Physicochemical properties of meat from Mangalitsa pig breed

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SUMMARY

This study was conducted to investigate physicochemical characteristics of meat from Mangalitsa pig breed. The research was carried out on three muscles: longissimus dorsi, gluteus medius and triceps brachii. Compared to the Swedish Landrace pig breed, which was used as a control group in this research, it was found out that the meat of the Mangalitsa had considerably higher intramuscular fat content and a darker colour (lower L values). Cooking weight loss was lower in muscles from Mangalitsa pig and meat was more tender compared to Landrace pig. Based on the results obtained in this research, it can be concluded that meat from Mangalitsa pig have higher meat quality traits compared to the commercial pig breed.*

***Key words:** physicochemical properties, pig meat, Mangalitsa breed*

INTRODUCTION

Meat and meat products from autochthonous pigs are highly appreciated by consumers because of their high sensory quality (Živković et al., 2012). The high amount of intramuscular fat, the great concentrations of heme pigments and the high levels of unsaturated fatty acids have been highlighted as some of the most relevant quality aspects in muscles from autochthonous pig breeds. However, unlike commercial/meaty pig breeds, due to low economical significance in developed countries, there is very little information in the scientific literature pertaining to carcass composition and quality of meat of autochthonous pig breeds.

In Republic of Serbia three native autochthonous pig breeds are registered: Mangalitsa, Moravka and Resavka. First one is the most present and the last one the least (Petrović et al., 2010). They have the ability to deposit great quantities of fat in and on their carcasses, which reduces their value at market. For this reason, producers have lost their interest in producing this pig breeds and there numbers have declined considerably to the point of extinction. However, the ability of this pigs to deposit intramuscular fat is very valuable, especially in the production of high quality, high priced cured meat products, such as proscuito and dry-cured ham (Antequera et al., 1992). Fat contributes to the juiciness of dry-cured hams and due to the lipolytic and oxidative processes that occurs during the curing treatment, it also influences the development of the aroma (López et al., 1992).

The present study was undertaken to evaluate the physicochemical characteristics of three muscles from one autochthonous pig breed (Mangalitsa) and one modern meaty breed (Swedish Landrace). Mangalitsa was selected as autochthonous Serbian pig breed, while Swedish Landrace, was chosen as the most represented commercial pig breed in Serbia.

MATERIALS AND METHODS

The research was carried out on three muscles: longissimus dorsi, gluteus medius and triceps brachii. Two pig genotypes were used: Mangalitsa (n=7) and Swedish Landrace (n=7). Pigs were raised and slaughtered at the Institute for animal husbandry (Belgrade, Serbia). The diet consisted of concentrated commercial feed administered

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"ad libitum". Water was provided using automatic feeding troughs. All pigs were slaughtered when they attained their target slaughter weight of 105 kg.

Animals were denied food 12 hours prior to slaughtering, but had free access to water. After slaughtering, pig carcasses were processed using standard techniques. After hair removal and evisseration, carcasses were cut into carcass sides and put in cooling chamber at temperature of 2-4°C for next 24 hours.

Analyses of technological characteristics (pH, water binding capacity, tenderness and cooking weight loss) and instrumental meat colour were performed on fresh meat samples, one day after slaughter and chilling of carcass sides. Chemical analyses were performed on defrosted meat samples, subsequent to freezing at -18°C.

The proximate composition was determined in the following manner: moisture content by drying samples at 105°C (ISO 1442, 1997); protein content by Kjeldahl method and multiplying by factor 6.25 (ISO 937, 1978); total fat content by Soxhlet method (ISO 1443, 1973), and ash content by mineralization of samples at 550 ± 25°C (ISO 936, 1998).

The pH value was measured by pH-meter Hanna, HI 83141 (Hanna Instruments, USA), equipped with a puncture electrode. The pH meter was calibrated using standard phosphate buffers (ISO 2917, 1999).

Water holding capacity (WHC) was done according to method by Grau et al. (1953).

Cooking loss was determined in the following way: sample of size of 3 x 4 x 2 cm is weighed and put into glass with boiling water and cooked for 10 minutes; difference in mass of sample before and after cooking represents loss of mass during heat treatment and it is expressed in percentages.

Samples used for determination of cooking loss were also used for determination of meat shear force (kg): muscles have been cut to parts of size of 1x1 cm in the direction of muscle fibre extension; meat tenderness, expressed by shear force, was measured on Volodkevich apparatus (Volodkevich, 1938); higher values read out on the apparatus marked higher values of shear force, i.e. firmer meat.

The colour of fresh cut meat surface following 30 min blooming time (samples were stored in contact with air at 4°C) was measured using Minolta CR-400 portable chromameter (illumination D65, geometry 0 projection angle). Values were given in the colour space CIEL*a*b* (CIE, 1976). Three readings were made on non-overlapping areas of the muscles and the average value was used for data analysis.

In order to determine the effect of breed on meat quality characteristics, a single-factor analysis of variance was performed using SPSS 20.0 software (IBM SPSS Statistics, Version 20, IBM Corp, USA). All data are presented as mean value ± standard deviation.

RESULTS AND DISCUSSION

Proximate composition of meat from Mangalitsa and Landrace pigs is presented in Table 1. The highest intramuscular fat content was determined in Mangalitsa pigs in M. longissimus dorsi (6.40%) and the lowest in Landrace pigs in M. triceps brachii (1.14%). Established statistically significantly higher intramuscular fat content in all analyzed muscles of Mangalitsa pig breed is consistent with research by Petrović et al. (2010). This higher fat content have a great impact on quality characteristics of meat and meat products. Gandemer (2002) stated that the share of intramuscular fat influence meat appearance (marbling) and also have an effect on tenderness, juiciness and flavour of fresh meat. Regarding this, Ouali (1990) indicate that the share of intramuscular fat is positively correlated with the quality of dry meat products such as ham, because it has a positive effect on the softness and intensity of aroma.

Table 1 Proximate composition of muscles from Mangalitsa and Landrace pig breeds

(%)	Mangalitsa	Landrace	Significance
		M. longissimus dorsi	
Water	70,03 ± 1,66	72,73 ± 1,77	ns
Fat	6,40± 0,80	1,65 ± 0,57	p<0,05
Protein	21,56 ± 1,47	23,43 ± 1,71	ns
Ash	1,02 ± 0,06	1,17 ± 0,07	ns
		M. gluteus medius	
Water	72,83 ± 3,02	74,39 ± 2,92	ns
Fat	5,95 ± 0,75	1,25 ± 0,27	p<0,05
Protein	20,15 ± 1,63	23,09 ± 0,87	p<0,05
Ash	1,03 ± 0,05	1,23 ± 0,09	ns
		M. triceps brachii	
Water	72,14 ± 1,23	75,01 ± 2,06	p<0,05
Fat	6,29 ± 0,70	1,14 ± 0,24	p<0,05
Protein	21,04 ± 179	22,50 ± 1,61	ns
Ash	1,10 ± 0,03	1,32 ± 0,03	ns

ns-non significant

Some studies have indicated the occurrence of lower protein content in meat from autochthonous pig breeds compared to meat from commercial pig breeds (Kim et al., 2008; Parunović et al., 2012). In this study, the share of protein was lower in Mangalitsa pigs, but differs significantly between groups only for M. gluteus medius (p<0.05).

The share of water and ash did not differ significantly between the analyzed groups, except for M. triceps brachii where the share water was significantly higher in Landrace group (p<0.05).

Pale, soft and exudative (PSE) pork was not an issue in the current trial as the pH measured in the muscles 45 minutes post slaughter were all <6.0 (results not shown). The ultimate pH of all muscles was 5.5-5.7, which is normally observed for pork (Table 2).

Higher share of intramuscular fat and hydrogen ions (lower pH value) can influence the decrease of the water binding capacity of meat (Oprzadek and Oprzadek, 2000). However, in this trial, pH value of meat after 24 hours of chilling, did not differ and despite the fact that Mangalitsa pigs had higher intramuscular fat content, the water binding capacity (WBC) of meat was approximately the same between groups (Table 2).

According to Ouali (1990) meat tenderness is affected by the origin and age of animals, their sex, breed, environmental conditions associated with the pre-slaughter stress, the slaughter itself as well as the time of meat ageing. An objective measure of tenderness is the force required to shear a piece of meat with low shear values being desirable. The lowest values of shear force (the most tender meat) was determined in Mangalitsa pig breed for *M. longissimus dorsi* and *M. gluteus medius*, while for *M. triceps brachii* no significant difference was established in this parameter between the analyzed groups (Table 2).

Cooking led to a systematic and significant loss of matter and the cooking yields differed depending on the muscle and cooking process (Gerber et al., 2009). In this trial, cooking weight loss (CWL) was greater in muscle from Landrace pig and statistically significant differences in this parameter was found for *M. longissimus dorsi* and *M. gluteus medius* (p<0.05).

Table 2 Technological properties of meat from Mangalitsa and Landrace pig breeds

(%)	Mangalitsa	Landrace	Significance
		M. longissimus dorsi	
pH	5,47 ± 0,06	5,47 ± 0,10	ns
T[1]	5,05 ± 1,13	6,40 ± 0,32	p<0,05
CWL[2]	29,60 ± 1,82	37,09 ± 1,97	p<0,05
WBC[3]	13,20 ± 2,15	14,51 ± 1,98	ns
		M. gluteus medius	
pH	5,61 ± 0,08	5,68 ± 0,04	ns
T	7,39 ± 1,02	9,45 ± 1,46	p<0,05
CWL	31,04± 1,71	38,58 ± 2,16	p<0,05
WBC	11,05 ± 1,27	11,80 ± 1,06	ns
		M. triceps brachii	
pH	5,56 ± 0,11	5,76 ± 0,09	p<0,05
T	6,18 ± 1,12	6,81 ± 1,61	ns
CWL	34,08 ± 2,33	37,61 ± 2,70	ns
WBC	9,23 ± 1,58	11,50 ± 2,11	ns

1 T – Tenderness (kg);
2 GMK – Cooking weight loss (%);
3 WBC – Water binding capacity (cm2);
ns-non significant

The colour of meat is primarily dependant on the concentration and chemical state of the pigment myoglobin, which is responsible for moving oxygen through the muscle (Stanišić et al., 2012). Although meat colour is a poor guide to eating quality, most consumers make purchase decisions based on display colour and discriminate against meat that is not red and bright, considering it is old or of poor quality (Young et al., 1999). In this research, significantly lighter meat was found in Landrace pigs, for *M. longissimus dorsi* and *M. gluteus medius*, while Mangalitsa pigs have significantly higher L* values for *M. triceps brachii* (Table 3). Additionally, no significant difference was established in the share of red colour (a*) of meat between the analyzed groups, while the share of yellow colour (b*) was significantly higher in Landrace pig breeds for *M. longissimus dorsi* and *M. gluteus medius* (p<0.05).

Table 3 Instrumental colour of meat from Mangalitsa and Landrace pig breeds

(%)	Mangalitsa	Landrace	Significance
		M. longissimus dorsi	
L*	38,19 ± 1,92	55,69 ± 2,83	p<0,05
a*	10,58 ± 2,50	10,38 ± 1,97	ns
b*	2,68± 0,88	5,74 ± 1,28	p<0,05
		M. gluteus medius	
L*	32,20 ± 1,24	41,88 ± 1,17	p<0,05
a*	12,39 ± 1,03	14,43 ± 1,24	ns
b*	3,39 ± 1,11	5,81 ± 0,88	p<0,05
		M. triceps brachii	
L*	34,15 ± 1,73	30,73 ± 2,12	p<0,05
a*	16,60 ± 1,91	17,40 ± 1,11	ns
b*	5,48 ± 0,96	5,42 ± 1,05	ns

ns-non significant

CONCLUSION

Compared to the Swedish Landrace, it was found that the meat of the Mangalitsa had considerably higher intramuscular fat content and a darker colour (lower L* values). After cooking, meat from Mangalitsa was more tender compared Landrace pig, probably due to a higher fat content and had less coking weight loss. It can be concluded that the Mangalitsa pig have favourable meat quality traits, which are very desirable for production of traditional meat products of high quality.

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