

The influence of sex of Pulawska fattening pigs on slaughter value and consumer quality of meat

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Summary

An analysis of the slaughter value and consumer quality of meat from Pulawska fattening pigs was conducted, taking into account their sex. The experimental material consisted of 100 gilts and surgically castrated Pulawska boars. The animals were housed in accordance with animal welfare requirements in a litter system. They were fed ad libitum, two-phase, grain-based bulk feed with the addition of a supplementary feed mixture. The fattening pigs were slaughtered at a body weight of approximately 120 kg. After slaughter, basic slaughter value indicators were determined, including the proportion and commercial value of pork cuts. The consumer quality of the ham and loin subjected to thermal processing, i.e., grilling, steaming, and frying, was assessed. Higher fat parameters were demonstrated in barrows, whose carcasses contained more back fat and “fatty” cuts. A higher consumer quality was also observed for pork loin and ham, both fried, grilled, and steamed, in terms of overall quality, tenderness, and juiciness.

Keywords: fattening pigs, sex, Pulawska pigs breed, slaughter value, pork consumption quality

The slaughter value of fattened pigs and carcass quality traits are influenced by genetic and environmental factors (1, 8, 15). These include breed (5, 15) and sex (11, 12). Currently, in Poland and other developed countries, primarily meat-type pigs are raised, such as Duroc, Hampshire, and Pietrain. According to Gomes et al. (5), these breeds are characterized by high meat content, ranging from 57.74% to 60.61%. In this regard, it should be emphasized that most consumers prefer lean pork, hence the need for breeding meat-type pigs and the mass production of high-meat slaughter raw material. However, this trend does not improve pork quality due to the risk of quality defects and the deterioration of organoleptic characteristics. For this reason, attention is drawn to native pig breeds, which in Europe include, among others, Alentejano, Apulo Calabrese, Basque, Bísaro, Black Slavonian, Cinta Senese, Gascon, Ibérico, Krškopolje, Lithuanian Native Wattle, Lithuanian White, Majorcan Black, Mangalitsa, Mora Romagnola, Moravka, Nero Casertano, Nero Siciliano, Sarda, Schwäbisch-Hällisches, and Turopolje (3). In Poland, this group includes the Pulawska breed. It is the oldest native breed of domestic pig, and its breeding history dates back to 1926. Initially, it was kept as a fat-type pig, but later, due to changing market

demand, it shifted toward a type with clearly defined slaughter characteristics. Currently, it is maintained in conservative breeding and classified as a fat-meat type, with the meat content of breeding boars and gilts reaching 56.09-56.68% in 2024 (16, 20).

Research shows that meat from native pig breeds is characterized by desirable technological and consumer quality, as well as optimal nutritional value (15). However, research is ongoing to gather as much information as possible on the factors determining the production of native pig breeds in Poland, which may help stabilize their numbers and develop breeding in the future. One such factor, previously poorly understood in the native Pulawska breed, is the sex of the fattening pig. While entire boars and gilts are used for breeding, female gilts and castrated boars are used for fattening. Castration of male pigs aims to prevent the presence of skatole and androsterone in fat tissue and muscles, as well as to eliminate traits that may manifest as aggressive behavior (13). Currently, the most common form of castration is surgery. Public opinion, including among pork consumers, considers this method controversial in terms of ensuring adequate animal welfare; however, it remains effective and does not negatively affect meat quality (19). An alternative

to surgery may be immunological castration (13). As demonstrated, the castration method and the age of the pigs can shape the subsequent tissue composition of the carcass and the physical and chemical characteristics of the meat (7, 10).

This study aimed to analyze the slaughter value and consumer quality of meat from Pulawska fattening pigs, taking into account their sex.

Material and methods

The experimental material consisted of 100 Pulawska breed fattening pigs with an equal sex distribution (1:1 gilts and surgically castrated males-barrows). The animals were obtained under the Pulawska Pig Genetic Resources Protection Program and maintained on litter in accordance with animal welfare regulations (Journal of Laws 2010, No. 56, item 344, as amended).

Feed and water were provided *ad libitum*. A two-phase feeding program was applied using a grain-based compound feed supplemented with a complementary feed. In the first phase of fattening (from 30 to 70 kg of body weight), the animals were fed a diet containing 15.8% crude protein, 2.4% fat, 5.5% crude fiber, and 13 MJ of metabolizable energy (ME)/kg of feed. In the second phase (from 70 kg to the end of fattening), the diet contained 14.2% crude protein, 2.0% fat, 5.0% crude fiber, and 12.5 MJ ME/kg of feed.

The final slaughter weight of the fattening pigs was 119.93 ± 8.12 kg. Slaughter of the fattening pigs was carried out in an abattoir, 2-4 hours after transport, according to the slaughterhouse regulations, using automatic electrical stunning (230 V, 3 A, 50 Hz, 700 W) and bleeding in the hanging position.

Hot carcass weight was determined using an in-line scale approximately 25 min post-mortem. Lean meat content was measured using a single-point method with a SYDEL CGM device (code: YXX20123.01.T01).

Carcasses were dissected into primary cuts. First, the basal dividing line (BDL) was established, running tangentially to the lower edge of the cervical spine arch and the lower edge of the pubic bone cross-section. Two transverse dividing lines (TDL) were then determined: TDL-1, running perpendicular to the BDL between the 4th and 5th thoracic vertebrae, and TDL-2, running perpendicular to the BDL between the 2nd and 3rd sacral vertebrae. Subsequently, the head was detached at the occipito-atlantal joint (perpendicular to the BDL), the foreleg at the carpal joint (between the forearm and wrist bones), and the hind leg at a right angle to its axis, slightly below the hock joint (through the tarsal bones). This procedure yielded the following primary cuts: ham, loin, neck, shoulder, belly, ribs, jowl, fore shank, hind shank, foreleg, hind leg, head, backfat, tail, groin, kidney fat, and tenderloin.

The weight of the main cuts was determined using an electronic scale with an accuracy of 5 g. The percentage of the following cuts relative to the weight of the chilled right half-carcass was calculated:

- the most valuable cuts (ham, loin, neck, shoulder, and belly),
- cuts considered by consumers to be „lean” (ham, loin, shoulder, and tenderloin),

- cuts considered by consumers to be „fatty” (pork neck and belly),
- pork fat (backfat and leaf fat).

The ham composition was determined based on the weight of meat, fat, skin, and bone. At the slaughterhouse, laboratory samples weighing 200 g each were collected from the loin (*musculus longissimus lumborum*) and ham (*musculus semimembranosus*), vacuum-packed, transported, and stored at a refrigeration temperature of 2-4°C.

Three types of heat treatment were used for the raw ham and loin: grilling, frying, and steaming. The loin and ham samples were prepared as 1.5 cm thick slices.

Grilling. The samples were heat-treated at 85°C using an electric contact grill (230 V, 1.5 kW; Morphy Richards, model 48018) with corrugated heating plates. The samples were grilled on both sides until the internal temperature reached 72°C.

Steaming. Loin and ham samples were steamed to a core temperature of 72°C using a compact steamer (Morphy Richards, model 48775).

Frying. Samples were fried at 120°C in a covered electric frying pan (230 V, 1.4 kW; Hendi model), until a core temperature of 72°C was reached. Rapeseed oil was used as the frying medium.

Sensory evaluation. After heat treatment, a consumer evaluation of the ham and loin was conducted with 100 participants (50 men and 50 women). The evaluation was performed using the scaling method according to the PN-ISO 4121:1998 (PN-EN ISO 4121:2005) standard. The following quality attributes were evaluated: overall quality; aroma (meaty, roasted, sour, fatty, and foreign); juiciness; tenderness; ease of chewing; and flavour (meaty, roasted, sour, bitter, fatty, and foreign).

Statistical analysis. Statistical analysis was performed using SAS software (version 9.4, SAS Institute Inc., Cary, NC) via a one-way analysis of variance (ANOVA). The experimental factor was the sex of the animal (gilt vs. barrow meat). The normality of distribution was assessed using the Kolmogorov-Smirnov test, and Levene's test was used to verify the homogeneity of variance. Tukey's test was applied for multiple comparisons of means, with statistical significance established at $p < 0.01$ and $p < 0.05$.

Results and discussion

The analysis of carcass value traits in finishing pigs, with sex taken into account (Tab. 1), demonstrated that these traits were dependent on the sex of the animals. The basic parameters, hot and cold slaughter yield, remained higher for barrows by 0.46% and 0.35%, respectively, even with a lower slaughter weight. A significantly ($P \leq 0.05$) lower loin „eye” depth (by 3.65 mm) was observed in barrows compared with gilts. A tendency toward greater fat deposition was also noted in barrows, as reflected by a 0.79 mm thicker backfat compared with gilts; however, this difference was not statistically significant. Because these characteristics determine carcass muscle composition, the meatiness of slaughtered barrows was 54.96%, which was 0.61 percentage points lower compared to gilts

Tab. 1. Slaughter value indicators of fattening pigs according to sex

Sex		Weight of fattening pig (kg)	Hot carcass weight (kg)	Hot dressing percentage (%)	Cold carcass weight (kg)	Cold dressing percentage (%)	Backfat thickness (mm)	Loin „eye” height (mm)	Lean meat content (%)
Gilts	$\bar{x}$	120.35	98.00	81.43	96.01	79.80	18.93	63.43 ^a	55.57
	SD	7.99	8.38	4.03	8.15	3.94	4.58	7.10	2.62
Barrows	$\bar{x}$	119.83	98.14	81.89	95.69	80.15	19.72	59.78 ^b	54.96
	SD	7.13	7.89	2.13	7.68	2.07	3.36	7.94	2.29

Explanations: Means marked with different letters (a, b) in the columns differ significantly at $P \leq 0.05$.

Tab. 2. Dissection results and value of half-carasses of gilts and barrows

Cuts (kg)	Gilts		Barrows	
	$\bar{x}$	SD	$\bar{x}$	SD
Tenderloin	0.46	0.07	0.42	0.08
Loin	4.33	0.73	4.25	0.70
Ham	12.49	0.22	11.99	1.71
Shoulder	6.44	0.84	6.33	1.54
Neck	3.33	0.38	3.21	0.42
Belly	3.83	0.72	3.86	0.76
Ribs	2.37	0.29	2.33	0.29
Chump	0.43	0.09	0.40	0.08
Front knuckle	0.76	0.17	0.48	0.13
Hind knuckle	1.30	0.24	1.34	0.19
Foreleg	0.48	0.11	0.46	0.05
Hind leg	0.68	0.19	0.68	0.09
Head	2.20	0.23	2.25	0.28
Jowl	1.63	0.36	1.53	0.37
Tail	0.46	0.22	0.41	0.12
Groin	1.38	0.53	1.25	0.45
Backfat	2.95	0.78	3.18	0.59
Leaf fat	1.05	0.40	1.09	0.28
5 cuts – commercial value (PLN)*	629.88		612.25	

Explanations: *Accepted prices: loin 25 PLN/kg, ham 18 PLN, shoulder 17 PLN/kg, neck 22 PLN/kg, belly 29 PLN/kg

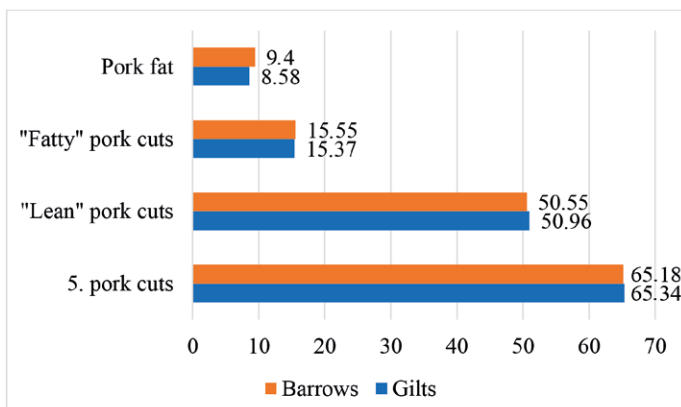


Fig. 1. Proportion of cuts in the half-carass weight of gilts and barrows

(55.57%). These results are confirmed by the work of other authors investigating this topic (2, 9). As demonstrated by Knecht et al. (9), pig sex determines not only the amount of meat in the carcass but also its quality. Carcasses from barrows are characterized by thicker backfat and their meat contains more intramuscular fat, while gilts are characterized by higher muscle development indicators, i.e., a larger area of the loin „eye”, a higher proportion of ham in the carcass, as well as higher overall muscle content in the carcass (14).

Table 2 presents the results of dividing gilts and barrows carcasses into culinary cuts. No significant differences were found, although gilt carcasses contained more of the most valuable cuts, i.e., ham, loin, shoulder, and neck, but less backfat and jowl, among other things. Consequently, the commercial value of gilt carcasses was higher. The difference between gilts and barrows was PLN 35.26 per carcass. This is due to the different production of muscle and fat tissue. The results of the assessment indicate a higher fat content in barrows carcasses than in gilts, as evidenced by the higher average weight of cuts: backfat by 0.23 kg, fat by 0.04 kg, and jowl by 0.10 kg. The presented data support the thesis regarding increased lipid production in barrows (4, 9, 10, 18). Barrows produce more fat, and the maximum degree of protein deposition in tissues is reduced by approximately 30%.

This is also demonstrated by the results presented in Figure 1. Compared to gilts, barrows carcasses contained more pork fat (+0.82 percentage points) and fatty pork cuts (+0.18 percentage points), which translates to a higher lipid content in the slaughter and culinary raw material, which is currently beneficial and appreciated by a large group of consumers.

It was shown that hams obtained from gilt carcasses contained more meat (Tab. 3, Fig. 2), i.e., 0.34 kg (0.36 percentage points) more meat than those from barrows.

Tab. 3. Ham dissection results of carcasses from gilts and barrows

Sex		Ham (kg)	Meat (kg)	Fat with skin (kg)	Bone (kg)
Gilts	$\bar{x}$	12.49	7.45	4.08	0.96
	SD	1.99	1.07	1.30	0.17
Barrows	$\bar{x}$	11.99	7.11	3.91	0.97
	SD	1.65	1.03	1.00	0.11

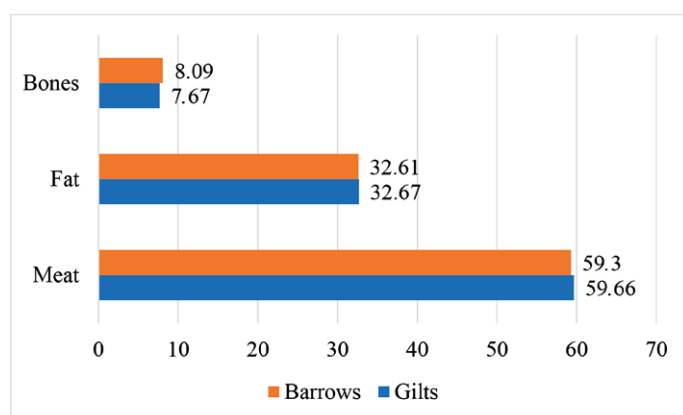


Fig. 2. Tissue composition of the ham from gilts and barrows

These observations may constitute a source of information about slaughter yield and the possibilities of its use, especially regarding hams with a high fat content, including subcutaneous fat, which is necessary in the production of high-quality cured meats (17).

The analysis of the results of the consumer evaluation of heat-treated pork ham and loin revealed specific consumer preferences (Fig. 3-5). For pork loin and ham, whether fried, grilled, or steamed, the meat obtained from barrows received higher scores for overall quality, tenderness, and juiciness. This is undoubtedly related to the amount of intramuscular fat, the even distribution of which enhances flavor and promotes muscle relaxation. Consequently, the meat is more tender (6).

The evaluation of the carcass value of Pulawska fattening pigs revealed that carcasses obtained from barrows have a higher fat content. It was found that lean pork from gilts is more suitable for meat processing. However, for consumers who prefer juicier and more tender meat, barrows may be preferable.

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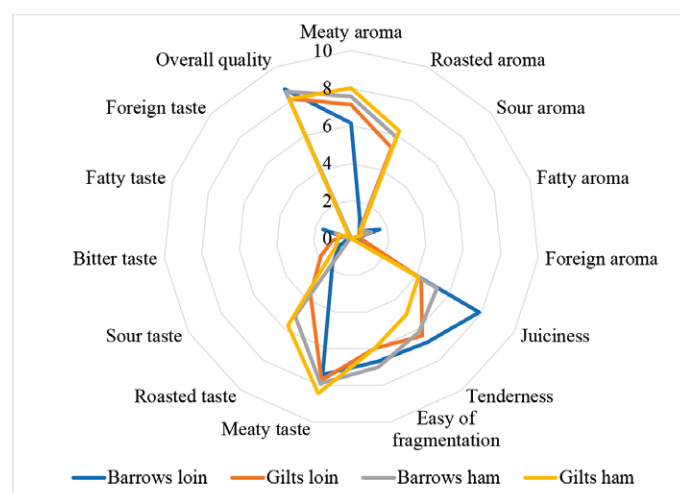


Fig. 3. Consumer evaluation of grilled loin and ham

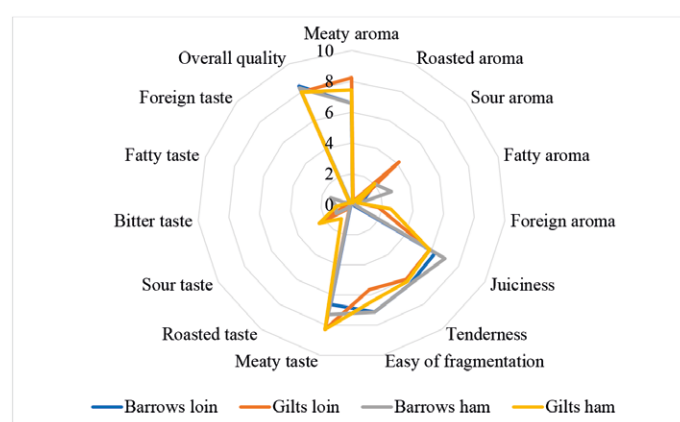


Fig. 4. Consumer evaluation of steamed loin and ham

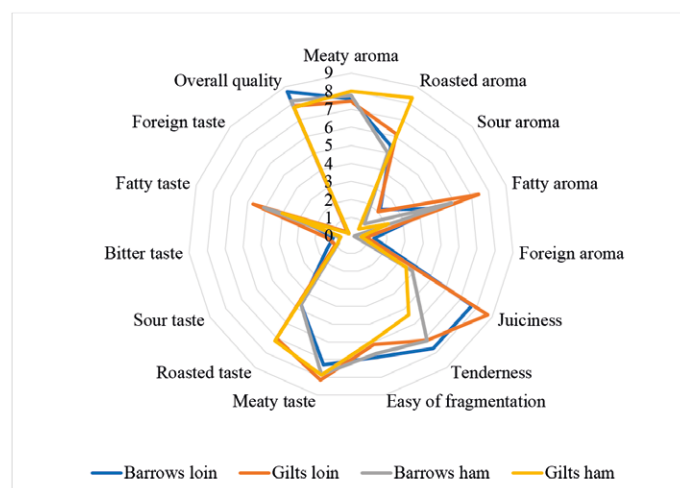


Fig. 5. Consumer evaluation of fried loin and ham

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