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INFLUENCE OF GENDER AND SLAUGHTER WEIGHT ON MEAT QUALITY TRAITS OF HEAVY PIGS

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ABSTRACT

The investigation was carried out on 99 PIC pig carcasses (49 gilts and 50 barrows) divided into six groups according to their slaughter weight (120, 130, 140, 150, 160 and ≥170 kg), with the aim to investigate the influence of gender and slaughter weight on meat quality traits. At the slaughter line and in laboratory following meat quality traits were measured: initial and ultimate pH in MS and LD muscle, drip loss, EZ drip, colour parameters, cooking loss and instrumental tenderness. Out of all investigated meat quality traits, gender influenced only cooking loss, while differences between slaughter weight groups were found for almost all meat quality traits measured. However, increasing slaughter weight to ≥170.00 kg had no major benefit on technological meat quality traits.

Key words: pigs / gender / slaughter weight / meat quality

1 INTRODUCTION

In order to produce pig carcasses with high lean meat content and simultaneously to save on feed, pig producers aspire to decrease the fattening period. As a consequence, pigs are slaughtered at younger age when meat does not have necessary characteristics for processing into dry-cured or certain traditional fermented products. In Croatia, it is generally accepted that meat from older animals, slaughtered at high live weight is more suitable for processing into dry-cured hams and kulen, a traditional PGI (protection of geographical indication) protected dry-fermented sausage. Indeed, an increase of age/slaughter weight can improve some meat quality traits, such as IMF(intramuscular fat content) content, flavour profile, juiciness, colour and cooking loss (Čandek-Potokar *et al.*, 1998; Weatherup *et al.*, 1998; Toldrà, 2002; Latorre *et al.*, 2004), but due to reduced growth and feed efficiency the cost of production is increased. In addition, meat from older animals is often characterised as having less desirable meat quality traits (Cisneros *et al.*, 1996; Čandek-Potokar *et al.*, 1998; Latorre *et al.*, 2004; Latorre *et al.*, 2009) and the production of heavy pigs in most cases results in overly fatty primal cuts with lower added value. Thus, it is important to determine slaughter weight/age at which the pig meat will have suitable quality traits for further processing into dry-cured or fermented products at optimal costs of production such as feeding. Therefore, the aim of this study was to evaluate the effects of sex and slaughter weight of finishing pigs on meat quality traits.

2 MATERIAL AND METHODS

The investigation was carried out on 99 P337xC23 PIC (Pig Improvement Company) pigs in 2x6 factorial arrangement. Pigs were grouped based on gender and

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average slaughter weight (120, 130, 140, 150, 160 and ≥170 kg).

Animals were reared in the test station under controlled conditions and had *ad libitum* access to feed and water. The pigs were fed ST-1 diet (till 58^{th} day of the fattening), ST-2 diet (from 58^{th} till 100^{th} day of the fattening) and ST-3 diet (from 100^{th} until the last day of the fattening). These diets were designed to meet the nutritional requirements of the pigs at mentioned phases of fattening. Live weight of the pigs was recorded at the beginning and at the end of the investigation; after the pigs reached 100 kg live weight the weighing was performed at two weeks interval.

When the animals reached the planned average slaughter weight (±3 kg), they were transported to slaughter house, so the pigs within each treatment were slaughtered at the same day.

After stunning using CO_2, the pigs were exsanguinated and further processed according to the common practice used in commercial abattoirs.

At the slaughter line and in laboratory, following meat quality traits were measured: initial pH values (pH_{45}) measured 45 minutes after slaughter and ultimate pH values measured after 24h of cooling at *m. longissimus dorsi* (LD) and *m. semimembranosus* (MS) of primarily processed pig carcasses. Drip loss was measured by bag method according to Honikel (1987) after 24h of cooling at 4 °C, while EZ drip was measured as described by Christensen (2003).

Light reflectance scores for CIE L*, a* and b* were obtained using a Minolta CR-410 colorimeter (Minolta Camera Co. Ltd., Osaka Japan) with a D65 light source and eight-degree standard observer. Instrumental tenderness was measured on at least four subsamples of 2.54 cm thick LD chops. Prior to measurements chops were defrosted for 24h, sealed in plastic bags and cooked in water bath until an internal temperature of 73 °C. The samples were cooled at 4 °C overnight. Shear force was measured using a TA.XTplus Texture Analyser fitted with a 1 mm thick Warner-Bratzler shear attachment. The mean value of maximal strength necessary for cutting the samples was calculated with a Texture Exponent 4.0 Software (Stable Micro Systems Ltd., UK) and presented as Warner-Bratzler Shear Force (WBSF, N). Cooking loss was established from LD chops used for shear force determination. It was calculated from weights taken before and after cooking and expressed as a percentage.

Data were analysed using GLM procedure of Statistica 8.0. The model included gender, slaughter weight (SW) as fixed effects. The differences between investigated groups were determined by Fisher LSD test, where $P < 0.05$ was classified as significant difference.

3 RESULTS AND DISCUSSION

The effect of gender and slaughter weight on meat quality traits are presented in Table 1. No significant differences between sexes were obtained in pH values measured 45 minutes and 24h *post mortem* in LD and MS muscles. This is in accordance with the results of Latorre *et al.* (2004), Jaturasitha *et al.* (2006), Renaudeau and Mourot (2007), Peinado *et al.* (2008) and Palomares-Cuellar *et al.* (2011). Contrary, Larzul *et al.* (1997) reported higher pH values in LD muscle in barrows than in gilts, while Barton-Gade (1987) reported higher ultimate pH values in SM muscle in barrows than in gilts. The inconsistency between these two studies can be explained by the difference in genotypes, body weight as well as pre-slaughter handling and handling of the carcasses. Furthermore, there was no difference between genders neither in drip loss and EZ drip nor in Minolta colour (CIE-L^*, a^*, b^*) values. Opposite to our results, Renaudeau and Mourot (2007) reported significant effect of sex on drip loss values, while Cisneros *et al.* (1996) and Palomares-Cuellar *et al.* (2011) reported higher CIE-a^* values in gilts than in barrows. In addition, Cisneros *et al.* (1996) reported that subjective colour, firmness, and marbling scores were higher for barrows, indicating that they had darker, firmer muscle with more visible marbling compared to gilts. Finally, in the present study, the only difference between sexes was found for cooking loss values. This could be a consequence of higher intramuscular fat level usually found in barrows, which is in negative correlation with cooking loss (Huff-Lonergan *et al.*, 2002). Our results are in agreement with the results of Eikelenboom and Hoving-Bolink (1993), Piao *et al.* (2004) and Latorre *et al.* (2004), who also found that meat from gilts had greater cooking losses than meat from barrows.

Most studies which investigated influence of slaughter weight on meat quality traits did not find any effect of slaughter weight on pH values (Leach *et al.*, 1996; Čandek-Potokar *et al.*, 1998; Correa *et al.*, 2006). This is in agreement with our results on pH_{24}, but not pH_{45} values. Pigs slaughtered at 140 kg (Table 1) had higher pH_{45} in MS muscle than pigs slaughtered at 120 kg and ≥170 kg, while the other groups did not differ significantly. The same group also had the highest pH_{45} measured in LD muscle. Although we could not establish significant differences between groups in pH values measured 24h *post mortem* in MS or LD muscle, in the table it can be seen that the highest pH_{24} values in MS muscle was recorded in groups slaughtered at 130 kg and 140 kg LW (live weight). Also, the difference between these two groups and the group slaughtered at 150 kg with the lowest pH_{24} values was close to significant ($P = 0.0511$ and 0.0501, respectively). It is well known that a higher pH is associated with better water holding capacity of meat. Thus, the pig group slaughtered at 140 kg had the lowest drip loss and EZ drip values. Drip loss decreased significantly with an increase of slaughter weight from 73 to 137 kg reported by Martin *et al.* (1980) and 100 to 130 kg determined by Piao *et al*. (2004). The results could not be confirmed in our investigation. However, the slaughter weights in the present study were markedly higher than slaughter weights in those investigations.

Meat colour represents one of the most important meat quality traits because of its direct influence on consumer acceptance and high correlation to functional characteristics of meat, such as pH and water holding capacity. Results presented in Table 1 show that pigs slaughtered at 130 and 150 kg had higher CIE-L* values than pigs slaughtered at 140 and 160 kg, while pigs slaughtered at 120 and ≥170 kg LW did not differ statistically from other pig groups. Contrary to these results, other studies (Čandek-Potokar *et al.*, 1998; Piao *et* al., 2004; Correa *et al.*, 2006) reported that slaughter weight did not influence luminosity. Increase of slaughter weight is accompanied with an increase of age and due to higher pigment content, meat from older animals usually produce redder meat (Martin *et al.,* 1980; Piao *et al*., 2004; Latorre *et al*., 2004). Our results are in agreement with the results of these authors.

A pig meat should have CIE-L* values between 42 and 50, drip loss less than 5% and pH_{24} less than 6.00 in order to be classified into RFN (Red, Firm, Non-exudative) quality class (Warner *et al.* (1997)). In Table 1, it can be noticed that mean CIE-L*, drip loss, and EZ drip values were to some extent higher than normal in all investigated pig groups. This could be due to scalding process and depressed heat transfer during chilling of the carcasses originated from pigs slaughtered at higher live weights.

The slaughter weight influenced significantly cooking loss and WBSF values. The highest cooking loss was found in group slaughtered at 120 kg live weight, while the lowest was in group slaughtered at ≥170 kg. Instrumental tenderness, by WBSF was higher in groups slaughtered at 140 and 160 kg than in groups slaughtered at 120, 130, 150 and ≥170 kg. These differences between investigated groups might be a consequence of different calpain status and *CAST* genotype of the animals as it has been reported that activity of calpain system, as well as genetic background of the animal represents the key determinant of meat tenderness (Koohmariae, 1992; Taylor *et al*., 1995; Maltin *et al.*, 2003; Đurkin, 2011).

4 CONCLUSIONS

In the present study, no significant differences between genders were found for any of investigated technological meat quality traits, except for cooking loss. Although we found significant differences between groups for pH_{45} in MS and LD muscle, drip loss, EZ drip, Minolta colour parameters, cooking loss and instrumental tenderness, these differences actually have no practical importance. Therefore, from technological aspect, slaughtering animals at higher live weights has no major benefit on quality of their meat. However, further investigations which will include chemical composition and

Table 1: *Influence of gender (G) and slaughter weight (SW) on investigated meat quality traits*

	Gender (G)			Slaughter weight (SW)								
Variable	Barrows	Gilts	MSE	120 kg	130 kg	140 kg	150 kg	160 kg	≥170 kg	MSE	G	SW
Number	50	49		15	17	15	17	18	17			
pH_{45} MS*	6.14	6.15	0.03	6.07^{b}	6.17^{ab}	6.29^{a}	6.18^{ab}	6.13^{ab}	6.05^{b}	0.06	n.s.	<0.001
pH_{45} LD**	6.21	6.21	0.04	6.23^{ab}	6.16^{b}	6.37^{a}	6.19^{ab}	6.23^{ab}	6.12^{b}	0.06	n.s.	n.s.
pH_{24} MS	5.69	5.66	0.02	5.64	5.73	5.73	5.62	5.72	5.63	0.04	n.s.	n.s
pH_{24} LD	5.61	5.59	0.08	5.61	5.62	5.64	5.58	5.60	5.57	0.03	n.s.	n.s.
Drip loss (%)	6.12	6.31	0.37	5.70^{bc}	5.66^{b}	4.67^{c}	7.73^{a}	7.09^{ab}	6.14^{abc}	0.64	n.s.	<0.01
EZ drip (%)	6.46	6.55	0.41	5.85^{b}	5.92^{b}	5.21^{b}	9.11^{a}	6.31^{b}	6.40^{b}	0.71	n.s.	<0.01
CIE-L*	53.54	54.10	0.32	54.31^{ab}	54.50^{a}	52.73^{b}	54.51^{a}	52.85^{b}	53.99^{ab}	0.55	<0.1	n.s.
CIE-a*	17.28	17.23	0.13	16.16^{c}	17.11^{b}	17.04^{b}	17.11^{b}	17.86^{a}	18.05^{a}	0.23	n.s.	<0.001
CIE-b*	7.52	7.62	0.11	7.13^{c}	7.81^{ab}	6.96^{c}	8.08^{a}	7.47^{bc}	7.83^{ab}	0.19	n.s.	<0.001
Cooking loss (%)	31.85^{y}	33.03^{x}	0.21	33.66^{a}	32.01^{bc}	33.09^{ab}	32.19^{b}	32.69^{ab}	31.15^{c}	0.36	<0.001	<0.001
Shear force (N)	50.83	50.96	1.05	50.56^{b}	47.66^{b}	56.99^{a}	46.71^{b}	54.85^{a}	49.04^{b}	1.81	n.s.	<0.001

$^{a, b, c, d, x, y}$ $P < 0.05$; n.s.-not significant; *m. *semimembranosus*, **m. *longissimus dorsi* sensory aspects of meat quality, such as IMF level, juiciness and flavour profile are recommended.

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