MICROSTRUCTURE OF M. LONGISSIMUS LUMBORUM IN CROSSBREED PIGS OF DIFFERENT GENETIC GROUPS

Kłosowska D., Kłosowski B., Koćwin-Podsiadła M*., Przybylski W*., Elminowska-Wenda G.
University of Technology and Agriculture, Faculty of Animal Production, Bydgoszcz, Poland
*Agricultural and Pedagogical University, Institute of Animal Breeding, Siedlce, Poland

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INTRODUCTION

Meat quality of pigs depends on their genetic constitution. The halothane gene (n) is regard as a major gene that determines porcine muscle metabolism. Recently, RN⁻ gene has been found to be the dominant which affects the meat quality of pigs by increasing the glycogen content of muscle and inducing the production of „acid meat" (Monin, 1989; Fernandez et al. 1992). Hampshire and Hampshire crossbred pigs have a much higher muscle glycogen content than pigs of the other European breeds (Monin and Sellier 1985, Essen-Gustavsson and Fjelkner-Modig, 1985). Marinova et al. (1992) showed the difference between Hampshire crossbred and Large White pigs in visually estimated glycogen content on the basis of histochemical staining in the different types of muscle fibers . The excess of muscle glycogen typical of Hampshire and Hampshire crossbred pigs was more expressed in fibers with high glycolytic and contractile activities. It was of interest to study glycogen content by histochemical method, with the use of Image Analysis System in relation to fiber types and fiber size in some pure breeds, their crosses and crossbreed where RN⁻ gene was observed.

OBJECTIVES

The examination was carried out on m. longissimus lumborum of 42 pigs of the following groups of pigs: Large White (LW), Polish Landrace (line 23)(PL), LWxPL, (LWxPL)xPL, LWxP-76 (crossboar from PEN AR LAN French company where were founded two lines with breeds French Large White x Pietrain x Duroc x Hampshire, where RN⁻ gene was observed), (LWxPL) x P-76, (LWxPL)xL-990 (this line was synthetic line with the share of Hampshire pigs). The pigs were fattened at the Agricultural Experimental Station Zawady.

METHODS

Muscle samples from m. longissimus lumborum of the pigs were taken at 70-80 kg liveweight by shot biopsy (Talmant et al 1989). The samples were immediately frozen in liquid nitrogen. Transverse serial sections were cut in a cryostat and were subjected to double reaction for activity of NADH-TR oxidoreductase and myofibrillar ATPase after acid preincubation (Wegner et al. 1993). Slow twich oxidative (STO), fast twich oxidative (FTO), fast twich glycolytic (FTG) fibers were identified. The percent distribution of fiber types within each muscle was estimated in ten primary bundles (it contained approximately 350 individual fibers per sample). The least diameters (Kłosowska, 1984) of fibers were determined by measuring 200 fibers/muscle/animal on lanameter. Glycogen content in the muscle was studied using periodic acid-Schiff's (PAS) stained sections and by Leica Q500MC Image Analysis System. Data were analysed using one-way variance analysis.

RESULTS AND DISCUSSION

The distribution and diameters of muscle fiber types in longissimus muscle different genotypes of pigs are shown in Table 1. No significant differences were found for STO fibers in examined pig groups. Significant differences were noticed in FTO and FTG fiber types distribution. The least FTO fibers were found in the muscles of LW breed and crossbreed of LW x P-76 and (LWxPL)xL-990. The most FTO fibers were found in crossbreed LWxPL. The percentage of FTG muscle fibers was the least in the crossbreed LWxPL and the most in breed LW and crossbreed LWxP-76 and (LWxPL)xL-990 ($p<0.01$). The differences in the proportions of FTO and FTG fibers in the pigs of the same body weight may be explained as the difference in the physiological maturition rate. More FTO fibers and less FTG fibers may show the less mature animals according to suggestion of Ashmore et al. (1972). In fiber diameters only significant differences showed FTO fibers which were larger in (LWxPL)xL-990 group in comparison to another groups ($p<0.05$). Similary results was obtained by Marinova et al. (1992), in Pen Ar Lans pigs as compared with Large White breed of pigs.

Determination of PAS stain intensity of red colour in histochemical sections by Leica Q500MC Image Analysis System allowed to estimate of glycogen content in muscle fibers.

As shown in Figure 1, 2, 3 and 4, different grey levels histograms of red ingredient were obtained for examined groups of pigs. The least content of glycogen (Fig. 1 and 2) was showed by pigs of LW and PL breeds. Higher glycogen content was showed by crossbreed of LWxP-76 and (LWxPL)xL-990 (Fig. 3 and 4), the crossbreed with Hampshire blood. These results are in good agreement with those obtained by biochemical techniques on the same genetic groups (Przybylski et al. 1995). Glycolytic potential for LW group was 162.48 µmol/g in comparison to LWxPLxH and (LWxPL)xP-76 (206.8 and 258.58 µmol/g, respectively). The groups with Hampshire breed showed higher glycolytic potential, lower ultimate pH and also technological yield of meat characteristic for animals with RN⁻ gene that induces „acid meat"

CONCLUSION

The histochemical methods with the using of Image Analysis System allowed to show that the excess of glycogen was evident in the biopsy sampled muscles of crossbreed pigs with Hampshire blood. These groups of pigs were characterised by the higher proportion of muscle fibers with high contractile and glycolytic activities.

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TABLE 1. Longissimus muscle fiber histochemical and histological characteristics in different genotypes of pigs.

Histological characteristics		GENOTYPES						
		LW	PL	LWxPL	LWxP-76	(LWxPL)xPL	(LWxPL)xP-76	(LWxPL)xL-990
Fibre type %	STO	15.04±1.99 A	14.04±3.01 ABC	13.64±4.47 C	11.53±1.39 AB	16.74±4.15 ABC	11.94±2.96 ABC	13.82±2.36 AB
	FTO	15.25±3.62 BC	1984±3.54 ABC	25.35±3.69 A	16.49±1.93 C	20.95±5.10 AB	22.13±3.92 AB	17.02±3.37 ABC
	FTG	69.71±5.20	66.12±3.92	61.00±2.86	71.97±2.55	62.31±2.76	65.93±3.37	69.16±2.95
Fibre diameters µm	STO	57.84±8.75 ab	62.95±6.02 ab	66.56±4.14 ab	65.34±7.51 ab	53.21±6.83 a	55.78±7.15 a	60.76±5.01 b
	FTO	64.72±10.62	69.47±8.30	66.88±5.89	69.45±3.37	55.22±5.37	55.14±7.39	74.12±8.31
	FTG	85.71±10.04	88.89±9.13	92.69±1.45	88.30±6.47	80.74±6.08	83.13±11.33	95.26±9.82

Means signed by different letter differ significantly: a, b - at the level $p<0.05$; A, B, C - at the level $p<0.01$

FIGURES: Glycogen content in m. longissimus lumborum of different genotypes of pigs

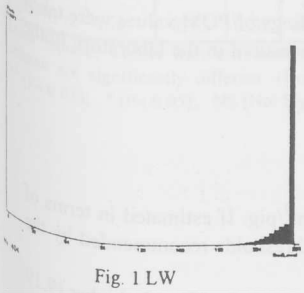

Fig. 1 LW

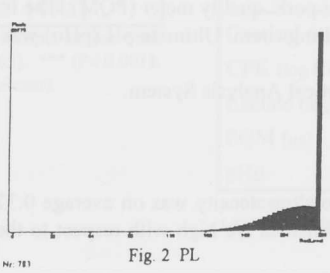

Fig. 2 PL

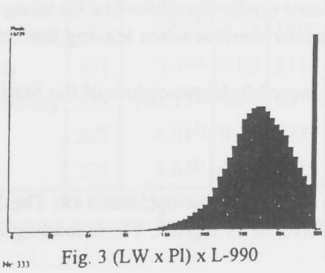

Fig. 3 (LW x Pl) x L-990

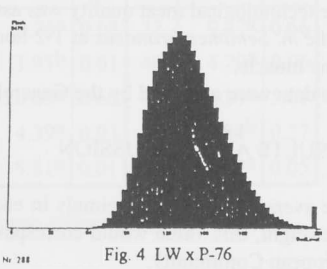

Fig. 4 LW x P-76