THE TISSUE COMPOSITION OF BELLY WITH BONES AS AFFECTED BY CARCASS WEIGHT OF GILTS AND BARROWS

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Abstract

A total of 90 pig carcasses were analysed with the aim to determine the effects of gender and carcass weight on the tissue composition of belly with bones. The analysed carcasses represented the current pig production in the CR with respect to an equal gender ratio and the most frequently used hybrid combinations.

While the carcass weight was similar between genders, gilts had a higher carcass lean meat content compared to barrows (56.90 ± 0.580 % and 55.58 ± 0.616 %, respectively). Also, the lean meat content in the belly with bones was higher in gilts than in barrows by 2.15 percent points (59.47 and 57.32 %, respectively). On the contrary, the content of intermuscular fat was significantly higher in barrows compared to gilts (16.97 ± 0.638 and 14.89 ± 0.571 %, respectively). The contents of remaining tissues, i.e. skin including subcutaneous fat and bones was similar between genders.

Different tissue growth dynamics was observed between genders when assessing the effect of carcass weight on belly with bones composition. The carcasses were grouped according to weight (up to 80 kg, 80 – 100 kg, above 100 kg). In gilts, the composition of belly with bones was similar in the weight groups up to 80 kg and 80 – 100 kg (lean contents 60.96 ± 1.589 % and 61.38 ± 0.878 %, respectively), while the lean content was significantly lower in the group above 100 kg of carcass weight (56.21 ± 1.280 %). In contrast, belly composition of barrows was deteriorated already in the weight group 80 – 100 kg. The lean meat contents in the three weight groups of barrows were 61.47, 58.45 and 52.27 %, respectively.

Key Words: pig; belly composition; lean meat content; gender; carcass weight

Carcass and meat quality are complex characteristics affected by a number of intrinsic and extrinsic factors. Of the intrinsic factors, a considerable attention is given to gender and carcass weight. Effort is made to determine the effects of these factors and their interaction on the tissue composition of important carcass parts including belly.

The effect of gender on belly lean meat contents has been described in a number of reports with the conclusion that the lean content in the belly of gilts is higher compared to barrows. Čítek et al. (2001) found 6.05 % lower lean content in barrows than in gilts. Similarly, Stupka (2002) reported this difference at the level of 3.32 %. In the study of Pulkrábek et al. (2001), the lean from the belly of gilts represented 10.22 % of carcass weight while this value was by 0.62 percent point lower in barrows.

The relationship between increasing carcass weight and belly composition has been described by Höreth (1995). Heavier carcasses were associated with a higher weight proportion of the belly in the carcass but also with a lower lean meat content. The content of fat increases more rapidly in the belly than in other carcass parts (Willam et al, 1990).

The identification of these effects is important for the meat processing industry. With respect to the attributes of this part where individual layers of fat and muscle mingle into one another, the belly lean content can be predicted with different rates of accuracy under the conditions of a slaughterhouse (Pfeiffer et al., 1993). Accurate but expensive methods predicting pig belly composition under experimental conditions (CT, MRI, VIA) have been previously described (e.g. Schwerdtfeger et al., 1993; Tholen et al., 2003). Based on its composition, the belly can either be further processed or used directly for grilling which may appear to be both economically efficient and consumer-beneficial (Tholen et al., 1998; Pour a Pourová, 2004).

The aim of the study was to determine the effects of gender and carcass weight and their interaction on pig belly with bones tissue composition.

Material and Methods

A total of 90 pig carcasses representing the most frequent hybrid combinations and originating from common production conditions in the Czech Republic were analysed. To assess the effect of carcass weight on belly composition, the carcasses were grouped according to their weight as follows: up to 80 kg (L), 80 – 100 kg (M) and above 100 kg (H). The ratio gilts : barrows was 1 : 1 in the whole set and both weight subsets.

Twenty-four hours *post mortem*, left carcass sides were dissected according to the method of Walstra and Merkus (1996). Bellies with bones were dissected in detail and the weights of different tissues (muscle, intermuscular fat, bones and skin including subcutaneous fat) were recorded.

The dissection results are expressed in absolute values (g) and as proportions of different tissues from the weight of belly (%). Data were analysed using the procedures

MEANS and GLM of the SAS programme, version 9.1. (SAS Institute Inc., 2002). The used model included alternatively gender and carcass weight as fixed effects and also the fixed effect of carcass weight within different gender subgroups.

Results and Discussion

Basic characteristics of the analysed data set are presented in Table 1.

The average carcass weight and carcass lean meat content were 88.83 ± 1.272 kg and 56.24 ± 0.426 %, respectively. These results are comparable with the overall values obtained from the SEUROP grading scheme applied in the Czech Republic. The belly represented 9.11 ± 0.069 % of carcass weight and its lean meat content was 58.39 ± 0.598 %.

Carcass quality traits were further analysed with respect to the effect of gender. No significant differences were found between genders in cold carcass weight (0.71 kg) while gilts had significantly higher lean content than barrows (56.90 ± 0.580 % and 55.58 ± 0.616 %, respectively). Such a tendency was also reported by Kernerová et al. (2007) and others. However, in contrast to the study by Stupka (2002), we found no significant differences in the proportion of belly with bones. In agreement with the above mentioned author, the lean content of belly was higher in gilts compared to barrows (59.47 ± 0.805 % and 57.32 ± 0.865 %, respectively).

The effect of gender on belly composition is given in Table 2. Only small differences were observed between the weights of muscle, skin with subcutaneous fat and bones. However, the weight of intermuscular fat was higher in barrows than in gilts (700 ± 40.9 g and 611 ± 33.3 g, respectively). When expressed as the contribution to belly weight, intermuscular fat proportion was also higher in barrows compared to gilts (16.97 and 14.89 %, respectively). In contrast, the content of lean meat was higher in gilts as mentioned above. The proportions of remaining tissues were similar between genders.

Table 1. Basic carcass quality characteristics

Trait	Total (n = 90)	Gilts (n = 45)	Barrows (n = 45)
	$\bar{x} \pm s_{\bar{x}}$		
Cold carcass weight (kg)	88.83 ± 1.272	89.19 ± 1.761[a]	88.48 ± 1.855[a]
Carcass lean content (%)	56.24 ± 0.426	56.90 ± 0.580[a]	55.58 ± 0.616[b]
Belly with bones proportion of carcass weight (%)	9.11 ± 0.069	9.05 ± 0.092[a]	9.17 ± 0.102[a]
Belly lean content (%)	58.39 ± 0.598	59.47 ± 0.805[a]	57.32 ± 0.865[b]

[a, b] Values with different superscripts differ significantly ($P \leq 0.05$)

Table 2. Belly composition as affected by gender

Trait	Gilts	Barrows
	$\bar{x} \pm s_{\bar{x}}$	
Weight of tissue dissected from the belly with bones (g):		
Muscle	2391 ± 56.1[a]	2303 ± 46.1[a]
Intermuscular fat	611 ± 33.3[a]	700 ± 40.9[b]
Skin with subcutaneous fat	730 ± 30.7[a]	740 ± 34.8[a]
Bones	305 ± 7.0[a]	310 ± 7.5[a]
Proportion of tissue from the belly with bones (%):		
Muscle	59.47 ± 0.805[a]	57.32 ± 0.865[b]
Intermuscular fat	14.89 ± 0.571[a]	16.97 ± 0.638[b]
Skin with subcutaneous fat	17.91 ± 0.404[a]	17.99 ± 0.490[a]
Bones	7.73 ± 0.146[a]	7.72 ± 0.158[a]

[a, b] Values with different superscripts differ significantly ($P \leq 0.05$)

The effects of carcass weights on belly composition irrespective to gender and in both gender subgroups are summarized in Tables 3 and 4.

Increasing carcass weight is associated with increasing belly weight. The weights of different tissues in this part also significantly increased. The differences between L a H groups in muscle, intermuscular fat, skin with subcutaneous fat and bones weights were 581, 444, 406, and 67 g, respectively. Due to the fact that the development of fat tissues (intermuscular and subcutaneous fat) was more rapid compared to muscle, the proportions of tissues were modified as well. The tendency towards the reduction of lean meat content and the elevation of fat tissue proportion with increasing carcass weight was confirmed. Significant differences were observed mainly between M and H groups. The lean meat content was reduced from 55.99 to 54.24 % while the proportions of intermuscular and subcutaneous fat increased from 15.09 to 18.68 and from 17.15 to 19.94 %, respectively. In summary, the lean content decreased by 5.75 percent points and the fat content increased by 6.38 percent points. Vališ et al. (2006) reported the reduction of belly lean meat content in similar carcass weight intervals from 56.7 to 52.8 % and the increase of intermuscular fat from 15.9 to 19.3 %. The comparison of these results shows that the quality of belly increases while its variability is reduced over time.

Table 3. Effect of carcass weight on belly composition

Trait	Carcass weight		
	< 80 kg (L) (n = 30)	**80 – 100 kg (M)** (n = 30)	**> 100 kg (H)** (n = 30)
	$\bar{x} \pm s_{\bar{x}}$		
Weight of tissue dissected from the belly with bones (g):			
Muscle	2057 ± 46.2[a]	2346 ± 38.4[b]	2638 ± 52.4[c]
Intermuscular fat	465 ± 27.6[a]	592 ± 25.1[b]	909 ± 39.1[c]
Skin with subcutaneous fat	563 ± 17.1[a]	673 ± 19.2[b]	969 ± 34.7[c]
Bones	277 ± 5.3[a]	302 ± 7.8[b]	344 ± 8.4[c]
Proportion of tissue from the belly with bones (%):			
Muscle	61.12 ± 1.023[a]	59.99 ± 0.666[a]	54.24 ± 0.932[b]
Intermuscular fat	13.81 ± 0.752[a]	15.09 ± 0.525[a]	18.68 ± 0.700[b]
Skin with subcutaneous fat	16.79 ± 0.441[a]	17.15 ± 0.310[a]	19.94 ± 0.652[b]
Bones	8.28 ± 0.150[a]	7.77 ± 0.177[b]	7.14 ± 0.167[c]

[a, b, c] Values with different superscripts differ significantly ($P \leq 0.05$)

Different tissue growth dynamics was observed between genders when assessing the effect of carcass weight on belly with bones composition, as implied from tissue proportions in different carcass weight groups. In gilts, the composition of belly with bones was similar in the weight groups L and M and the quality was only reduced in heavy carcasses of the group H. The contents of muscle were 60.96, 61.38 and 56.21 % in the groups L, M and H, respectively. A different tendency was shown for intermuscular fat (13.62, 13.98 and 17.11 %, respectively) and skin with subcutaneous fat (16.97, 17.06 and 19.61 %, respectively). In contrast, belly composition of barrows was deteriorated already in the weight group M. Significant differences were observed between the weight groups in muscle and intermuscular fat proportions. The observed lean meat contents were 61.47, 58.45 and 52.27 % in the groups L. M and H, respectively.

The proportion of intermuscular fat increased from 13.96 ± 0.968 % in the lightest carcasses to 20.25 ± 1.016 % in the heaviest ones. It is concluded that the differences in intermuscular fat (6.29 percent point), skin with subcutaneous fat and muscle (9.2 percent points) were quite distinct. The bellies from the heavy carcasses over 100 kg are perceived by both meat processors and consumers as less valuable and their price is lower, as was also confirmed in the study by Stupka et al. (2004). These authors reported that the belly tissue composition of gilts was favourable even in the higher carcass weights where barrows deposited high amounts of fat and the content of lean meat was reduced.

Table 4. Effect of carcass weight on belly composition within gender

Trait	Carcass weight		
	< 80 kg (L)	**80 – 100 kg (M)**	**> 100 kg (H)**
	$\bar{x} \pm s_{\bar{x}}$		
GILTS			
Weight of tissue dissected from the belly with bones (g):			
Muscle	2000 ± 63.2[a]	2445 ± 42.9[b]	2730 ± 66.7[c]
Intermuscular fat	447 ± 42.6[a]	557 ± 33.1[a]	830 ± 44.1[b]
Skin with subcutaneous fat	561 ± 27.0[a]	679 ± 24.6[b]	951 ± 42.9[c]
Bones	274 ± 7.3[a]	300 ± 9.6[a]	341 ± 12.3[b]
Proportion of tissue from the belly with bones (%):			
Muscle	60.96 ± 1.589[a]	61.38 ± 0.878[a]	56.21 ± 1.280[b]
Intermuscular fat	13.62 ± 1.182[a]	13.98 ± 0.704[a]	17.11 ± 0.805[b]
Skin with subcutaneous fat	16.97 ± 0.625[a]	17.06 ± 0.442[a]	19.61 ± 0.803[b]
Bones	8.45 ± 0.212[a]	7.58 ± 0.213[b]	7.07 ± 0.206[b]
BARROWS			
Weight of tissue dissected from the belly with bones (g):			
Muscle	2115 ± 66.2[a]	2247 ± 53.6[a]	2548 ± 75.7[b]
Intermuscular fat	484 ± 35.8[a]	627 ± 36.5[b]	988 ± 59.0[c]
Skin with subcutaneous fat	566 ± 22.0[a]	667 ± 30.4[a]	987 ± 55.8[b]
Bones	280 ± 7.9[a]	304 ± 12.7[a]	347 ± 11.8[b]
Proportion of tissue from the belly with bones (%):			
Muscle	61.47 ± 1.344[a]	58.45 ± 0.877[b]	52.27 ± 1.184[c]
Intermuscular fat	13.96 ± 0.968[a]	16.30 ± 0.672[b]	20.25 ± 1.016[c]
Skin with subcutaneous fat	16.43 ± 0.637[a]	17.34 ± 0.447[a]	20.26 ± 1.050[b]
Bones	8.14 ± 0.215[a]	7.91 ± 0.281[a]	7.22 ± 0.270[b]

[a, b, c] Values with different superscripts differ significantly ($P \leq 0.05$)

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