MEAT QUALITY IN TWO GENETIC GROUPS OF PIGS WITH RYR1 AND RN⁻ GENES

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SUMMARY

The aim of the study was comparison between three stress susceptibility genotypes (NN, Nn, nn) and as well as between two RN genotypes (rn^+rn^+, RN^-rn^+) on the glycolytic potential measured in vivo and meat quality parameters criteria. A total 47 pigs of polish landrace (PL) breed (16-NN, 19-Nn, 12-nn) and 36 crossbreeding (C) fatteners (large white*polish landrace*P76; 22-rn^+rn^+, 14-RN^-rn^+) were investigated. The results showed that HAL (RYR1) gene affected lactate level measured in biopsy samples and rate of post mortem in muscle changes expressed in pH_1 and R_1 values and also meat lightness. Whereas the RN major locus influenced on muscle glycolytic potential and ultimate pH as well as meat lightness. The lactate content evaluated in biopsy samples was significantly correlated with pH_1, R_1 and meat lightness in PL breed (r=-0.68*; r=0.69*; r=0.56*) and with pH_1, R_1 in C group (r=-0.41*; r=0.42*). The significant correlation for glycolytic potential with other traits was observed only in C group of pigs between PG and pH_{24} (r=-0.67*).

OBJECTIVES

Meat quality of pigs is determined mainly by environmental and genetic factors. For genetics factors the variation in meat quality traits is induced by polygenes and major genes (Sellier and Monin 1994). Two major genes are actually know as unfavourable for fresh and technological quality of meat. The incompletely recessive of stress susceptibility HAL^n (RYR1) and dominant RN^- genes, that induces respectively PSE and „acid-hampshire type „ meat. The aim of the study was the comparison between three stress susceptibility genotypes (NN, Nn, nn) and also between two RN genotypes (rn^+rn^+, RN^-rn^+) for glycolytic potential and lactate level measured in biopsy samples and meat quality parameters after slaughter.

MATERIAL AND METHODS

A total 83 animals were investigated from experimental herd of Agricultural University at Siedlce on Farm in Zawady. Two different genetic groups of pigs were investigated: 47 animals were from polish landrace breed with identified HAL^n genotypes (as follows: 16 NN - 6 castrated males and 10 gilts; 19 Nn - 7 castrated males and 12 gilts; 12 nn - 4 castrated males and 8 gilts) and 36 crossbreeding pigs of sows poilsh large white*polish landrace with P76 crossbreeding French boars (originated from composite lines Laconie and Penshire) with identified RN genotypes (22 rn+rn+ - 11 castrated males and 11 gilts; 14 RN^-rn+ - 9 castrated males and 5 gilts). For identification of HAL genotypes the blood samples for genomic DNA isolation were collected into 10 ml sterilised Sarstedt tubes with ethylenediamine-tetraacetic acid-dipotassium salt as anticoagulant. The genomic DNA was isolated according to Kawasaki (1990) and Coppieters et al. (1992). The RYR1 genotypes were identified by PCR/RFLP method as described by Kurył and Korwin-Kossakowska (1993). The RN genotypes were identified on the basis of glycolytic potential (PG) and its bimodal distribution as were showed by Fernandez et al. (1992).

The biopsies were taken at a live weight of 70 to 80 kg by using "Spring biopsy" apparatus produced by "Biotech" Slovak firm, from the *Longissimus lumborum* muscle according to procedure described by Talmant et al. (1989). In biopsy samples were evaluated glycogen, glucose and glucose-6-phosphate following the procedure of Dalrymple and Hamm (1973) and lactate according to Bergmeyer (1974). Glycolytic potential (GP) was calculated according to Monin and Sellier (1985). The animals were slaughtered at live weight about 100 kg in the same slaughterhouse by electrical stunning (180-220 V; 0.5-0.8 A; 8 s). Meat quality was evaluated on the *Longissimus dorsi (LD)* muscle at the level of the last rib. In the *Longissimus dorsi* muscle were evaluated pH_1 and R_1 (IMP/ATP) value at 45 min. after slaughter. In 24 hours after slaughter the pH_{24} and muscle lightness were evaluated. Muscle lightness were determined using an apparatus Momcolor-D3098 with white standard. The R value was determined according to the method of Honikel and Fischer (1977). The pH values was recorded using microcomputer pH-meter with a combined glass electrode in muscle homogenates. Data were analysed using classical procedures of one-way analysis of variance for group with HAL genotypes. The differences between means for RN genotypes were calculated using t-Student test. The simple correlation was calculated for each group of pigs between biopsy parameters and meat quality traits measured after slaughter.

RESULTS AND DISCUSSION

The obtained results were agreed with results of other authors, that HAL^n gene, in opposition to RN^- gene, not affected glycolytic potential, but it influenced on the lactate content, rate of post mortem pH fall, ATP breakdown (R value) and meat lightness (Koćwin-Podsiadła et al. 1995; Klont 1994; Przybylski and Koćwin-Podsiadła 1996) (tab. 1 and 2, fig. 1). The average values of glycolytic potential for all three genotypes were higher than for rn+rn+ pigs but lower from RN^- gene carriers. The pigs with different stress susceptibility genotypes were not significantly different for ultimate pH that was low and this is probably effects of relative high level of glycolytic potential (tab. 1). For

Table 1
Effect of the HAL^n gene on the biopsy and meat quality parameters

Traits	Halothane genotype		
	NN	Nn	nn
Number of animals	16	19	12
GP (μmol/g)	206.86±14.29	205.81±18.15	209.17±19.64
lactate (μmol/g)	a 6.20±1.12	b 11.28±3.08	c 14.93±3.15
pH_1	a 6.23±0.15	b 6.06±0.21	c 5.63±0.15
pH_{24}	5.41±0.13	5.48±0.13	5.43±0.11
R_1	a 0.91±0.08	b 1.03±0.16	c 1.21±0.16
Meat lightness	a 15.35±1.74	ab 17.05±1.78	b 18.74±3.47

Results are given as means±; Sd.; means with different letter are different at the P<0.05 level; GP-glycolytic potential

comparison Przybylski et al. (1995) reported for polish large white pigs the glycolytic potential around 162 µmol/g with pH ultimate 5.71 for the same muscle. Results obtained for rn+rn+ pigs shown in table 2 were respectively around 176 µmol/g with pH_{24}=5.63. The effect of RN⁻ gene on analysed traits of meat quality (tab. 2, fig. 1) confirmed, that this gene affected the glycogen level of white muscle, ultimate pH and the meat lightness. Results obtained are agree with data reported by Le Roy et al. (1995) and Lundström et al. (1994). The observed value of glycolytic potential in RN⁻ carriers was higher around 56% from non carriers pigs and ultimate pH differs approximately 1.2 standard deviation unites (tab. 2, fig. 1). Relationship between GP and ultimate pH confirm of hypothesis that abnormality accumulation of glycogen in white muscle in RN⁻ gene carriers is the main reason of lowering the meat quality. The relationship between ultimate pH and glycolytic potential (glycogen) is negative and as noted by Fernandez and Gueblez (1992) and Przybylski et al. (1994, 1996) represented quadratic model with plateau, when with a decrease ultimate pH glycolytic potential increases up to a convergence point. From this threshold, pH remained constant (plateau) regardless of GP. These values reported by Przybylski et al. (1996) for LD muscle are respectively GP=217 µmol/g and pHu=5.43. High residual glycogen content could influence technological yield of meat independently of its effect on ultimate pH (Monin 1994). Monin (1994) described that lower technological yield of curing cooked ham from RN⁻ carriers may by explained by low pHu, high glycogen level and low protein content.

Table 2
Effect of the RN⁻ gene on the biopsy and meat quality parameters

Traits	RN genotype	
	rn+rn+	RN⁻rn+
Number of animals	22	14
GP (µmol/g)	a 175.84±26.89	b 274.25±40.18
lactate (µmol/g)	6.13±1.63	5.97±1.96
pH_1	6.21±0.28	6.26±0.35
pH_{24}	a 5.63±0.17	b 5.39±0.15
R_1	0.99±0.13	0.95±0.13
Meat lightness	a 16.71±2.62	b 18.88±3.33

Results are given as means±Sd.; means with different letter are different at the P<0.05 level; GP-glycolytic potential

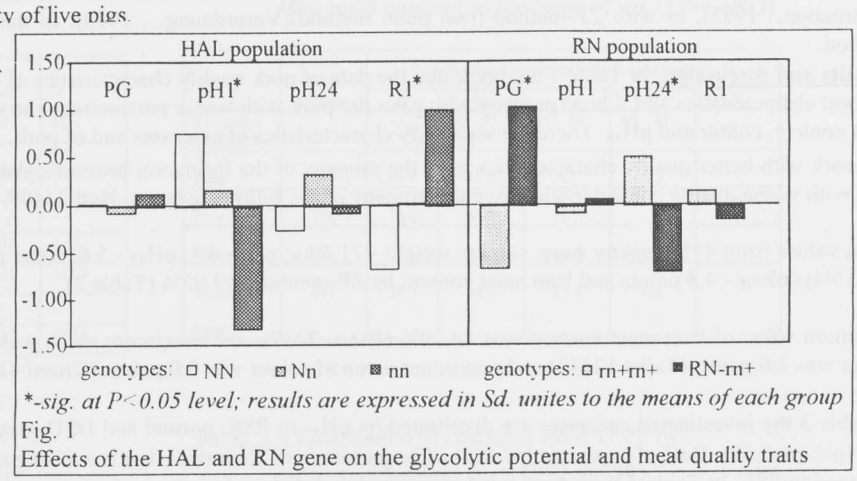
Table 3
Correlations between biopsy parameters and meat quality traits for both investigated group

Meat quality traits	Group	Biopsy parameters	
		lactate	GP
pH_1	HAL	-0.68*	-0.15
	RN	-0.41*	-0.04
pH_{24}	HAL	-0.22	0.37
	RN	0.24	-0.67*
R_1	HAL	0.69*	-0.08
	RN	0.42*	-0.10
Meat lightness	HAL	0.56*	-0.26
	RN	0.19	0.32

**-Significant at the P<0.05*

CONCLUSIONS

The stress susceptibility gene affected on the level lactate in biopsy samples and post mortem pH fall, ATP breakdown and meat lightness. The RN locus affected on the glycolytic potential measured in biopsy samples, ultimate pH and meat lightness. The correlation between the content of lactate, glycolytic potential and with meat quality traits confirmed of possibility to prediction the potential meat quality of live pigs.



**-sig. at P<0.05 level; results are expressed in Sd. unites to the means of each group*

Fig. 1
Effects of the HAL and RN gene on the glycolytic potential and meat quality traits

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