Pig carcass quality and pH_1 values of meat

J. Pulkrábek, J. Pavlík, L. Vališ

Research Institute of Animal Production, Prague-Uhříněves, Czech Republic

ABSTRACT: The data on 964 pig carcasses were examined with the objective to determine the relationship between a high carcass lean meat content in currently used pig hybrids and deterioration of the quality traits important for further processing of meat. The average slaughter weight of pigs was equal to 106.2 ± 0.417 kg. Lean meat percentage determined by the FOM instrument with the average value of 54.50 ± 0.139% was used as the main quantitative carcass trait. For the assessment of meat quality, the pH_1 value (average 6.15 ± 0.011) was used in the same way as in the system of breeding animals' progeny testing. The relationship between the mentioned traits is characterised by the low correlation coefficient $r = –0.13$. This result was further confirmed by correlations determined between pH_1 and loin, shoulder and ham percentages ($r = –0.33$, $r = –0.13$ and $r = –0.12$, respectively). These relationships are rather surprising as the studies from the beginning and the first phase of realization of hybridisation programmes usually emphasized that the increasing lean meat content in carcass was connected with the higher incidence of negative side effects. Our conclusions are also in agreement with the results of the separate analysis of carcasses with pH_1 above 5.8 and equal to or lower than 5.8. The carcasses with pH_1 referring to less favourable technological properties of meat showed somewhat higher average values characterising carcass meat content but the differences between the groups were small and insignificant. We were not able to find any relationships between higher meat contents in carcasses and less favourable pH_1 values when the carcasses were classified according to meat content.

Keywords: pig; final hybrid; lean meat content; technological properties of meat; pH_1

The effort to achieve higher meat content in pig carcasses was considerably intensified after the development and realization of hybridisation programmes as the result of closely specified requirements of the processing industry and consumers. In connection with the utilization of the mentioned breeding schemes under our conditions, the study of Šiler (1975) should be recalled.

Already in that period, some studies referred to negative effects accompanying the selection exclusively aimed at increasing the content of carcass lean meat. A positive correlation between the development of meaty parts and the susceptibility of pigs to stress factors was described by Eikelenboom *et al*. (1979). In addition, a higher incidence of meat defects was reported in individuals more susceptible to stress factors. The most important pork quality defect is the PSE meat. The mentioned relationships were confirmed by a number of authors, e.g. Carlson *et al*. (1980) and Webb (1981).

The incidence of pork carcasses with quality defects in connection with the selection conducted in the original pig populations used in the hybridisation programme was analysed by Šiler *et al*. (1982) and Šiler and Pavlík (1984). The authors focused on different sources of animals' susceptibility to stress factors and incidence of technological defects of meat (mainly PSE). They concluded that the elimination of stress susceptible animals from the breeding programme would result in a certain reduction but not the total elimination of this defect.

The detection of PSE meat is quite difficult under practical conditions (Froysten *et al*., 1981). As a consequence, mainly pH_1 values of meat are used in breeding practice (Ivánek, 1982). The values of pH exceeding 5.8 obtained 45 to 60 minutes after slaughter are considered normal while those equal to or lower than 5.8 indicate a reduced quality of pork.

In the course of further realisation of pig hybridisation programmes, current scientific findings in

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this area were applied, which was reflected in the selection carried out within the original pig populations when individuals susceptible to stress factors were detected and eliminated.

Carcass lean meat content has been introduced as a new trait evaluating pig carcass composition. This trait is determined on the basis of measurements carried out by special instruments on undissected carcasses. Its use was firstly analysed in some countries of EU (Oster *et al*., 1987; Branscheid *et al*., 1992). The application of this method in the Czech Republic was described by Pulkrábek *et al*. (1994).

Data obtained from a relatively numerous set of pig carcasses were analysed with the objective to determine the effect of higher meatiness on the characteristics of meat quality connected with further processing of meat.

MATERIAL AND METHODS

The data were obtained from a set of 964 pig carcasses representing final hybrids currently produced in the Czech Republic. Crossbred sows of Czech Large White and Landrace breeds were used as dams while the breeds of Large White (sire line), Pietrain, Czech Meaty Pig, Duroc, and Hampshire were used in the sire position. Mostly the parental lines developed on the basis of the mentioned breeds were employed. The animals of imported special lines were used only in a limited number. The ratio of gilts to barrows was 1 : 1.

After slaughter, carcass weights were recorded and lean meat contents were determined on the basis of *S*-value (fat thickness in mm) and *M*-value (muscle depth in mm) measured at P_2 point (between the 2nd and 3rd last ribs 70 mm from the line of the splitting cut). In addition, fat thickness was measured above the last thoracic vertebra. Afterwards, values of pH_1 were determined. Cold carcasses were cut and weights and percentages of loin, shoulder and ham were recorded. Slaughter live weights of animals were calculated by multiplication of carcass weights by the coefficient 1.23.

At first, the data set was described by basic statistical characteristics. To evaluate the relationships between different traits, correlation coefficients were determined. The main stress was put on relationships between different traits characterising meatiness of carcasses and pH_1 of meat. Further analysis was carried out with the aim to examine the incidence of pH_1 values that may me related to a reduced quality of meat. The carcasses were divided into the two groups with pH_1 higher than 5.8 and with pH_1 equal to or lower than 5.8 and the means of the other observed traits were calculated for these respective groups. Finally, the frequency of pH_1 equal to or lower than 5.8 in individual groups of carcasses differing in lean meat content by 5% was determined.

RESULTS AND DISCUSSION

The basic characteristics of pig carcasses are given in Table 1. The average carcass weight corresponds to the live weight at slaughter of 106.2 ± 0.417 kg. This value and the average lean meat content (54.50 ± 0.139%) provide information about the observed data set in comparison with the average of pigs currently produced in the Czech Republic. Matoušek *et al*. (1995), Václavovský *et al*. (1997) and Čechová *et al*. (1997) analysed pig production in terms of evaluation by the SEUROP classification system. In comparison with these studies, the average slaughter live weight in the present study was

Table 1. Pig carcass traits (n = 964)

Trait	$\bar{x} + s_{\bar{x}}$
Carcass weight (kg)	86.3 ± 0.339
Lean meat proportion (%)	54.50 ± 0.139
Loin proportion (%)	10.92 ± 0.032
Shoulder proportion (%)	10.46 ± 0.027
Leg proportion (%)	20.48 ± 0.057
Fat thickness above the last *thoracic vertebra* (mm)	16.8 ± 0.192
pH_1 of meat	6.15 ± 0.011

Table 2. Correlations between different traits (n = 964)

Trait		2	3	4	5	6	7
				r			
1	Carcass weight	–0.34	–0.18	–0.36	–0.38	0.58	–0.10
2	Lean meat proportion (%)		0.63	0.59	0.72	–0.68	–0.13
3	Loin proportion (%)			0.41	0.50	-0.38	-0.03
4	Shoulder proportion (%)				0.63	–0.47	–0.13
5	Leg proportion (%)					–0.54	–0.12
6	Fat thickness above the last *thoracic vertebra* (mm)						–0.01
7	pH_1 of meat						

Table 3. Effect of pH_1 on carcass traits

Trait	Carcasses with pH_1 of meat	
	above 5.8 (n = 832)	5.8 and less (n = 132)
	$\bar{x} + s_{\bar{x}}$	
Carcass weight	$86.0^a \pm 0.368$	$88.3^a \pm 0.844$
Lean meat proportion (%)	$54.40^a \pm 0.148$	$55.15^a \pm 0.406$
Loin proportion (%)	$10.91^a \pm 0.034$	$10.98^a \pm 0.088$
Shoulder proportion (%)	$10.44^a \pm 0.029$	$10.63^a \pm 0.086$
Leg proportion (%)	$20.46^a \pm 0.060$	$20.63^a \pm 0.163$
Fat thickness above the last *thoracic vertebra* (mm)	$16.7^a \pm 0.205$	$17.7^a \pm 0.549$

The differences with the same superscripts are not significant

slightly lower but the lean meat content was higher. It is in agreement with the conclusions of the cited authors who assumed such changes in slaughter weight and lean content to occur in future.

The selection of traits characterising pig meatiness was based on the study of Pulkrábek *et al*. (2001). The relationships between proportions of different joints and carcass meat content were investigated. The highest correlation coefficients were calculated for loin, shoulder and leg. In contrast to the currently used evaluation system, a low predicative capability of neck was found. These results are widely in agreement with the findings of Walstra and Merkus (1995). The pH_1 value of meat is the main characteristic describing the quality of pork in the process of breeding (Ivánek, 1982). It is necessary to emphasise that regarding the high number of tested animals it would be complicated to apply any more elaborated systems because of their price.

The relationships between the different characteristics are given in Table 2. The correlation coefficients between different traits characterising meatiness are high and correspond to the results of the authors mentioned above. The correlations between these traits and carcass weight are also in agreement with generally accepted patterns of relationships between pig slaughter weight and lean and fat contents. On the other hand, the low correlations between pH_1 and carcass traits do not confirm the theory that with the increasing level of meatiness the quality traits important for meat processing are deteriorated.

More accurate conclusions can, however, be derived from the analysis of data classified according to pH_1 of meat. The carcasses were divided into the group with pH_1 higher than 5.8 characterising normal meat (n = 832) and the group with pH_1 equal to or lower than 5.8 which may refer to the incidence of meat of low technological quality (n = 132). The

Table 4. Proportions of carcasses with pH_1 equal to or lower than 5.8 classified according to lean meat content

Carcass lean meat content (%)	Total number	Number of carcasses with pH_1 5.8 or less	
		number	proportion (%)
60.5 and more	84	16	19.0
55.5 to 60.4	318	49	15.4
50.5 to 55.4	399	45	11.3
45.5 to 50.4	146	21	14.4
45.4 and less	17	1	5.9

proportion of carcasses classified into the latter group was 13.7%.

The differences found in lean meat contents and proportions of different carcass joints were rather small and statistically insignificant (Table 3). There was only a slight tendency towards higher meatiness of carcasses with pH_1 equal to or lower than 5.8. These results do not correspond to the much higher differences between stress susceptible and unsusceptible pigs reported by Webb (1981). The proportion of carcasses with pH_1 equal to or lower than 5.8 was also lower than the proportions reported at the time when pig hybridisation programmes were introduced (Bachmayer, 1981).

With respect to the new methods of pig carcass evaluation (Pulkrábek *et al*., 1999), the proportions of carcasses with pH_1 equal to or lower than 5.8 in different classes according to lean meat content were determined (Table 4). However, no clear tendency could be found in the percentage of carcasses in different classes. The only higher differences appeared in the ultimate classes represented by low numbers of carcasses.

Based on the above-mentioned results it seems that there is no distinct negative relationship between meatiness and the incidence of individuals with a lower technological quality of meat in the currently used types of pigs. It also appears that the opinion of some authors recommending no further price support of carcasses with extremely high lean meat content (above 59%) is not substantiated.

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ABSTRAKT

Jatečná kvalita prasat a hodnoty pH_1 v mase

Byl sledován soubor 964 jatečně upravených těl prasat s cílem přešetřit, do jaké míry je u současných typů finálních hybridů spojena jejich zvyšující se zmasilost se sníženým předpokladem pro další technologické úpravy masa. Průměrná porážková hmotnost představovala v celém souboru 106,2 ± 0,417 kg. Za hlavní ukazatel zmasilosti byl vybrán podíl svaloviny v jatečně upraveném těle zjištěný přístrojem FOM (54,50 ± 0,139 %). Pro charakteristiku kvality masa to byla hodnota pH_1 tak, jak se uplatňuje při testaci potomstva plemenných zvířat v šlechtitelské sféře (6,15 ± ,011). Pro vztah mezi uvedenými ukazateli byl stanoven nízký korelační koeficient, a to ve výši r = –0,13. Tento výsledek byl potvrzen i údaji v případě podílů pečeně, plece a kýty z hmotnosti jatečně upraveného těla (r = –0,33, r = –0,13, r = –0,12). Zjištěné hodnoty jsou poměrně překvapivé, neboť v pracích z doby vzniku a počáteční etapy realizace hybridizačních programů v chovu prasat se zdůrazňovalo, že se zvyšující se úrovní zmasilosti prasat je spojen vyšší výskyt negativních průvodních jevů. Tyto závěry jsou též v souladu s odděleným sledováním jatečně upravených těl s hodnotou pH_1 nad 5,8 a hodnotu 5,8 a nižší v mase. Jatečně upravená těla s hodnotou pH_1 v mase poukazující na méně výhodné technologické vlastnosti měla sice při tomto porovnání poněkud vyšší průměrné hodnoty u ukazatelů charakterizující zmasilost, avšak diference mezi průměry takto vzniklých skupin byly jen velmi malé a statisticky nevýznamné. Rovněž při třídění podle podílu svaloviny nebylo možné odvodit u zmasilejších jatečně upravených těl prasat výraznější výskyt nevýhodnějších hodnot pH_1 v mase.

Klíčová slova: prase; finální hybrid; podíl svaloviny; technologické vlastnosti masa

Corresponding Author

Ing. Jan Pulkrábek, CSc., Výzkumný ústav živočišné výroby, Přátelství 815, P.O.Box 1, 104 01 Praha 10-Uhříněves, Česká republika
Tel. +420 267 009 577–8, fax + 420 267 710 779, e-mail: pulkrabek@vuzv.cz