular fat (10.3%) (Lugasi et al 2006) and lower values of protein (23.87%) (Csapo et al 1999).

Quality of meat is influenced by the intramuscular fat percentage and also by the fatty acid composition. In the case of SFA, C16:0 and C18:0 are the main fatty acids, while C18:1 n-9 and C18:2 n-6 are the main fatty acids for MUFA and PUFA (Table 2). Statistical analysis showed a few significant differences between the tested genotypes. However, two (C18:0 and C18:2 n-6) out of four fatty acids mentioned before shown significance differences ($p<0.01$).

The proportions of SFA, MUFA and especially PUFA are very important. Higher levels of MUFA and PUFA were observed at Mangalitsa meat, with significant differences ($p<0.05$ and $p<0.01$ respectively) in comparison with Mangalitsa x Duroc hybrids.

The ratios of P/S and n-6/n-3 PUFA are widely used to evaluate the nutritional value of fatty acids. However, health related lipid indices including h/H ratio, AI and TI were calculated for a better characterization of meat quality and their impact on human health. The AI and TI take into account the different effects that single fatty acid might have on human health and in particular on the probability of increasing the incidence of pathogenic phenomena, such as atheroma and/or thrombus formation. The recommended values of the AI are below 0.5 (Ulbricht & Southgate 1991) and it were obtained on both genotype tested. The TI was significantly lower ($p<0.01$), while the h/H ratio was higher ($P<0.01$) at Mangalitsa meat in comparison with hybrids.

Table 2

Fatty acids composition of Mangalitsa and Mangalitsa x Duroc hybrids meat

Fatty acids	*Mangalitsa (n = 6)*	*Mangalitsa x Duroc (n = 6)*	*p value*
C12:0 (lauric)	0.12±0.04	0.24±0.15	Ns
C14:0 (myristic)	0.89±0.02	0.98±0.06	Ns
C14:1 (myristoleic)	2.18±0.14	1.90±0.18	Ns
C16:0 (palmitic)	22.18±0.23	23.23±0.62	Ns
C16:1 n-9 (cis-7 hexadecenoic)	0.08±0.03	0.47±0.08	< 0.001
C16:1 n-7 (palmitoleic)	0.14±0.04	0.45±0.05	< 0.001
C18:0 (stearic)	11.20±0.67	14.24±0.34	< 0.01
C18:1 n-9 (oleic)	47.94±0.77	46.71±0.46	Ns
C18:1 n-7 (cis-vaccenic)	4.49±0.16	4.11±0.11	Ns
C18:2 n-6 (linoleic)	8.84±0.28	6.35±0.47	< 0.01
C20:0 (arachidic)	0.12±0.06	0.14±0.05	Ns
C20:1 n-9 (eicosenoic)	1.14±0.21	0.82±0.10	Ns
C20:3 n-3 (eicosatrienoic)	0.43±0.12	0.26±0.08	Ns
C20:4 n-6 (arachidonic)	0.15±0.03	0.18±0.08	Ns
C22:0 (behenic)	0.08±0.03	0.03±0.01	Ns
SFA	34.59±0.88	38.87±0.73	<0.01
MUFA	55.96±1.06	54.46±0.30	<0.05
PUFA	9.41±0.32	6.79±0.61	<0.01
P/S	0.27±0.01	0.18±0.02	<0.01
n-6/n-3	21.06±0.63	24.95±2.16	Ns
h/H	2.68±0.05	2.39±0.09	<0.05
AI	0.39±0.01	0.44±0.01	<0.05
TI	1.05±0.04	1.26±0.04	<0.01

n – number of samples, Ns – non significant, SFA – saturated fatty acids, MUFA – monounsaturated fatty acids, PUFA – polyunsaturated fatty acid, P/S – polyunsaturated fatty acid / saturated fatty acids, n-6/n-3 – polyunsaturated fatty acid n-6 / polyunsaturated fatty acid n-3, h/H – hypocholesterolemic / Hypercholesterolemic ratio, AI – atherogenic index, TI – thrombogenic index.

Meat quality of Mangalitsa and hybrids between Mangalitsa and different commercial breeds was studied by Romanian (Hăbeanu et al 2011; Hoha et al 2016), Hungarian (Csapo et al 1999; Holló et al 2003; Szabo 2006) and Serbian (Parunović et al 2013, Petrović et al 2014) researchers. Their result was not the same, but as a general characteristic Mangalitsa meat had better MUFA, PUFA, P/S and n-6/n-3 values.

Conclusions. On the basis of our research, we observed better values in Mangalitsa meat regarding MUFA, PUFA and a good P/S, n-6/n-3, h/H, AI and TI ratio, while Mangalitsa x Duroc hybrid meat had better dry matter, protein and fat levels. For this reason both are suitable for a healthy consumption and Mangalitsa x Duroc hybrid could be a good choice for small farms.

Acknowledgements. This work was supported by the Ministry of Agriculture and Rural Development of Romania, ADER research project no. 5.1.6./2015.

References

Csapo J., Husveth F., Csapo Z. S., Horn P., Hazas Z., Varga E., Bocs K., 1999 Fatty acid composition and cholesterol content of the fat of pigs different breeds. Acta Agraria Kaposvariensis 3(3):1-13.

Fernandez M., Ordonez J. A., Cambero I., Santos C., Pin C., de la Hoz L., 2007 Fatty acid compositions of selected varieties of Spanish dry ham related to their nutritional implications. Food Chemistry 101:107–112.

Givens D. I., Kliem K. E., Humphries D. J., Shingfield K. J., Morgan R., 2009 Effect of replacing calcium salts of palm oil distillate with rapeseed oil, milled or whole rapeseeds on milk fatty-acid composition in cows fed maize silage-based diets. Animal 3(7):1067-1074.

Hăbeanu M., Hebean V., Țăranu I., Ropota M., Lefter N., Marin D., 2011 Dietary ecologic camelina oil – a beneficial source of n-3 PUFA in muscle tissue and health status in finishing pigs. Rom Biotechnol Lett 16:6564-6571.

Hoha G. V., Pandelea M., Costăchescu E., Nistor C. E., Măgdici E., Păsărin B., 2016 The quality of meat to different type mangalitsa breeds's. Scientific Papers-Animal Science Series 65:84-87.

Holló G., Seregi J., Ender K., Nuernberg K., Wegner J., Seenger J., Holló I., Repa I., 2003 Examination of meat quality and fatty acid composition of Mangalitsa. Acta Agraria Kaposváriensis 7(2):19-32.

Lugasi A., Gergely A., Horvari J., Barna E., Lebovics V. K., Kontraszti M., Herman I., Gundel J., 2006 Meat quality and human nutritional importance of Mangalica. Hungarian J Anim Prod 55:263-277.

Parunović N., Petrović M., Matekalo-Sverak V., Radović Č., Stanišić N., 2013 Carcass properties, chemical content and fatty acid composition of the musculus longissimus of different pig genotypes. South African Journal of Animal Science 43 (2):123-136.

Petrescu-Mag I. V., Stoian R. O., Todoran C., 2017 Pork production in Romania. Porc Res 7(1):32-38.

Petrović M., Wähner M., Radović Č., Radojković D., Parunović N., Savić R., Brkić N., 2014 Fatty acid profile of *m. longissimus dorsi* of Mangalitsa and Moravka pig breeds. Archiv Tierzucht 57(17):1-12.

Szabo P., 2006 Fatty acid composition of the tissues of Mangalica and other pig genotypes. Hungarian J Anim Prod 55:293-311.

Ulbricht T. L., Southgate D. A., 1991 Coronary heart disease: seven dietary factors. Lancet 338(8773):985–992.

Wood J. D., Enser M., Fisher A. V., Nute G. R., Sheard P. R., Richardson R. I., Hughes S. I., Whittington F. M., 2008 Fat deposition, fatty acid composition and meat quality: A review. Meat Sci 78(4):343-358.

Received: 13 September 2019. Accepted: 22 October 2019. Published online: 31 October 2019.
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How to cite this article:
Zăhan M., Miclea I., Nagy A., Copolovici L., 2019 Comparison between Mangalitsa and Mangalitsa x Duroc hybrids meat quality. Porc Res 9(1):21-25.