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The effect of sex and terminal sire line on carcass characteristics of pork belly

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Abstract

The objective of study was to evaluate the effect of sex and terminal sire line on pork belly composition of commercially produced pigs. The animals were progeny of White Meaty sows and three terminal sire lines: HA×PN, LA and YO×PN. Barrows: gilts ratio was 97:102. Pigs were slaughtered at average carcass weight 85.73-89.0 kg according to genotype. Day after slaughter, the dissection of right half sides was done. After that, the detailed dissection of trimmed belly to individual tissues (bones, meat, fat and skin) was performed. The effect of sex on belly characteristics was significant. Gilts had higher meat proportion in belly than barrows (51.41 vs. 47.21 %), which reached higher content of subcutaneous and intermuscular fat (43.92 vs. 38.83 %). The influence of terminal sire line was also significant. All differences were found between HaxPN genotype and other two terminal sire lines. Progeny of HA×PN sire line had the highest percentage of meat in belly (51.28 %) while progeny of YO×PN had the highest content of fat and skin (42.79 %) and bones in belly (9.48 %).

Keywords: pigs, carcass, sex, terminal sire line, pork belly

Zusammenfassung

Einfluss von Geschlecht und Endstufeneberlinie auf die Schlachtkörpermerkmale von Schweinebauch

Das Ziel dieser Studie bestand in der Prüfung des Einflusses von Geschlecht und Endstufeneberlinie auf die Zusammensetzung des Bauches von Schlachtschweinen. Die Tiere waren Nachkommen von White Meaty Sauen und Ebern der Endstufenlinien HA×PN, LA sowie YO×PN. Das Verhältnis von Börgen zu weiblichen Tieren betrug 97:102. Geschlachtet wurden die Tiere abhängig vom Genotyp bei einem Schlachtkörpergewicht von 85,73 bis 89,00 kg. Am Tag nach der Schlachtung erfolgte die Zerlegung der rechten Hälfte sowie die Teilstückzerlegung des Bauches (Knochen, Fleisch, Fett, Haut). Der Einfluss des Geschlechtes auf die Bauchmerkmale war signifikant. So zeigten die weiblichen Tiere gegenüber den Börgen einen signifikant höheren Fleischanteil (51,41 bzw. 47,21 %) während Börge einen höheren Gehalt an Unterhaut- und intramuskulärem Fett (43,92 bzw. 47,21 %) aufwiesen. Der Einfluss der Eberlinie war ebenfalls signifikant. So unterschieden sich die Nachkommen des HA×PN Genotyps mit einem Bauchfleischanteil von 51,28 % gegenüber den zwei weiteren Eberlinien, während die Nachkommen von YO×PN mit 42,79 % signifikant den höchsten Gehalt an Fett und Haut und einem Knochenanteil im Bauch von 9,48 % aufwiesen.

Schlüsselwörter: Schwein, Schlachthälfte, Geschlecht, Endstufeneberlinie, Bauch

Introduction

Due to consumer demands for leaner meat products, the aim of pig production has been to reduce body fat and increase lean meat content in carcasses (Stites *et al.* 1991). One important part of the pork carcass is the belly. In currently produced pigs, lean meat percentage of pork belly has large economic effect for the processing industry and consumer´s popularity.

Over the last 40 years, belly lost almost 29 % of fat and became thinner and softer and lower processing yields (Lévesque 2003, Person *et al.* 2005). A lean meat content exceeding 50 % of pork belly weight is considered as a favourable belly composition (Pulkrábek *et al.* 1998). This fact is closely connected with evaluation of pig carcasses based on lean meat content (Vališ *et al.* 2005). Study on pork belly characteristics showed higher lean meat deposition in gilts and boars compared to barrows (Correa *et al.* 2008, Lo Fiego *et al.* 1992).

Among the various fat depots in pig carcasses, it is the belly which has been affected the most by the selection to decrease the fatness level of the pig carcass and to improve the belly without affecting lean yield (Marcoux *et al.* 2007, Schinckel *et al.* 2002). Suitability of selection for lean meat in the belly is suggested by coefficient of heritability in the studies of Hermesch (2008), h^2=0.23-0.34 and Tholen *et al.* (2001), h^2=0.27-0.31.

The aim of this study was to evaluate the effect of some factors on pork belly composition of commercially produced pigs.

Material and methods

Carcass composition of pig bellies of three genotypes was investigated. Pigs were progeny of White Meaty sows and three different terminal sire lines: (HA×PN), n=78; LA, n=66 and (YO×PN), n=55. Barrows: gilts ratio was 97:102. Pigs were slaughtered in experimental abbatoir of the Animal Production Research Centre in Nitra. The average carcass weight (CW) was 89.0, 86.17 and 85.73 kg according to genotypes. Day after slaughter, the dissection of right half sides to partial carcass parts was done. After that, the detailed dissection of trimmed belly (Walstra & Merkus 1995) to individual tissues (bones, meat, intermuscular and subcutaneous fat with skin) was performed.

The percentages of single tissues from weight of trimmed belly were calculated. The following carcass traits were analysed: carcass weight (CW), backfat thickness (BF), lean meat percentage (LMP), weight of belly (WB), meat of the belly, fat and skin of the belly, bones of the belly, percentage of belly (from CW), percentage of meat in the belly, percentage of fat and skin in the belly, percentage of bones in the belly.

Statistical package SAS/STAT v. 9.1.3 (SAS 2002/2003) was employed in the analyses. Basic statistics was done using MEANS procedure. CORR procedure was used to calculate Pearson´s correlation coefficients between the traits under study. The effect of terminal sire line, sex, carcass weight and weight of belly was investigated using GLM procedure according to the following model equations:

$$y_{ij}= \mu+S_i+G_j+bw_{ij}+e_{ij} \qquad (1)$$

where y_{ij} is the dependent variable: weight of belly, kg; meat of belly, kg; fat and skin of belly, kg; bones of belly, kg; percentage of belly, %; μ is the intercept, S_i is the fixed effect of sex, (barrow, gilt), $\sum_i S_i=0$; G_j is the fixed effect of sire's genotype (HAPN, LA, YPN), $\sum_j G_j=0$; b is the linear regression coefficient of dependent variable (weight of belly, meat of belly, fat and skin of belly, bones of belly, percentage of belly) on carcass weight w_{ij} and e_{ij} is the random error; $e_{ij} \sim N(0,\sigma_e^2)$.

$$y_{ij}=\mu+S_i+G_j+bl_{ij}+e_{ij} \quad (2)$$

where y_{ij} is the dependent variable: meat of belly percentage, fat and skin of belly percentage, bones of belly percentage, μ is the intercept, S_i is the fixed effect of sex (barrow, gilt), $\sum_i S_i=0$; G_j is the fixed effect of sire's genotype (HAPN, LA, YPN), $\sum_j G_j=0$; b is the linear regression coefficient of dependent variable (meat of belly percentage, fat and skin of belly percentage, bones of belly percentage) on weight of belly l_{ij} and e_{ij} is the random error; $e_{ij} \sim N(0,\sigma_e^2)$.

Results and discussion

Basic statistics of whole dataset is given in Table 1. Weight of meat in the belly represents almost 50 % of weight of belly. Average lean meat percentage reached 56.72 % (class E) which documents a good meatiness of pigs observed.

Table 1
Basic statistics for carcass and belly traits

Trait	Mean	SD	Min	Max
Carcass weight, kg	87.20	7.26	70.00	106.00
Backfat thickness, mm	27.21	5.00	16.72	39.74
Lean meat percentage, %	56.72	3.98	45.68	66.23
Weight of belly, kg	4.87	0.69	3.07	7.64
Meat of belly, kg	2.40	0.35	1.63	3.32
Fat and skin of belly, kg	2.02	0.53	0.60	3.54
Bones of belly, kg	0.45	0.16	0.19	0.87
Percentage of belly, %	11.24	1.23	8.44	17.15
Percentage of meat in belly, %	49.57	6.15	33.94	65.12
Percentage of fat and skin in belly, %	41.15	6.72	24.95	58.55
Percentage of bones in belly, %	9.17	1.83	4.10	16.54

SD: standard deviation

Statistically significant or highly significant effect of sex on all observed carcass characteristics of belly except for weight of bones in belly was determined (Table 2). Barrows had higher weight of belly than gilts. Stupka *et al.* (2004a) also reported higher weight of belly in barrows than gilts (4.35 vs. 4.12 kg). Żak & Tyra (2006) found lower weight of belly in gilts of Polish LW×Polish Landrace (4.05 kg) than that in our study. Barrows reached higher percentage of belly from carcass weight than gilts. This result is in agreement with findings of Stupka *et al.* (2004a) who state 9.96 % in barrows and 9.56 % in gilts. Similar values have been described by Pulkrábek *et al.* (2006), from 9.74 to 10.74 % according to carcass lean meat proportion. They state decreasing percentage of belly with increasing carcass lean meat proportion.

Table 2
Least-squares means and standard errors (sex and sire's genotype effects)

	Sex		Sire line		
	Barrows (1)	Gilts (2)	HA×PN (1)	LA (2)	YO×PN (3)
	N=97	N=102	N=78	N=65	N=55
Trait	$\mu_i \pm s_{\mu_i}$	$\mu_i \pm s_{\mu_i}$	$\mu_i \pm s_{\mu_i}$	$\mu_i \pm s_{\mu_i}$	$\mu_i \pm s_{\mu_i}$
Weight of belly, kg	5.03±0.049	4.78±0.048	4.57±0.055	5.08±0.060	5.06±0.065
	1:2**			1:2**, 3**	
Meat of belly, kg	2.34±0.029	2.46±0.028	2.36±0.032	2.45±0.035	2.39±0.038
	1:2**			-	
Fat and skin of belly, kg	2.25±0.042	1.85±0.041	1.81±0.047	2.14±0.050	2.19±0.055
	1:2**			1:2**, 3**	
Bones of belly, kg	0.45±0.010	0.45±0.010	0.40±0.011	0.47±0.012	0.48±0.013
	-			1:2**, 3**	
Percentage of belly, %	11.57±0.111	11.03±0.109	10.58±0.125	11.70±0.135	11.64±0.148
	1:2**			1:2**, 3**	
Percentage of meat in belly, %	47.21±0.529	51.41±0.514	51.28±0.585	48.91±0.631	47.75±0.688
	1:2*			1:2*, 3**	
Percentage of fat and skin in belly, %	43.92±0.582	38.83±0.565	39.88±0.643	41.46±0.694	42.79±0.756
	1:2**			1:3*	
Percentage of bones in belly, %	8.90±0.185	9.51±0.180	8.79±0.205	9.35±0.221	9.48±0.241
	1:2*			-	

**P<0.01, *P<0.05 (Scheffe´s test), N: number of observations

On the other hand, gilts in our study had significantly higher weight of meat in belly and percentage of meat and bones in belly than barrows. Similarly, Stupka *et al.* (2004a) found significantly higher proportion of meat in gilts (by 3.32 %) compared to barrows. In our study, this difference was 4.20 % in favour of gilts. In another study, Stupka *et al.* (2004b) state that increasing meat proportion of carcass, the weight and percentage of meat in the belly were increasing. This is in agreement with results of Pulkrábek *et al.* (2006). Higher meat proportion in the belly of gilts than in our study is reported by Żak & Tyra (2006): 52.79 % and Vališ *et al.* (2005): 55.17 %. Softer bellies of gilts than those of barrows were found by Correa *et al.* (2008). Vališ *et al.* (2005) suggested that belly composition is mainly influenced by the lean meat proportion of carcass, and effect of sex (and slaughter weight) is much more important than influence of the hybrid combination.

In the present study, the effect of terminal sire line was evident in all carcass characteristics of belly except for weight of meat and percentage of bones in the belly (Table 2). The effect of genotype on weight of belly was investigated by Tholen *et al.* (2003). The significant differences between genotypes were similar to those reported in our study (about 0.5 kg). The proportions of individual tissues in the belly were observed by Vališ *et al.* (2005) according to different sire genotype (LW×synthetic line, D×PN and HA×PN). They found higher proportion of meat in the belly (51.59-53.80 %) but lower percentage of bones (7.13-7.60 %) and of fat with skin (38.11-40.56 %) in comparison with our results.

Adjustments for considered effects diminished standard deviations of weight of belly from 0.689 to 0.483, for meat of belly from 0.345 to 0.299, for fat and skin of belly from 0.525

to 0.407 and for bones of belly from 0.159 to 0.093. R^2 ranged from 0.322 to 0.520 for weight of belly, meat of belly and fat and skin of belly and their percentages. The lower R^2 were found for weight and percentage of bones in the belly and percentage of belly (0.219, 0.075 and 0.240, respectively).

Weight of belly correlated significantly positively with carcass weight but negatively with lean meat percentage in carcass (Table 3). Correlations between percentages of belly, meat, bones, fat in the belly and carcass weight were lower than those between meat, bones, intermuscular, subcutaneous fat in the belly and slaughter weight (r=−0.31 to 0.25) of authors Vališ *et al.* (2005). These authors also report higher correlations of belly characteristics to lean meat percentage in carcass (r=−0.79 to 0.92) than our results.

The relationship between carcass weight and belly traits was positive, which is documented by regression coefficients (Table 4). However, with increasing weight of belly is percentage of meat and bones decreasing while percentage of fat and skin increasing.

Table 3
Correlations between carcass traits

Trait	CW	WB	BF	LMP
Weight of belly	0.61***	-	0.16	−0.30**
Meat of belly	0.52***	0.71***	−0.09	0.26**
Fat and skin of belly	0.43***	0.77***	0.27**	−0.57***
Bones of belly	0.17	0.31**	0.01	0.02
Percentage of belly	0.01	0.79***	−0.09	−0.39***
Percentage of meat in belly	−0.13	−0.37***	−0.32**	0.65***
Percentage of fat and skin in belly	0.11	0.33**	0.27**	−0.62***
Percentage of bones in belly	−0.02	−0.19	−0.05	0.22*

**P*<0.05, ***P*<0.01, ****P*<0.001, CW: carcass weight, WB: weight of belly, BF: backfat thickness, LMP: lean meat percentage

Table 4
Estimates of linear regression coefficients

	Estimate	Standard Error
Linear regression on carcass weight		
Weight of belly, kg	0.0621	0.00486
Meat of belly, kg	0.0283	0.00281
Fat and skin of belly, kg	0.0272	0.00410
Bones of belly, kg	0.0060	0.00094
Percentage of belly, %	0.0201	0.01097
Linear regression on weight of belly		
Percentage of meat in belly, %	−2.4321	0.55736
Percentage of fat and skin in belly, %	2.6237	0.61269
Percentage of bones in belly, %	−0.3647	0.19523

It can be concluded that the effect of sex on carcass characteristics of belly was significant. Gilts reached higher meat proportion in the belly than barrows which had higher content of subcutaneous and intermuscular fat. The influence of the genotype of terminal sire was also evident. This fact might be useful when decisions on breed or breed combination usage in hybridisation programme are made. The belly and its meatiness represent the potential to increase the lean meat percentage in pig carcasses.

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