QUANTIFICATION OF CHANGES OF THE CARCASS AT VARIOUS SLAUGHTER WEIGHT*

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Regarding the effects acting in evaluation of pigs according to the percentage of muscles, quantification of changes in the structure of carcasses that follow from changing slaughter weight was studied. An analysis of the carcass into different parts and subsequent detail carcass analysis of these parts into body components showed a significant action of this factor on worsening of the carcass of pigs. At increasing slaughter weight ranging from 80 to 154.5 kg in investigated set the percentage of muscles decreased in the carcass from 53.0 to 43.2%. In evaluation of changes in different carcass parts it can be manifested on example that in this range of slaughter weight the weight of lard with skin from back increased from 2.46 ± 0.295 kg to 6.71 ± 0.352 kg and weight of leg with bone from 7.13 ± 0.258 kg to 10.20 ± 0.308 kg. These changes confirm also correlation coefficients between slaughter weight and different slaughtered parts. Only some data are presented as examples. In the case of lard with skin from back it was the value $r = 0.56 \pm 0.058$ and in the case of leg with bone $r = -0.42 \pm 0.063$.

pig; structure of carcass; slaughter weight; relationships

INTRODUCTION

At the present slaughter weight reached in pigs follows from more or less unified technological procedures used in animal fattening. In the Czech Republic with the development of large-capacity production buildings for rearing and fattening of pigs cyclic systems started to be used. It is advantageous above all from the point of view of prevention of diseases (Černý, 1989) and others. Different level of growth capacity of different animals brings certain variability at their identical age in their slaughter weight. Just these

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problems are dealt with in this study when the slaughter weight is a resultant of merely different level of growth capacity of different animals.

Our approach to the study of changes in the structure of the carcass with respect to increasing slaughter weight compared with other authors is different under these circumstances. References present studies which investigate the given effect simultaneously with the effect of uniformly with growing age of animals (Hovorka, Pavlík, 1973) and others.

The importance of the presented problems are emphasized newly in the Czech Republic introducing apparative classification of slaughter pigs. Their significance follows e.g. from the study of Branscheid et al. (1987). For example the studies written by Oster et al. (1987) and Vrchlabský, Palásek (1992) and others inform on different procedures in examination proper of the percentage of muscles in undissected half-carcasses of pigs. It is logical that with regard to the mentioned basic parameter animals with lower slaughter weight will be evaluated better.

However, the practical breeder has not many possibilities how to come to terms with somewhat lower slaughter weight.

Biological prerequisites influencing economy of pig fattening force him rather to opposite conclusions (Pavlík, 1993). Shortening of the time of fattening without certain losses is eliminated in many cases yet in investment plan by firmly determined number of days for the rest of animals in weaner rearing of early weaned piglets and in the proper fattening of pigs.

The aim of the presented study was to give detail information on changes in the structure of the carcass of pigs with respect to their different slaughter weight. Detail carcass analyses were based on methodological approach as reported by Sack (1982).

This information should serve in considerations leading to evaluation of slaughterable pigs according to the share of muscles in the carcass of pigs for the Czech Republic.

MATERIAL AND METHODS

To process the presented problems data from studies of 209 pigs were used. Animals of the breeds Large White (n = 60), Landrace (n = 28), Hampshire (n = 40), Duroc (n = 43) and Czech Meat (n = 38). Fattening of animals corresponded to cyclic system, control fattening was of the character of station test of fattening for tests of final products. The fattening test started at 30 kg of live weight of pigs and was finished after 130 ± 30 days.

During carcass analysis first left half-carcass dissected into different carcass parts was analyzed whose survey follows from the table. In addition, these parts were dissected into different tissues while muscles, fat, bones, skin and other components, i.e. head and trotters which were not subject of detail dissection.

The results found were processed in grading of animals by their slaughter weight. Five grades were followed within the range of 80 to 154.5 kg. Interval here represented 15 kg. Routine mathematical and statistical methods were used, including determination of correlation coefficients to express relationships between slaughter weight and different carcass parts. Basic characteristics of studied material give Tab. I. It is evident from the table that also greater level of growth capacity in hogs than in gilts.

I. Basic data on pigs classified according to the slaughter weight

Indicator	Slaughter weight (kg)				
	80.0–94.5	95.0–109.5	110.0–124.5	125.0–139.5	140.0–154.5
Number of animals	11	50	89	51	8
Percentage of animals	5.3	23.9	42.6	24.4	3.8
Percentage of muscles in carcass	53.0	50.2	46.7	44.6	43.2
Percentage of hogs in weight category	45.5	30.0	47.2	70.6	87.5
Percentage of gilts in weight category	54.5	70.0	52.8	29.4	12.5

RESULTS AND DISCUSSION

Tab. II gives the weight of different parts of the whole half-carcass of pigs. It is logical that with increasing slaughter weight weight of carcass parts is increasing as well. Naturally, with respect to unevenness of formation of different body tissues the increase of these parts is much different. The greatest increase of weight was demonstrated by the parts with predominance of muscles. For example in fat with skin from back and from ham this increase was 158.4% and in spare rib, loin, shoulder with bone and ham with bone only 42.7%. The above relationships correspond to the conclusions presented in the study written by Hovorka and Pavlík (1973). It can be concluded from comparison of our results with those found by mentioned authors that the differences in composition of the carcass are given by different slaughter weight, even at identical age of evaluated animals. This fact should be emphasized also from more general point of view.

Correlation coefficients between slaughter weight and different carcass parts (Tab. III) were positive for the parts with predominance of fat and

II. Weight of parts of half-carcass classified according to the slaughter weight

Weight of carcass parts in kg	Slaughter weight (kg)				
	80.0–94.5	95.0–109.5	110.0–124.5	125.0–139.5	140.0–154.5
	$\bar{x} \pm s_{\bar{x}}$	$\bar{x} \pm s_{\bar{x}}$	$\bar{x} \pm s_{\bar{x}}$	$\bar{x} \pm s_{\bar{x}}$	$\bar{x} \pm s_{\bar{x}}$
Spare rib	3.50a ± 0.153	4.04b ± 0.070	4.37c ± 0.050	4.74d ± 0.068	4.91d ± 0.182
Loin	3.76a ± 0.180	4.46b ± 0.082	4.86c ± 0.059	5.25d ± 0.080	5.71e ± 0.216
Shoulder with bone	3.33a ± 0.135	3.62a ± 0.062	3.78b ± 0.044	4.13c ± 0.060	4.47d ± 0.162
Ham with bone	7.13a ± 0.258	8.10b ± 0.118	8.53c ± 0.085	9.23d ± 0.114	10.20e ± 0.308
Belly	5.07a ± 0.172	6.53b ± 0.078	7.46c ± 0.056	8.39d ± 0.076	9.63e ± 0.205
Cut from belly and other cuts	1.61a ± 0.122	1.80a ± 0.056	1.96b ± 0.040	2.15c ± 0.054	2.33c ± 0.146
Backfat with skin	2.46a ± 0.295	3.55b ± 0.135	4.72c ± 0.097	5.76d ± 0.131	6.71d ± 0.352
Fat with skin from ham	1.84a ± 0.184	2.41b ± 0.084	3.06c ± 0.060	3.77d ± 0.082	4.40e ± 0.220
Flare fat	0.48a ± 0.110	0.84b ± 0.050	1.18c ± 0.036	1.49c ± 0.049	1.65d ± 0.132
Jowl	0.90a ± 0.064	0.93a ± 0.029	1.00a ± 0.021	1.18b ± 0.028	1.22b ± 0.076
Fore hock	1.04a ± 0.052	0.98a ± 0.024	1.00a ± 0.017	1.09b ± 0.023	1.22b ± 0.063
Hind hock	1.31a ± 0.039	1.36a ± 0.018	1.41b ± 0.013	1.55c ± 0.017	1.66d ± 0.046
Sacrum	0.27a ± 0.021	0.32b ± 0.010	0.35c ± 0.007	0.38d ± 0.009	0.40d ± 0.025
Head	1.92a ± 0.090	2.19b ± 0.041	2.40c ± 0.029	2.67d ± 0.040	2.78d ± 0.107
Trotters	0.82a ± 0.025	0.73b ± 0.011	0.76c ± 0.008	0.81a ± 0.011	0.84a ± 0.030

III. Relationships between slaughter weight and percentages of different of parts in half-carcass

Relationship between		r	s_r
Slaughter weight	spare rib	–0.28+	0.067
	loin	–0.19+	0.068
	shoulder with bone	–0.40+	0.064
	ham with bone	–0.42+	0.063
	belly	0.20+	0.068
	cut from belly and other cuts	0.12	0.069
	backfat with skin	0.56+	0.058
	fat with skin from ham	0.47+	0.061
	flare fat	0.44+	0.062
	jowl	–0.06	0.069
	fore hock	–0.41+	0.063
	hind hock	–0.54+	0.058
	sacrum	–0.17+	0.068
	head and trotters	–0.37+	0.065

+ $P \leq 0.05$

negative for parts with predominance of muscles as well as of bones. The only exception was the relationship in the case of jowl, however, the value determined here was very low.

The percentages of muscles and fat (Tabs. IV and V) are given out of results of detail analyses of carcass parts with respect to the briefness.

The percentage of muscles was falling almost regularly with advancing slaughter weight, namely in all studied parts of the carcass of pigs. It was manifested most considerably in belly where this difference between the group of lightest and heaviest pigs was 14.3%. The decrease in spare rib by 7.2% corresponded to this, in loin by 3.9%, in shoulder with bone by 3.5% and in leg with bone by 2.3%. Increase of percentage of fat with advancing slaughter weight was then confirmed in all carcass parts.

Results of detail analyses show further worsening of the structure of the carcass of pigs with increasing slaughter weight. This is the case above all of main lean cuts where the percentage of fat is increasing due to unfavourable higher representation of intermuscular fat. This fact regarding the proper structure of parts utilized as a principal parameter of the carcass value has not been presented since now in the literature. The mentioned finding was

IV. Percentage of muscles in carcass parts in pigs classified according to slaughter weight

Percentage of muscles in carcass part	Slaughter weight (kg)				
	80.0–94.5	95.0–109.5	110.0–124.5	125.0–139.5	140.0–154.5
	$\bar{x} \pm s_{\bar{x}}$	$\bar{x} \pm s_{\bar{x}}$	$\bar{x} \pm s_{\bar{x}}$	$\bar{x} \pm s_{\bar{x}}$	$\bar{x} \pm s_{\bar{x}}$
Spare rib	69.9a ± 1.584	67.9a ± 0.723	65.9b ± 0.520	64.8b ± 0.702	62.7b ± 1.894
Loin	71.9a ± 1.163	71.2a ± 0.531	69.0b ± 0.381	68.0b ± 0.515	68.0b ± 1.390
Shoulder with bone	73.4a ± 1.116	74.8a ± 0.509	72.9 ± 0.366	71.7b ± 0.494	69.9b ± 1.334
Ham with bone	80.4a ± 0.886	80.9a ± 0.404	80.0a ± 0.291	78.8a ± 0.392	78.1 ± a.059
Belly	57.8a ± 1.769	50.8b ± 0.807	46.7c ± 0.580	45.4c ± 0.783	43.5c ± 2.114
Cut from belly and other cuts	61.3a ± 1.924	55.7b ± 0.878	53.0c ± 0.631	52.0c ± 0.852	51.4c ± 2.233
Jowl	24.3a ± 1.868	23.5a ± 0.853	22.1a ± 0.613	22.1a ± 0.827	20.7a ± 2.233
Fore hock	42.1a ± 1.149	40.2a ± 0.525	38.6b ± 0.377	38.4b ± 0.509	38.0b ± 1.374
Hind hock	42.1a ± 1.308	40.2a ± 0.597	39.1a ± 0.429	38.6b ± 0.579	36.8b ± 1.563
Sacrum	39.7a ± 2.843	39.0a ± 1.298	38.2a ± 0.932	36.1a ± 1.259	32.9a ± 3.398

Differences between averages of groups denoted by identical letters are not mutually statistically significant

V. Percentage of fat in carcass parts in pigs classified according to slaughter weight

Percentage of fat in carcass part	Slaughter weight (kg)				
	80.0–94.5	95.0–109.5	110.0–124.5	125.0–139.5	140.0–154.5
	$\bar{x} \pm s_{\bar{x}}$	$\bar{x} \pm s_{\bar{x}}$	$\bar{x} \pm s_{\bar{x}}$	$\bar{x} \pm s_{\bar{x}}$	$\bar{x} \pm s_{\bar{x}}$
Spare rib	11.6a ± 1.588	16.1a ± 0.725	18.9b ± 0.521	20.3b ± 0.703	21.9b ± 1.898
Loin	8.0a ± 1.100	10.1a ± 0.502	12.5b ± 0.361	14.0c ± 0.487	15.1bc ± 1.314
Shoulder with bone	9.1ab ± 1.101	8.7a ± 0.500	10.4bc ± 0.351	11.7bc ± 0.477	13.8b ± 1.303
Ham with bone	3.0a ± 0.766	4.9b ± 0.350	6.4c ± 0.251	7.6d ± 0.339	8.7d ± 0.915
Belly	25.9a ± 2.079	34.9b ± 0.949	40.4c ± 0.682	42.6c ± 0.921	45.1c ± 2.485
Cut from belly and other cuts	29.7a ± 1.768	34.4b ± 0.807	37.0c ± 0.580	38.9c ± 0.783	41.0c ± 2.113
Backfat with skin	79.3a ± 1.320	81.6a ± 0.602	85.6b ± 0.433	87.8c ± 0.584	89.3c ± 1.577
Fat with skin from ham	73.8a ± 1.912	76.7a ± 0.873	81.6b ± 0.627	83.9c ± 0.847	85.4c ± 2.286
Flare fat	100.0	100.0	100.0	100.0	100.0
Jowl	46.0a ± 2.600	48.7a ± 1.187	53.6b ± 0.853	55.1b ± 1.151	60.4b ± 3.108
Fore hock	5.8a ± 1.348	9.1b ± 0.615	10.6b ± 0.442	11.3b ± 0.597	12.3b ± 1.611
Hind hock	11.0a ± 1.593	15.1b ± 0.727	15.8b ± 0.522	18.7c ± 0.705	20.2c ± 1.904
Sacrum	4.8a ± 2.104	7.1ac ± 0.960	9.3b ± 0.690	11.8b ± 0.932	13.2bc ± 2.514

Differences between averages of groups denoted by identical letters are not mutually statistically significant

made possible by methodological approach to detail carcass analysis which followed from the Sack's study (1982). This was very exact and at the same time laborious determination of muscles by separation of intermuscular fat.

Generally speaking, the results of the study quantify the changes in fast changing structure of the carcass within the range of the slaughter weight reached in cyclic fattenings in different pigs.

References

BRANSCHEID, W. – SACK, E. – SCHOLZ, W.: Apparative Klassifizierung von Schweineschlachtkörpern: Marktprobleme und Wege zu ihrer Lösung. Züchtungskunde, *59*, 1987: 430–442.

ČERNÝ, M.: Veterinární problematika v chovu prasat s minimální nemocností (Veterinary problems in pig rearing with minimum incidence of diseases). In: Proc. Conf. VŠZ, Praha, 1989: 16–20.

HOVORKA, F. – PAVLÍK, J.: Biological aspects of the determination of the optimum slaughter weight of pigs. Scientia Agric. Bohemoslov., *5*, 1973: 243–252.

OSTER, A. – FEWSON, D. – KOMENDER, P. – BRANSCHEID, W. – SACK, E.: Schätzung des Muskelgewebeanteils beim Schwein angrund der Forchheimer Teilstückzerlegung sowie üblicher Schlachtkörpermasse. Züchtungskunde, *59*, 1987: 281–295.

PAVLÍK, J.: Kvantifikace hlavních biologických vlivů působících na ekonomiku výkrmu prasat (Quantification of main biological effects acting on economy of pig fattening). Živoč. Výr., *38*, 1993: 567–573.

SACK, E.: Apparative Klassifizierung. Beiträge zum Schlachtwert vom Schweinen, Kulmbach, 1982: 42–73.

VRCHLABSKÝ, J. – PALÁSEK, J.: Objektivizace třídění jatečných zvířat (Objectification of classification of slaughter animals). [Report of the research task.] Brno, VÚVL 1992: 1–19.

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Kvantifikace změn jatečného těla při různé porážkové hmotnosti.

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Práce se zabývá změnami ve složení jatečného těla prasat ve vztahu k jejich porážkové hmotnosti, a to při výkrmu, který odpovídá turnusovému systému. Do sledovaného souboru jatečných prasat (n = 209) byla zařazena zvířata plemen bílé ušlechtilé (n = 60), landrase (n = 28), hampshire (n = 40), duroc (n = 43) a české výrazně masné (n = 38). Uvedený soubor jatečných prasat jsme roztřídili do pěti tříd podle dosažené porážkové hmotnosti, která kolísala od 80 do 154,5 kg. Interval pro jednu třídu představoval vždy rozpětí 15 kg. V prvé hmotnostní kategorii (80,0 až 94,5 kg) bylo 11 jedinců, ve druhé, tj. od 95,0 do 109,5 kg, bylo 50 jedinců, ve třetí hmotnostní kategorii (110,0 až 124,5 kg) dosáhlo zastoupení sledovaných zvířat maxima (n = 89). Ve čtvrté třídě s porážkovou hmotností 125,0 až 139,5 kg se nacházelo 51 zvířat a v páté, tj. od 140,0 do 154,5 kg, 8 jedinců. Uvedené třídění vyplynulo z obecných zákonitostí variability. Při jatečném rozboru jsme nejprve rozdělili levou jatečnou půlku na jednotlivé partie, které jsme pak analyzovali až na svalovinu, sádlo, kosti, kůži a ostatní části, jako jsou šlachy, mízní uzliny, žíly, tepny apod. První část práce uvádí hmotnost jednotlivých jatečných partií. Je logické, že se zvyšující se porážkovou hmotností rostla i hmotnost jednotlivých jatečných partií. Toto zvýšení bylo však značně odlišné. Tak např. u sádla s kůží ze hřbetu a kýty představovalo v rámci sledovaného rozpětí zvýšení 158,0 %, zatímco u krkovice, pečeně, plece s kostí a kýty to bylo jen 42,7 %. Uvedenou nerovnoměrnost dokládají i hodnoty korelačních koeficientů, které byly mezi porážkovou hmotností a partiemi s převahou sádla většinou kladné, a to v rozmezí od r = 0,12 ± 0,069 do r = 0,56 ± 0,058. V případě partií s převahou svaloviny – ale i kostí – to byly hodnoty záporné. Rozpětí zde bylo od r = –0,17 ± 0,068 do r = –0,54 ± 0,058.

Při detailní analýze jsou tyto relace dokumentovány ještě výrazněji, neboť uvedené změny se promítly i do složení jednotlivých jatečných partií. Např. podíl svaloviny v pečeni poklesl ze 71,9 ± 1,163 % u prasat s nejnižší porážkovou hmotností na 68,0 ± 1,390 % u prasat s nejvyšší porážkovou hmotností.

Celkově tedy výsledky kvantifikují změny jatečného typu prasat s ohledem na výhodnější složení jatečného těla u prasat poražených v nižší hmotnosti. Jsme si vědomi toho, že je to jen jedno z hledisek, která je nutné brát v úvahu při stanovení optimální porážkové hmotnosti prasat. Problematika sledovaná v předložené práci nabývá v poslední době na důležitosti, a to s ohledem na perspektivní způsoby hodnocení jatečných zvířat.

Zároveň chceme upozornit na to, že výsledky práce poukazují na nutnost charakterizovat údaj o podílu svaloviny u prasat vždy jejich porážkovou hmotností nebo hmotností jatečného těla.

prase; složení jatečného těla; porážková hmotnost; vztahy

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