

Carcass and pork quality traits of indigenous pure breeds (Mangalitsa, Moravka) and their crossbreeds

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ABSTRACT

Objective of this paper was to evaluate phenotypic variability of carcass side and pork quality traits of fatteners (male castrated and female heads). Investigation included 12 pigs per group of Mangalitsa (Genotype 1), Moravka (Genotype 2), cross-breed Mangalitsa with Moravka (Genotype 3) and cross-breed Moravka with Duroc boar (Genotype 4). Results show that Mangalitsa had lower daily gain (268 g) than other genotypes ($p < 0.001$). The greatest difference for fat thickness was determined between Genotype 1 and Genotype 4. As expected, the thinnest fat and maximum value for gain and depth of *Musculus longissimus* (*ML*) had the Genotype 4. The highest value for the *ML* surface was found in Genotype 4 (47.52 cm²) whereas for the same trait in Mangalitsa the lowest value was observed (24.16 cm²). Mangalitsa had significantly lower L*, a* and b* values of *ML* compared with all other groups ($p < 0.001$). Considering the low production performance of indigenous pig breeds, crossbreeding with the Duroc breed will contribute a improvement of growth and carcass traits.

Key words: Color, Genotype, Indigenous pig breeds, Meatiness, pH, Sex.

INTRODUCTION

Local (indigenous) pig populations are usually constituted by a quite low number of active boars and sows. Their pedigree information is lacking or absent, complete phenotypic description is usually not available for most of these populations that are very well adapted to specific local agro-climatic environments. The population of Mangalitsa and Moravka breed is endangered and risky endangered. Small number of both indigenous breed produce many negative effect (low reproductive performance, high mortality, low daily gain, etc.). In Europe, a large number of indigenous pig breeds is nearly extinct. Serbia already lost 2 indigenous pig breeds (Šiška and Šumadinka breeds) which belonged to the most primitive breeds of pig – fatty breeds.

In Republic of Serbia today, there are three registered native, indigenous breeds: Mangalitsa, Moravka and Resavka. Mangalitsa (Swallow-Belly Strain) is found on the territory of Srem (vicinity of Ruma, village Budanovci, and the residents of this village in Srem are called “Lasans”) and is typical fatty pig breed. Because the meat and adipose tissue as well as meat products of Mangalitsa are much appreciated by the Serbian consumers, the scientific efforts were not limited to preserve the breed as such but also to better exploit its potential for human consumption. It has in carcass sides 65-70% of fat and approx. 28-35% lean meat (Egerszegi *et al.*, 2003; Petrovic *et al.*, 2009). Today, the Mangalitsa breed is reared in an organized system in several herds in the Republic of Serbia and is the most numerous

indigenous pig breed. Moravka and Resavka are breeds of combined production abilities, reared in the same region of Serbia, and were studied in comparative research (Živković and Kostić, 1952). Moravka has somewhat more lean meat in carcass sides and considerably less fat than Mangalitsa (Petrovic *et al.*, 2007a).

One of the indicators of technological quality of meat is a muscle pH value. On the varying of the pH values some other factors such as: growing conditions, nutrition, transport, procedures on animals pre-slaughter, during processing on the slaughter line and cooling of carcass halves exert their effect. Values of pH of muscle is about 5.6-5.7 of a “normal” quality within 6-8 hours after slaughter, and then to about 5.3-5.7 after 24 hours (Janicki and Buzala, 2013). The color and appearance of meat are crucial for making decisions while buying meat. Unusual and changed color of meat and release of fluids act repulsive to the customers.

Objective of this paper was to evaluate phenotypic variability of carcass and some meat quality properties of indigenous pure breeds, Mangalitsa and Moravka, and their available cross-breeds.

MATERIALS AND METHODS

Animal trial: Research was carried out on pig farm and in experimental slaughterhouse of the Institute for Animal Husbandry, Belgrade, Serbia. Investigation included heads of Mangalitsa (Genotype 1), Moravka (Genotype 2), cross-breed Mangalitsa with Moravka (Genotype 3) and cross-

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breed Moravka with Duroc boar (Genotype 4). The investigation included 12 pigs per group. Besides the genotype as fixed factors in the model included sex of progeny (per genotype, 6 animals were male castrates-surgical castration and 6 animals were females). A traditional low-input technology was applied. Apart from pasture, the pigs were given of corn (to 0.3 kg/animal/day).

Evaluation of carcass and pork quality traits: Pre-slaughter mass, mass of warm and cold carcasses were measured with accuracy of 0.5 kg. On slaughter line, linear measures of warm carcass sides were taken. Fat thickness was measured in the middle of the back where fat tissue is the thinnest (between 13th and 15th vertebrae; FTMB) and withers back fat thickness (WBF). Back fat thickness was measured with accuracy of 1 mm. Yield of meat was determined on cooled left carcass sides by method of partial dissection (according to methodology recommended by EU Commission Regulation (EC) 1249/2008; Walstra and Merkus, 1996). Percentage of meat in carcass sides was calculated using two formulas/equations:

1. Commission Regulation EC No 3127/94 (EC 94):

$$y = 1.3 \times 100 \times \frac{\text{weight of tender loin} + \text{weight of lean (fascia included)} \\ \text{in shoulder, loin, ham and belly}}{\text{weight of tender loin} + \text{weight of dissected cuts} + \text{weight of remaining cuts}}$$

2. Commission regulation EC No 1197/06 (EC 06):

$$y = 0.89 \times 100 \times \frac{\text{weight of tender loin} + \text{weight of lean (fascia included)} \\ \text{in shoulder, loin, ham and belly}}{\text{weight of tender loin} + \text{weight of dissected cuts}}$$

Measuring of mass of warm carcass sides was done 45 min *post-mortem*, and before cutting on warm right carcass sides, percentage of muscle tissue was assessed by simulation of the instrumental method FOM and lean meat content in carcass sides and class of carcass sides was determined (SEUROP classification system). According to formula defined by Radovic *et al.* (2010), content of meat was determined by measuring of the fat thickness on two locations/points which are adequate to positions where FOM probe is inserted (LF and RF) and diameter (RM) of *Musculus longissimus* (ML), where: LF – fat tissue thickness (with skin) in millimetres, measured 8 cm away from medial carcass line, between 3rd and 4th lumbal vertebrae, from caudo-cranial point of view; RF – fat tissue thickness (with skin) in millimetres, measured 7 cm from medial carcass line, between 3rd and 4th rib, from caudo-cranial point of view; RM – diameter of ML in millimetres, measured at the same time and same position as RF. In accordance to regulations of the majority of EU countries, linear measures of LF, RF and RM were taken manually using a ruler. Based on obtained results, percentage of meat in carcass sides was calculated using mathematical model defined and presented in the proposal of the Regulation on quality of slaughtered pigs:

$$Y = 55.6925 - 0.2402 LF - 0.4575 RF + 0.1578 RM$$

Meatiness was also established using “Two-point method” (Radovic *et al.*, 2010) as follows: fat thickness was measured at the thinnest point of the rump, i.e. where *M. gluteus medius* (MGM) penetrated the fat tissue the most (S) and the second measure was depth of ML measured as the shortest link/connection between the front (cranial) end of the MGM and the top (dorsal) rim/edge of the spinal canal (M). For calculation of meatiness using this method the following equation was used:

$$Y = 49.6358 - 0.5667 S + 0.2069 M$$

Meat value pH *Musculus longissimus* (ML) and *M. semimembranosus* (SM) was determined 45 minutes (pH₁) and 24 hours post mortem (pH₂) by pH-meter (Hanna, HI 83141). The print/mark of the long back muscle ML and fat was taken on tracing paper to determine the eye muscle area (AML) and fat areas which associated muscle (FA). The color of ML was determined 24 hours *post-mortem* measured at the same position as RF and RM (between 3rd and 4th rib, from caudo-cranial point of view) using Chromameter CR-400 (Minolta Co. Ltd, Tokyo, Japan). The measurements were done according to CIE L*a*b* system: lightness (L*), redness (a*) and yellowness (b*) (CIE, 1976).

Statistical analysis: Processing of data was done by implementation of adequate programme, i.e. use of the method of least squares (LSMLMW and MIXMDL – Harvey, 1990) in order to determine the significance (P<0.001) of systematic influences on quality traits of carcass sides. The LSD test was used to evaluate differences in each of the main values.

Model for analysis of yield and share of meat in carcass sides:

$$y_{ijk} = \mu + G_i + S_j + b_1(X_1 - \bar{X}_1) + \varepsilon_{ijk}$$

where: y_{ijk} – expression of trait in k individual animal, i genotype, j sex; μ – general population average, G – genotype, S – sex, b₁ – linear regression effect of the warm carcass side mass, e – random error.

RESULTS AND DISCUSSION

General population average pre-slaughter mass of investigated genotypes was 131.79 kg (Table 1). Mangalitsa (Genotype 1) had lower daily gain (268 g) than other genotypes and established differences were statistically very highly significant (p<0.001). Back fat thickness measured on different positions in Mangalitsa pigs was greater by approx. 9.3 mm (WBF) to 9.8 mm (FTMB) compared to Genotype 4. Differences between the sex are not determined (p>0.05). All measures traits in Table 1 depended on mass of warm carcass sides (WCM) except WBF.

The greatest difference for fat thickness RF (+25.3 mm) was determined between Genotype 1 and Genotype 4 (Table 2.). Highest depth of muscle ML had Genotype 4 and male castrated animals (56.37 mm and 47.98 mm). Established differences between genotypes (Table 2) were

Table 1: Effect of Genotype and sex of pre-slaughter mass, daily gain and fat thickness (WCM=110.45 kg)

| Sources of variation | PSM ³⁾ , kg | DG, g | WBF, mm | FTMB,mm |
|--------------------------|------------------------|---------------------------------|-------------------------------|--------------------------------|
| $\mu \pm$ S.E. | 131.79 \pm 0.78 | 369.15 \pm 8.36 | 66.41 \pm 1.52 | 47.00 \pm 1.60 |
| Genotype 1 ¹⁾ | 133.00 \pm 1.60 | 267.86 \pm 17.19 ^a | 68.30 \pm 3.12 ^a | 50.5 \pm 3.29 ^a |
| Genotype 2 | 134.81 \pm 1.56 | 368.86 \pm 16.77 ^b | 66.97 \pm 3.04 ^a | 44.44 \pm 3.20 ^{ab} |
| Genotype 3 | 128.77 \pm 1.56 | 336.91 \pm 16.82 ^a | 67.34 \pm 3.05 ^a | 48.29 \pm 3.21 ^{ab} |
| Genotype 4 | 130.58 \pm 1.62 | 502.95 \pm 17.43 ^b | 59.02 \pm 3.16 ^b | 40.74 \pm 3.33 ^b |
| P ²⁾ | NS | *** | ** | * |
| Female | 130.69 \pm 1.21 | 365.61 \pm 13.07 | 65.97 \pm 2.37 | 45.96 \pm 2.50 |
| Male | 132.89 \pm 1.09 | 372.68 \pm 11.71 | 66.85 \pm 2.12 | 48.03 \pm 2.24 |
| P | NS | NS | NS | NS |
| WCM(b) | 1.18 ^{***} | 4.01 ^{***} | 0.32 ^{NS} | 0.66 ^{***} |

¹⁾ 1-Mangalitsa, 2-Moravka, 3- ♂Mangalitsa x ♀Moravka, 4- ♂Duroc x ♀Moravka;

²⁾ P-Level of significance for factors NS - P>0.05; * - P<0.05; ** - P<0.01; *** - P<0.001;

³⁾ PSM-Preslaughter mass, DG-Daily gain, WBF-withers back fat thickness, FTMB-Fat thickness in the middle of the back; WCM (b)- linear effect of warm carcass side mass

Table 2: Effect of Genotype and sex of carcass quality traits (WCM=110.45 kg)

| Sources of variation | LF ³⁾ , mm | RF, mm | RM, mm | S, mm | M, mm |
|--------------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|--------------------------------|
| $\mu \pm$ S.E. | 52.00 \pm 1.36 | 50.14 \pm 1.31 | 47.06 \pm 1.00 | 47.74 \pm 1.22 | 61.72 \pm 1.35 |
| Genotype 1 ¹⁾ | 59.27 \pm 2.80 ^a | 62.53 \pm 2.70 ^a | 38.74 \pm 2.06 ^a | 57.91 \pm 2.50 ^a | 61.22 \pm 2.78 ^{ab} |
| Genotype 2 | 51.98 \pm 2.73 ^a | 45.74 \pm 2.64 ^{bc} | 45.34 \pm 2.01 ^b | 48.15 \pm 2.44 ^{ab} | 61.49 \pm 2.71 ^{ab} |
| Genotype 3 | 56.28 \pm 2.73 ^a | 55.11 \pm 2.64 ^{ab} | 47.77 \pm 2.01 ^b | 48.04 \pm 2.45 ^b | 55.51 \pm 2.72 ^a |
| Genotype 4 | 40.48 \pm 2.83 ^b | 37.19 \pm 2.74 ^c | 56.37 \pm 2.09 ^c | 36.87 \pm 2.53 ^c | 68.66 \pm 2.82 ^b |
| P ²⁾ | ** | *** | *** | *** | * |
| Female | 49.05 \pm 2.12 | 46.58 \pm 2.05 | 46.14 \pm 1.57 | 44.68 \pm 1.90 | 62.42 \pm 2.11 |
| Male | 54.96 \pm 1.90 | 53.71 \pm 1.84 | 47.98 \pm 1.40 | 50.81 \pm 1.70 | 61.02 \pm 1.90 |
| P | NS | * | NS | * | NS |
| WCM(b) | 0.35 [*] | 0.32 [*] | 0.12 ^{NS} | 0.19 ^{NS} | 0.28 ^{NS} |

¹⁾ 1-Mangalitsa, 2-Moravka, 3- ♂Mangalitsa x ♀Moravka, 4- ♂Duroc x ♀Moravka;

²⁾ P-Level of significance for factors NS - P>0.05; * - P<0.05; ** - P<0.01; *** - P<0.001;

³⁾ LF=fat tissue thickness, RF-fat tissue thickness, RM=diameter of ML, S- fat tissue, M- depth of ML; WCM (b)- linear effect of warm carcass side mass

statistically significant ($p < 0.05$; $p < 0.01$ and $p < 0.001$). Female animals had lower fat tickness (WBF, FTMB, LF, RF and S) and lower diameter of ML (RM), whereas the value of ML depth (S) was higher (+1.4 mm) compared to male castrated animals.

In the fattening, from 31.92 to 94.33 kg, Petrovic *et al.* (2007a) have found the average daily gain for Moravka of 385g/day while in our studies for the same genotype the value of life daily gain of 369 g was determined. Petrovic *et al.* (2010) reported lower average body weight of animals at slaughtering (101.22 kg) compared to our study (133 kg and 134.8 kg). Petrovic *et al.* (2010) had identified thinner fat tissue WBF (61.85 and 63.15 : 68.30 and 66.97 mm), FTMB (43.78 and 43.22 : 50.52 and 44.44 mm) and the fat thickness of the genotype 1 (51.94: 57.91 mm), while in case of genotype 2 higher values for fat thickness S were found (51.46 : 48.15 mm), respectively for reported and our study.

The greatest difference in share of meat to the tune of 8.3% was determined between EC 06 and FOM method (Table 3). The differences in the meatiness estimated by dissection of four parts (EC 94 and EC 06) between Genotypes 1 and 3 were almost non-existent while these

differences were more pronounced when assessing meatiness based on backfat thickness and depth of the ML (FOM and TP). The thinnest fat and maximum value for gain and depth of ML had as expected the Genotype 4. Established differences from shares of muscle tissue between genotypes (Table 3) were very highly significant ($p < 0.001$). Females were having higher estimated lean meat as compared to the castrated male animals. The influence of gender on the estimated lean meat content was determined using FOM and the TP method ($p < 0.05$) but not for the meatiness estimated by dissection (EC 94 and EC 06).

In the same study (Petrovic *et al.*, 2010), share of muscle tissue in the carcass sides of the Moravka breed was 4.3% higher than in the carcass sides of the race Mangalitsa, whereas in our study slightly lower difference between these genotypes was identified (EC 94, 2.69% and the EC 06, 2.03%). Share of meat in carcass sides (EC 06) of Swallow-Belly Mangalitsa was higher as compared to values determined by Kralik and Petricevic (2001) 28.8%, Petrovic *et al.* (2009, 2010) 27.81% and Petrovic *et al.* (2011) 31.97% and lower compared to the results by Egerszegi *et al.* (2003) and Petrovic *et al.* (2012).

Table 3: Effect of Genotype and sex of share of meat (WCM=110.45 kg)

| Sources of variation | EC 94 ³⁾ , % | EC 06, % | FOM,% | TP, % |
|--------------------------|-------------------------------|-------------------------------|--------------------------------|-------------------------------|
| $\mu \pm$ S.E. | 34.15 \pm 0.62 | 35.98 \pm 0.60 | 27.68 \pm 0.89 | 35.35 \pm 0.74 |
| Genotype 1 ¹⁾ | 30.33 \pm 1.27 ^a | 33.20 \pm 1.24 ^a | 18.95 \pm 1.83 ^a | 29.50 \pm 1.52 ^a |
| Genotype 2 | 33.02 \pm 1.24 ^a | 35.23 \pm 1.21 ^a | 29.44 \pm 1.79 ^b | 35.07 \pm 1.49 ^a |
| Genotype 3 | 30.54 \pm 1.24 ^a | 33.92 \pm 1.21 ^a | 24.47 \pm 1.79 ^{ab} | 33.91 \pm 1.49 ^a |
| Genotype 4 | 42.72 \pm 1.28 ^b | 43.55 \pm 1.26 ^b | 37.85 \pm 1.86 ^b | 42.93 \pm 1.54 ^b |
| p ²⁾ | *** | *** | *** | *** |
| Female | 35.31 \pm 0.96 | 37.20 \pm 0.94 | 29.87 \pm 1.39 | 37.25 \pm 1.16 |
| Male | 32.99 \pm 0.86 | 34.75 \pm 0.84 | 25.49 \pm 1.25 | 33.46 \pm 1.04 |
| P | NS | NS | * | * |
| WCM(b) | -0.07 ^{NS} | -0.10 ^{NS} | -0.21 [*] | -0.05 ^{NS} |

¹⁾1-Mangalitsa, 2-Moravka, 3- ♂Mangalitsa x ♀Moravka, 4- ♂Duroc x ♀Moravka;

²⁾P-Level of significance for factors NS - P>0.05; * - P<0.05; ** - P<0.01; *** - P<0.001;

³⁾EC 94 -share of meat in carcass sides (EC No 3127/94), EC 06 -share of meat in carcass sides (EC No 1197/06), FOM- share of meat determined by Fat-O-Meater, TP- share of meat determined Two-point method, WCM (b)- linear effect of warm carcass side mass.

Values of pH₁ (45 minute *post-mortem*) of the *Musculus longissimus* (ML) and *Musculus semimembranosus* (SM) were 6.23 and 6.46 (Table 4). For both muscles was found that Genotype 3 and female animals had the highest values of pH₁ and pH₂. Both factors influenced statistically (p<0.05, p<0.01 and p<0.001) the value of pH₂.

In the research of Fortina *et al.* (2005), in genotypes Casertana and Mora Romagnola, higher values of pH₂ for

ML and SM were found compared to our genotypes, while for pH₁ in both muscles similar values were observed.

The highest value for the ML surface (AML) was found in Genotype 4 (47.52 cm²), whereas for the same trait in genotype 1, the lowest value was determined (24.16 cm²). Established differences between genotypes (Table 5) were very highly significant (p<0.001). The values obtained by measuring the fat areas which associated muscle (FA)

Table 4: Effect of Genotype and sex of meat value pH ML and pH MSM (WCM=110.45 kg)

| Sources of variation | pH ₁ -ML ³⁾ | pH ₁ -SM | pH ₂ -ML | pH ₂ -SM |
|--------------------------|-----------------------------------|-------------------------------|-------------------------------|---------------------|
| $\mu \pm$ S.E. | 6.23 \pm 0.06 | 6.46 \pm 0.06 | 5.58 \pm 0.03 | 5.79 \pm 0.03 |
| Genotype 1 ¹⁾ | 6.11 \pm 0.13 ^a | 6.23 \pm 0.12 ^a | 5.50 \pm 0.06 ^{ab} | 5.78 \pm 0.06 |
| Genotype 2 | 6.53 \pm 0.13 ^b | 6.59 \pm 0.12 ^{bc} | 5.65 \pm 0.05 ^{ab} | 5.71 \pm 0.06 |
| Genotype 3 | 6.59 \pm 0.13 ^b | 6.73 \pm 0.12 ^c | 5.71 \pm 0.05 ^a | 5.91 \pm 0.06 |
| Genotype 4 | 5.69 \pm 0.13 ^c | 6.27 \pm 0.12 ^{ab} | 5.46 \pm 0.06 ^b | 5.68 \pm 0.06 |
| p ²⁾ | *** | * | * | NS |
| Female | 6.34 \pm 0.10 | 6.46 \pm 0.09 | 5.72 \pm 0.04 | 5.97 \pm 0.04 |
| Male | 6.13 \pm 0.09 | 6.45 \pm 0.08 | 5.44 \pm 0.04 | 5.61 \pm 0.04 |
| P | NS | NS | ** | *** |
| WCM(b) | 0.00 ^{NS} | 0.00 ^{NS} | 0.00 ^{NS} | 0.02 ^{***} |

¹⁾1-Mangalitsa, 2-Moravka, 3- ♂Mangalitsa x ♀Moravka, 4- ♂Duroc x ♀Moravka;

²⁾P-Level of significance for factors NS - P>0.05; * - P<0.05; ** - P<0.01; *** - P<0.001;

³⁾pH₁ and 2 *Musculus longissimus* (ML), pH₁ and 2 *M. semimembranosus* (MSM) WCM (b)- linear effect of warm carcass side mass.

Table 5: Effect of Genotype and sex of ML and fat area and color ML (WCM=110.45 kg)

| Sources of variation | AML ³⁾ , cm ² | FA, cm ² | L*value | a*value | b*value |
|--------------------------|-------------------------------------|--------------------------------|-------------------------------|-------------------------------|-------------------------------|
| $\mu \pm$ S.E. | 32.33 \pm 1.17 | 49.36 \pm 1.62 | 48.84 \pm 0.72 | 12.79 \pm 0.50 | 5.73 \pm 0.22 |
| Genotype 1 ¹⁾ | 24.16 \pm 2.41 ^a | 55.88 \pm 3.33 ^a | 40.13 \pm 1.48 ^a | 11.77 \pm 1.04 ^a | 3.73 \pm 0.45 ^a |
| Genotype 2 | 28.51 \pm 2.35 ^a | 51.54 \pm 3.25 ^{ab} | 48.92 \pm 1.44 ^b | 12.00 \pm 1.01 ^a | 5.91 \pm 0.44 ^b |
| Genotype 3 | 29.13 \pm 2.36 ^a | 48.70 \pm 3.26 ^{ab} | 50.43 \pm 1.45 ^b | 12.10 \pm 1.01 ^a | 6.02 \pm 0.44 ^{bc} |
| Genotype 4 | 47.52 \pm 2.44 ^b | 41.33 \pm 3.38 ^b | 55.87 \pm 1.50 ^c | 15.30 \pm 1.05 ^b | 7.26 \pm 0.46 ^c |
| p ²⁾ | *** | NS | *** | NS | *** |
| Female | 33.00 \pm 1.83 | 46.42 \pm 2.53 | 48.55 \pm 1.13 | 12.57 \pm 0.79 | 5.58 \pm 0.35 |
| Male | 31.65 \pm 1.64 | 52.30 \pm 2.27 | 49.12 \pm 1.01 | 13.02 \pm 0.71 | 5.88 \pm 0.31 |
| P | NS | NS | NS | NS | NS |
| WCM(b) | 0.27 [*] | 0.60 ^{**} | 0.11 ^{NS} | -0.07 ^{NS} | 0.00 ^{NS} |

¹⁾1-Mangalitsa, 2-Moravka, 3- ♂Mangalitsa x ♀Moravka, 4- ♂Duroc x ♀Moravka;

²⁾P-Level of significance for factors NS - P>0.05; * - P<0.05; ** - P<0.01; *** - P<0.001;

³⁾AML-eye muscle area, FA-fat areas which associated muscle; WCM (b)- linear effect of warm carcass side mass.

indicate that, although in the absolute values of the genotypes certain differences were found (Genotype 1: Genotype 4 = 14.55 cm²), the difference between genotypes was not statistically significant ($p > 0.05$). Observing these genotypes, i.e. by comparing colours of ML Mangalitsa (Genotype 1) with Genotype 4 (where we have 50% of genes of Duroc breed), it was found that Mangalitsa had a brighter ML ($L^* = 40.13:55.87$ $p < 0.001$), with a smaller proportion of red ($a^* = 11.77:15.30$, $p > 0.05$) and a smaller proportion of the yellow colour ($b^* = 3.73:7.26$, $p < 0.001$). No statistically significant difference (Table 5) was determined between genders ($p > 0.05$).

Compared to the research of Petrovic *et al.* (2007b), in our study for genotype 1 lower values were found for AML (24.16 : 24.43 cm²) and FA (55.88 : 81.35 cm²), although the animals had a higher average pre-slaughter body weight (133 : 125 kg).

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The tested genotypes in our researched had darker meat (except for Genotype 1 $L^* = 40.13$), with a higher proportion of red and yellow in comparison with research of Fortina *et al.* (2005) in Genotype Casertana and Mora Romagnola.

Indigenous pig breeds Mangalitsa and Moravka is the fatty and fatty-meat breed. Considering with the low production performance (low daily gain and meatness), crossbreeding with the Duroc breed will contribute a improvement of growth and carcass traits, with the shorter fattening and higher percentage of meat content in the carcass.

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