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Effect of weight, sex and age on technological quality of meat in Krškopolje pigs

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ABSTRACT

The effects of weight, sex and age on the technological quality were investigated. Forty-two Krškopolje pigs were included in experiment, 19 barrows and 23 gilts. Pigs were divided in two groups. One group had the average live weight 125 kg (G125) and the other 155 kg (G155). Age at slaughter varied from 236 to 364 days. Technological quality traits were measured in M. longissimus dorsi (LD) and M. semimembranosus (SM). pH value and conductivity were determined 45 min and 24 hrs after slaughter in LD and SM. Drip loss was observed after 24 and 48 hrs. Instrumental and visual colours were measured 24 hrs after slaughter in LD. Intramuscular fat content was analysed in LD. Statistical analysis was carried out by GLM procedure in SAS/STAT. G125 had lower pH measured 45 min after slaughter in LD compared to G155. Sex did not influence the technological quality traits. Older pigs had lower pH measured 24 hrs after slaughter in SM. Conductivity in LD measured 45 min and 24 hrs after slaughter and drip loss after 48 hrs were higher in older than in younger pigs. Furthermore, older pigs had more reddish colour and better visual evaluation of LD. In conclusion, younger Krškopolje pigs had better technological quality in comparison to older pigs with exception of colour.
(Keywords: Krškopolje pig meat, technological quality, weight, sex, age)

INTRODUCTION

Technological quality is very important for meat processing. It is determined by technological traits such as pH value, electrical conductivity, drip loss and colour. Firstly, the effect of pH value and electrical conductivity on technological quality was confirmed by *Blendl et al.* (1991). Further, drip loss in pig meat industry is economically important stated *Otto et al*. (2004). Meat with high drip loss has unattractive appearance (*Ngapo et al.,* 2004). It has low consumer acceptance, which leads to poor sales results. In addition, meat colour, which can be effected by drip loss and pH value, often influences the consumer's choice of product (*Ngapo et al.,* 2004). Finally, intramuscular fat (IMF) content is in correlation with some technological quality traits (*Huff-Lonergan et al.,* 2002). Technological quality of indigenous pig meat is interesting research topic because of its special meat characteristics.

Krškopolje pig (KP) is Slovenian indigenous pig breed. It is known for good meat quality (*Šalehar,* 1994). KP is black, with white unbroken belt over the shoulders and down to both front legs. It has an average fertility, good growth ability and relatively high losses under the barren rearing conditions (*Šalehar,* 1994). KP was neglected from 1971 onwards (*Šalehar,* 1991). Due to small herd size, it was endangered by extinction. In 1990 breed reconstruction began by increasing the population size and setting up a breeding program. There was some uncontrolled integration of other breeds used for mating due to

low number of sires (*Šalehar,* 1994). Latter on, breeding has focused on the elimination of undesired characteristics of other breeds. Production traits of KP were studied prior to neglect period by *Ferjan (*1969) and *Eiselt* (1971). Since the revival of this breed, *Kastelic* (2001) and *Čandek-Potokar et al.* (2003) investigated KP technological meat quality.

Indigenous pig breeds from other countries are also a common subject of research, where the effect of weight, sex and age on meat quality is analysed. *Galián et al*. (2009) found darker and less reddish meat 45 min after slaughter in lighter than in heavier indigenous Chato Murciano pigs. Lighter pigs had also darker and less yellowish meat 24 hrs after slaughter compared to the heavier ones. There were small differences between sexes in technological quality (*Pugliese et al.,* 2004; *Pugliese et al.,* 2005; *Franci et. al.,* 2005; *Serrano et. al.,* 2008). Moreover, the influence of age on meat quality of indigenous pig breeds is poorly researched.

The aim of the study was to determine the effect of live weight, sex and age at slaughter on technological quality traits of pig meat. Value pH, conductivity, drip loss, as well as instrumental and visual colour were observed. Intramuscular fat content was analyzed in the laboratory.

MATERIALS AND METHODS

Forty-two Krškopolje pigs, 19 barrows and 23 gilts, were included in the experiment. They were housed in the same box with the same food composition and quantity for all pigs (*Table 1*). Feed composition was mainly wheat, barely and maize. Aftermath and water was available *ad libitum*.

Table 1

Chemical feed composition

Feed composition	Feed (g/100 kg dry matter)	Aftermath (g/100 kg dry matter)
Crude protein	149.9	118.6
Crude fat	23.4	23.0
Crude fibre	47.8	286.1
Ash	39.7	100.1
Nitrogen-free extract	739.2	472.3
Phosphorous	4.5	3.6
Calcium	5.1	7.7
Magnesium	2.0	
Potassium	7.0	
Sodium	1.2	

Pigs were divided in two groups, due to comparison characteristics of heavier 155 kg (G155) and lighter 125 kg (G125) pigs. Slaughter was carried out in four groups. In each of them G125 and G155 were chosen. Slaughter age of G125 was between 236 and 364 days and G155 between 247 and 360 days.

After slaughter the warm carcasses were weighted. The pH was obtained by pH meter Metter Toledo (MA130 Ion Meter) in *M. longissimus dorsi* (LD) and *M. semimembranosus* (SM). It was measured 45 min (pH_{45}) and 24 hrs (pH_{24}) *post mortem*. The electrical conductivity was measured with conductometer LF/PT-STAR

(Matthäus) also in LD and SM 45 min and 24 hrs *post mortem*. Furthermore, drip loss was determined after 24 and 48 hrs by bag method (*Honikel,* 1998). Colour (L*, a*, b*) was measured in LD cut at the last rib 24 hrs *post mortem* by Minolta Chromameter CR300 (Minolta Camera Co., Osaka, Japan). Visual colour was evaluated on the scale from 1 to 6 (*Nakai,* 1975). In addition, samples of LD were cut at the last rib and frozen to -20°C. Intramuscular fat content (IMF) was analyzed by the method of *Folch et al.* (1956).

Model used for statistical analysis was as follows (model 1):

$$y_{ijk} = \mu + G_i + S_j + b(x_{ijk} - \bar{x}) + e_{ijk} \quad (1)$$

where y_{ijk} is the observation value of the trait; μ the overall mean; G_i the group class effect with two levels (G125, G155); S_j sex (barrows, gilts); b linear regression coefficient; x_{ij} age at slaughter included as covariable; $\bar{x}$ the age at slaughter; e_{ij} the error. Statistical analysis was carried out using the GLM procedure with statistical package SAS/STAT (*SAS Institute Inc.,* 2001). Differences between least square means were tested by the Tukey multiple test.

RESULTS AND DISCUSSION

Technological quality traits of the KP did not show differences between weight groups and sexes (*Table 2*), except in pH_{45}LD. G155 had higher value of the pH_{45}LD (6.09) in comparison to G125 (5.91). Rapid decrease of pH value was the consequence of larger amount of lactic acid produced 45 min after slaughter. This process could lead to pale, soft and exudative (PSE) meat in G125. Heavier pigs usually had more marbling meat compared to the lighter pigs, which decelerate reduction of pH value. However, there was no difference in pH_{24}LD (*Table 2*). The result was in agreement with *Čandek-Potokar et al.* (1997), where no differences in pH_{24}LD between 100 and 130 kg live weight of hybrids Duroc×(Landrace×Large White) were found. They also determined no differences in pH_{45}LD between lighter and heavier pigs. Furthermore, 100 kg pigs had more reddish (a*), yellowish (b*) and higher chromatic intensity (c*) than pigs at 130 kg (*Čandek-Potokar et al.,* 1997), which is not confirmed with the results in this study (*Table 2*). *Galián et al.* (2009) reported darker (L*) and less yellowish (b*) colour of *M. longissimus lumborum* in lighter Chato Murciano pigs than in heavier ones. This is also not in agreement with this study, where the colour of G125 did not differ from G155 (*Table 2*). Furthermore, no difference in technological quality traits between sexes were found (*Table 2*) similarly as *Fracni et al.* (2005) and *Pugliese et al.* (2004) in Cinta Senese and *Pugliese et al.* (2005) in Nero Siciliano pigs.

Age at slaughter varied from 236 to 364 days and influenced the technological quality traits. The pH_{45}SM and pH_{24}LD were downward trend with age. Additionally, pH_{24}SM was significantly lower in older pigs. *Peinado et al*. (2004) found higher pH_{45}LD (6.39) and pH_{24}LD (5.71) in 10 month old Chato Muricano pigs considering the results in *Table 2*. The KP had low pH value, which is not desired from nutritional point of view. However, it is still in lower limit of normal meat quality (*Van Laack et al.,* 1995). The consequence of higher formation of lactic acid is a lower pH value, which influenced the degradation of cell membranes. Such membranes did not hold the cell fluid. It led to worse water holding capacity and higher drip loss. Higher drip loss of LD after 48 hrs and trend after 24 hrs was determined in older than younger pigs (*Table 2*).

Table 2

Least square means for group, sex and age effects on technological quality traits

Traits	R^2	Group		Sex		MSE	P-value			RC for age
		G125	G155	Barr.	Gilts		Group	Sex	Age	
pH45LD	0.16	5.91	6.09	6.00	6.00	0.05	0.0166	0.9809	0.7716	
pH45SM	0.14	6.04	6.10	6.07	6.08	0.06	0.4085	0.9019	*0.0543*	-0.003±0.002
pH24LD	0.10	5.45	5.47	5.46	5.46	0.01	0.5173	0.8307	*0.0858*	-0.001±0.000
pH24SM	0.49	5.42	5.42	5.41	4.42	0.02	0.9344	0.5786	<.0001	-0.002±0.000
Con45LD	0.25	4.52	4.23	4.52	4.23	0.17	0.3079	0.2620	0.0014	0.015±0.004
Con45SM	0.14	3.91	3.70	3.94	3.66	0.16	0.3835	0.2120	0.3872	
Con24LD	0.29	9.21	8.79	8.61	9.39	0.51	0.5962	0.2991	0.0035	0.039±0.013
Con24SM	0.21	7.34	6.66	7.56	6.43	0.56	0.4147	0.1482	0.1479	
Drip24(%)	0.11	3.05	2.47	2.79	2.73	0.56	0.1755	0.8593	*0.0556*	0.013±0.007
Drip48(%)	0.14	4.61	3.90	4.29	4.22	0.71	0.1690	0.8846	0.0219	0.019±0.008
L*	0.13	49.53	48.37	48.67	49.22	0.61	0.2590	0.5490	0.2691	
a*	0.13	10.77	10.58	10.65	10.71	0.26	0.6616	0.8731	0.0430	0.015±0.007
b*	0.11	5.76	5.47	5.44	5.79	0.21	0.3841	0.2482	0.1640	
c*	0.13	12.23	11.92	11.96	12.19	0.31	0.5504	0.6268	*0.0519*	0.017±0.008
h*	0.07	0.49	0.48	0.47	0.49	0.01	0.4409	0.1478	0.8560	
Colour	0.25	4.02	4.15	4.10	4.08	0.10	0.5824	0.9654	0.0178	0.007±0.003
IMF (%)	0.22	4.49	4.50	4.89	4.11	0.33	0.9869	0.1083	0.1218	

R^2: coefficient of determination; MSE: mean standard error; RC: regression coefficient; G125, G155: groups with average body weight 125 kg, 155 kg; Barr: barrows, LD: *M. longissimus dorsi*; SM: *M. semimembranosus*; Con: conductivity; Drip: drip loss; Colour: visually determined colour on the scale from 1 to 6; IMF: intramuscular fat.

Results are in agreement with *Čandek-Potokar et al*. (1997) who found higher drip loss in 30 days older pigs than in younger ones. Muscles with higher drip loss, which means more mobile water, have usually higher electrical conductivity. So, conductivity measured 45 min and 24 hrs after slaughter was increased with age (*Table 2*). This signified worse meat quality of older pigs. However, it is still inside the limit for a normal quality 45 min after slaughter, where the limit is 8 mS/cm (*Blendl et al.,* 1991). Electrical conductivity of meat in heavier pigs exceeded the limit for normal quality (9 mS/cm; *Blendl et al.,* 1991) and represents danger for PSE meat. The colour of LD in older pigs was more reddish (a*) and there was a trend in chromatic intensity (c*) compared to younger pigs. Additionally, visual colour of LD had better evaluation in older than younger pigs. No influence of live weight, sex and age on the IMF content was observed.

CONCLUSIONS

Weight and sex did not effect the technological quality of *M. longissimus dorsi* and *M. semimembranosus*. The exception was pH value measured 45 min after slaughter in *M. longissimus dorsi*, which was higher in heavier than in lighter pigs.

The study did not confirm the general opinion that older animals had better meat quality than younger ones. Older Krškopolje pigs had lower pH value, higher drip loss and limit value of conductivity. In conclusion, meat of older Krškopolje pigs was more liable to PSE quality.

The colour of LD was more reddish and better visually evaluated in older than in younger pigs.

The intramuscular fat content was not effected by weight group, sex nor age at slaughter.

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