THE CHARACTERISTIC OF THE CARCASS COMPOSITION CHANGES IN RELATION TO LIVE WEIGHT IN BARROWS AND GILTS

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Abstract

The aim of the study was to evaluate the effect of sex and slaughter weight on the carcass composition in barrows and gilts of the Dan-Bred genotype. The test used the total amount of 144 pigs, all within the weight range of 25-114 kg of live weight.

In order to determinate the weight and carcass part proportions a slaughter dissection was carried out following the termination of the experiment. Subsequently the influence of sex and body weight on pig carcasses composition was evaluated. For the purposes of describing the influence of sex and slaughter weight on the weight and carcass parts proportions regression equations were created.

Our study detected significant differences in the body composition of gilts and barrows. The final results show that gilts are on average meatier and less fatty than barrows. Gilts have a higher lean meat share in individual carcass parts as well as lower fat share than barrows. The study also found an important relationship between the live weight and the meat and fat amount in main meat parts.

For each 1 kg of body weight increase the fat coverage increases as well. The increase is +0,03kg in ham, + 0.01kg in neck and shoulders and 0.04kg in the loin parts.

With increasing live weight the weight of the fat coverage of all the main meat parts increases as well, while the fat coverage share increases only in the shoulder and the loin. With increasing live weight there is also a significant increase in the amount of meat contained in the individual carcass parts, however, if this trend is expressed as a proportional share based on the total weight of the carcass there was only a slight meat increase observed in the ham and the loin (i.e. the increase was observed in the more valuable parts). For the parts of the neck and the shoulder the study showed that with the increasing body weight the weight of these parts decreases.

The monitored genotype shows a lower decrease of lean meat indicators as compared with the less recently published data.

Key Words: Pig, carcass, regression

The Czech Republic, in comparison with the north-western European countries, shows a relatively high slaughter weight. However animals with higher body weight display worse fattening parameters (Pfeiffer, 1984) as well as worse carcass composition (Fuacitano, 2002, Kerner et al., 1992 and Sladek et al., 2003). Many authors demonstrated that with the increasing live weight the lean meat share decreases, the fat share increases and the overall carcass yield improves (Stupka et al., 2004 and Pulkrábek, 2004). However the lower lean meat share does not necessarily mean lower absolute weight of the main meat parts (Šprysl et al., 2010). The influence of the body weight on the fat content is not sufficiently described in the current literature (the dorsal fat may be regarded as a valuable carcass part).

The aim of this study is to quantify the influence of slaughter weight on the important carcass parts and to construct regression equations in order to characterize the influence of body weight on the carcass composition in pigs.

Hypothesis: Sex and slaughter weight influence the pig carcass composition. There are regression equations which can be compiled and then serve as a valuable tool in estimating the pig carcass composition at different slaughter weights.

Material and Methods

The total amount of 144 pigs of the DanBred genotype was used. The fattening test was performed on animals with live weight (LW) ranging from 25 to 114 kg. Animal nutrition in the test was carried out according to the Nutrient requirements and tables of nutritive value of feeds for pigs (Šimecek et al., 2000). The pigs were fed ad-libitum in three phases. The main nutrients found in the complete feed mixtures (CFM) were: A1 (25-35 kg of LW) - 13 MJ ME, 12 g lysine, A2 (36-65 kg of LW) - 12.9 MJ ME, 10.61 g lysine, A3 (66-114 kg of LW) - 12.8 MJ ME, 8.7 lysine.

All animals were slaughtered after achieving an average LW of 114 kg. Subsequently, the next day the standard dissection of individual animals was performed and the following indicators were determined: right half cold carcass weight (kg), lean meat share (determined by the FOM in %), carcass yield (%) weight and main meaty part shares (%, kg), loin area (MLLT in mm^2), weight and proportion of the ham, shoulder, neck and ham (kg, %). These parts were then cut into meat with bones and fat cover.

Experimental results were analyzed with the use of statistical methods in the SAS program. In order to determine the effects of individual factors, MEANS and GLM procedures were used. The following model was used for the final evaluation:

$Y_{ijk} = \mu + a_i + b_j + a\ x\ b_{ij} + e_{ijk}$, where:

μ - population average of the reference character,
ai - fixed effect of sex,
bj - slaughter weight,
e_{ijk} - residual error.

In order to determine the effect of live bodyweight the regression equations for each monitored variable were calculated.

Results and Discussion

Table 1 shows the average values of monitored variables for the whole group, as well as the average values reached separately in barrows and gilts. The table also shows P-values for the observed fixed effects (body weight, sex and their interaction). It is apparent that gilts showed a higher proportion of the lean meat share parts (as compared with the barrows). At the same carcass weight, gilts displayed a higher lean meat share (by 1.58%), larger loin eye area (about 261 mm^2) and higher weight and main meat part shares. Similar results were also found by Stupka et al. (2008a, 2008b) and Pulkrábek et al. (2009).

The differences in the growth and carcass composition between barrows and gilts lie in the anabolic effects of androgen receptors on the muscle cells. These receptors have an apparent impact on the storage of protein and fat (Blendl et al., 1989). The carcass weight of the leg, loin, neck and shoulder (including its fat cover) is not influenced by sex; seeing as the study showed only insignificant differences between barrows and gilts. A higher weight and proportion of the belly was found in barrows. The belly is, as distinct from the main meaty parts, a body part that is composed of a higher share of fat. It can be stated that the higher lean meat share in the carcass part, the smaller the difference between barrows and gilts is. Conversely, the fatty parts of carcass show higher weight in barrows, due to the higher fat share found in these parts. This fact is especially evident when the main meaty parts are dissected, so that the obtained cuts include the fat coverage including the skin and the meat on the bone. In parts dissected in such a way, the fat coverage reaches higher weight in barrows as compared with gilts. These differences (with the exception of the shoulder) are all statistically significant. Latorre et al. (2008) found that barrows are characterized by meat with higher fat share, wider ham and smaller shoulder than gilts.

The table 1 also shows the P-values for the effect of sex, body weight and their interactions. The study showed a significant effect of the live body weight on almost all of the observed indicators. In order to quantify this relationship, table 2 shows the regression analysis results – the dependence of the monitored character on the live weight. There were three regression equations calculated for all of the monitored characters: equation for the whole test group, equation for barrows and equation for gilts. The values obtained from the regression equations show the change in the monitored parameters (by the number of units) when the live body weight changes by 1 kg. As it is evident, with increasing body weight the body composition deteriorates. The study observed a significant increase in the fat content and decrease in the lean meat share. This trend, however, is not the same in barrows and gilts. Wood (2000) found that when the body weight increases, there is also an increase of both total and intramuscular fat. The increase of intramuscular fat was confirmed by the research of Wagner et al. (1999).When the LW of barrows increased by 10 kg the muscle mass share decreased by 0.85%, while the decrease in gilts is about 1.14%. Pulkrábek (2004) observed that when the slaughter weight increases by 10 kg, the muscle mass then decreases by 1.5%. The dependence of main meaty parts on the live body weight was not confirmed. Šprysl et al. (2010) states, that main meaty parts share decreases with increasing body weight.

Despite the higher average slaughter weight of about 114 kg, our work did not demonstrate any significant deterioration in the carcass composition. However Latorre et al. (2004) demonstrated a significant decrease in carcass conformation when the slaughter weight exceeded the threshold of 115 kg. The differences between our and previously published results could be explained by the current use of modern hybrid combinations with higher lean meat share and also by lower decrease of the monitored parameters with increasing weight.

The study demonstrated a significant effect of live weight on the meat weight and share in the ham. In barrows the increasing LW (increase by 1 kg) leads to insignificant decrease (-0.004), while the gilts show a slight increase (+0.025). Regarding the loin meat share with LW increasing by 1 kg, the change in the parameters was the same in both barrows and gilts (increase by +0.024). Concerning the shoulder the observed change with regards to LW increasing by 1 kg was not significant, while the neck displays a decrease in the meat share in both of the sexes (gilts and barrows). Höreth (1995) reported that with higher increase of live body weight, the decrease in main meaty parts proportions becomes deeper. The neck, shoulder and loin show 0.2% decrease in the main meaty parts proportions while the ham shows 1% decrease.

The fat coverage of all the monitored parts (with the exception of shoulder) increased with the increasing live weight. The highest observed increase was found in the loin, where the values reached +0.041% in barrows and +0.057% in gilts.

Table 1. The effect of live weight and sex on carcass characteristics (mean, SD, P-value)

Item			Total	Barrows	Gilts	Significance		
						live weight	sex	live weight x sex
Live weight		kg	89.67 ± 9.21	89.94 ± 9.79	89.39 ± 8.64	<0.001	0.1202	0.5496
Carcass yield		%	78.44 ± 1.52	78.68 ± 1.34	78.20 ± 1.66	0.5214	0.0483	0.2115
Lean meat share		%	55.28 ± 2.61	54.50 ± 2.48	56.08 ± 2.51	<0.001	<0.001	0.4525
MLLT area		mm^2	4637 ± 568	4510 ± 600	4771 ± 502	<0.001	0.0037	0.3697
Main part		kg	22.42 ± 2.32	22.15 ± 2.51	22.68 ± 2.12	<0.001	0.1046	0.7858
		%	51.62 ± 1.93	50.91 ± 2.07	52.33 ± 1.50	0.8645	0.0009	0.9172
Other less valuable part		kg	5.49 ± 0.46	5.54 ± 0.50	5.43 ± 0.41	<0.001	0.0272	0.6774
		%	12.66 ± 1.08	12.78 ± 1.20	12.53 ± 0.92	<0.001	0.1889	0.211
Ham	whole	kg	11.94 ± 1.53	11.86 ± 1.65	12.01 ± 1.41	<0.001	0.7559	0.521
		%	27.33 ± 1.20	27.12 ± 1.25	27.55 ± 1.10	0.1098	0.0462	0.8999
	meat	kg	9.28 ± 1.08	9.13 ± 1.12	9.43 ± 1.02	<0.001	0.0627	0.7728
		%	2.41 ± 0.39	2.47 ± 0.41	2.34 ± 0.36	<0.001	0.0504	0.7813
	fat	kg	21.36 ± 1.20	20.98 ± 1.28	21.74 ± 0.99	0.7417	0.0042	0.4019
		%	5.53 ± 0.67	5.67 ± 0.72	5.40 ± 0.58	0.499	0.571	0.5544
Loin	whole	kg	7.60 ± 1.21	7.54 ± 1.28	7.66 ± 1.13	<0.001	0.717	0.3975
		%	17.33 ± 1.20	17.16 ± 1.17	17.52 ± 1.21	<0.001	0.0944	0.5905
	meat	kg	5.35 ± 0.69	5.30 ± 0.72	5.41 ± 0.67	<0.001	0.3571	0.6565
		%	2.10 ± 0.53	2.19 ± 0.55	2.02 ± 0.51	<0.001	0.0352	0.7908
	fat	kg	12.30 ± 0.69	12.14 ± 0.63	12.45 ± 0.73	0.0852	0.0519	0.6329
		%	4.79 ± 0.89	4.97 ± 0.92	4.61 ± 0.84	<0.001	0.0263	0.7234
Neck	whole	kg	3.52 ± 0.52	3.55 ± 0.57	3.50 ± 0.46	<0.001	0.1732	0.0897
		%	8.08 ± 0.78	8.11 ± 0.80	8.04 ± 0.76	0.2423	0.4594	0.275
	meat	kg	2.82 ± 0.29	2.80 ± 0.36	2.84 ± 0.21	<0.001	0.6611	0.0104
		%	0.56 ± 0.16	0.56 ± 0.17	0.57 ± 0.14	<0.001	0.9149	0.4269
	fat	kg	6.53 ± 0.62	6.46 ± 0.67	6.59 ± 0.58	0.0039	0.358	0.026
		%	1.29 ± 0.29	1.27 ± 0.31	1.30 ± 0.27	<0.001	0.8446	0.4672
Shoulder	whole	kg	6.04 ± 0.69	6.09 ± 0.73	5.99 ± 0.64	<0.001	0.0833	0.528
		%	13.86 ± 0.81	13.95 ± 0.88	13.77 ± 0.72	0.0405	0.2408	0.9075
	meat	kg	4.47 ± 0.60	4.45 ± 0.63	4.49 ± 0.57	<0.001	0.9081	0.5778
		%	1.61 ± 0.29	1.68 ± 0.26	1.54 ± 0.30	0.0012	0.0224	0.7418
	fat	kg	10.27 ± 0.93	10.20 ± 0.93	10.35 ± 0.94	0.9899	0.4948	0.628
		%	3.72 ± 0.60	3.86 ± 0.51	3.57 ± 0.64	0.6727	0.0311	0.8962
Belly		kg	7.78 ± 1.18	7.86 ± 1.24	7.70 ± 1.11	<0.001	0.0184	0.8473
		%	17.77 ± 1.18	17.94 ± 1.16	17.61 ± 1.18	<0.001	0.0484	0.6487

Table 2. The parameters of regression live weight on carcass characteristics (r)

Item			Total	Barrows	Gilts
Live weight		kg	0.7839	0.7773	0.7933
Carcass yield		%	0.0001	-0.0073	0.0106
Lean meat share		%	-0.0977	-0.0858	-0.1142
MLLT area		mm2	35.0109	36.2790	32.3476
Main part		kg	0.2135	0.2065	0.2238
		%	-0.0053	-0.0040	-0.0100
Other less valuable part		kg	0.0263	0.0256	0.0276
		%	-0.0619	0.0256	-0.0597
Ham	whole	kg	0.1242	0.1216	0.1283
		%	0.0205	0.0202	0.0200
	meat	kg	0.0927	0.0844	0.1053
		%	0.0255	0.0231	0.0296
	fat	kg	0.0077	-0.0040	0.0250
		%	0.0063	0.0020	0.0138
Loin	whole	kg	0.0977	0.0970	0.0987
		%	0.0569	0.0595	0.0519
	meat	kg	0.0620	0.0600	0.0650
		%	0.0403	0.0373	0.0455
	fat	kg	0.0242	0.0243	0.0237
		%	0.0472	0.0414	0.0572
Neck	whole	kg	0.0334	0.0358	0.0296
		%	-0.0005	0.0051	-0.0095
	meat	kg	0.0162	0.0204	0.0094
		%	0.0113	0.0122	0.0099
	fat	kg	-0.0252	-0.0136	-0.0440
		%	0.0141	0.0166	0.0100
Shoulder	whole	kg	0.0690	0.0515	0.0535
		%	-0.0136	-0.0136	-0.0132
	meat	kg	0.0424	0.0408	0.0450
		%	0.0126	0.0135	0.0115
	fat	kg	-0.0067	-0.0021	0.0002
		%	-0.0011	-0.0042	-0.0100
Belly		kg	0.0964	0.0927	0.1030
		%	0.0512	0.0433	0.0650

Conclusion

The study showed that with increasing body weight the fat deposition becomes more significant and there is an apparent decrease in the lean meat share. There are differences between barrows and gilts in relation to this process. The gilts show on average better lean meat conformation and less fat than barrows.

The study also demonstrated a relationship between the carcass weight and the amount of fat in the main meaty parts. When the live body weight increases by 1 kg, the amount of fat contained in the ham, neck, shoulder and loin increases by 0.03 kg, 0.01 kg, 0.01 and 0.04 kg, respectively.

In comparison with less recently published results our study showed, that with increasing live weight the decrease in lean meat share and main meaty parts proportions is lower. This may be caused by the intensive selection favoring the higher lean meat share in modern pig genotypes.

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