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OPPORTUNITIES TO USE PUŁAWSKA PIGS FOR HEAVY FATTENER PRODUCTION

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Abstract

The aim of the study was to evaluate the slaughter value of heavy fatteners weighing over 130 kg body weight. Fatteners were divided into three groups: I – Puławska pigs fed alfalfa (*Medicago sativa L.*) dietary supplement; II – Puławska pigs; III – Puławska × Duroc hybrids (50% × 50%). Analysis of slaughter value was performed based on cut weights, proportion of different tissues in primal cuts, and physical and chemical properties of ham and loin. The evaluation of physical properties of ham and loin tissues in heavy fatteners of particular genetic groups did not reveal quality deviations of lean, which indicates that the Puławska breed can be used to produce fatteners with high body weight. In view of the fact that meat with a certain fat content is used for production of maturing products, Puławska and Duroc crosses had the most advantageous values of that trait. The levels of fat determined in ham and loin were 2.78% and 3.05%, respectively, which was higher compared to the other groups.

Key words: Puławska pigs, body weight, slaughter value, meat quality

Problems in the pork market associated with low prices that fail to compensate for production costs, have forced breeders to look for new solutions. One of these solutions is production of heavy fatteners as a material for maturing products. These products are characterized by high quality and storage life, as well as desirable health-promoting qualities associated with low fat, high protein, free amino acid, phosphorus and vitamin content. They are easily digestible and low in cholesterol (Olkiewicz et al., 2006). Material from lean of specially kept and fed pigs that have certain traits that make the breed suitable for production of raw maturing products (Parma ham – Prosciutto di Parma, Spanish raw hams – Jamon Iberico and Jamon Serrano) is required. Juicy and aromatic lean with appropriate fat content can be obtained from selected swine breeds such as Mora Romagnola, Iberico, and Duroc hybrids (Morcuende et al., 2007).

Puławska pigs are characterized by good technological and eating quality value of lean and fat, and a body weight of about 100–110 kg, which was confirmed by nume-

rous studies (Walkiewicz et al., 1997, 1998, 2000). However, analyses have revealed that the technological quality of lean may vary considerably with increasing slaughter weight (Łyczyński et al., 2000).

The aim of the present study was to evaluate the usefulness of Puławska pigs for production of heavy fatteners based on results of slaughter value evaluation.

Material and methods

Puławska fatteners were maintained at an individual farm in the Lublin region. They were divided into three groups: group I – Puławska pigs fed alfalfa (*Medicago Sativa L.*) dietary supplement (Puławska A); group II – Puławska pigs; group III – Puławska sows × Duroc boar hybrids (50% × 50%). Each genetic group was represented by 30 gilts. Animals were fattened in accordance with pig feeding standards (1993). Diet composition for particular groups was differentiated by the addition of alfalfa green forage (1.2 kg at the beginning and 2 kg at the end of fattening) for pigs from group I.

The animals were slaughtered at a body weight of about 135–140 kg. Evaluation of carcass slaughter value was performed according to the following scheme: backfat thickness was measured at 5 points on the lying right half-carcass (accurate to 0.1 cm): 1. at the thickest point over the shoulder; 2. on the back – between last thoracic vertebra and first lumbar vertebra; 3.4.5. at three points over the loin (rostral, middle and caudal edges of gluteal muscle section). The measurements were followed by dissection into primal cuts. Loin eye section and detailed loin and ham dissection were performed. Loin (*musculus longissimus thoracis*) and ham (*musculus adductor femoris*) samples were analysed for physical traits such as lean colour (with a leukometer), pH_1 45 minutes and pH_2 24 hours after the slaughter (PH-STAR CPU device), and water holding capacity (Grau and Hamm's method with Pohja and Niinivaara's modifications). Chemical composition was also determined by means of standard techniques.

The results obtained were analysed statistically using STATISTICA 6.0 software by calculating arithmetic means and standard deviations, and by determining significant differences between fattener groups using one-factor variance analysis.

Results

Table 1 presents values of carcass musculature and fatness. Backfat thickness found in the study was related to the anatomical site of fat deposition and fattener genetic group. Duroc inheritance caused an increase in backfat thickness. Mean backfat thickness from 5 measurements for hybrids was 4.58 cm, which was 0.5 cm higher compared to the other groups. Significant differences were recorded for loin eye area. The largest transverse section of 58.37 cm^2 was characteristic of heavy Puławska fatteners whose diet included alfalfa. This value was 5.45 cm^2 lower than that of Puławska × Duroc pigs.

Table 1. Indices of carcass musculature and fat deposition

Item	Genotype					
	Group I		Group II		Group III	
	Puławska (A)		Puławska		Puławska × Duroc	
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
Backfat thickness (cm):						
over the shoulder	5.70	1.10	5.40	1.20	6.20	1.70
on the back	3.10	0.70	3.00	0.90	3.30	0.90
over the pelvic muscle – 1st measurement	4.10 ab	0.90	4.30 a	1.00	3.30b	0.90
– 2nd measurement	3.40	0.70	3.40	0.60	3.50	0.70
– 3rd measurement	4.20	0.80	4.30	0.90	5.00	1.20
Mean backfat thickness from 5 measurements	4.09	0.90	4.08	0.90	4.58	1.10
Loin eye height (cm)	6.40	1.20	6.60	1.40	6.30	0.90
Loin eye width (cm)	11.40 a	1.70	11.00	1.60	10.50 b	1.40
Loin eye area (cm^2)	58.37 a	4.80	58.08 a	3.20	52.92 b	4.20

a, b – $P \leq 0.05$.

Table 2. Weight of carcass cuts

Item	Genotype					
	Group I		Group II		Group III	
	Puławska (A)		Puławska		Puławska × Duroc	
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
Weight of:						
neck (kg)	8.00	0.69	7.97	0.58	8.07	0.71
shoulder (kg)	6.01	0.39	5.85	0.37	5.96	0.46
bacon (kg)	5.67	0.26	5.71	0.89	5.97	0.97
loin (kg)	8.21 A	0.71	8.09 A	0.63	8.82 B	0.59
ham (kg)	10.81	0.81	10.72	0.71	10.64	0.87
front shank (kg)	0.95	0.10	0.95	0.12	0.98	0.20
rear shank (kg)	1.65	0.29	1.62	0.38	1.80	0.49
head (kg)	2.46	0.31	2.41	0.20	2.56	0.48
ribs (kg)	1.83 A	0.15	1.80 A	0.12	2.08 B	0.20
chump (kg)	1.12 A	0.10	1.10 A	0.10	1.26 B	0.12
collar (kg)	1.41	0.15	1.44	0.10	1.56	0.19

A, B – $P \leq 0.01$.

Table 3. Tissue composition of loin and ham

Item	Genotype								
	Group I Puławska (A)			Group II Puławska			Group III Puławska × Duroc		
	$\bar{x}$	SD	100%	$\bar{x}$	SD	100%	$\bar{x}$	SD	100%
Weight of:									
loin (kg):	8.21 A	0.71	100.00	8.09 A	0.54	100.00	8.82 B	0.39	100.00
lean (kg)	4.03	0.17	49.10	3.90	0.12	48.20	4.05	0.21	46.00
backfat + skin (kg)	2.87 A	0.22	34.90	2.87 A	0.15	35.50	3.14 B	0.19	35.60
bones (kg)	1.31	0.05	16.00	1.32 a	0.05	16.30	1.63 b	0.09	18.50
ham (kg):	10.81	0.57	100.0	10.72	0.76	100.00	10.64	0.48	100.00
lean (kg)	7.26	0.48	67.20	7.09	0.51	66.10	7.01	0.39	65.90
backfat + skin (kg)	2.67	0.13	24.70	2.69	0.21	25.10	2.81	0.28	26.40
bones (kg)	0.88 AB	0.10	8.10	0.94 A	0.10	8.80	0.82 B	0.10	7.70

a, b – P≤0.05; A, B – P≤0.01.

Table 4. Physical properties of ham and loin

Item	Genotype					
	Group I Puławska (A)		Group II Puławska		Group III Puławska × Duroc	
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
Ham						
pH_1	6.15	0.52	6.02	0.28	6.12	0.41
pH_2	5.63	0.38	5.40	0.12	5.51	0.14
% of free water	18.40	1.90	17.00	1.40	15.60	1.70
Redness (rL)	42.40 B	2.80	39.20 A	2.40	46.30 B	2.90
Loin						
pH_1	6.06	0.47	5.89	0.32	6.01	0.28
pH_2	5.52	0.57	5.34	0.21	5.41	0.18
% of free water	25.00	2.10	23.70	2.00	23.30	2.40
Redness (rL)	40.70 A	2.90	42.60 A	2.20	45.00 B	1.80

A, B – P≤0.01.

Table 5. Chemical properties of ham and loin

Item		ASM (%)		Ash (%)		Crude protein (%)		Fat (%)	
		$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
					Ham				
Group I	Puławska (A)	26.08	0.79	1.10	0.11	22.29	0.85	2.61	0.31
Group II	Puławska	26.19	0.75	1.06	0.09	22.46	0.77	2.60	0.28
Group III	Puławska × Duroc	26.18	0.91	1.12	0.07	22.21	0.87	2.78	0.38
					Loin				
Group I	Puławska (A)	26.95	0.73	1.20	0.10	23.12	0.90	2.51 B	0.51
Group II	Puławska	26.91	0.98	1.17	0.17	23.10	0.96	2.53 B	0.48
Group III	Puławska × Duroc	27.67	0.93	1.13	0.19	23.37	1.01	3.05 A	0.62

A, B – $P \leq 0.01$.

Analysis of half-carcass dissection (Table 2) revealed that the groups of heavy fatteners differed significantly in terms of the following cuts: loin 8.21 kg (group I) vs. 8.82 kg (group III); ribs 1.80 and 1.83 kg (groups II and I) vs. 2.08 kg (group III); and chump 1.10 and 1.12 kg (groups II and I) vs. 1.26 (group III). The weight of the other cuts from heavy fatteners of both groups of Puławska pigs and hybrids with the Duroc breed was at a similar level.

The highest lean weight in ham (Table 3) was found in the carcasses from Puławska fatteners fed alfalfa (7.26 kg), and the lowest for Puławska × Duroc hybrids (7.01 kg). The proportion of backfat and skin in ham ranged from 24.70% (group I) to 26.40% (group III). Similar values (with statistical differences) were observed for the weight of backfat and skin in loin.

Tables 4 and 5 contain data on physical and chemical properties of lean from heavy fatteners. Mean values of pH_1 for ham ranged from 6.02 to 6.15. Higher pH values were recorded for Puławska fatteners supplemented with alfalfa. Mean pH values of loin 45 minutes postmortem ranged from 5.89 to 6.06, while pH values determined 24 hours postmortem ranged from 5.52 to 5.41. These values remained at a level characteristic of normal-quality lean. Water holding capacity expressed as the percentage of free water in ham of the analysed heavy fatteners ranged from 15.60% for Puławska × Duroc hybrids to 18.40% for Puławska pigs fed alfalfa. Considering the free water content of loin, the lowest water holding capacity was found for Puławska × Duroc fatteners (23.30%) and the highest for Puławska fatteners supplemented with alfalfa (25.00%).

As regards the chemical composition of lean, it is assumed that protein and fat are the main two components of lean. Analysis of loin samples revealed that the highest crude protein percentage was characteristic of Puławska × Duroc hybrids (23.37%). The values recorded for the other groups were 23.12% for Puławska fatteners fed alfalfa and 23.10% for Puławska fatteners. The highest percentage of fat was found in the loin of Puławska × Duroc hybrids (3.05%). This value was significantly higher compared to the other fattener groups, in which fat content ranged from 2.51% for Puławska pigs fed alfalfa to 2.53% for group II. Also in ham, the highest fat percentage was recorded for Puławska × Duroc hybrids (2.78%).

Discussion

Backfat thickness and loin eye area can be regarded as principal parameters of carcass musculature and fatness. In the present study, the values of these traits depended on fatteners' genetic group and feeding. The thickest backfat was observed in the carcasses of Puławska × Duroc hybrids (3.30 cm), and the widest transverse section of loin in Puławska fatteners receiving alfalfa (58.37 cm^2). Using alfalfa in growing pig feeding corresponds to ecological trends of pig breeding, but it also may bring financial benefits through decreasing the inputs on industrial mixtures and fodder additives (Grela, 2004).

Nowadays, consumers look for lean with desirable nutritional and dietetic values. Therefore, the prices offered for particular cuts vary considerably. As a result,

carcasses with high percentage of ham, loin, and shoulder – the elements containing large amounts of lean – are preferred. At the same time, a worldwide trend to use the Duroc breed to improve slaughter value, namely carcass quality, can be observed (Ramirez and Cava, 2007). The present study using heavy Puławska fatteners and their hybrids with Duroc revealed relatively high gains of ham and loin in relation to total valuable cuts. The ham percentage amounted to 22.5%, while loin ranged from 16.9% for Puławska fatteners (group II) to 17.7% for Puławska × Duroc hybrids. Also Florowski et al. (2006) noted that ham weight of Puławska fatteners was 9.5 kg, which was higher by 0.6 kg as compared to that of ham in Polish Large White fatteners.

Determining the proportions of particular tissues in carcass cuts is necessary for proper evaluation of a fattener's slaughter value. This results from the fact that lean is the most valuable cut and hence its maximum amounts are preferred. In our study, we found that lean weight in ham and loin was not significantly dependent on fattener's genetic group and feeding. According to Łyczyński et al. (2000), the increase in warm slaughter weight of fatteners significantly decreases the percentage of lean in carcass resulting from increased fat deposition in the carcass.

The carcass slaughter value is determined both by meatiness, and technological and eating quality of lean. The concentration of hydrogen ions is one of the principal indicators determining pork quality. It is assumed that with appropriate lean quality, pH_1 should range from 6.00 to 5.84 (Olszewski, 1999; Brzóska, 2001).

Measurements made on the samples of ham from heavy Puławska fatteners and their hybrids with Duroc revealed slightly higher values (6.02–6.15), nevertheless lean maintained its good quality. It was also observed that higher pH was characteristic of lean from fatteners fed alfalfa. Water holding capacity is an important trait associated with pH value. A study by Stasiak and Kamyk (2001) revealed that water holding capacity of ham from Puławska fatteners was 25.20%, which was the highest compared to Polish Large White (23.86%) and Polish Landrace breeds (23.22%).

For the heavy fatteners investigated in our study, this indicator remained at a much lower level (15.60–18.40%), which is consistent with the thesis that water content decreases as the organism develops.

According to Różyczka (1974), lower pH values correspond to lighter lean colour. Such a relationship was also observed in the present study (Table 4). Colour parameters revealed that ham lean from Puławska × Duroc hybrids was characterized by significantly the highest proportion of redness, which means that lean from hybrids was darker compared to the other groups of experimental fatteners.

The percentage of protein, fat, minerals and vitamins, known as nutritional quality, is important for nutritional value (Brzóska, 2001). The mean content of protein and fat in muscle tissue of fatteners was 22.0% and 1.9%, respectively (Chizzolini et al., 1999). However, their proportions varied during the fattening process and depended on fattener's slaughter weight (Łyczyński et al., 2000; Puigvert et al., 2000).

Carcass fat content is determined not only by backfat thickness, but also by intra- and intermuscular fat. Intramuscular fat content in lean determines its quality. It affects the organoleptic properties and is associated with palatability, juiciness, and tenderness (Blicharski et al., 2007).

The optimum level of intramuscular fat in *musculus longissimus dorsi* should approximate 2–3% (Łyczyński et al., 2007). In the case of maturing products, fat is the most important component that enables proper maturation processes; its proportion should be high and amount to about 3.5% (Olkiewicz et al., 2006).

Chemical analysis of muscular tissue in heavy fatteners revealed relatively high levels of fat, whose amount may be increased by crossbreeding with the Duroc breed.

Also Florowski et al. (2006) found that the lean of Puławska pigs was characterized by high intramuscular fat content.

It is possible to restore raw maturing products on the basis of Puławska breed and its hybrids with Duroc in Poland. Analyses of the slaughter value of heavy fatteners indicate good quality of lean with technological parameters that may be utilized for producing products with specific nutritional and taste qualities.

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Możliwości wykorzystania świń rasy puławskiej do produkcji tuczników ciężkich

STRESZCZENIE

Przeprowadzone badania i analizy miały na celu określenie wartości rzeźnej tuczników ciężkich o masie ciała przekraczającej 130 kg. Tuczniki uszeregowano w trzech grupach: grupa I – rasa puławska żywiona z dodatkiem lucerny (*Medicago Sativa* L.) w dawce pokarmowej; grupa II – rasa puławska; grupa III – mieszańce ras puławska × Duroc (50% × 50%). Analizę wartości rzeźnej wykonano w oparciu o masę wyrębów, udział poszczególnych tkanek w elementach zasadniczych oraz właściwości fizyczne i chemiczne mięsa szynki i polędwicy. Przeprowadzona ocena właściwości fizycznych tkanki mięśniowej szynki i polędwicy tuczników ciężkich poszczególnych grup genetycznych nie wykazała odchyleń jakościowych mięsa, co oznacza, że rasa puławska może być wykorzystywana do produkcji tuczników o wysokiej masie ciała. Z uwagi na fakt, że do produkcji wyrobów dojrzewających przeznacza się surowiec o określonej zawartości tłuszczu, najkorzystniejszą wartość tej cechy wykazały mieszańce rasy puławskiej i Duroc. Oznaczony poziom tłuszczu w próbach szynki i polędwicy wynosił odpowiednio 2,78% oraz 3,05% i był wyższy w porównaniu do pozostałych grup.