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COMPARISON OF CULINARY AND TECHNOLOGICAL PROPERTIES OF MEAT FROM SELECTED GENETIC GROUPS OF PIGS

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The aim of this study was to compare culinary and technological properties of meat obtained from five genetic groups of pigs. The investigations comprised 174 pigs of Danish Landrace (L), Danish Landrace x Duroc (LxD), Danish Landrace x Yorkshire (LxY), (Danish Landrace x Yorkshire) x Duroc [(LxY) x D] and the 890 line. The highest tenderness values were determined 48 h after slaughter in the meat of L x D porkers, whereas 144 h after slaughter – in the meat obtained from the (LxY) x D crosses. The L x D meat was also characterised by lower ($p \leq 0.05$) storage losses 48 h after slaughter in comparison with the meat obtained from the LxY and (LxY)xD genetic groups. The meat obtained from the (LxY)xD hybrids received the highest notes for its juiciness and was also characterised by the highest water holding capacity estimated on the basis of the amount of centrifugal drip and thermal losses 144 h after slaughter. The meat from line 890 received the worst assessment for its culinary properties.

INTRODUCTION

Meat colour, tenderness, juiciness as well as taste and flavour are among the basic parameters which serve as the basis for the evaluation of its culinary usefulness. On the other hand, its technological properties depend primarily on its water binding and holding capacities as well as its gelling and emulsifying capacities. The above-mentioned meat properties are influenced by a number of factors but the most important one is the origin of animals. The improvement of domestic swine breeds is achieved on the basis of imported material [Falkowski & Milewska, 1999; Kozłowski, 2005; Różycki, 1999]. Therefore, it seemed interesting to investigate both culinary and technological properties of swine breeds imported to Poland such as, for example, Danish Landrace or breed in Poland using imported material, such as line 890.

The objective of the presented research project was to compare culinary and technological properties of meat derived from 5 genetic groups of pig.

MATERIAL AND METHODS

The experimental material was the *longissimus thoracis* (LT) and *lumborum* (LL) muscle collected from the following animals: 18 pigs of the Danish Landrace (L), 36 pigs of L x Duroc (LxD), 30 pigs of L x Yorkshire (LxY), 36 pigs of (LxY)xD and from 54 pigs of the 890 line. The total number of experimental animals was 174. The LT was taken for analysis 48 h and the LL 144 h after slaughter. Our earlier investigations revealed that the differences in their chemical composition were small and statistically not significant [Szalata, 2003].

The assessment of the culinary properties of the examined fatteners was performed on the basis of analyses of tenderness, colour, taste, flavour and juiciness 48 and 144 h after slaughter. Technological meat properties were evaluated on the basis of the analyses of water binding and holding capacities after the same time from slaughter.

Meat tenderness was estimated employing both instrumental and sensory methods following its thermal treatment. Samples were heated in a convection furnace of the Rational Combi type in hot air of 160°C for about 15 min until the temperature in the sample centre reached 72°C. Instrumental measurement of meat tenderness consisted in the determination of the maximum shear force using for this purpose the Instron 1140 type apparatus with the Warner-Bratzler attachment [Dobrzycki, 1990]. Meat samples were shaped as cuboids and measured 10 x 10 x 40 mm, with fibres running perpendicular to the cutting plane. The measurements were carried out at the

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TABLE 1. Analysis of selected parameters of LT and LL muscles obtained from five genetic groups of pigs.

Evaluated parameters	Time after slaughter	Genetic groups				
		Danish Landrace (n=18)	L x D (n=36)	L x Y (n=30)	linia 890 (n=54)	(L x Y) x D (n=36)
Shear force (N/cm^2)	48 h	62.44^{ab}±13.52	54.58^{a}±14.78	56.54^{a}±15.53	63.72^{a}±12.80	61.21^{ab}±20.22
	144 h	43.96^{cd}±7.95	35.65^{ab}±5.53	39.03^{bc}±9.89	47.12^{e}±15.37	33.79^{a}±5.48
Taste (scores)	48 h	7.57^{ab}±0.73	8.05^{d}±0.68	7.58^{c}±0.64	7.39^{ab}±0.79	7.22^{a}±0.54
	144 h	7.58^{bc}±0.36	7.99^{d}±0.51	7.88^{cd}±0.51	7.53^{b}±0.48	6.78^{a}±0.88
Flavour (scores)	48 h	7.96^{a}±0.72	8.57^{b}±0.41	7.76^{a}±0.75	8.43^{b}±0.66	7.74^{a}±0.45
	144 h	7.85^{b}±0.33	8.35^{d}±0.37	8.04^{bc}±0.34	8.15^{cd}±0.52	7.40^{a}±0.69
Tenderness (scores)	48 h	6.10^{a}±1.64	7.43^{b}±0.96	6.79^{a}±1.01	6.53^{a}±1.26	6.60^{a}±1.18
	144 h	6.66^{ab}±1.05	8.81^{c}±0.83	7.12^{b}±0.84	6.56^{b}±1.71	7.31^{bc}±1.06
Juiciness (scores)	48 h	6.59^{a}±0.71	7.55^{d}±0.79	7.19^{cd}±0.56	6.81^{ab}±0.78	7.09^{bc}±1.18
	144 h	6.44^{a}±0.74	7.14^{b}±0.68	6.27^{a}±0.62	6.52^{a}±0.91	7.31^{b}±1.15
Colour (scores)	48 h	7.81^{b}±0.64	8.67^{c}±0.47	8.12^{b}±0.66	8.61^{c}±0.76	7.13^{a}±0.88
	144 h	8.26^{b}±0.32	9.13^{c}±0.51	8.33^{b}±0.40	8.43^{b}±0.62	7.28^{a}±1.22
Centrifugal drip (%)	48 h	21.59^{ab}±3.58	22.11^{b}±2.37	21.82^{b}±2.31	21.04^{ab}±2.86	20.22^{a}±3.16
	144 h	17.11^{b}±5.55	16.93^{b}±2.72	17.35^{b}±3.33	15.53^{b}±4.38	13.66^{a}±4.63
Drip losses (%)	48 h	2.59^{a}±0.77	2.60^{a}±1.31	3.85^{b}±1.65	2.75^{a}±1.13	3.77^{b}±1.51
	144 h	4.65^{a}±1.69	4.96^{a}±2.40	5.42^{a}±2.25	5.34^{a}±1.99	5.83^{a}±3.02
Cooking losses (%)	48 h	30.14^{bc}±5.00	28.41^{bc}±6.09	27.82^{b}±3.66	30.18^{b}±2.41	24.75^{a}±7.38
	144 h	33.39^{c}±2.38	29.34^{b}±3.18	32.87^{b}±2.20	30.04^{b}±3.16	23.99^{a}±8.90
Fat content (%)	24 h	2.28^{b}±0.95	2.05^{ab}±0.76	1.79^{a}±0.92	1.71^{a}±0.55	2.17^{b}±0.72
Protein content (%)	24 h	22.68^{ab}±0.45	22.40^{a}±0.53	22.93^{b}±0.51	22.94^{b}±0.87	22.55^{a}±0.56

$^{a.b...}$ mean values from the same row having various letters differ statistically significantly at $p \leq 0.05$

following head settings: the cutting force from 5 to 500 N, head feed rate – 100 mm/min, cross-bar speed – 500 mm/min and the cross-beam working range – 200 mm. The sensory evaluation of the selected meat parameters (colour, flavour, taste, juiciness and tenderness) was conducted directly after its thermal treatment. The analysis was performed with the assistance of linear scaling with a straight section 100 mm long, separate for each evaluation characteristic. The sensation intensity of each characteristic was plotted in 0 – 10 point scale [Adamik, 1997; Baryłko-Pikielna,1990].

The meat water binding capacity was analysed on the basis of the level of drip and cooking losses as well as on the basis of the tissue centrifugal drip. The drip losses expressed in percent were determined from the difference in the weight of meat pieces (weighing from 500 to 800 g) before and after storage for 48 h and 144 h at a temperature of 2-4^{o}C. Before storage, all samples were vacuum packed. On the other hand, the thermal losses were calculated from the weight difference before and after cooking of meat slices weighing 120-160 g. Finally, the centrifugal drip was obtained by centrifuging 6 g of meat tissue in the SIGMA type 3K30 centrifuge (20 min, 25480xg) [Hofmann *et al.*, 1980].

The content of fat was determined by the Soxhlet method [according to Polish Norm PN-ISO 1444 2000] and that of protein – by the Kjeldahl method [according to Polish Norm PN-85-A-82100 1985].

All the research results were subjected to the single factor analysis of variance employing the STATISTICA 6.0 software package, The significance of differences between groups of mean values ($p \leq 0.05$) was determined using the Fischer test [Stanisz, 1998].

RESULTS AND DISCUSSION

Of all the analysed culinary meat properties, special attention was paid to its tenderness, palatability (taste and flavour) and juiciness (Table 1).

The best tenderness, assessed not only by instrumental but also sensory method, 48 h after slaughter was recorded in the case of the meat derived from the LxD crosses (Table 1). The mean value of the shear force for this meat was 54.58 N/cm^2 and did not differ statistically significantly ($p \leq 0.05$) from the other genetic groups (Table 1). However, in the sensory assessment, the note given to the meat derived from the LxD crosses for tenderness was significantly ($p \leq 0.05$) higher (7.43 points) when compared with that for the L (6.10 points), LxY (6.79 points) and (LxY)xD breeds (6.60 points) as well as with that for the 890 line. Also the juiciness (7.55 points), taste (8.05 points) and flavour (8.57 points) of the meat from the LxD breed obtained the highest scores (Table 1). Statistically significant ($p \leq 0.05$) differences in the assessment of juiciness 48 h after slaughter were found between the LxD breed and

LxY and (LxY)xD breeds. With regard to the taste, significant ($p \leq 0.05$) differences occurred between the LxD breed and L, LxY, (LxY)xD and the 890 line breeds, while with regard to the flavour, between the LxD breed and L, LxY and (LxY)xD breeds (Table 1).

The lowest value of the shear force, *i.e.* the best tenderness 144 h after slaughter was recorded in the meat of the (LxY)xD breed (33.79 N/cm^2). In the case of this breed, the mean value of the maximum shear force did not differ statistically significantly ($p \leq 0.05$) only in respect to the LxD breed meat (35.65 N/cm^2). Furthermore, meat obtained from the (LxY)xD breed was also characterized by the best juiciness (7.31 points) (Table 1). On the other hand, the worst meat with regard to tenderness, determined both instrumentally and by sensory evaluation, derived from the 890 line (Table 1). The synthetic 890 line was developed in the result of crossing line 990 with the Pietrain breed [Różycki, 1999]. It is characterized by better fattening traits than the Pietrain breed and as regards its slaughter traits, it is far superior to the animals from the 990 line [Tyra & Kamyczek, 1999]. Our investigations showed that, in comparison with the imported raw material (both the Landrace breed but also its crosses), the meat derived from the 890 line was characterized by significantly worse culinary properties (Table 1). This was probably associated with a significantly ($p \leq 0.05$) lower fat content (1.71%) which is the carrier of meat juiciness and palatability.

The results of the above-presented analysis of culinary properties found their reflection in the evaluation of meat water binding capacity carried out on the basis of drip and cooking losses as well as the centrifugal drip from the muscle tissue (Table 1). Meat derived from the LxD pigs was characterized by significantly ($p \leq 0.05$) lower drip losses (2.60%) 48 h after slaughter in comparison with the LxY (3.85%) and (LxY)xD (3.77%) breeds (Table 1). However, significantly ($p \leq 0.05$) smaller cooking losses as well as lower centrifugal drip 144 h after slaughter were recorded in (LxY)xD crosses (23.99% and 13.66%, respectively) when compared with the remaining genetic groups (Table 1).

Experiments carried out in the course of this study revealed that 48 h after slaughter the best culinary and technological properties were observed for the meat derived from pigs of the LxD breed, while 144 h after slaughter – for the meat from the (LxY)xD breed. The high palatability and juiciness assessment, especially of the LxD breed, could have been associated with the increase in fat content of its meat, which was also reported by other researchers [Koćwin-Podsiadła, 2004]. On the other hand, the worse culinary properties of the meat derived from the 890 line pigs were accompanied by lower fat content and higher protein content (Table 1).

CONCLUSIONS

1. The best tenderness assessed instrumentally 48 h after slaughter was found in the meat obtained from the Danish Landrace x Duroc (LxD) breed fatteners, while 144 h after slaughter – in the meat from the (Danish Landrace x Yorkshire) x Duroc breed [(LxY)xD].
2. The best results of the instrumental tenderness assessment 48 h after slaughter of the meat derived from the LxD breed found significant ($p \leq 0.05$) confirmation in its sensory evaluation.
3. The high evaluation of palatability and juiciness of the LxD breed meat could have been associated with its high fat content.
4. Meat of the LxD breed was characterized by significantly ($p \leq 0.05$) lower drip loss values 48 h after slaughter in comparison with the LxY and (LxY)xD genetic groups.
5. Meat of the (LxY)xD breed pigs was given the highest notes for juiciness and was characterized by the highest water holding capacity assessed on the basis of the amount of the obtained centrifugal drip and cooking losses 144 h after slaughter.
6. Meat derived from the 890 line was characterized by the worst tenderness and taste as well as the lowest fat content.

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PORÓWNANIE WŁAŚCIWOŚCI KULINARNYCH I TECHNOLOGICZNYCH MIĘSA POZYSKANEGO OD WYBRANYCH GRUP GENETYCZNYCH ŚWIŃ

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Celem pracy było porównanie właściwości kulinarnych i technologicznych mięsa pozyskanego od 5 grup genetycznych świń. Badaniom poddano 174 świnie rasy Landrace duńska (L), Landrace duńska x Duroc (LxD), Landrace duńska x Yorkshire (LxY), (Landrace duńska x Yorkshire) x Duroc [(LxY)xD] oraz linii 890. Wykazano, że najlepszą kruchością po 48 godz. od momentu uboju charakteryzowało się mięso pozyskane od tuczników rasy LxD, natomiast po 144 godz. - od krzyżówki (LxY)xD. Z mięsa świń rasy LxD pozyskano też istotnie ($p \leq 0{,}05$) niższe ubytki przechowalnicze po 48 godz. od uboju w porównaniu do grupy genetycznej LxY i (LxY)xD. Natomiast mięso pozyskane od mieszańców (LxY)xD uzyskało najwyższą notę za soczystość i odznaczało się największą wodochłonnością ocenioną na podstawie ilości pozyskanego wycieku wirówkowego oraz ubytków termicznych po 144 godz. od momentu uboju. Najgorzej pod względem właściwości kulinarnych oceniono mięso pochodzące od linii 890.