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EFFECT OF HAL GENOTYPE ON NORMAL AND FAULTY MEAT FREQUENCY IN HYBRID FATTENERS*

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This study involved an analysis of 119 hybrid fatteners. Blood was sampled directly after slaughter and was used for DNA analysis to identify individuals carrying the stress sensitivity gene HAL^n. Thereafter, the carcasses were dissected according to the Polish Station for Swine Slaughter Performance Inspection (SKURTCh). The following qualitative analyses were carried out: pH, meat lightness, water binding capacity, water-soluble protein content; additionally, Q_{11} quality index was evaluated. Moreover, the frequency of normal and faulty (partly-PSE and PSE) meat was estimated. Recessive homozygotes (nn) were characterised by higher carcass leanness and poorer meat quality (higher PSE rate) in comparison to dominant homozygotes (NN). The pigs of the heterozygous genotype (Nn) yielded the most normal meat with a lower rate of carcasses with partly PSE or PSE meat. Not all the pigs that were sensitive to stress (nn) displayed PSE meat symptoms, whereas faulty meat was observed in some genetically stress-resistant animals (NN).

INTRODUCTION

Intensive selection for improved swine meatiness has led to a considerable increase in sensitivity to stress and, consequently, to a higher rate of carcasses with defects. The tendency of pork quality deterioration, which has been observed over recent years, is expressed by an increased frequency of various post-slaughter defects of meat, such as PSE, RSE, or acid meat [Koćwin-Podsiadła *et al.*, 1998].

It is widely accepted that the recessive gene HAL^n determines swine sensitivity to stress. The halothane gene in the form of recessive homozygote nn takes part in pork quality decline, which is at the same time accompanied by a positive effect on slaughter performance of the pigs. Dominant homozygotes NN, on the other hand, display better meat quality with worse slaughter performance [Kurył, 1998]. Heterozygotes (Nn), however, occupy an intermediate position between the two types of homozygotes (NN and nn). They distinguish themselves by having significantly higher carcass meat content in relation to animals with dominant homozygotes (NN) and by better meat quality in relation to individuals susceptible to stress (nn) [Blicharski & Ostrowski, 1998].

The aim of this study was to estimate the frequency of normal and faulty meat (partly PSE and PSE) occurring in hybrid fatteners in relation to HAL genotype.

MATERIAL AND METHODS

Studies were performed on 119 porkers from the pig fattening farm of the Animal Husbandry Experimental Station at Kołbacz. The paternal component was made up of hybrid boars with the participation of such breeds as Pietrain, Duroc and line 990, and the maternal component included hybrid Polish Large White (wbp) × Polish Landrace (pbz) sows. The porkers were kept and fed individually; the energy value and basic chemical composition of the feed-mix corresponded to Pig Feeding Standards [1993]. The porkers, after they reached the weight of 100±2 kg, were slaughtered at the ZZD Kołbacz experimental slaughter-house 3 km from the farm. During slaughter, the blood was sampled for DNA analysis with the PCR/RFLP method to identify animals loaded with HAL^n stress-susceptibility gene. About 45 min after slaughter, the meat pH_1 was measured in the LD muscle in the region between lumbar verterbrae 4 and 5 of right half-carcass. Thereafter, after 24 h of cooling the carcasses were dissected at the MAS-AR Experimental--Production Works in Szczecin according to the SKURTCH (Pig Slaughter Testing Station) method [Różycki, 1996] and meat pH_{24} was measured. The dissection results were used to calculate carcass meat content. During jointing, samples of the *musculus longissimus dorsi* were removed from the region between lumbar vertebrae 1–4 of right half-carcass. Approx. 48 h after slaughter, a sensory evaluation of the raw meat was carried out and meat colour and water-binding capacity were determined according to the methods given by Kortz [1986]. On the basis of the physical and chemical trait values, the meat quality index, Q_{11}, was calculated which was then used in the determination of normal *vs*. defective meat frequency [Grajewska *et al.*, 1984]. The results were analysed statistically using Statistica PL computer software.

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RESULTS AND DISCUSSION

The fatteners genetically susceptible to stress (nn) were characterised by the highest carcass leanness (Table 1) in relation to those of heterozygous genotype (Nn) or those genetically resistant to stress (NN). The better meatiness of the nn-genotype pigs, compared to those of Nn and NN genotype, corresponds to the results published by other authors [Oliver *et al.*, 1993]. However, the results of previous studies indicating that Nn-genotype pigs have higher meatiness compared to NN-homozygotes [De Smet *et al.*, 1996; Koćwin-Podsiadła *et al.*, 2001] have not been confirmed. Besides the influence of genetic factors on meatiness, sex also has a great influence. Gilts usually have about 2–3% greater meat content than barrows [Blicharski, 2001]. In our experimental, stress-susceptible porkers nn overweight gilts and porkers NN genotype overweight barrows were studied. In connection with above, it is possible that sex exerted an influence on the formation of meatiness in several genetic factors.

TABLE 1. Mean values ($\bar{x}$) and standard deviations (s) for meatiness and meat quality according to HAL genotype.

Traits		HAL genotype		
		nn n=8 (♀=6; ♂=2)	Nn n=79 (♀=39; ♂=40)	NN n=32 (♀=14; ♂=18)
Carcass leanness (%)	$\bar{x}$	56.84^{A}	53.45^{B}	53.21^{B}
	s	2.50	3.19	2.58
pH_1	$\bar{x}$	5.75^{A}	6.21^{B}	6.36^{B}
	s	0.38	0.32	0.24
pH_{24}	$\bar{x}$	5.53^{A}	5.42^{B}	5.42^{B}
	s	0.15	0.08	0.08
Q_{11}	$\bar{x}$	2.09^{A}	2.62^{B}	2.97^{C}
	s	0.63	0.46	0.46
Brightness (%)	$\bar{x}$	30.07^{A}	26.59^{B}	25.07^{B}
	s	5.95	3.42	3.31
Thermal drip loss (%)	$\bar{x}$	30.03^{a}	30.17^{a}	28.58^{b}
	s	1.69	2.66	2.81
WHC (% of bound water)	$\bar{x}$	69.14^{A}	71.72^{A}	76.55^{B}
	s	3.31	5.38	5.17
Water-soluble proteins (% in meat)	$\bar{x}$	8.08^{A}	9.09^{B}	9.76^{C}
	s	0.95	0.98	0.98

A, B, C – values in rows marked with different letters differ significantly at $p \leq 0.01$.
a, b, c – values in rows marked with different letters differ significantly at $p \leq 0.05$.

In the presented studies, the nn-genotype individuals of the highest carcass leanness showed the worst meat quality (Table 1). The meat of those fatteners displayed the lowest pH level, the lowest Q_{11} score, the lowest water-soluble protein content, the highest meat lightness and pH_{24} in comparison to the meat of the heterozygous genotype (Nn) and dominant homozygotes (NN). What is more, the fatteners of the nn genotype yielded the highest number of PSE-meat carcasses (Table 2). The results obtained confirm the reports of authors who concluded that deterioration of the consumption and technological quality of meat rises with an increase in carcass leanness [Larzul *et al.*, 1997]. This negative relationship between carcass leanness and desired meat quality characteristics increases along with the growth of nn-genotype pig rate [De Smet *et al.*, 1996; Blicharski & Ostrowski, 1998].

The heterozygous genotype pigs (Nn) are closer to the dominant homozygotes (NN) in respect to such meat quality characteristics as pH_1, pH_{24}, or meat lightness. On the other hand, in relation to such traits as water-holding capacity and meat thermal drip loss, the heterozygotes (Nn) are more similar to the recessive homozygotes (nn). The results obtained in this study confirm those reported by other authors, who did not record differences in meat quality between the pigs of Nn and NN genotypes [Zhang *et al.*, 1992]. Considering the level of Q_{11} index and water-soluble protein content, the animals of heterozygous genotype (Nn) were characterised by better meat quality than the recessive homozygotes (nn), although they were worse than the dominant homozygotes (NN). Moreover, the heterozygotes yielded the highest rate of carcasses with normal meat (60%), average partially-PSE meat (15%), and the lowest rate with PSE meat (10%), which was confirmed by previous studies [Koćwin-Podsiadła *et al.*, 1993].

In the analysed experiment, not all the genetically stress-sensitive nn pigs displayed PSE meat symptoms (25%).

TABLE 2. Frequency of normal and defective meat according to HAL genotype.

Meat quality classes		Genotype HAL			Total
		nn	Nn	NN	
PSE	n	6	7	1	14
	%	75	10	3.22	11.76
Partially PSE	n	0	12	1	13
	%	0	15	3.22	10.93
Normal	n	2	60	30	92
	%	25	75	93.55	77.31

What is more, faulty meat was found in some individuals genetically resistant to stress (NN). The results obtained in this study confirm the results of previous studies [Houriuchi *et al.*, 1996; Kurył *et al.*, 1998], which reported from 60% to 80% of PSE-meat carcasses in pigs with the nn genotype, and 14–30% of PSE meat incidence in NN fatteners.

CONCLUSIONS

1. Recessive homozygotes (nn) were characterised by a higher percentage of carcass lean and poorer meat quality (higher rate of PSE meat) in relation to dominant homozygotes (NN).
2. Heterozygous-genotype pigs (Nn) produced the most normal meat with a lower rate of partially-PSE or PSE meat carcasses.
3. Not all stress-sensitive pigs (nn) displayed PSE meat symptoms, and faulty meat was found in the group of individuals genetically resistant to stress (NN).

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WPŁYW GENOTYPU HAL NA CZĘSTOŚĆ WYSTĘPOWANIA MIĘSA NORMALNEGO I WADLIWEGO U TUCZNIKÓW MIESZAŃCÓW

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Badania przeprowadzono na 119 tucznikach mieszańcach. U tuczników po uboju pobierano krew do analizy DNA w celu identyfikacji osobników obciążonych genem wrażliwości na stres HAL^n. Następnie tusze poddano dysekcji wg metodyki stosowanej w SKURTCh. Wykonano oznaczenia jakościowe mięsa: pomiary pH, jasności barwy, zdolności wiązania wody, zawartości białka rozpuszczalnego w wodzie oraz wyliczono wskaźnik jakości mięsa Q_{11}. Ponadto określono częstość występowania mięsa normalnego i wadliwego (częściowo PSE i PSE).

Homozygoty recesywne (nn) cechowały się wyższą mięsnością tusz i gorszą jakością mięsa (częstsze występowanie mięsa PSE) w stosunku do homozygot dominujących (NN) (tab. 1). U tuczników o genotypie heterozygotycznym (Nn) stwierdzono najwięcej mięsa normalnego przy niższym udziale tusz z mięsem częściowo PSE i PSE. Nie wszystkie świnie wrażliwe na stres (nn) wykazywały cechy mięsa PSE oraz stwierdzono mięso wadliwe u osobników genetycznie odpornych na stres (NN) (tab. 2).