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MEAT QUALITY CHARACTERISTICS OF HYBRID FATTENERS OBTAINED FROM THREE- AND FOUR-WAY CROSSINGS WITH CONTRIBUTION OF PIETRAIN BOARS OR CROSSES OF PIETRAIN WITH DUROC AND LINE 990

Artur Rybarczyk[1], Jerzy Kortz[1], Arkadiusz Pietruszka[2], Roman Czarnecki[2], Tadeusz Karamucki[1], Małgorzata Jakubowska[1], Wanda Natalczyk–Szymkowska[1]

[1]*Department of Evaluation of Animal Products, Agricultural University of Szczecin, Poland*
[2]*Department of Pig Breeding, Agricultural University of Szczecin, Poland*

ABSTRACT

Meat quality was examined in 120 fatteners in 5 experimental groups. The analysis included meat quality traits of hybrid pigs, which had been obtained from crossing Polish Large White × Polish Landrace sows with boars of the following breeds and crosses: Pietrain (P), L.990 × Pietrain (LP), Pietrain × L.990 (PL), Duroc × Pietrain (DP), Pietrain × Duroc (PD). The studies demonstrated that the fatteners sired by Pietrain boars (P) were characterised by the highest meatiness, though attained worse meat quality in relation to those from hybrid sires that had 25% of Pietrain blood. It was also demonstrated that the combining ability in reciprocal crossing had no significant influence on the difference in meat quality between the groups LP and PL, as well as DP and PD. In the whole studied material, the meat of barrows had higher intramuscular fat content and brighter colour compared to that of gilts.

Key words: pigs, reciprocal crossing, meat, quality

INTRODUCTION

In the production of fatteners, the utilisation of pure Polish breeds results in insufficient carcass meatiness, while the high–yielding breeds produce the meat of poor quality [25]. The problem of meat quality deterioration applies especially to fatteners sired by Pietrain boars, since a drawback of this breed is its high sensitivity to stress [11]. Interracial crossing is a way to reduce meat quality defects, which frequently occur in this breed. Therefore, the breeding practice should be aimed at creating optimal interracial crossing variants, which would enable us to obtain maximum profits from both increase in quantity and improvement of quality of the meat. Up till now, no studies have been undertaken in Poland on the meat quality of fatteners obtained from reciprocal crossing of Pietrain with Duroc and Line 990, which were next crossed with Polish Large White × Polish Landrace sows.

The aim of this study was to analyse whether the application of the Pietrain breed on the position of sire or dam to produce hybrid boars, which would next be used in four–way crossing, might influence the meat quality of their offspring.

MATERIALS AND METHODS

Meat quality of 120 fatteners distributed into 5 experimental groups was examined. The fatteners had been reared in the commercial pig–fattening farm of the Experimental Unit for Animal Husbandry (Agricultural University of Szczecin) in Kołbacz, Poland. Each group comprised of 24 fatteners (12 barrows and 12 gilts), obtained from 3 sires and 12 sows by crossing each boar with four different sows (Table 1).

Table 1. Experimental groups

Group	Sire component	**Maternal component**
P	Pietrain boars	Hybrid sows (Polish Large White × Polish Landrace)
LP	Hybrid boars (♀ L.990 x ♂ Pietrain)	
PL	Hybrid boars (♀ Pietrain x ♂ L.990)	
DP	Hybrid boars (♀ Duroc x ♂ Pietrain)	
PD	Hybrid boars (♀ Pietrain x ♂ Duroc)	

The animals (one gilt and one boar from a single litter) were selected for the analyses at about 100 days of age, with average body weight about 34 kg. The fatteners were kept and fed individually, and the energetic value as well as basic chemical composition of feed mixture corresponded with the Polish Standards for Pig Feeding [16].

The fatteners were slaughtered at body weight of 100 ± 2 kg, in the experimental slaughterhouse of the Unit, which is approx. 3 km away from the farm. Approximately 45 minutes after slaughter, pH (pH_1) was measured in the LD muscle in the right half–carcass between the 4th and the 5th lumbar vertebra. The carcasses were dissected after 24–hour cooling, according to the Polish Station for Swine Slaughter Performance Inspection (SKURTCh) [20], at the meat processing plant "MAS–AR" in Szczecin, and pH_{24} was determined. The results of the dissection were next used in calculation of percentage carcass leanness. In the course of the carcass dissection, samples of longissimus dorsi muscle were collected from between the 1^{st}–4^{th} lumbar vertebrae of the right half–carcass. The samples, wrapped in plastic bags, were transported to the laboratory. The following day, i.e. approx. 48 hours after slaughter, the meat colour, wateriness, texture and marbling were evaluated sensorially, and the following were determined: dominant wavelength and colour brightness, water holding capacity, thermal drip loss and water–soluble proteins content, and basic chemical composition of the meat. Basing on these results, the meat quality indices were calculated, i.e. I_2 and Q_{11}. The analyses and calculations were carried out according to the methods by Kortz [8]. Statistical analysis was done basing on the methods given by Ruszczyc [22].

RESULTS AND DISCUSSION

Basing on the obtained results, it was observed that the fatteners sired by purebred Pietrain boars were characterised by the highest meatiness and the worst meat quality (Tables 2, 3 and 4). The meat of these fatteners had the lowest water holding capacity and water–soluble protein content, the brightest colour, the lowest dominant wavelength, the highest sensorially tested wateriness, as well as the lowest values of Q_{11} index, compared to the fatteners of the groups LP, PL, DP, and PD, whose genotype was in 25% Pietrain. Similar results were reported by other authors, who observed the tendency of meat quality deterioration in the crossbreds with 50% of Pietrain genes [21, 10]. However, the results obtained in this study did not confirm the reports that

50% of Pietrain blood would not contribute to meat quality deterioration of the resulting crosses [1, 2, 19, 24]. In the analysed experiment, the negative relationship was confirmed between carcass leanness and quality traits in crossbreds with Pietrain [9, 11]. Thus, this negative relation between carcass leanness and quality traits increases with the percentage of Pietrain genes in the genotype of the studied fatteners. In this aspect, the meat of fatteners sired by purebred Pietrain boars were characterised by significantly lower mean values of pH_1 and I_2 indices, and by larger thermal drip, which implies higher loss in processing, compared to the meat of fatteners sired by crossbred Duroc and Pietrain boars (DP and PD). The meat of the fatteners sired by purebred Pietrain boars, on the other hand, did not differ significantly in the mentioned traits from the meat of the fatteners sired by crossbred Pietrain and Line 990 boars (LP and PL). Consequently, 50% of Duroc genes in the genotype of crossbred boars with Pietrain share improved the quality of meat in relation to 50% of Line 990 in the genotype of crossbred boars with Pietrain share. Lower meat quality of the fatteners from the sows of White breeds and sired by Pietrain boars, in relation to the crossbreds sired by Pietrain × Duroc boars, was also confirmed in other studies [17, 6, 13]. The application of crossbred sires with Pietrain share enabled obtaining the fatteners with 25% of Pietrain in the genotype, which had acceptable quality of meat [17]. Crossbred Pietrain × Duroc boars mated with Polish Large White × Polish Landrace sows clearly improve the meatiness of the offspring [23] without reducing the technological value of their meat [5].

Table 2. Mean values ($\bar{x}$) and standard deviations (s) of meatiness and meat quality indices in individual experimental groups

Trait		Experimental group					Sex		Statistical significance of differences	
		P	LP	PL	DP	PD	♂	♀	group	between groups
Carcass leanness [%]	$\bar{x}$	55.2	53.5	53.7	52.7	52.8	52.1^{A}	55.0^{B}	**	P > LP, PL, DP, PD
	s	3.21	2.94	3.15	2.52	3.27	2.77	2.77		
pH_1	$\bar{x}$	6.15	6.20	6.14	6.29	6.35	6.23	6.22	*	PD > P, PL
	s	0.33	0.35	0.33	0.33	0.29	0.34	0.33		
pH_{24}	$\bar{x}$	5.45	5.42	5.42	5.43	5.43	5.43	5.43		
	s	0.09	0.07	0.08	0.09	0.12	0.09	0.09		
I_2	$\bar{x}$	3.09	3.06	3.07	3.28	3.48	3.22	3.17	*	PD > P, LP, PL
	s	0.56	0.57	0.53	0.56	0.61	0.58	0.59		
Q_{11}	$\bar{x}$	2.38	2.72	2.68	2.79	2.79	2.65	2.69	*	LP, PL, DP, PD > P
	s	0.50	0.48	0.47	0.53	0.56	0.54	0.51		

*** Significant at $p \leq 0.05$; ** significant at $p \leq 0.01$.**
Means marked with capital letters differ significantly at $p \leq 0.01$.

Table 3. Mean values $\bar{x}$ and standard deviations (s) of meat organoleptic traits in individual experimental groups

Trait		Experimental group					Sex		Statistical significance of differences	
		P	LP	PL	DP	PD	♂	♀	group	between groups
Colour [pts]	$\bar{x}$	2.21	2.57	2.49	2.50	2.61	2.43	2.52		
	s	0.61	0.56	0.59	0.75	0.60	0.62	0.65		
Wateriness [pts]	$\bar{x}$	2.07	2.53	2.38	2.47	2.57	2.44	2.36	**	LP, PL, DP, PD > P
	s	0.51	0.46	0.50	0.58	0.55	0.51	0.57		
Texture [pts]	$\bar{x}$	2.19	2.56	2.48	2.43	2.55	2.46	2.43		
	s	0.60	0.58	0.48	0.60	0.58	0.52	0.63		
Marbling [pts]	$\bar{x}$	1.64	1.83	1.50	1.72	2.11	1.94^{A}	1.58^{B}	*	PD > P, PL, DP
	$s_{\bar{x}}$	0.57	0.78	0.52	0.52	0.88	0.78	0.53		

Explanations as in Table 2.

Table 4. Mean values ($\bar{x}$) and standard deviations (s) of meat quality measures in individual experimental groups

Trait		Experimental group					Sex		Statistical significance of differences	
		P	LP	PL	DP	PD	♂	♀	group	between groups
Brightness [%]	$\bar{x}$	28.61	25.53	26.77	25.10	26.23	27.23[a]	25.67[b]	**	P > LP, DP, PD
	s	3.43	3.46	3.91	3.90	3.30	3.96	3.40		
Dominant wavelength [nm]	$\bar{x}$	585.8	586.7	586.1	587.4	586.8	586.4	586.7	**	DP, PD > P DP > PL
	s	1.25	1.27	1.65	1.82	1.65	1.76	1.47		
Water–soluble proteins [% in meat]	$\bar{x}$	8.41	9.21	9.22	9.59	9.46	9.06	9.29	**	LP,PL,DP, PD > P
	s	0.86	1.04	1.17	1.04	0.94	1.01	1.14		
Thermal drip [%]	$\bar{x}$	30.13	30.67	30.04	28.26	29.75	30.14	29.40	*	P, LP, PL > DP
	s	2.52	3.25	2.70	2.39	2.41	2.58	2.89		
Water holding capacity [% of bound water]	$\bar{x}$	69.69	74.10	71.74	74.74	73.98	72.88	72.82	**	LP, DP, PD > P
	s	5.34	5.52	4.81	5.99	4.42	6.21	5.11		

Explanations as in Table 2.

There are few reports in the literature that have analysed meat quality traits of fatteners obtained from reciprocal crossing of various breeds of pigs. In our experiment, in which this aspect was considered, no statistically significant differences were observed in the mean values of the traits and indices of meat quality between the groups of fatteners sired by Pietrain and Line 990 boars, regardless of their position in the crossing (LP or PL). Also, no significant differences were observed in most of the meat quality traits and indices between the groups of fatteners sired by hybrid boars of Pietrain and Duroc (DP and PD). Only in the case of one trait, i.e. sensorially tested meat marbling, a significant difference was observed between the groups DP and PD. The meat of the offspring of hybrid PD boars had more intensive marbling in relation to the meat of the offspring of hybrid DP boars, which may indicate the combining ability in the crossing influencing the formation of this trait in the offspring. Lo *et al.* [12], who studied the effect of reciprocal crossing of Landrace and Duroc pigs, demonstrated that application of Duroc on sire position significantly contributed to the increase in intramuscular fat. Generally however, it should be stated that no effect of combining ability on meat quality traits of the offspring was observed in this study. This observation finds its confirmation in the studies by other authors who analysed the effect of reciprocal crossing on the formation of meat quality traits in the offspring [3, 12, 14, 15].

Table 5. Mean values ($\bar{x}$) and standard deviations (s) of meat chemical composition in individual experimental groups

Trait		Experimental group					Sex		Statistical significance of differences	
		P	LP	PL	DP	PD	♂	♀	group	between groups
Total protein [% in meat]	$\bar{x}$	23.49	23.28	23.38	23.75	23.60	23.44	23.55		
	s	0.58	0.75	0.43	0.79	0.68	0.71	0.63		
Dry matter [% in meat]	$\bar{x}$	26.42	26.19	25.90	26.67	26.77	26.50	26.28	**	P > PL DP, PD > LP, PL
	s	0.63	0.55	0.69	0.69	0.88	0.81	0.68		
Fat [% in meat]	$\bar{x}$	2.43	2.66	2.28	2.66	2.74	2.79^{A}	2.32^{B}		
	s	0.73	0.90	0.77	0.86	0.77	0.81	0.75		
Ash [% in meat]	$\bar{x}$	1.15	1.18	1.21	1.14	1.12	1.14	1.17		
	s	0.12	0.15	0.11	0.09	0.11	0.11	0.13		

Explanations as in Table 2.

Many articles report no significant differences in meat quality traits between barrows and gilts [4]. The differences that have been recorded refer mainly to intramuscular fat content, which is higher in barrows than in gilts [7, 18]. In this study, the meat of the barrows was characterised by a higher content of intramuscular fat compared to that of the gilts (Table 5), which also might have contributed to its brighter colour (Table 4).

CONCLUSIONS

1. The studies demonstrated higher meatiness and lower meat quality in the group of fatteners sired by purebred Pietrain boars in relation to hybrid fatteners with 25% share of this breed.
2. No statistically significant differences were observed in the mean values of majority of the studied meat quality traits between the fatteners obtained from crossing sows (Polish Large White × Polish Landrace) with hybrid boars derived from reciprocal crossing of Pietrain and Line 990 (LP and PL) as well as with Duroc boars (DP and PD).
3. From the five studied groups of fatteners, those obtained from crossing White breeds of sows (Polish Large White × Polish Landrace) with hybrid boars Pietrain × Duroc (DP and PD) and Pietrain × Line 990 (LP) should be recommended for commercial production, as the meat of their offspring was characterised by the highest technological quality, i.e. the most attractive colour, best water holding capacity and pH_1.
4. The meat of the barrows had higher intramuscular meat content and brighter colour compared to that of gilts.

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Artur Rybarczyk, Jerzy Kortz, Tadeusz Karamucki,
Małgorzata Jakubowska, Wanda Natalczyk–Szymkowska
Department of Evaluation of Animal Products
Agricultural University of Szczecin
ul. Doktora Judyma 24, 71–460 Szczecin, Poland
tel. (091) 4541–521 w. 363–366 fax (091) 4541–642
e–mail: rybarczyk@ar.zsi.pl

Arkadiusz Pietruszka, Roman Czarnecki
Department of Pig Breeding
Agricultural University of Szczecin
ul. Doktora Judyma 10, 71–460 Szczecin, Poland
tel. (091) 4541–433 fax (091) 4541–642
e–mail: rczarnecki@ar.zsi.pl

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