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Technological parametres of meat in pigs of two Polish local breeds – Zlotnicka Spotted and Pulawska*

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The search for methods of improving the pork quality produced in Poland led to an increased interest in local breeds. Responding to the needs of the meat industry it became necessary to determine precisely the processing value of meat obtained from those breeds. Samples of the *longissimus thoracis* (LT) muscle from Zlotnicka Spotted (ZS) and Pulawska (Pul) pigs were compared with those from Polish Landrace (PL) porkers. Water, protein, fat and ash contents of LT were determined, as well as pH_{48}, water holding capacity, cooking loss (minced samples), colour lightness (L*) and shear and compression force. The meat of both local breeds was characterized by a higher protein and intramuscular fat content, a lower drip loss and lower cooking loss than that of PL. The meat from ZS demonstrated higher quality than meat from Pul porkers. The former contained more intramuscular fat and was characterized by better technological properties expressed in the water holding capacity and lower values of shear and compression force.

KEY WORDS: local pig breeds / meat quality / pork / Pulawska pig / technological parametres / Zlotnicka Spotted pig

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Over the last years both consumers and meat industry emphasize the descending quality of the pig meat offered. The principal reservations refer to the high frequency of PSE fault expressed, among others. by a high drip loss and low water holding capacity. Another trait emphasised is the unacceptable taste of pork arising from the excessively low content of intramuscular fat [Pisula and Florowski 2006].

The reasons for the descending pork quality may, among others, lie in the systematic improvement of the performance traits in pigs and principally of the muscle deposition of carcass. With the increasing lean content of carcass an increasing frequency of PSE meat is observed. For these reasons the modern meat industry seeking for methods of improving pork quality is paying increasing attention to breeding of animals with high but not exceptional lean content of carcass *i.e*. not exceeding 56%, and with a confirmed high meat quality (e.g. Duroc). Moreover, it is being emphasized that work aiming at the improvement of pork quality may increasingly consider the use of local breeds for commercial crossing. The meat thus obtained may be used for the production of high quality regional products [Blicharski 2001].

In certain regions of the world traditional, well-known, cured meat products of high quality are being produced, obtainable only from the local breeds, e.g. the Hungarian "dry paprika sausage" produced of meat of the local Mangalica pig [Incze 2003], traditional Spanish "Iberico" hams based on the meat of Iberian pigs or pigs of a local black breed [Jankiewicz and Słowiński 2000], or the "Jinhua" hams, known on international markets, produced in central China from pork of the Jinhua pig breed [Hammermeister 2004].

Among the Polish local breeds the distinguishing quality traits of the Pulawska pig are being emphasized. Attempts are currently made at increasing its reproduction rate, so as to obtain raw material for the production of high quality products, as for instance the "Lublin filet" of a highly valued taste [Kondracki 1999, Kasprzyk and Walkiewicz 2004]. Among the pig breeds producing high quality meat the Zlotnicka breed is also valued. Meat obtained from those animals is characterized by a higher culinary value than that from mass production. Due to the high intramuscular fat content, desirable colour and texture, as well as exceptional taste, it may become in future a desirable product, competitive on the Polish and European market [Buczyński *et al.* 2003].

The increased interest in the meat of local pig breeds makes it necessary to characterize more precisely its technological quality. The data available in literature refer principally to palatability and do not include a detailed description of indicators of technological value. For this reason the present work aimed at evaluating the technological quality of meat from two local pig breeds – Zlotnicka Spotted and Pulawska. The results obtained may constitute a valuable information both for scientists working on the improvement of the quality of local pork and for technology specialists who in future will more frequently work on the processing of meat from local pig breeds.

Material and methods

Samples of the *longissimus thoracis* (LT) muscle with a mean weight of 700 g, were obtained from the vicinity of the last breast vertebra from pigs of two local breeds – Zlotnicka Spotted (ZS) and Pulawska (Pul), 17 gilts in each group. The material was compared to the meat obtained from 18 Polish Landrace (PL) gilts, the latter being wide-spread in Poland. The pigs were slaughtered at the mean body weight of 100 kg. Twenty-four hours post-slaughter LT samples were cut out of chilled carcasses, vacuum packed and transported in coolers to the laboratory of the Department of Meat Technology, Warsaw Agricultural University, where the meat technological properties were evaluated.

Forty eight hours *post mortem* drip loss was determined in whole meat samples (expressed as per cent of a fresh meat sample weighing 100 g within 24 hours of storage at 4°C). Moreover, the pH_{48} was measured using an Elmetron CP-551 pH-meter with a combined glass-calomel electrode according to Polish Standard PN-ISO 2917 [2001] and colour lightness L* of meat was analysed using a Minolta CR-200 colorimeter.

After completing the determinations listed, meat samples (about 300 g) were minced twice (5 mm diameter of holes in a plate) and next carefully mixed to obtain a homogenic sample. Such samples were analysed according to Polish Standards for the content of water – [PN-ISO 1442, 2000], protein – [PN-75/A-04018], fat – [PN-ISO 1444, 2000] and ash – [PN-ISO 936, 2000]. Cooking loss was determined by heating a 30 g minced meat sample in a covered beaker at 72˚C for 30 min, and water holding capacity (WHC) by the filter paper method and by the centrifuge method [Mroczek 1997]. Not comminuted part of the LT (about 400 g), after soaking for 24 hours in a 1% NaCl solution, heating (74°C, 40 min.) and cooling (4°C, 24 h) was used for determining the shear and compression force. The texture measurements were made using a ZWICKI (1120 model) testing machine. The shear force was determined with the Warner-Bratzler device on a rectangular sample with a square cross-section (20×20 mm). The shearing was performed across the muscle fibres until the sample was cut right through. The maximum force necessary to cut the sample constituted the result. The shifting speed of the countershaft amounted to 30 mm/min until the initial strain of 0.5 N, and 50 mm/min during the actual test. The material for determining the compression force consisted of a cubic (20×20 mm) LT sample. The samples were compressed along the fibres, between two parallel plates. The speed of the countershaft shift was the same as for the shear force determination. Samples were compressed down to 50% of their initial height.

The results obtained were subject to a statistical evaluation with the STATGRAPHICS 4.1 software. A one-way analysis of variance was conducted and significance of differences identified with the Tukey's test. Correlation coefficients were calculated between the level of individual chemical meat components and meat technological indicators.

Results and discussion

Means for the chemical meat components in pigs of three breeds are presented in Table 1. Characteristic for the ZS and Pul pigs was the high content of protein and intramuscular fat accompanied with low content of water (differing significantly from PL). The higher level of intramuscular fat in the meat of local breeds could be the effect of the lower meat content of carcass, as it has been indicated that an increasing carcass meat deposition has a negative effect on the fat content of *longissimus dorsi* muscle [Wajda *et al.* 1995, Daszkiewicz *et al.* 2005]. Thus, one may state that the high protein content (determining the technological value of meat) as well as the intramuscular fat content (optimum for a satisfactory taste tenderness and juiciness of meat) both confirm the high quality of meat from local pig breeds considered.

Table 1. Chemical composition of *longissimus thoracis* muscle

Component (%)	Breed						Significance of inter-breed differences
	Zlotnicka Spotted		Pulawska		Polish Landrace		
	mean	SD	mean	SD	mean	SD	
Water	73.3^{A}	0.6	73.7^{A}	0.4	75.1^{B}	0.6	P≤0.0001
Protein	22.3^{B}	0.5	22.4^{B}	0.5	21.8^{A}	0.7	P≤0.01
Fat	3.1^{C}	0.8	2.5^{B}	0.3	1.3^{A}	0.3	P≤0.0001
Ash	1.1^{A}	0.2	1.2^{A}	0.1	1.2^{A}	0.1	P>0.05

^{AB}Within rows means with different superscripts are significantly different at P≤0.01.
SD – standard deviation.

The meat obtained from local pigs compared to that of PL porkers was characterized by a low drip loss and low cooking loss (Tab. 2). The high quality of meat from pigs of local breeds means that their use in commercial crossing is favourable for the quality of the meat of crossbreds obtained [Buczyński *et al.* 1997, Kondracki 1999, Blicharski 2001]. As regards WHC, *i.e.* the trait affecting directly the processing value of meat, a significantly higher quality meat was obtained from the ZS pigs. The inter-breed differences in the quality of meat also result from the differences in carrying of gene $RYR1^{T}$ responsible for the incidence of PSE meat. The highest meat quality was recorded in ZS pigs in which animals with genotype $RYR1^{T}RYR1^{T}$ (susceptible to stress) are not observed while in the Pul pigs such animals comprise from 3 to 28%, and from 6 to 32% in PL [Janik and Kamyczek 2001].

In order to explain the differences observed in the technological quality of meat, correlation coefficients were estimated between the LT quality indicators and its chemical composition and pH (Tab. 3). The technological quality of meat significantly

Table 2. Indicators of the technological quality of *longissimus thoracis* muscle

Indicator	Breed						Significance of inter-breed differences
	Zlotnicka Spotted		Pulawska		Polish Landrace		
	mean	SD	mean	SD	mean	SD	
pH_{48}	5.54^{A}	0.08	5.52^{A}	0.05	5.52^{A}	0.10	P>0.05
Drip loss (%)	3.3^{A}	1.3	3.7^{A}	1.5	5.1^{B}	1.4	P≤0.001
Water holding capacity – filter paper method (cm^2/g)	22.1^{A}	2.2	25.2^{B}	2.6	26.0^{B}	3.6	P≤0.001
Water holding capacity – centrifuge method (%)	26.9^{B}	9.3	17.0^{A}	4.2	14.1^{A}	3.3	P≤0.0001
Cooking loss - minced samples (%)	4.3^{A}	1.6	4.8^{A}	1.4	8.6^{B}	2.0	P≤0.0001
Colour lightness (L*)	49.29^{A}	2.93	50.68^{A}	2.4	50.66^{A}	2.47	P>0.05

^{AB}Within rows means with different superscripts are significantly different at P≤0.01.
SD – standard deviation.

Table 3. Relationship (coefficients of linear correlation) between the chemical composition and pH_{48} of *longissimus thoracis* muscle and indicators of its technological value and texture parametres

Indicator	Water content	Protein content	Fat content	pH_{48}
Drip loss	0.33	ns	-0.39	-0.59
Water holding capacity (filter paper method)	0.39	ns	-0.36	-0.53
Water holding capacity (centrifuge method)	-0.40	ns	0.49	0.39
Cooking loss (minced samples)	0.63	ns	-0.65	-0.31
Colour lightness (L*)	ns	ns	ns	-0.38
Shear force	0.31	ns	-0.42	ns
Compression force	ns	ns	-0.31	-0.35

Relations significant at P≤0.05; ns – relations not significant.

correlated with the pH_{48} value. Moreover, meat with a higher intramuscular fat and lower water content showed more desirable technological quality indicators (Tab. 3). According to Daszkiewicz *et al*. [2005] the higher content of intramuscular fat has only a small effect on the technological quality of meat, resulting rather in a poorer

WHC and higher cooking loss. In turn, Wicke *et al*. [1995] claim that higher content of intramuscular fat is related to a higher technological value of meat.

High quality of meat in ZS porkers was shown also by the texture parametres (Tab. 4). The ZS meat showed a significantly lower force needed to shear samples and a lower compressing force than those from Pul and PL pigs. This may have been an effect of the significantly higher intramuscular fat content of the former, as the estimated correlation demonstrated that the higher the intramuscular fat content of meat, the lower force is necessary for shearing and compressing the meat sample (Tab. 3). Positive effect of the high level of intramuscular fat on the shear force and chewiness has also been reported by Wood *et al*. [1994]. Thus, one may state that the tendency to decrease the fat content of pork observed in the recent years and aimed at improving the dietetic value of meat may have a negative effect on its quality.

Table 4. Texture parametres of *longissimus thoracis* muscle

Indicator	Breed						Significance of inter-breed differences
	Zlotnicka Spotted		Pulawska		Polish Landrace		
	mean	SD	mean	SD	mean	SD	
Shear force (N)	18.3^{A}	4.4	31.7^{B}	10.6	30.1^{B}	5.6	P≤0.0001
Compression force (N)	83.4^{A}	15.5	99.3^{B}	14.9	102.9^{B}	29.5	P≤0.01

^{AB}Within rows means with different superscripts are significantly different at P≤0.01.
SD – standard deviation.

Summarizing, one may state that meat obtained from local Zlotnicka Spotted and Pulawska breeds as compared to that of the Polish Landrace was characterized by a higher quality expressed by a higher protein and intramuscular fat content, lower drip loss and lower cooking loss. This indicates that breeding work aimed at improving the quality of pork produced in Poland should, to a greater degree, include commercial crossing with local breeds.

A comparison of the quality of meat obtained from pigs of the Zlotnicka Spotted and Pulawska breeds demonstrated that the meat of the former was of a higher quality – it contained more intramuscular fat, showed a higher technological quality expressed by the water holding capacity, as also lower values of shear and compression force.

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Ocena jakości technologicznej mięsa świń ras rodzimych – złotnickiej pstrej i puławskiej

S t r e s z c z e n i e

Poszukiwanie metod poprawy jakości krajowej wieprzowiny spowodowało wzrost zainteresowania rodzimymi rasami świń. Wychodząc naprzeciw potrzebom sektora mięsnego uznano za celowe szersze scharakteryzowanie jakości przetwórczej mięsa pozyskiwanego od świń tych ras. Materiał stanowiły próbki mięśnia najdłuższego (*m. longissimus thoracis*) świń ras rodzimych – złotnickiej pstrej i puławskiej. Materiałem porównawczym było mięso świń rasy pbz. Oznaczano zawartość wody, białka, tłuszczu i popiołu, pH_{48}, zdolność utrzymywania wody własnej, wodochłonność, ilość wycieku po obróbce termicznej, jasność barwy (L*) oraz siłę cięcia i ściskania. Stwierdzono, że mięso świń obu ras rodzimych charakteryzowało się lepszą jakością wyrażoną wyższą zawartością białka i tłuszczu śródmięśniowego, mniejszą ilością wycieku swobodnego oraz wycieku powstałego po obróbce termicznej niż mięso świń rasy pbz. Mięso świń rasy złotnickiej pstrej odznaczało się lepszą jakością niż mięso świń rasy puławskiej. Stwierdzono w nim wyższą zawartość tłuszczu śródmięśniowego, charakteryzowało się ponadto lepszą jakością technologiczną wyrażoną zdolnością utrzymywania wody własnej i wodochłonnością oraz niższymi wartościami siły cięcia i ściskania.