THE EFFECT OF *PKM2* GENE POLYMORPHISM ON PORK MEAT QUALITY[#]

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Introduction

The genetic conditioning of glycogen level variability is the goal of interests in many investigations (Milan *et al.* 2000, Fontanesi *et al.* 2003). Pyruvate Kinase Muscle (PKM) gene is responsible for production of M_1 and M2 forms of pyruvate kinase enzyme which plays a role in glycogen pathway (Noguchi *et al.* 1986). Results obtained by Fontanesi *et al.* (2003) indicate that polymorphism of PKM2 gene influence on the glycogen level in muscle tissue of fatteners.

The aim of this study was to analyse the association between PKM2 gene polymorphism and meat quality traits of fatteners of three genetic groups: Landrace, Landrace x Yorkshire, (Landrace x Yorkshire) x Duroc.

Materials and Methods

The studies covered 243 pigs, of which 95 were of the Landrace breed, 66 Landrace x Yorkshire and 82 (Landrace x Yorkshire) x Duroc crossbreeds. All animals were free from gene *RYR1*^{T}. The animals were slaughtered using electric stunner (INARCO line, STORK) and bleeding lying down, 2-4 h after transportation, during autumn and winter season. The quality of meat was evaluated after slaughter on the *musculus Longissimus lumborum* (*LL*) (after last rib), on the basis of the following parameters: pH of the muscle tissue measured directly in the LL muscle 35 min, 2h, 3h, 24h, 48h, 96h and 144h and in water homogenate of muscle tissue at 45 min *post mortem*, electric conductivity (EC) measured with LF-Star conductometer (Matthaüs) 35 min, 2h, 3h and 24 h *post mortem*, colour lightness (L*, Minolta CR310), rate of ATP breakdown expressed by R_1 = IMP/ATP indicator at 45 min *post mortem* (Honikel & Fischer 1977), water holding capacity (WHC) (Grau-Hamm 1952 as modified by Pohja & Ninivaara 1957), drip loss at 48h, 96h and 144h (Prange *et al.* 1977), technological yield in the curing and thermal processing (TY). The samples cut from the *LL muscle* at 45 min *post mortem* were analysed for the glycolytic potential (GP) and content of glycogen and lactate using enzymatic methods. The GP was calculated according to Monin & Sellier (1985). The chemical composition of muscle tissue was also analysed. Genotypes of PKM2 gene were identified by the PCR/SSCP method according to Fontanesi *et al.* (2003). The data were statistically analysed using two-way anova (PKM2 genotype, genetic group ant their interaction).

Results and Discussion

In analysed group of 243 fatteners it was establish that TT homozygotes of PKM2 gene in comparison to CC homozygotes by higher GP (141,14 vs. 128,93 µmol/g) and lactate level (43,69 vs. 37,72 µmol/g) were characterised (P≤0,05). The highest level of lactate in TT homozygotes by lowest pH value at 45 min, 24 h and 144 h *post mortem* was confirmed (P≤0,05). Average values of analysed meat quality traits of heterozygous TC fatteners were similar to average values of TT animals excluding lactate and pH_{45} value. Drip loss at 96 h *post mortem* of CT heterozygous animals was intermediate between CC and TT homozygotes. In these investigations

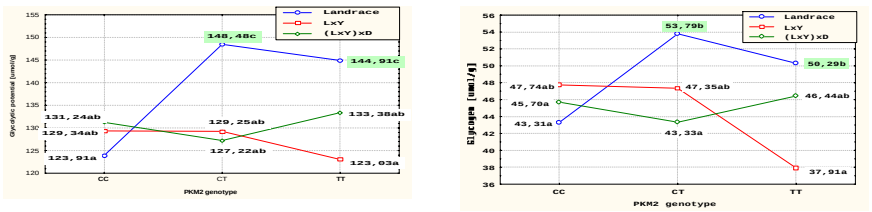

Fig. 1 Interaction between PKM2 genotype and breed for a-glycolytic potential; b-glycogen

the association between PKM2 gene polymorphism and glycogen level noted by Fontanesi *et al.* (2003) wasn't confirmed.

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Analysing the influence of breed – the second factor - on meat quality traits it was state that (Landrace x Yorkshire) x Duroc crossbreed fatteners in comparison to pure Landrace fatteners had statistically significant lower GP and glycogen level (P≤0,05). The breed of animals was also associated with acidity of LL muscle tissue from 45 min to 144 h after slaughter, drip loss at 48, 96 and 144 h, dry matter and intramuscular fat content. Excluding GP there wasn't significance difference between average values of meat quality of Landrace and Landrace x Yorkshire fatteners.

The interaction between PKM2 genotype and breed of fatteners for GP and glycogen level was statistically significant (P£0,05) (Fig 1a, 1b).

It was establish that association between polymorphism of PKM2 gene and meat quality especially among Landrace fatteners is significant. This dependency was the basis to analyse the association of PKM2 genotypes with meat quality traits separately for Landrace fatteners. Conducted additionally one-way anova showed that among Landrace fatteners PKM2 gene polymorphism is associated with GP and glycogen. TT homozygous animals had higher value (P≤0,05) of these traits than CC homozygotes (21 and 6,92 mmol/g for PG and glycogen respectively) (Tab. 1). It should stress that GP and glycogen are the determinants of faulty acid meat. Meat obtained from TT Landrace fatteners by higher lactate level, lower pH at 96 and 144 h post mortem, paler lightness and greater drip loss was also characterised (Table 1).

Table 1. The influence of PKM2 genotypes on meat quality traits of Landrace fatteners

Trait	PKM2 genotype		
	CC	CT	TT
Glycogen (µmol/g)	43,31a±13,71	53,79b ±16,14	50,29b ±16,92
GP (µmol/g)	123,91a ±26,92	148,48b ±32,05	144,91b ±35,01
Lactate (µmol/g)	37,20a ±7,73	40,90b ±10,17	44,32b ±11,16
pH_{94}	5,42b ±0,10	5,37a± 0,6	5,35a ±0,05
pH_{144}	5,49b ±0,13	5,41a± 0,11	5,41a ±0,08
Drip $loss_{96}$ (%)	9,79a ±2,61	11,27b± 3,08	11,91b ±2,54
Meat lightness (L*)	53,49a ±3,14	54,77ab± 3,18	55,89b ±3,11

In the table mean values and standard deviations are given. a, b – means signed by different small letters differ at P≤0,05

Statistically proved influence of PKM2 gene polymorphism on lactate level with simultaneous non-significant association with pH_{24} suggest that PKM2 gene isn't a gene with major effect for acid meat.

Conclusions

The TT homozygotes of PKM2 gene by highest GP were characterised in comparison to CC homozygous animals.

The influence of PKM2 genotypes on glycogen level wasn't confirmed for all analysed population but only for Landrace breed fatteners. The association between PKM2 genotypes and meat quality traits among Landrace fatteners was especially noted, what is confirm by statistically significant interaction between PKM2 genotype and breed for GP and glycogen level.

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