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Quality traits and physicochemical characteristics of pork from crossbreds depending on age

Cechy jakościowe tusz i właściwości fizykochemiczne mięsa mieszańców świń w zależności od wieku

Summary. The objective of this paper is to show differences in pork quality and in quality characteristics of carcasses obtained from crossbred pigs slaughtered at the same body mass but differing in their age at slaughter date. Crossbreds from group II exhibited the best quality of carcasses (the highest values of such characteristics as meat share in ham and in loin as well as the meat content in carcass), whereas the fatteners belonging to group I were the worst in that respect.

Key words: pork, physicochemical characteristics, age

INTRODUCTION

The pork quality is affected by an entire complex of characteristics (chemical composition, physicochemical and sensory properties), which co-determine its nutritional value, consumer acceptance and processability. Pork proteins play a special role in influencing such meat properties as color, water absorbability and tenderness, emulsifying and gelling capacities [Zin 1995]. Changes in those properties are interrelated, as many of them are affected by the same proteins, or the same factors which affect them. Among the mentioned properties tenderness is the most complicated characteristic in sensory perception. Probably it is the consequence of the large number of factors that determine it.

Meat tenderness is determined by changes in proteins of myofibrils fraction, as well as by connective-tissue proteins. The latter principally constitute the only group of defective proteins found in meat. They are present in the greatest numbers in legs and their average content in pork is approx. 2%, with a variation within 1 to 6% [Pospiech and Borzuta 1998]. That variability has a more general effect on the biological value of meat.

Over the recent years one ascertained high variability of the natural outflow from the muscle of the longissimus back determination after 48 hours from slaughtering, both among laden hogs and those free from genes causing of the defect of the meat [Koćwin-Podsiadła *et al*. 2003, Bertram *et al*. 2004, Krzęcio *et al*. 2005].

The cause of meat hardness rise with the age of animals is primarily the rise in cross-linking of collagen as the main ingredient of connective tissue. The other important connective-tissue protein, also occurring in meat, is elastin, which is usually to be found in meat only in a small quantity, although sometimes with significant variation. The longest dorsal muscle contains elastin in small quantity, usually below 2% of connective-tissue proteins, whereas the semi-tendinous muscle may contain even up to 37% of elastin [Greaser 1997].

The objective of this paper is to show differences in pork quality and in quality characteristics of carcasses obtained from crossbred pig slaughtered at the same body mass but differing in their age at slaughter date.

MATERIAL AND METHODS

The experiment was performed on 131 crossbred baconers of polish landrace, duroc, hampshire and pietrain breeds with the division into 3 age groups:

– group I (34 pieces) – 150–169 days,
– group II (57 pieces) – 170–189 days,
– group III (40 pieces) – 190–210 days.

The fattening was run in uniform conditions of environment and feeding in the Swine Fattening House in Hruszowice. The animals were fed full-portions of nutritive fodder supplied ad libitum in dry condition from automatic devices. Once the fattening was finished, the baconers were delivered to the Slaughter House in Jarosław, where, after weighing, they were slaughtered by methods obligatory in the meat industry.

Pork content in carcass was determined with the Ultra-Fom 100 apparatus on hanging carcasses. Then, 45 minutes after slaughter moment, the initial pork pH (pH_1) was determined in the longest dorsal muscle (*m. longissimus dorsi*). Pork acidity was measured with microcomputer CI-316 ionometer with integrated electrode of the ESAgP-307W type. The carcasses were subjected to cooling for 24 hours at the temperature of 0–4°C and then pork pH (pH_{24}) was determined in a similar manner as for pH_1.

For carcass quality determination, right-hand porkhalves were partitioned to basic parts, which were weighed to the nearest 0.1 kg, and then ham and loin were dissected to meat, fat and bones.

Pork samples were taken from the longest dorsal muscle (*m. longissimus dorsi*) from above the last three chest vertebrae in order to determine the pH after 48, 72, 96 and 120 hours after slaughter.

Meat color was also measured on the samples by a point-wise method, in accordance with color patterns (1 – meat of lightcolor, 5 – very dark meat), meat marmoration determined by 5-point method – according to patterns of intramuscular adiposity, as well as tenderness of raw meat determined with the use of Warner-Bratzler shear-meter [Tyszkiewicz 1969]. Then, the meat sample was passed three times through a meat grinder and its sieve with 4.0-mm holes, and the color lightness was measured with the „Spekol"

spectro-colorimeter and the R 45/0 reflective attachment at the wavelength of 555 nm [Kortz 1968]. Pork Water-absorbability of pork was determined on the basis of measurement of free water by Grau-Hamm method [Grau and Hamm 1953] as modified by Pohja and Ninivaara [1957]. The thermal efflux was determined by Walczak method [Walczak 1959], while the total water content in meat was determined by a dryer method.

All obtained numerical data were segregated and subjected to statistical and mathematic processing. Tables specify arithmetic means ($\overline{x}$) of each of the studied characteristics as well as the value of standard deviation (S). Analysis of variance (ANOVA) was used in calculations which were then checked with Tukey's confidence intervals, at two significance levels $\alpha \leq 0.01$ and $\alpha \leq 0.05$. The zero hypothesis in ANOVA was verified, using the test constructed by Fisher Snedecor (test F).

Calculations were performed on the basis of the Statistica ver. 5.1 software program.

DISCUSSION

The quality of carcasses obtained from individual age groups of fatteners, consisting primarily of the mass and share of the most valuable pork parts in carcass, as well as the share of meat in ham, loin and meat content in carcass, are presented in Table 1.

Table 1. Quality of carcasses obtained from fatteners in specific age groups
Tabela 1. Jakość tusz uzyskanych od poszczególnych grup wiekowych tuczników

Specification Wyszczególnienie	Statistical measures Miary statystyczne	Age group Grupa wiekowa		
		I	II	III
The mass most valuable pork parts in half-carcasses, kg	$\overline{x}$	29.01	29.63	30.31
Masa wyrębów najcenniejszych w półtuszy	S	3.08	2.61	2.35
Share the most valuable pork parts in carcasses, %	$\overline{x}$	71.00^{a}	72.33	72.40^{c}
Udział wyrębów najcenniejszych w tuszy	S	2.04	3.94	2.50
Meat share in ham, %	$\overline{x}$	69.27	70.34	69.62
Udział mięsa w szynce	S	5.41	4.30	6.35
Fat share in ham, %	$\overline{x}$	15.93	15.41	14.36
Udział tłuszczu w szynce	S	3.93	4.00	4.65
Bones share in ham, %	$\overline{x}$	6.76^{A}	7.68^{B}	7.18
Udział kości w szynce	S	0.82	1.04	0.83
Meat share in sirloin, %	$\overline{x}$	67.89	68.56	67.90
Udział mięsa w schabie	S	6.77	5.18	5.86
Meat share in carcass, %	$\overline{x}$	48.33^{a}	50.25	49.54^{c}
Udział mięsa w tuszy	S	4.04	5.07	3.98

^{ABC} – means in the same row with different letters are significantly different at essential level; $\alpha \leq 0.01$
^{abc} – means in the same row with different letters are significantly different at essential level; $\alpha \leq 0.05$
^{ABC} – średnie w tym samym rzędzie z różnymi literami są statystycznie różne przy istotnym poziomie; $\alpha \leq 0{,}01$
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Crossbreds from group III exhibited the highest share of the most valuable pork parts in carcass (72.40%), and animals belonging to group I – had the lowest share (71.00%), the differences being statistically significant. Moreover, the statistically significant differences were also found between groups I and III in meat content in carcasses, as well as

between groups I and II – in bone share in ham. Fatteners from age group II exhibited the highest values of such traits as meat share in ham (70.34%), meat share in loin (68.56%), as well as meat content in carcasses (50.25%). On the other hand, crossbreds in group I achieved the lowest values of those characteristics, i.e. 69.27%; 67.89% and 48.33%, respectively. However, these differences were not statistically significant.

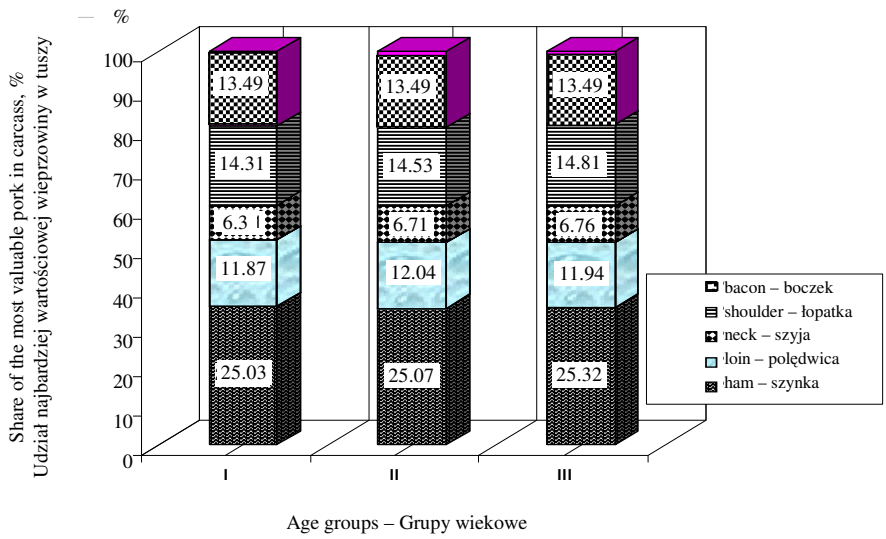

Fig. 1. Share of the most valuable pork parts in carcass in individual age groups fatteners
Rys 1. Udział wyrębów najcenniejszych w tuszy w poszczególnych grupach wiekowych tuczników

The percentage share of individual types of the most valuable pork parts in carcasses in all age groups was similar, as can be seen from Fig. 1. However, in crossbreds of group I the average values of these characteristics were slightly lower. In research by Michalska *et al*. [2004] carried out on 2 groups of gilts (differing with the thickness of the pork fat) slaughtered on 185 day of the life, one did not find out any essential differentiation between groups with reference to the mass of the meat, whereas a high essential difference between these groups was found for the mass of the fat of the sirloin and the neck shoulder. In turn, such guilds as the thickness of the pork fat, the mass of the loin of pork and the ham and the content of the meat in the ham grow larger together with the height of the mass of carcass [Przyłucka 2006].

The meat processability is determined by physicochemical characteristics (Table 2). These data show that animals in group II were characterized by their meat being most suitable for processing. The color lightness measured at the wavelength of 555 nm in that group averaged at 25.60%, the acidity (pH) determined at 45 minutes after slaughter

Table 2. Physico-chemical properties of meat of individual age group porkers
Tabela 2. Właściwości fizykochemiczne mięsa tuczników pochodzących z poszczególnych grup wiekowych

Specification Wyszczególnienie	Statistical measures Miary statystyczne	Age group Grupa wiekowa		
		I	II	III
Colour of meat, points Kolor mięsa, pkt	$\bar{x}$ S	2.60 0.84	2.54 1.03	2.24 0.81
Marbling of meat, points Marmurkowatość mięsa, pkt	$\bar{x}$ S	3.65 0.81	3.32 0.97	3.36 0.99
Brightness at the waves length of 555 nm, % Jasność barwy przy długości fali 555 nm,	$\bar{x}$ S	32.94^{A} 5.63	25.60^{B} 6.87	27.88 9.35
Water absorbtion – quantity of free water, % Wodochłonność – ilość wolnej wody	$\bar{x}$ S	21.77 2.50	22.33 2.78	21.10 2.95
Thermal drip, % Wyciek termiczny	$\bar{x}$ S	26.91 3.25	26.38 4.04	26.85 4.93
Tenderness before coocking meat, kG/cm^2 Kruchość mięsa surowego	$\bar{x}$ S	5.24 0.92	5.38 0.79	5.31 0.78
pH_1	$\bar{x}$ S	6.20^{a} 0.28	6.32^{b} 0.30	6.31 0.42
pH_{24}	$\bar{x}$ S	5.64 0.19	5.77 0.23	5.71 0.20
pH_{48}	$\bar{x}$ S	5.59 0.18	5.60 0.20	5.57 0.12
pH_{72}	$\bar{x}$ S	5.68 0.20	5.62 0.22	5.59 0.15
pH_{96}	$\bar{x}$ S	5.71^{Aa} 0.27	5.63^{BbCc} 0.24	5.55^{CcBb} 0.16
pH_{120}	$\bar{x}$ S	5.68^{a} 0.26	5.61^{b} 0.24	5.56 0.16
Total water content, % Zawartość wody ogólnej	$\bar{x}$ S	72.95^{a} 1.66	72.45^{b} 2.05	71.15^{c} 1.55

^{ABC} – means in the same row with different letters are significantly different at essential level; $\alpha \leq 0.01$
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was at the level of 6.32 and the thermal efflux reached 26.38%. On the other hand, the fatteners from group I exhibited the worst value in these traits: 32.94%, 6.20% and 26.91%, respectively. However, the differences between those groups were statistically significant for color lightness and pH_1 only. The lowest shearing force was found for crossbreds in group I (5.24 kG/cm^2), and the highest one – for those in group II (5.38 kG/cm^2). Besides, statistically significant differences between groups I and II were also found for such characteristics as total water content, pH_{96}, pH_{120} and color lightness at the wavelength of 555 nm. Between groups II and III, on the other hand,

such significant differences occurred only for total water, as it averaged at 72.45% and 71.15% in meat of fatteners from groups II and III, respectively. Michalska *et al.* [2004] showed that the meat obtained from hogs with the thicker pork fat had been characterized with more profitable values of such features as pH1, the light of the colour and the content of the solvable protein, compared to that with the raw material obtained from animals about the thinner pork fat. On the other hand, Łyczyński *et al.* [2004] in the group of lighter (to 80 kg) porkers showed a little greater light sarcoline and the electric conductivity comparatively to the meat obtained from carcasses of hogs with the mass above 80 kg.

CONCLUSIONS

The analysis of these results, as presented in the previous section, permits the following conclusions:

1. Animals belonging to group II reached the highest suitability for processing (lowest average values of thermal efflux and color lightness and the highest pH_1), whereas those from group I had the lowest suitability for processing.

2. Crossbreds from group II exhibited the best quality of carcasses (the highest values of such characteristics as meat share in ham and in loin, as well as the meat content in carcass), whereas the fatteners belonging to group I were the worst in that respect.

3. Animals in group I were found to have the lowest values of percentage share of individual types of the most valuable pork parts in carcasses.

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Streszczenie. Celem niniejszej pracy jest wykazanie różnic w jakości mięsa i cechach jakościowych tusz, uzyskanych od mieszańców świń, poddawanych ubojowi przy takiej samej masie ciała, a różniących się wiekiem w dniu uboju. Najlepszą jakością tuszy charakteryzowały się mieszańce z grupy II (największe wartości takich cech, jak udział mięsa w szynce i w schabie, a także zawartość mięsa w tuszy), a najgorsze pod tym względem były tuczniki z grupy I.

Słowa kluczowe: wieprzowina, właściwości fizykochemiczne, wiek