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THE EFFECT OF GENOTYPE AND SEX ON PORK QUALITY

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Original scientific paper

SUMMARY

The effects of genotype and sex on the most important factors for technological meat quality were analyzed. In the experiment 63 gilts and 57 barrows of three different boar genotypes (44, 54 and 74) were included. Slaughter was carried out in two groups, the first was about 100 kg and the second group was about 125 kg of live weight. After the slaughter colour of meat, pH value, drip loss and conductivity were measured and intramuscular fat was defined in laboratory. Statistical analysis of data was done with statistical package SAS/STAT with last square method where procedure for general linear models (GLM) was used. The effects were genotype, sex and carcass weight as regression. The results showed that barrows had significant higher content of intramuscular fat than gilts at 100 kg (p=0.0019) and 125 kg (p<0.0001) of live weight, respectively. In other traits sex did not have an influence. Genotype had no effect on intramuscular fat content. Genotype 74 had darker meat (lower value L*) in both groups. Genotype 44 had significant higher value a* and value b*. There were no differences between genotype in pH and conductivity in the first group. In the second group genotype 44 had lower pH value as genotype 54 (p=0.0345) and genotype 74 (p=0.0188) and higher conductivity (p=0.0004 and p=0.0001) on m. longissimus dorsi. On m. semimembranossus genotype 54 had higher pH than genotype 44 (p=0.0160) and lower than genotype 74 (p=0.0148). Drip loss on both muscles was higher in genotype 44 in the first group and higher than genotype 74 in the second group.

Key-words: meat quality, pork, genotype, sex

INTRODUCTION

Pork quality is defined as food safety, eating quality, nutritional value, technological quality, and social quality. One of important parts of technological quality is meat colour which is critically appraised by consumers and often is the basis for product selection or rejection. Conditions at the time of measuring affect meat colour (Little, 1976). Usually, the colour of foods has been measured in CIELab (L* a* b*; Hunt et al., 1991). Furthermore, pH value measured 24 hrs have influence on technological and eating quality (Serra et al, 1998). Electrical conductivity is another indicator of pork quality (Shirsat, 2004). Drip loss in pig meat industry is important from financial point of view. In addition, meat with high drip loss has unattractive appearance and therefore, has low consumer acceptance, which leads to loss of sales (Otto et al., 2004). Marbling has been related to sensory characteristic of pork meat and is good indicator of eating quality.
Sex and genotype influence growth performance and meat quality. Barrows have lighter and more red colour compared with gilts (Nold et al., 1999; Latorre et al., 2003). There is no influence of sex on pH value (Nold et al., 1999; Latorre et al., 2003; Latorre et al., 2004; Lampe et al., 2006) and drip loss (Suzuki et al., 2003). Boars are leaner than barrows and gilts owing to lower proportion of intramuscular fat (Latorre et al., 2003). Nold et al. (1999), Armero et al. (1999), Latorre et al. (2003), Lampe et al. (2006) found differences in marbling between gilts and barrows.
The objective of research was to determine the effect of sex and genotype on pig meat quality traits: colour, pH value, conductivity, drip loss, and intramuscular fat content.

MATERIAL AND METHODS

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Material used in the study was 120 fatteners, 57 barrows and 63 gilts. They were offspring of 20 sires and belong to three genotypes (1244, 1254 and 1274). Sows were crossbred of Landrace*Large White (L*LW) and sires were Pietrain (P), Slovenian Landrace, line 55*P and Hampshire*P. Food composition was the same for all groups. They were fed *ad libitum*, until 70 kg of body weight and later on feed was restricted to 35 MJ of energy per day. Half of the pigs were slaughtered at 100 kg (G100) and the rest at 125 kg (G125) of live weight. Animals were weighed at the beginning of the experiment, at 60 kg, 100 kg and 125 kg of live weight. Four animals were excluded from experiment because of injures.

The colour (L*, a*, b* co-ordinates) was measured between the sixth and seventh rib on *m. longissimus dorsi* (LD) 24 hrs *post mortem* by a CR300 Minolta Chromameter (Minolta Camera Co., Osaka, Japan). The pH was obtained by a Metter Toledo (MA130 Ion Meter) pH meter in LD and *m. semimembranosus* (SM) 24 hrs *post mortem*. The electrical conductivity was aquired with a LF/PT-STAR (Matthäus) conductometer also in LD and SM 24 hrs *post mortem*. Drip loss was measured 24 and 48 hrs after slaughter by tube method (Ramussen and Andersson, 1996). Sample of LD for analysis of intramuscular fat content (IMF) was taken and frozen to -20°C. It was analyzed by the method of Folch et al. (1956).

Statistical analysis was performed by general least square method (GLM) of statistical package SAS/STAT (SAS Institute Inc., 2001). The chosen model (model 1) was used for G100 and G125 separately. It contained sex (S_i), boar genotype (G_j) as class effects and carcass weight (x_{ijk}) as linear regression. Scheffe multiple test was used for comparison the genotypes.

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

RESULTS AND DISCUSSION

Mean carcass weight for G100 was 76.7 kg and for G125 100.9 kg (Table 1). Pigs in G100 were slaughtered on the average 193 days and 227 day in G125. There were slightly lower values of L*, a* and b* in G100 than in G125. In both groups, average pH value in SM was higher than in LD. Conductivity was also higher in SM than in LD in both groups. Standard deviation was higher on SM compared to LD in G100. There was higher standard deviation for drip loss after 48 hrs in comparison with 24 hrs in G100. In G100, IMF was on the average 1.29 % and varied between 0.82 and 1.91 %. In G125 the average IMF was higher (1.42 %) than in G100. The highest IMF content in G125 was 2.70 %.

Table 1. Descriptive statistics for meat quality traits for pigs slaughtered at 100 kg (G100) and at 125 kg (G125)

		G100			G125	
	N	Mean	SD	N	Mean	SD
Carcass weight (kg)	59	76.6	12.6	57	100.9	11.2
Age of slaughter (day)	59	193	7	57	227	7
Value L*	55	49.77	2.67	56	52.54	3.32
Value a*	58	6.82	1.25	55	8.47	1.72
Value b*	56	2.96	0.93	55	4.60	1.26
Value pH *m. longissimus dorsi*	57	5.44	0.10	55	5.50	0.08
Value pH *m. semimembranosus*	56	5.78	0.23	56	5.71	0.15
Conductivity *m. longissimus dorsi*	56	3.4	1.2	54	5.2	2.7
Conductivity *m. semimembranosus*	58	5.0	1.6	57	8.2	2.6
Drip loss, after 24 hrs (%)	55	3.88	1.65	57	5.82	3.16
Drip loss, after 48 hrs (%)	56	6.49	2.48	57	8.25	3.39
Intramuscular fat content (%)	57	1.29	0.28	57	1.42	0.41

Sex did not influence meat colour either in G100 (L*, p=0.6309; a*, p=0.1733; b*, p=0.0795) or in G125 (Table 2; L*, p=0.3221; a*, p=0.2163; b*, p=0.4714). Latorre et al. (2004) measured fatteners of 116, 124 and 133 kg of body weight and there was also no difference in colour between sexes. Lampe et al. (2006) found no differences in colour between gilts and barrows at average live weight 130.2 kg. Nold et al. (1999) reported gilts had darker meat (lower value L*) than barrows and boars had less red meat than gilts and barrows slaughtered at 100 or 110 kg. Latorre et al. (2003) found more red colour in barrows than in gilts at 117 kg.

Table 2. Estimated differences (EST) with standard errors (SEE) and p-value between sexes and genotypes for colour for pigs slaughtered at 100 kg (G100) and at 125 kg (G125)

	Value L*		Value a*		Value b*	
	EST±SEE	p-value	EST±SEE	p-value	EST±SEE	p-value
G100						
Barrows-gilts	0.33±0.68	0.6309	0.43±0.31	0.1733	0.42±0.23	0.0795
1244-1254	1.36±0.82	0.1005	**0.84±0.38**	**0.0322**	**0.77±0.28**	**0.0087**
1244-1274	**1.89±0.85**	**0.0305**	0.18±0.38	0.6410	**0.71±0.29**	**0.0179**
1254-1274	0.53±0.84	0.5335	-0.66±0.38	0.0905	-0.06±0.29	0.8311
G125						
Barrows-gilts	0.73±0.73	0.3221	0.60±0.48	0.2163	0.23±0.32	0.4714
1244-1254	1.05±0.83	0.2131	**1.37±0.56**	**0.0186**	**0.97±0.37**	**0.0120**
1244-1274	**4.79±0.89**	**<0.0001**	0.63±0.58	0.2759	**1.53±0.38**	**0.0002**
1254-1274	**3.74±0.87**	**<0.0001**	-0.73±0.56	0.1993	0.56±0.37	0.1386

In both groups genotype 1244 had more intensive red colour (higher value a*) than genotype 1254 (Table 2). Lighter colour (higher value L*) genotype 1244 than 1274 was found in G100. Also more yellow cast was perceived in genotype 1244 than other two genotypes. In G125 genotype 1274 had darker meat than the other two genotypes. The deviation was more pronounced as in G100 and statistical significant while the difference between the genotype 1244 and 1254 was not significant. Serra et al. (1998) defined lighter meat in Landrace (L) than Iberian (I) but there was no difference in value a*. Armero et al. (1999) found some difference in values L*, a* and b* between genotype Duroc (D), Landrace (L) and Large White (LW). There was no difference in value L* and b* between D and Large white*Pietrain* (LW*P), but D had darker meat than LW*P (Latorre et al., 2003). Lampe et al. (2006) also found darker meat in fatteners from sire type D than Duroc*Hampshire (D*H).
Value of pH was not influenced by sex (Table 3). Nold et al. (1999), Latorre et al. (2003), Latorre et al. (2004), Lampe et al. (2006) also reported no difference in pH between sexes. We did also not find differences between genotypes in pH value for fatteners slaughtered at 100 kg. Slaughter at 125 kg showed that genotype 1244 had lower pH than 1254 (p=0.0345) and 1274 (p=0.0188). On SM, genotypes 1254 had higher pH than 1274 (p=0.0148). Armero et al. (1999) did not find differences in pH value between D, L and LW, while Serra et al. (1998) noticed that value pH (5.59) was lower in L than Iberian pigs (5.75). Offspring of Duroc had higher pH value 24 hrs after slaughter than offspring of D*H (Latorre et al., 2003) and H (Lampe et al., 2006).

Table 3. Estimated differences (EST) with standard errors (SEE) and p-value between sexes and genotypes for pH value and conductivity for pigs slaughtered at 125 kg

	EST±SEE	p-value	EST±SEE	p-value
Value pH	*M. longissimus dorsi*		*M. semimembranosus*	
Barrows-gilts	0.01±0.02	0.5827	0.05±0.04	0.1887
1244-1254	**-0.05±0.02**	**0.0345**	**-0.11±0.04**	**0.0160**
1244-1274	**-0.06±0.02**	**0.0188**	0.01±0.04	0.8994
1254-1274	-0.01±0.02	0.6971	**0.11±0.04**	**0.0148**
Conductivity				
Barrows-gilts	-1.21±0.65	0.0701	-0.54±0.70	0.4358
1244-1254	**2.92±0.76**	**0.0004**	1.53±0.79	0.0586
1244-1274	**3.60±0.77**	**0.0001**	**1.67±0.83**	**0.0492**
1254-1274	0.68±0.75	0.3730	0.14±0.81	0.8684

There were no differences in conductivity in G100. In G125, genotype 1244 had higher conductivity than 1254 and 1274 on LD (Table 3). On SM, only differences between 1244 and 1274 (p=0.0492) were found. No differences were found in electrical conductivity 30 min *post mortem* between offspring of Landrace*Large White (L*LW) crossbred sows mated with four different genetic types, Belgian landrace*Landrace (BL*L), Danish D, LW and L (Armero et al., 1999). However, 24 hrs *post mortem* offspring of L had the highest electrical conductivity (7.69) and offspring of LW the lowest (6.41).

Drip loss was not influenced by sex either at slaughter at 100 kg or at 125 kg of live weight (Table 4). Suzuki et al. (2003) did not find differences in drip loss between sexes. Genotypes 1244 slaughtered at 100 kg had higher drip loss than 1254 and 1274 at 24 hrs as well as 48 hrs *post mortem*. Heavier pigs showed difference in drip loss only between 1244 than 1274. There were no differences in drip loss between offspring of sire line D, L and LW (Armero et al., 1999) and no difference between D and Berkshire (Suzuki et al., 2003).

Table 4. Estimated differences (EST) with standard errors (SEE) and p-value between sexes and genotypes for drip loss (%) in pigs slaughtered at 100 kg (G100) and at 125 kg (G125)

	EST±SEE	p-value	EST±SEE	p-value
G100	After 24 hrs		After 48 hrs	
Barrows-gilts	0.36±0.42	0.3893	0.22±0.61	0.7186
1244-1254	**1.18±0.51**	**0.0243**	**1.97±0.75**	**0.0112**
1244-1274	**1.35±0.52**	**0.0121**	**1.99±0.76**	**0.0113**
1254-1274	0.17±0.50	0.7406	0.03±0.74	0.9715
G125				
Barrows-gilts	-0.18±0.84	0.8314	-0.17±0.87	0.8461
1244-1254	1.32±0.96	0.1747	1.61±0.99	0.1097
1244-1274	**2.61±1.00**	**0.0120**	**3.23±1.04**	**0.0029**
1254-1274	1.29±0.98	0.1963	1.62±1.02	0.1180

Barrows had higher IMF than gilts. Differences were significant in G100 ($p=0.0019$) and in G125 ($p<0.0001$). Armero et al. (1999), Nold et al. (1999), Latorre et al. (2003) and Lampe et al. (2006) also reported that barrows had more IMF than gilts. However, no differences were found between genotypes. Lampe et al. (2006) did not find differences in IMF between offspring of D and D*H either. However, offspring of Danish D was more marbled than offspring of LW and L (Armero et al., 1999) and more than offspring of P*LW (Latorre et al., 2003).

CONCLUSION

Sex of fatteners did not affect pH value, conductivity and drip loss. Barrows showed higher intramuscular fat content than gilts.

Genotype 1274 was known for darker meat colour compared to genotypes 1244 and 1254. Genotype 1244 had more red and yellow colour than genotype 1254. Higher acidity and consecutively more drip loss of fatteners 1244 compared with other two genotypes were noticed.

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