THE EFFECT OF PRE-SLAUGHTER TREATMENT ON THE HISTOCHEMICAL AND PHYSICOCHEMICAL TRAITS OF THE PIG MUSCLE

D. KŁOSOWSKA, S. GRAJEWSKA, B. KŁOSOWSKI and J. KORTZ

Institute of Physiology and Nutrition, Polish Academy of Sciences,
Meat Research Division, Bydgoszcz, Poland

INTRODUCTION

The Pale, Soft, Exudative /PSE/ meat and related problem Dark, Firm, Dry /DFD/ meat are the common phenomenon of the meat Quality deterioration in pigs /Briskey, 1964; Blendl and Puff, 1978/. These meat quality defects, in opinion of many authors /Sybesma, 1976; Lister et al., 1976/ originate from the inadequate animal's stress resistance and may be accentuated by pre-slaughter handling and treatment. Scheper /1976/ pointed out that with a greater stress during transportation, the PSE frequency decreases while the DFD condition increases. The aim of our study was to compare some muscle histochemical characteristics, physicochemical traits and frequency of incidence PSE or DFD in pigs which were slaughtered immediately after delivery and in those which were slaughtered four days after delivery.

MATERIALS AND METHODS

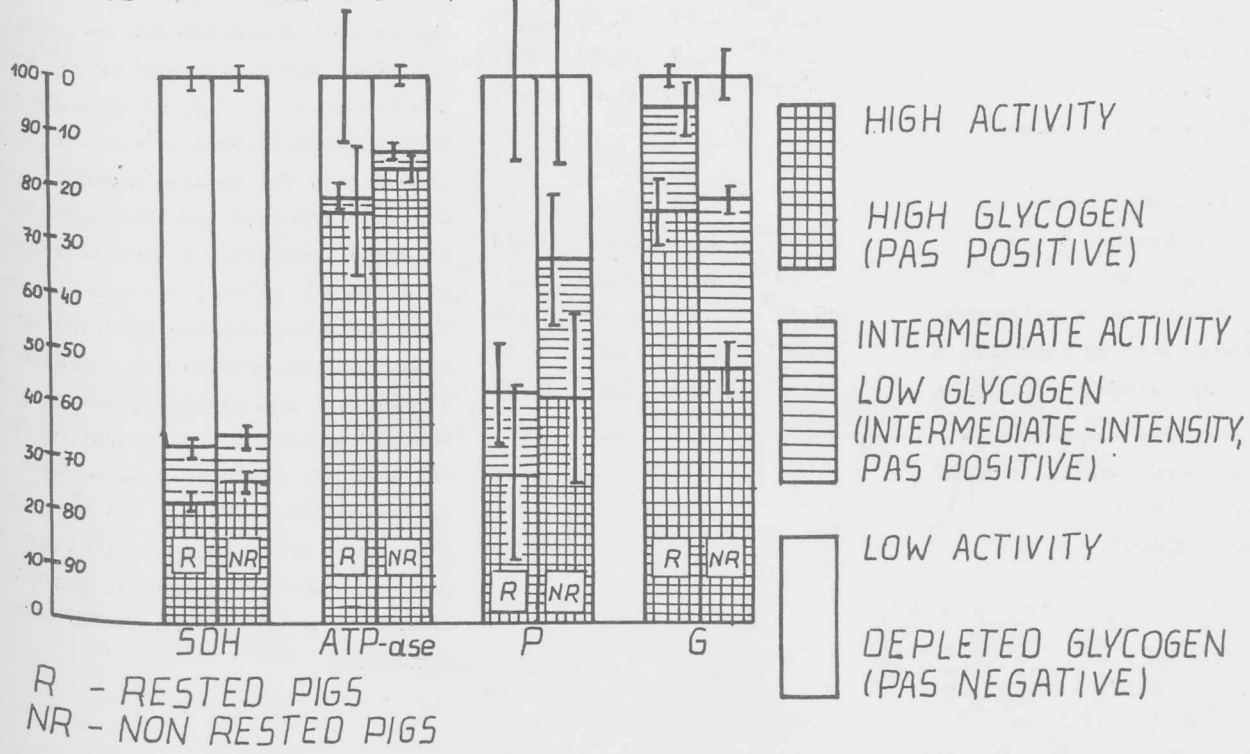
Experiment was carried out on the m. longissimus dorsi /LD/ of 60 pigs originated from the large scale production, divided into two groups: NR -group /non rested/ was slaughtered immediately after transportation /70 km, on a lorry, during 2 hours/; R-group /rested/ was slaughtered after 4 days resting in individual pens. Electrical stunning /70 volts/ has been used. Samples for histochemical examination were taken 5 minutes after slaughter. The muscle specimens were frozen in petroleum ether precooled with dry ice. Serial cryocut sections /10 um/ were reacted for: glycogen by periodic acid-Schiff /PAS/ reaction, for succinate dehydrogenase /SDH/, phosphorylase, and ATP-ase activity and for haematoxylin and eosin staining /Dubowitz et al., 1973/. On the basis of stain intensity, fibers were categorized as having high, intermediate, and low enzymic activity. The intensity of the PAS glycogen was rated dark, intermediate or negative. Staining differentiated fibers were estimated by counting their number in 10 muscle bundles on cross-sections. Glycogen content /Seifter, 1952/ and inorganic phosphate /Fiske and Subbarow, 1925/ were determined in muscle samples taken 5 and 45 minutes after slaughter. The following meat quality analyses were performed 48 hours after slaughter: gross morphology assesment including color, exudation and consistence; meat color as dominant wavelength, saturation, and lightness /Kortz et al., 1968/; color stability of meat; water holding capacity; pH_1 and pH_{48} /Różyczka and Michalski, 1978/. The data were subjected to analysis of variance /Snedecor, 1956/.

RESULTS AND DISCUSSION

Histochemical data showed that the LD muscle of the pigs slaughtered immediately after transport had a greater portion of the fibers with high ATP-ase and phosphorylase activity and greater portion of the muscle fibers depleted and with low content of glycogen /Fig. 1 and 5/ than those of the rested pigs. No significant differences in the number of the muscle fibers with high succinate dehydrogenase activity between groups were observed. Our results of the histochemically determined glycogen in the muscles of the rested pigs, a slight decrease in the ratio of PAS positive to PAS negative fibers /Fig. 1 and 6/, were similar to those obtained by Swatland /1975/. Biochemical analyses showed also that the muscles of NR pigs in comparison with the muscles of R pigs had a lower glycogen content, higher inorganic phosphate content /Fig. 2/, both immediately after slaughter and 45 minutes post mortem. Obvious differences in gross morphology and physicochemical traits of meat were also observed. /Tab. 1/. The meat of NR pigs as compared with that one of R pigs had darker and more stable color, higher values of water holding capaci-

ty and higher values of pH_1 and pH_{48} /Fig. 3/. The partial DFD and DFD condition occurred in 25 % of NR pigs; in the R pigs partial PSE and PSE condition was observed in 23 % of animals /Fig. 4/.

FIG.1 PERCENTAGE OF THE MUSCLE FIBERS DIFFERENTIATED BY SDH ATP-ase, PHOSPHORYLASE (P) ACTIVITY AND GLYCOGEN (G) IN MUSCULUS LONGISSIMUS DORSI (LD) OF THE RESTED (R) AND NON RESTED (NR) PIGS



R - RESTED PIGS
NR - NON RESTED PIGS

FIG.2 MUSCLE GLYCOGEN (G) AND INORGANIC PHOSPHATE (Pi) 5 AND 45 MIN POST MORTEM

FIG.3 pH VALUE IN MUSCLE 45 MIN AND 48 h POST MORTEM

FIG.4 INCIDENCE OF PSE AND DFD MEAT

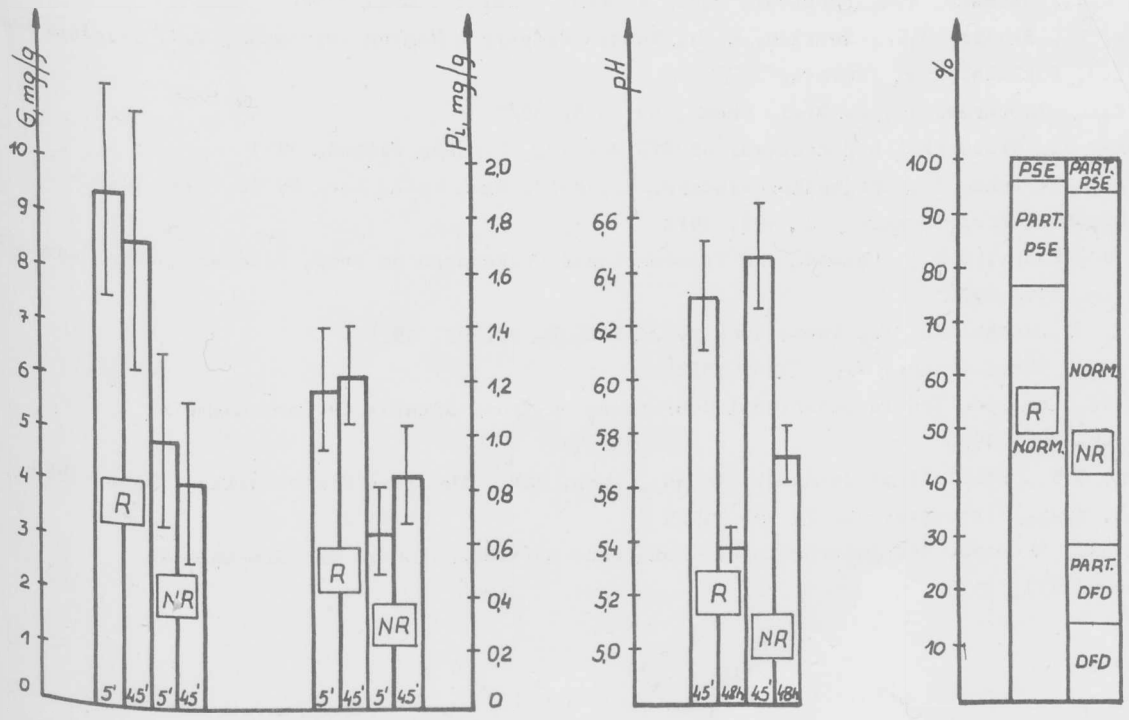


Table 1. Mean value /$\bar{x}$/ and standard deviation /s/ of meat traits of NR and R pigs

Traits	NR		R	
	$\bar{x}$	s	$\bar{x}$	s
Gross morphology, score[a]				
Color	2.99^{xx}	0.61	2.38	0.61
Exudation	3.05^{xx}	0.66	2.49	0.67
Consistence	3.11^{xx}	0.58	2.46	0.67
Physicochemical traits:				
Color:				
Dom. wavelength, nm	584.6	1.40	584.4	1.50
Saturation, %	21.60^{x}	2.50	22.97	3.78
Lightness, %	23.70^{xx}	2.83	26.29	3.85
Stability, % of change	9.54^{x}	5.85	12.97	7,50
Water holding capacity, %	74.97^{x}	6.11	71.36	4.74
Water binding ability, %	53.63^{x}	31.90	37.54	12.70

a/ Score 3 being optimal

x/ $P < 0.05$

xx/ $P < 0.01$

Characteristic giant fibers dark stained by H and E /Fig. 7/ and showing low phosphorylase activity /Fig. 8/ were found in the muscle from pigs classified as PSE and in some muscle classified as normal and DFD. The giant fibers composed about 1.9 % of the total fiber population in PSE muscles but in normal and DFD about 0.4 %. Cassens et al. /1969/ and Cooper et al. /1969/ have indicated that giant myofibers are primarily associated with PSE muscle. However, Linke /1972/, Kłosowska and Kłosowski /1973/ observed that giant fibers were not limited solely to PSE. Our results showed that the pre-slaughter handling and transport may promote the sequence of biochemical and physiological reactions which lead to the development of PSE or DFD meat. It may be concluded that stress-susceptible pigs exhibit a greater ante- or post-mortem glycogen depletion and acceleration of glycolysis reflected alternatively in DFD and PSE condition.

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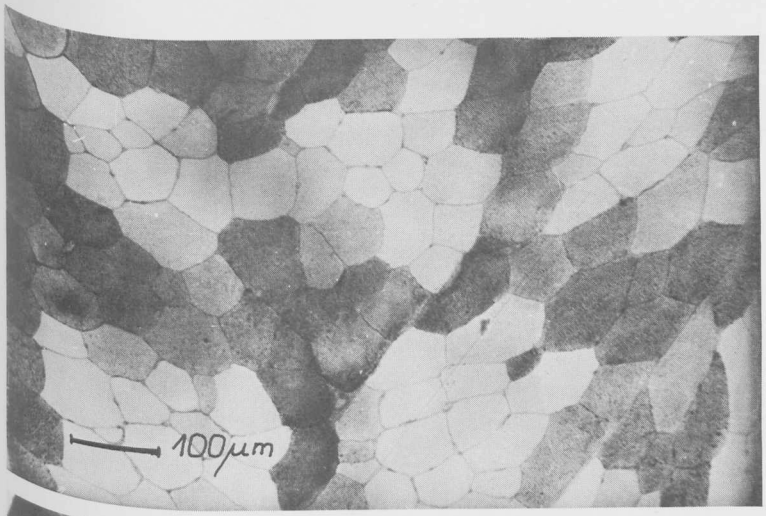

Fig. 5. LD muscle of NR pig containing great number of the fibers depleted of glycogen /PAS staining/.

Fig. 6. LD muscle of R pig showing muscle fibers containing great concentration of glycogen /PAS staining/.

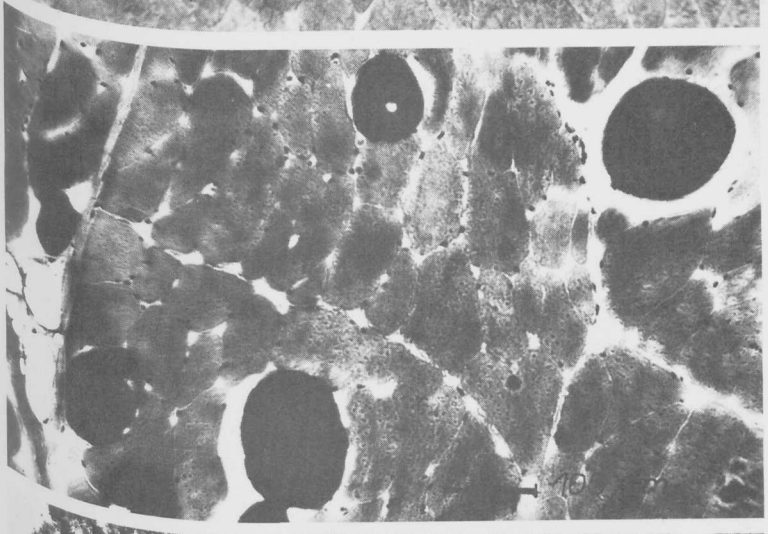

Fig. 7. Giant fibers in LD muscle of NR pig, dark stained by haematoxylin-eosin.

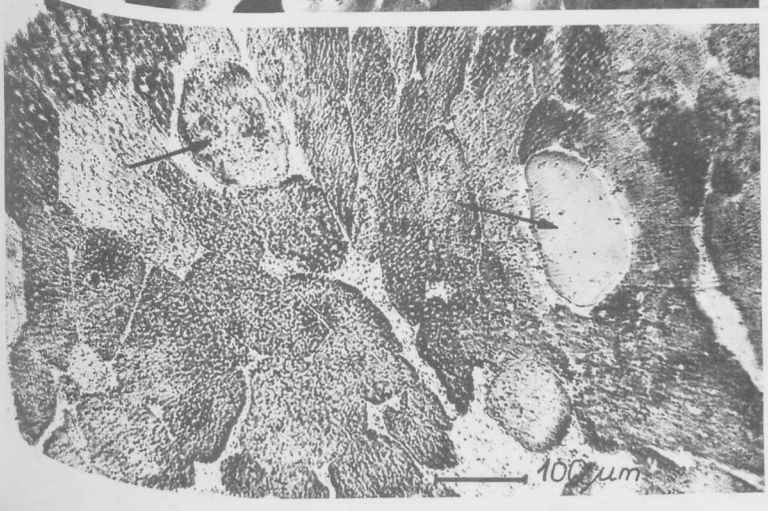

Fig. 8. LD muscle of NR pig incubated for phosphorylase activity. Giant fibers marked by arrows.