THE EFFICIENCY OF PREDICTION OF PSE PORK MEAT ON THE BASIS OF HALOTHANE TEST AND HAL-GPI-A1BG-PGD HAPLOTYPING AND PCR/RFLP ANALYSIS

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SUMMARY

The aim of studies was to examine the efficiency of prediction of PSE meat occurrence in German Landrace herd on the basis of HAL genotype defined by halothane test and HAL-GPI-A1BG-PGD haplotyping (Gahne and Juneja 1985) (Method 1) as compare to PCR/RFLP test (Fuji et al. 1992) (Method 2). A total 105 animals were evaluated. The HAL genotype within tested material identified by Method 1 was as follows: 30 NN (28,6%); 43 Nn (40,9%); 32 nn (30,5%) while by Method 2 - 25 NN (23,8%); 51 Nn (48,6%); 29 nn (27,6%). The genotype of 27 (25.7%) pigs was corrected by PCR/RFLP test. The PSE meat (qualified on the basis of pH_1 and R_1), was identified in 71,9% of animals of nn genotype defined by Method 1, whereas within group of the same HAL genotype but stated by Method 2 - 79,3% of pigs showed PSE meat post mortem. The meat quality rates (pH_1, R_1, meat colour) showed more profound changes within nn animals in favor of Method 2, but those differences found out insignificance.

Introduction

Various methods of predicting of meat quality in pigs have been described to reduce and eliminate the halothane sensitivity and PSE pork (see review Claes et al., 1992). Stress sensitivity to malignant hyperthermia induced by halothane is genetically determined. Malignant hyperthermia has been shown to be controlled by a recessive gene at a single autosomal locus HAL (Ollivier et al., 1975). The method of HAL genotype identification based on halothane test and typing of proteins polymorphism coded by genes linked to HAL locus was elaborated by Gahne and Juneja in 1985.

The ryanodine receptor of the sarcoplasmic reticulum calcium channel gene has been postulated to be the candidate for predisposition to porcine malignant hyperthermia. A single point mutation in ryanodine receptor gene (RYR 1) namely a cytosine (C) to thymine (T) at position 1843, led to an alteration in amino acid sequence from arginine at position 615 in the $HAL^{N}Hal^{N}$ pigs to cysteine in the $HAL^{n}HAL^{n}$ individuals. The genotyping test developed by Fuji et al. (1991) involved an amplification of RYR 1 gene fragment comprising 1843 nucleotide followed by HgiAI restriction endonuclease digestion. Electroforetic separation of digested DNA fragments allowed HAL genotype identification (PCR/RFLP test). The association between HAL genotype determined by haplotyping method (Gahne and Juneja, 1985) and meat quality has been shown by many laboratories (Sellier, 1987).

A similar studies are actually realized using HAL genotyping by PCR/RFLP test (Pommier and Houde, 1993).

The aim of presented study was to examine the efficiency of prediction of PSE meat occurrence within German Landrace herd on the basis of HAL genotype defined by haplotyping as compare to PCR/RFLP test.

Material And Methods

The investigations covered 105 German Landrace pigs from one herd. The HAL genotype was identified by HAL-GPI-A1BG-PGD haplotyping (according to Gahne and Juneja, 1985) and by PCR/RFLP test (according to Fuji et al., 1991).

The pigs were killed by the live weight about 100kg. Meat quality was evaluated on the basis of value of parameters: pH_1 and R_1 measured in M. longissimus dorsi at 45 minutes post mortem. Meat brightness was determined using an apparatus Momcolor-D3098 with white standard.

PSE meat was classified on the basis of pH_1 and R_1 (Honikel and Fisher, 1977 in modification of Koæwin-Podsiad³a and Chmura-Janowiak, 1988).

Data were analyzed using classical procedures of one-way variance analysis and means were compared using Tukey test.

The association between pH_1, R_1 values and PSE meat occurrence on one side and HAL^{n}HAL^n genotype on other was calculated according to 2x2 containing table (Vögeli and Schwörer, 1982).

Results And Discussion

The HAL genotypes within tested material identified by HAL-GPI-A1BG-PGD haplotyping were as follows: 30 NN (28,6%), 43 Nn (40,9%), 32 nn (30,5%) while by PCR/RFLP test - 25 NN (23,8%); 51 Nn (48,6%); 29 nn (27,6%). The genotype of 27 pigs was corrected by PCR/RFLP test. The PSE meat (qualified on the basis of pH_1 and R_1) was identified in 71,9% of animals of nn genotype defined by haplotyping whereas within by PCR/RFLP test - 79,3% of pigs - showed PSE meat post mortem (Table 1). About 20% of Nn animals developed PSE meat post mortem (Table 1). The necessity of explanation of this phenomenon is very significant for pig breeders.

The meat quality parameters (pH_1, R_1, meat colour) showed more profound changes within nn animals in favour of Method 2, but those differences found out insignificant on basis of variance analysis. The differences between R_1 values determined for both NN and Nn pigs appeared to be insignificant when HAL genotype was typed by haplotyping method, whereas differed significantly between pigs typed by PCR/RFLP test (Table 1).

The linkage disequilibrium coefficient values shown in Table 2 confirmed the association between nn genotype and values of pH_1 as well as PSE meat occurrence. However, the D_s value determined for HAL^{n}HAL^n - pH_1 pair (0,92) suggested more significant association between pH_1 and HAL genotype defined by PCR/RFLP test.

The disagreement between HAL genotype and meat quality was observed regarding 3 animals. Two nn pigs showed normal meat quality (pH_1=6,06 and R_1=1,037, meat colour 19,96). Third pig of Nn genotype developed PSE meat post mortem (pH_1=5,56, R_1=1,256, meat colour 21,97) what was signalized in literature earlier (Koæwin-Podsiad³a et al., 1993).

The pH_1 value determined for six Nn animals was below 6,0 (5,60 - 5,92) while the value of other parameters were characteristic for normal meat (R_1 from 0,771 to 1,025; meat colour from 14,9 to 16,09). Altogether 9 animals (8,5%) showed more or less disagreement between HAL genotype and values of meat quality parameters. The presented results led us to conclusion that additional factors affected meat quality in pigs.

Conclusions

1. PCR/RFLP test appeared to be more efficient method for porcine meat quality prediction as compare to haplotyping test.
2. Additional factors probably affects the value of pH_1, R_1 and meat colour leading to disagreement between HAL genotype and meat quality observed for some pigs.

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References

Claes V., Chaput M., Kettmann R., Barry A., Tieckemans M. F., Baert C., 1992. Molecular diagnosis of pig malignant hyperthermia. Landbouwtijdschrift - Revue de l'Agriculture, Vol. 45, 3, 505-511.

Fuji J., Otsu K., Zorzato F., De Leon S., Khanna V.K., Weiler J., O'Brien P.J. and MacLennan D.H., 1991. Identification of a mutation in porcine ryanodine receptor associated with malignant hyperthermia. Science, 253, 448-451.

Gahne B., Juneja R.K., 1985. Prediction of the halothane genotypes of pigs deducing Hal, Phi, Po2, Pgd haplotypes of parents and offspring: results from a large-scale practice in Swedish breeds. Anim. Blood Grps Biochem. Genet., 16, 265-283.

Hill W.G., 1974. Estimation of linkage disequilibrium in randomly mating populations. Heredity, 33, 229-239.

Honikel K.O. & Fisher M., 1977. A rapid method for detection of PSE and DFD porcine muscles. J. Food Sci., 42, 1633-1636.

Koæwin-Podsiad³a M., Chmura-Janowiak M., 1988. The ratio IMP/ATP nucleotides and the pH value determined in 45 min. after slaughter applied to evaluate the quality of fatteners meat. 6th World. Conf. Anim. Prod. Helsinki 1988 27.06-1.07, 8, 106, 707.

Koæwin-Podsiad³a M., Kury³ J., Przybylski W., Kaczorek S., Rozenek-Przybylska A., 1993. Hal^n gene effects on carcass and meat quality in porkers Polish Landrace 23 line. Animal Production Review. Polish Society of Animal Production. Pig Production and Breeding. Applied Science Reports., 9, 211-216.

Ollivier L., Sellier P., Monin G., 1975. Déterminism génétique du syndrome d'hyperthermie maligne chez le porc Piétrain. Ann. Génét. Sél. Anim., 7, 159-166.

Pommier S.A., Houde A., 1993: Effect of the genotype for malignant hyperthermia as determined by a restriction endonuclease assay on the quality characteristic of commercial pork loins. J. Anim. Sci., 71 (2), 420-425.

Sellier P.,1987. Crossbreeding and meat quality in pigs. A Seminar in the CEC Agricultural Research Program, Dublin (Ireland), 1985, Ed. Martinus Nijhoff Publishers, Dordrecht/Boston/Lancaster, 329-342.

Vögeli P., Schwörer D., 1982. Kopplungsungleichgewicht zwischen dem malignen hyperthermie syndrom (MHD, Halothanempfindlichkeit) und den Phänotypen des H-Blutgruppensystems und des PHI-Enzymsystems beim Schweizerischen Veredelten., Züchtungskunde 54, 124-130.