

Department of Swine Breeding and Production Technology, University of Life Sciences in Lublin,
Akademicka 13, 20-950 Lublin, e-mail: anna.kasprzyk@up.lublin.pl

ANNA KASPRZYK, MAREK BABICZ,
PIOTR KAMYK-KAMIENSKI, JERZY LECHOWSKI

Slaughter value and meat quality of Pulawska and Polish Landrace breeds fatteners

Wartość rzeźna oraz jakość mięsa tuczników rasy puławskiej i pbz

Summary. The study was aimed at evaluating the slaughter value, selected technological parameters, nutritional value, and sensory properties of loin. The study material consisted of Pulawska (30 animals) and Polish Landrace (30 animals) breeds fatteners fattened up to 100 kg of body weight. After the slaughter, carcass slaughter value and meat quality evaluations were carried out. A significant influence of the breed on average sirloin thickness from 5 measurements, as well as carcass meatiness was recorded (at $P \leq 0.01$). Pulawska swine carcasses, as compared to PL ones, were more fattened (1.69 vs. 1.46 cm) and less muscled (55.47 and 57.06%, respectively). The meat of Pulawska swine – as compared to PL – was characterized by better technological quality. It had statistically significantly higher pH_1 and pH_2 values, darker meat color, lower natural and thermal leakage, as well as better water absorption. The analysis of meat nutritional value revealed some differences in protein content in favor of pbz breed. However, fat and cholesterol proportions appeared to be more beneficial for the material from Pulawska fatteners. The caloric value of the meat of both breeds was at a low level, ranging from 146 kcal (for PL) to 150 kcal (for Pulawska). Pulawska swine meat gained higher scores referring to flavor, tenderness, and juiciness.

Key words: Polish Landrace, Pulawska, fatteners, carcass value, meat quality

INTRODUCTION

Selection to improve the fattening and slaughter features carried out for a few decades in swine production, led to creation of remarkably meaty and fast growing breeds and lines. The observed changes, suitable for the meat industry, contributed to the occurrence of undesirable properties of meat [Florowski *et al.* 2006, Łyczyński *et al.* 2006, Florowski *et al.* 2007, Jankowiak *et al.* 2010]. According to Przybylski *et al.* [2012], in the case of swine herds being under the program of allele $RYR1^T$ and RN – elimination (derived from crossbreeding of Naima line sows with hybrid boars of P76 line – PenAr-Lan) 15.38% of defective meat was found (PSE – 2.31%; partially PSE – 5.13%, sour –

5.38%, partly DFD – 2.56%). In studies carried out by Florowski *et al.* [2007], large proportion of PSE (23.8%) and partially PSE meat (6%) was observed in the Pulawska swine population evaluated in the control station and free of the mutant allele of the sensitivity gene to stress. Reduced quality of meat obtained from high-meaty swine results both from the frequent occurrence of water content, as well as the decreased amount of intramuscular fat [Wajda *et al.* 2004, Pisula and Florowski 2006]. Intramuscular fat content is an important indicator of the quality and meat usefulness for cooking [Wood *et al.* 1999]. Reported changes most often refer to the valuable muscle groups such as *musculus longissimus dorsi*, *musculus semimembranosus*, *musculus semitendinosus*, *musculus quadriceps femoris*, and *musculus gluteus mediocris*. Some authors suggest that not in every case the increase in meatability is accompanied by deterioration of the raw material quality [Pospiech *et al.* 1998, Grześkowiak *et al.* 2001]. Apart from genetic factors, a wide range of external factors occurring at each stage of production – from the selection of parental pairs, then fattening, pre-slaughter maintenance conditions, slaughter, handling of carcasses, through the meat distribution – plays an important role in the production of good-quality pork [Florowski *et al.* 2006, Łyczyński *et al.* 2006, Przybylski *et al.* 2012]. Variability for most slaughter traits and pork quality is high and depends on breed, sex, age, husbandry, and feeding system, as well as their interactions.

More and more consumers are looking for products characterized by high organoleptic qualities. In this regard, a significant change in relation to the perception of domestic animal breeds has been recently observed. Although they make up a small proportion of the population, their importance for the biological diversity and genetic variation conservation is very important. They require special care and protection. In addition, the consumers' attention increasingly directs toward regional products manufactured according to old recipes. The increased interest in local swine breeds meat tends to characterize its quality for cooking and technology. The share of Polish Landrace sows in the domestic stock is the highest and represents more than 42%, therefore much raw pork on the market comes from that breed.

Taking into account above information, the studies were undertaken aimed at assessing the slaughter value and selected physicochemical parameters, the sensory properties of sirloin from Pulawska and Polish Landrace breeds swine.

MATERIAL AND METHODS

The study included 60 fatteners (30 Pulawska and 30 Polish Landrace) bred in individual farm under similar environmental conditions. The percentage of gilts and barrows was uniform. Fatteners were fed *ad libitum* with a complete mixture manufactured on the basis of farm feeds with the addition of a concentrate containing nutrients in quantities in compliance with the recommendations of the Standards of Swine Nutrition [Normy Żywienia Świń 1993]. After fattening completion, the animals were slaughtered at 100 ± 1.2 kg body weight. After the slaughter, the slaughter value of carcasses and meat quality were assessed. The halves were subject to pH measurements of *musculus longissimus dorsi* (LD) 45 min and 24 h after the slaughter using a portable pH-meter CPU Star equipped with a glass combined dagger electrode. The meat samples from LD muscle were subject to determination of color parameters (L^* – brightness, a^* – resem-

blance to red color, and b* – saturation with yellow color) using saturation meter Minolta CR-310 [3]. Natural drip loss was defined according to methodology by Prange *et al.* [1977]. The meat sample collected 24 h *post mortem* in a form of a slice of 50 g weight cut perpendicularly to the muscle fibers and with equal sides, was put into the plastic bag and stored at 4°C. After 24 hrs, the sample was dried on a filter paper and weighed. The drip loss was expressed in per cents. Thermal drip was determined according to Honikel [1998]. Samples, after triple grinding in laboratory mill (\varnothing 3 mm) and thorough mixing to make it uniform, were subject to assess the water, intramuscular fat, protein, and ash contents [AOAC 2000]. Meat caloricity was calculated on a basis of fat and protein contents assuming the values of combustion heat for muscle protein (5.75 kcal g⁻¹) and animal fat (9.46 kcal g⁻¹) after Chachułowa and Skomiał [1997]. The level of total cholesterol was determined according to the methodology by Rhee *et al.* [1982]. The water holding capacity was determined by filter method by Grau and Hamm with modifications by Pohja and Ninivaara [1957], indicating the percentage of loose water. Sensory quality was assessed by a 6-person team of judges according to the methodology specified by Baryłko-Pikielna and Matuszewska [2009] applying a 5-point rating scale.

Values of slaughter traits and meat quality in different groups of fatteners were verified applying a univariate analysis of variance using Statistica software ver. 5.0. The significance of differences between means was calculated due to Duncan test adopting two levels of significance: $P \leq 0.01$ and $P \leq 0.05$.

RESULTS AND DISCUSSION

Table 1 presents results of the slaughter analysis of fatteners. The dressing percentage, that is the primary indicator of a slaughter usefulness, is an essential characteristic of this evaluation. It reached the same level in either groups of fatteners, which was above 79%. Łyczyński *et al.* [2003] reported the value of dressing percentage index for synthetic

Table 1. Results of slaughter value of fatteners Pulawska and PL
Tabela 1. Wyniki oceny wartości rzeźnej tuczników rasy puławskiej i pbz

Specification Wyszczególnienie	Pulawska Puławska		PL pbz		Significance of difference Różnice istotne
	\bar{x}	SD	\bar{x}	SD	
Body weight before slaughter (kg) Masa ciała tuczniaka (kg)	100.10	1.15	100.53	1.24	ns
Cold carcass weight (kg) Masa tuszy zimnej (kg)	79.32	3.11	79.57	2.98	ns
Slaughter yield (%) Wydajność rzeźna zimna (%)	79.24	1.70	79.15	1.54	ns
Mean of backfat thickness from 5 meas. (cm) Średnia grubość słoniny z 5 pom. (cm)	1.69	0.22	1.46	0.27	**
Meat in carcass (%) Zawartość mięsa w tuszy (%)	55.47	1.60	57.06	1.25	**

* $P < 0.05$; ** $P < 0.01$; ns – $P > 0.05$.

lines fatteners fed with dosed system and *ad libitum* at 79.8 and 80.9%, respectively. A proper slaughter value is important primarily for processing plants and it is irrelevant to a consumer. There has been recorded a significant effect (at $P \leq 0.01$) of breed on the backfat thickness defined as the average of five measurements. The carcasses of Pulawska breed animals, as compared to Polish Landrace ones, were more fatty (1.69 cm vs. 1.46 cm). Similar values of that trait for PenArLan fatteners were reported by Przybylski *et al.* [2012]. Definitely thick backfat was measured at fatteners of Złotnicka Pstra breed (2.96 cm) and PLW \times Landrace hybrids (2.28 cm) [Jankowiak *et al.* 2010]. Carcass meatiness of both breeds exceeded 55%, with a higher proportion of meat (statistically significant differences at $P \leq 0.01$) for Landrace breed. Meatability values for both groups were similar to the results obtained in the study by Przybylski *et al.* [2012]. Koćwin-Podsiadła and Krzęcio [2004] presented the view that efforts aiming at excessive (over 57%) increase in meatability should be given up due to the possibility of a negative impact on the quality of meat. According to Łyczyński *et al.* [2006], further genetic improvement may lead to the creation of “a broiler pork”.

Table 2. Physical properties of *m. longissimus dorsi*
Tabela 2. Właściwości fizyczne *m. longissimus dorsi*

Specification Wyszczególnienie	Pulawska Puławska		PL Pbz		Significance of difference Różnice istotne
	\bar{x}	SD	\bar{x}	SD	
pH ₁	6.38	0.17	6.24	0.25	*
pH ₂	5.67	0.11	5.51	0.13	**
Colour CIE L* Barwa CIE L*	48.75	1.79	51.14	2.06	**
a*	16.99	0.63	16.35	0.84	**
b*	5.04	1.16	5.68	1.57	ns
Natural drip loss (%) Wyciek naturalny (%)	4.20	3.10	6.40	3.53	*
Thermal drip (%) Wyciek termiczny (%)	27.46	1.12	33.32	1.24	**
WHC	20.03	2.57	25.29	3.46	**

* $P < 0.05$; ** $P < 0.01$; ns – $P > 0.05$.

When analyzing the technological properties of *musculus longissimus dorsi*, statistically significant difference in pH₁ and pH₂ were observed (Tab. 2). Significantly higher values of this parameter were recorded in the group of Pulawska fatteners. Converging results of pH₁ for native Spanish breed were achieved by Galian *et al.* [2008]. A similar degree of meat acidity in 45 minutes post-mortem for Polish Landrace fatteners as in the present study for carcasses of the same breed pigs assessed within SKURTCh in Pawłowice, was reported by Orzechowska *et al.* [2010]. Florowski *et al.* [2007], when evaluating the carcasses of Pulawska fatteners classified to the meatability classes E and S, indicated pH₁ values as 6.26 and 6.37, respectively. Acidity measurement is an analysis method indicating the rate of post-slaughter glycolysis that is the basis for the differentiation of meat quality, technological suitability, and its durability. On the basis of this pa-

parameter, a suitable degree of meat acidity was found for both breeds. Pulawska breed swine, as compared to Polish Landrace ones, were characterized by a significantly darker meat color, as evidenced by the lower value of L^* and higher proportion of red color ($P \leq 0,01$). The bright meat was characteristic for Polish Landrace swine, which has also been confirmed in the publication by Orzechowska *et al.* [2010]. The free drip loss is an indicator characterizing the loss of meat weight during storage and distribution. Considering this trait, statistically significant differences between the two breed groups were found. There has also been a significant (at $P \leq 0.01$) effect of breed on the water absorption and thermal drip features. Correct rate of post-slaughter changes in the meat of local breed swine and expressed as pH_1 and pH_2 , was reflected in the small quantity of the free drip and good water holding capacity. Jankowiak *et al.* [2010], when characterizing the meat of Złotnicka Pstra breed, reported lower loose water content (16.48%) and smaller free drip loss (2.53%). Rasmussen and Andersson [1996] suggested that a high, and thus adverse drip, may be caused by protein denaturation in muscles, the refrigerant contraction, or low pH value.

The chemical composition of meat is of great importance to consumers, because it determines the nutritional value. In the Table 3 summarizes the results of general chemical composition and calorific value of meat. The Polish Landrace fatteners meat, as compared to Pulawska breed, contained higher amount of protein (statistically significant difference). Similar levels of this component for Landrace breed were also recorded by Mieñkowska-Stępniewska [2006] and higher for Pulawska swine (23.22%). Łyczyński *et al.* [2003], when analyzing the protein content in pork depending on the feeding system (*ad libitum*, dosed, restrictive), provided the following values: 22.47, 22.79, and 22.91%. Numerous studies show a very low content of intramuscular fat at swine [Grąjewska and Bocian 2005, Schwörer *et al.* 2000, Czarniecka-Skubina *et al.* 2007].

Table 3. The nutritional value of meat of fatteners
Tabela 3. Wartość odżywcza mięsa tuczników

Wyszczególnienie Specification	Pulawska Puławska		PL Pbz		Significance of difference Różnice istotne
	\bar{x}	SD	\bar{x}	SD	
Water content (%) Zawartość wody (%)	73.99	0.26	74.10	0.29	ns
Protein content (%) Zawartość białka (%)	22.40	0.25	22.57	0.27	*
Intramuscular fat content (%) Zawartość tłuszczu śródmięśniowego (%)	2.20	0.32	1.91	0.28	**
Ash content (%) Zawartość popiołu (%)	1.11	0.11	1.09	0.10	ns
Caloric value (kcal/100 g) Wartość kaloryczna (kcal/100 g)	149.60	4.27	146.40	3.85	**
Cholesterol content (mg/100 g) Zawartość cholesterolu (mg/100 g)	64.30	2.40	67.51	2.50	**

* $P < 0.05$; ** $P < 0.01$; ns – $P > 0.05$.

In opinion of Schwörer *et al.* [2000], the level below 1% is considered to be unacceptable, because it threatens to decrease the flavor of pork, which after thermal treatment becomes dry and leathery. The American and Danish research shows that the threshold value for keeping the optimal consumption quality of pork (achieving appropriate taste features) is 3 and 2% fat content, respectively [Walstra *et al.* 2001, Wajda *et al.* 2004]. In assessing the chemical composition of meat, a significant ($P \leq 0.01$) effect of breed on the intramuscular fat content was observed in present study. A higher level of intramuscular fat in local Pulawska breed pigs, as compared with Polish Landrace breed, may be the result of a lower content of meat in the carcass. These results are consistent with those achieved by Mieñkowska-Stępniewska [2006], who showed an advantage in the fat content for Pulawska over Polish Landrace breed. Intramuscular fat greatly influences on the organoleptic value of meat, contributing to an increase in its tenderness, juiciness, and flavor. Considering the caloric value, it was found that the parameter was highly statistically significant. Galian *et al.* [2008] for pigs from the protective breeding in Chato Murciano recorded higher energy value (178 kcal). Observed differences in cholesterol levels between the groups appeared statistically significant (at $P \leq 0.01$). Favorable values were observed for meat of Pulawska fatteners. Mieñkowska-Stępniewska [2006] for breeds: Pulawska, Polish Landrace, and Złotnicka Pstra, found the following contents of this component: 58.41, 70.4 and 79.71 mg.

Table 4. Results of sensory evaluation of loin meat (points)
Tabela 4. Wyniki oceny sensorycznej mięsa polędwicy (pkt)

Specification Wyszczególnienie	Pulawska Puławska		PL Pbz		Significance of difference Różnice istotne
	\bar{x}	SD	\bar{x}	SD	
Flavor – Zapach	4.7	0.10	4.6	0.16	*
Tenderness – Kruchość	4.5	0.18	4.4	0.17	*
Juiciness – Soczystość	4.4	0.17	4.3	0.16	*
Palatability – Smakowitość	4.6	0.19	4.5	0.20	ns

* $P < 0.05$; ** $P < 0.01$; ns – $P > 0.05$.

Sensory characteristics of pork is a complement of its quality assessment (Tab. 4). Breed, in a statistically significant way ($P \leq 0.05$) influenced on the diversity in the sensory evaluation results of flavor, tenderness, and juiciness meat of swine being under the program of protecting the genetic resources of farm animals. Considering the palatability, meat from Pulawska pigs, as compared with Polish Landrace breed, received higher ranks – but no statistically significant differences were recorded. Czarniecka-Skubina *et al.* [2007] demonstrated the strong influence of the adiposity level and muscle tissue acidity on the sensory quality characteristics. This suggestion is supported by present study.

CONCLUSIONS

1. There was a significant effect of breed on average backfat thickness from five measurements (at $P \leq 0.05$) and carcass meatability (at $P \leq 0.01$). Pulawska swine car-

casses, in comparison with those of Polish Landrace, were more fatty (1.69 vs. 1.46 cm) and less muscular (55.47 vs. 57.06%, respectively).

2. Pork of Pulawska swine, as compared to that of Polish Landrace, was characterized by favorable quality technology, as higher pH₁ and pH₂ values were demonstrated. Fatteners of local breed were characterized by significantly darker color of meat, lower drip, and thermal loss, as well as better water absorption.

3. Analysis of nutritional value of meat showed higher of the protein content of Polish Landrace breed. However, the fat and cholesterol amounts proved to be more advantageous for raw material from Pulawska swine. The caloric value of pork of the two breeds was at low level ranging from 146 kcal (Polish Landrace) to 150 kcal (Pulawska).

4. Statistically significant relationship between breed and sensory quality was demonstrated. Meat of Pulawska swine received higher ranks for its flavor, tenderness, and juiciness.

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Streszczenie. Celem badań była ocena wartości rzeźnej oraz wybranych parametrów technologicznych, wartości odżywczej i właściwości sensorycznych mięsa polędwicy. Materiałem badawczym były tuczniki rasy puławskiej (30 szt.) i pbz (30 szt.) tuczone do masy ciała 100 kg. Po uboju

określono wartość rzeźną tusz oraz przeprowadzono ocenę jakości mięsa. Stwierdzono istotny wpływ rasy na średnią grubość słoniny z 5 pomiarów oraz mięsność tusz (przy $P \leq 0,01$). Tusze świń puławskich, w porównaniu z pbz, były bardziej otluszczone (1,69 wobec 1,46 cm) i mniej umięśnione (odpowiednio: 55,47 i 57,06%). Mięso świń rasy puławskiej, w porównaniu z pbz, odznaczało się korzystniejszą jakością technologiczną. Charakteryzowało się statystycznie istotnie większą wartością pH₁ i pH₂, ciemniejszą barwą mięsa, mniejszym wyciekami naturalnym i termicznym oraz lepszą wodochłonnością. Analiza wartości odżywczej mięsa wykazała różnice w zawartości białka na korzyść rasy pbz. Jednak zawartość tłuszczu i cholesterolu surowca pochodzącego z tuczników puławskich okazała się korzystniejsza. Wartość kaloryczna mięsa obu ras kształtowała się na niskim poziomie i wahała się od 146 kcal (pbz) do 150 kcal (puł). Mięso świń puławskich uzyskało wyższe noty w zakresie zapachu, kruchości i soczystości.

Słowa kluczowe: polska biała zwisłoucha, puławska, tuczniki, wartość rzeźna, jakość mięsa