

METABOLIC RATE OF PORCINE M. GLUTEUS MEDIUS AS INFLUENCED BY HANGING POSITION OF CARCASS PRIOR TO BLEEDING

M. Vada-Kovacs and E. Czibula, Hungarian Meat Research Institute, Budapest, Gubacsi ut 6/b, Hungary 1097.

SUMMARY

The average level of lactate in gluteus medius muscle measured at 45 min pm showed the highest value in the shackled leg when sticking had been performed in hanging position at 30 s after stunning. The minimum values were detected in the free leg when sticking had been performed in lying position within a short time after stunning. Differences have been found in the response of the different types of pigs.

INTRODUCTION

Electric stunning has been considered as critical procedure concerning meat quality due to the stimulating effect of catecholamines and violent cramps (Van der Wal, 1978). In order to avoid the unadvantageous effect of electric stunning very short stunning with immediate bleeding are recommended. CO₂ stunning is also recommended against high incidence of PSE. However, automatic and manual electric stunners are widely used frequently combined with hygienic blood collecting procedure. Hygienic bleeding increases the time interval between stunning to bleeding since stunned pigs are lifted to vertical position prior to bleeding by shackling of one hind leg. asymmetry of paired *M. semimembranosus* in term of post mortem metabolism due to hanging before bleeding was reported by Fischer and Augustini (1981) and the influence of delayed bleeding e.g. bleeding in vertical position was detected by Troeger and Woltendorf (1985). the aim of this study was to investigate the combined effect of electric stunning and mechanical strain evoked by hanging with attention to stress susceptibility of pigs.

EXPERIMENTAL METHODS

Twenty-three Hampshire (H), 41 Bacon Landrace (L) and 23 Belgian Landrace crossbred pigs were examined, which were slaughtered at the abattoir of pig form. Large White breed was involved in the crossbreds. Pigs were slaughtered at 8 occasions. At one occasion 10-12 pigs including different crossbreds were examined. 5 halothan positive and 8 halothane negative purebred Estonian Landrace pigs were transported on lorry (30 km distance) at 32°C environmental temperature. Pigs were slaughtered after unloading.

Stunning was conducted on the floor with manual stunner of square wave impulses at 200 Hz. 550 mA was set in, electrodes were placed to head (behind ears). Two stunning-bleeding combinations were applied: 1/4 S of stunning was followed by immediate bleeding. After 30 S of bleeding one leg was shackled and the carcass was lifted to conveyor 2/10 S of stunning was followed by shackling of one hind leg

and lifting the stunned pig to conveyor. Sticking was carried out on hanging pig at 30 S after stunning. Each carcass was left to hang for 6 min before scalding. *M. gluteus medius* (GM) in hanging leg was sampled at 1,5-2 min after stunning (appr. 1.0 g). At 45 min post mortem both hanging and free leg were sampled. Muscle samples were immediately minced by scissors in 9.00 g 7% cold perchloric acid then weighed. After homogenisation for 1 min (Ultra Turrax) at full speed extracts were centrifuged at 1000 g for 10 min. Lactate and R value was determined by Hohorst (1970) and Honikel (1976), respectively. In selected samples CrP, ATP and IMP was determined by Kremmer et al (1987). Blood samples were taken during bleeding, lactate in blood was determined as in muscle. At 45 min pm rigidity of GM was measured by rigormeter (Sybesma). Ultimate pH was measured at 24 h pm and visual signs of PSDE were observed. Muscles of pH_{ult} higher than 5.8 was classified

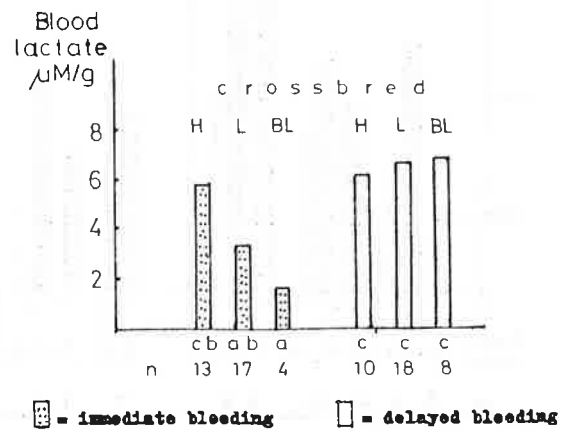


Fig. 1. Blood lactate at slaughter as influenced by bleeding /Means of different superscripts are different at least at 5 % probability level/

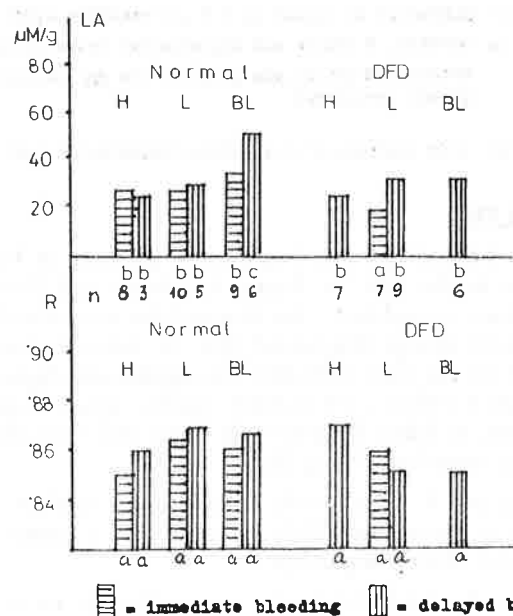


Fig. 2. Initial lactate and R value of GM muscle in hanging leg /Means of different superscripts in the same row are different at least 5 % probability level/

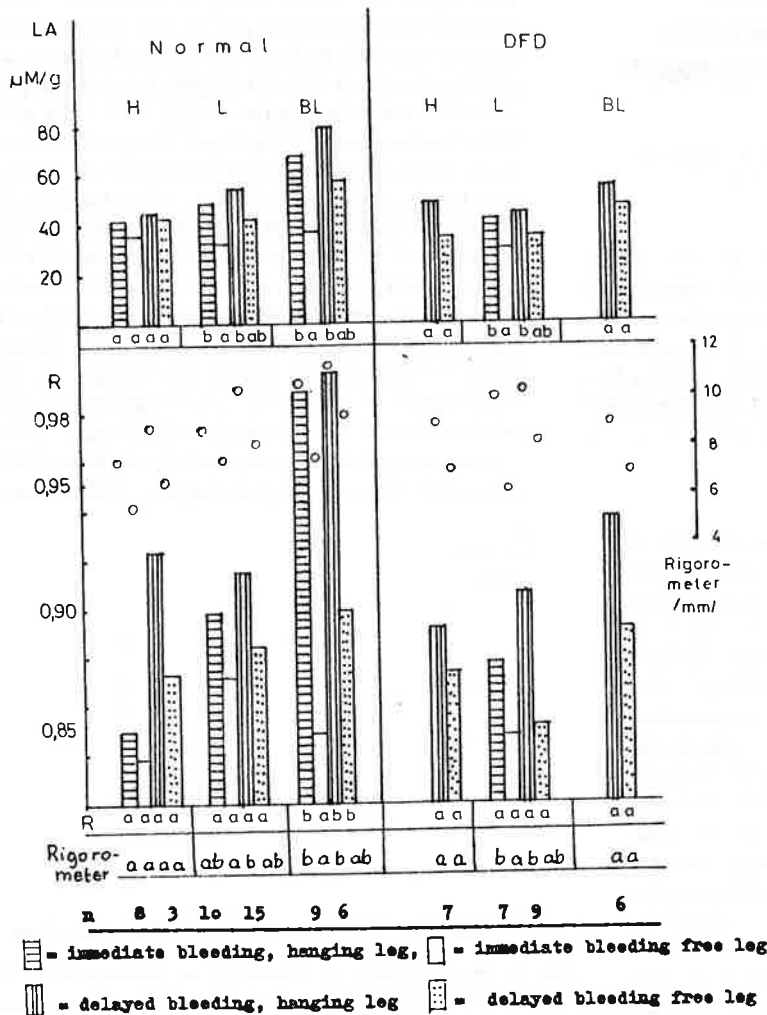


Fig. 3. Lactate, R value and rigorometer value of GM muscles determined at 45 min post mortem in relation to different crossbred

as DFD. For statistical evaluation Student's t-test was used.

RESULTS

Delayed bleeding caused significant increase or blood lactate in the case of Bacon Landrace and Belgian Landrace crossbred. In Hampshire crossbred no significant change was found (Fig. 1). Initial lactate of muscle (at the time of death) was significantly higher in Belgian Landrace of normal quality upon delayed bleeding, in initial R value only slight and insignificant changes were found (Fig. 2).

Lactate and R value of GM examined at 45 min pm are shown in normal and DFD categories after immediate and delayed bleeding in Fig. 3.

In normal and DFD quality categories the means of lactate and R value showed descending order as follows: delayed bleeding hanging leg; immediate bleeding hanging leg; delayed bleeding free leg; immediate bleeding free leg. In Landrace and Belgian Landrace crossbreds significant differences were found between

paired muscles in lactate and rigor value or between maximum and minimum value. Regarding R value, only the free legs differed significantly according to stunning-bleeding method. In normal quality increasing tendency can be observed in lactate, R value and rigor value from Hampshire to Belgian Landrace upon hanging and delayed bleeding; the more susceptible pig, the greater extent of acceleration of metabolism evoked by hanging or delayed bleeding. Lower level of lactate in DFD can be due to the limited amount of glycogen.

In order to compare immediate and delayed bleeding in relation to genetic determination hanging legs of halothan positive and negative pigs were examined (Fig. 4). R value at 45 min pm showed significant effect of genotype, while in the case of lactate at 45 min pm significant increase was found due to delayed bleeding. Cr.P, ATP and IMP content indicate that there are sufficient amount of ATP at the time of death except of PSE (f), however, CrP was depleted at the time of death in DFD (c, d) and PSE (f) muscles (Fig. 5). Comparing two PSE muscles - Hampshire crossbred (e) and halothan positive pig (f), both delayed bled - advanced depletion of ATP was found already at the time of death which continued. Rigorometer value of the latter was as low as in normal prerigor meat. At 45 min pm severe dehydration and very pale colour were observed. Metabolic rate of DFD was similar to normal (b), to PSE (d) or it was intermediate (c). Blood lactate level was much higher in this trial and slightly varied between genotypes or bleeding methods.

DISCUSSION

Relationship between electric stunning and PSE meat quality is well investigated including the time interval between stunning and sticking (Van der Wal 1978; Larsen 1983; Troeger and Wolendorf 1986). However, the relative importance of hanging the carcass by one hind leg before or after sticking (immediate and delayed bleeding) has not revealed yet. Hanging procedure after sticking is always applied in slaughter technology. Our results suggest that not only delayed bleeding (hanging before sticking) but the hanging after sticking (immediate bleeding) accelerates metabolism in susceptible breeds (Fig. 2, Fig. 3). In the consequence of this an asymmetry of paired muscles develops, the extent of asymmetry seemed to be parallel with susceptibility of breed. Similar tendency was observed with more resistant pig breed, however differences were unimportant. Among the four combinations of stunning and bleeding procedures "delayed bleeding, hanging leg" showed maximum while "immediate bleeding, free leg" showed minimum level of lactate at 45 min pm and R value. The high level of blood lactate in Fig. 4 can be related to stressful pre-slaughter conditions rather than to rate of metabolism. Post mortem patterns of PSE muscles (Fig. 5 e, f) demonstrate

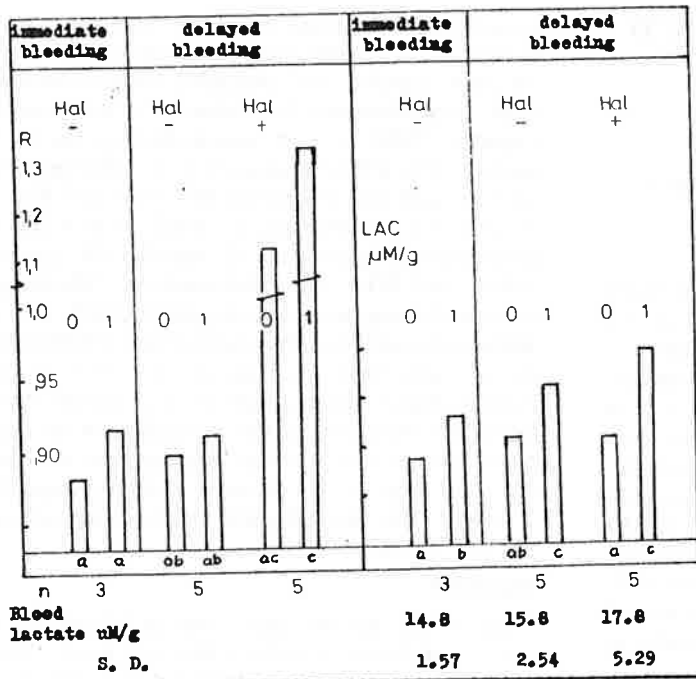


Fig. 4. R value and lactate determined in GM muscle at death and at 45 min pm in relation to halothan reaction and bleeding procedures /0-at death; 1= 45 min pm/ Means of different superscripts are different at least at 5 % probability level/

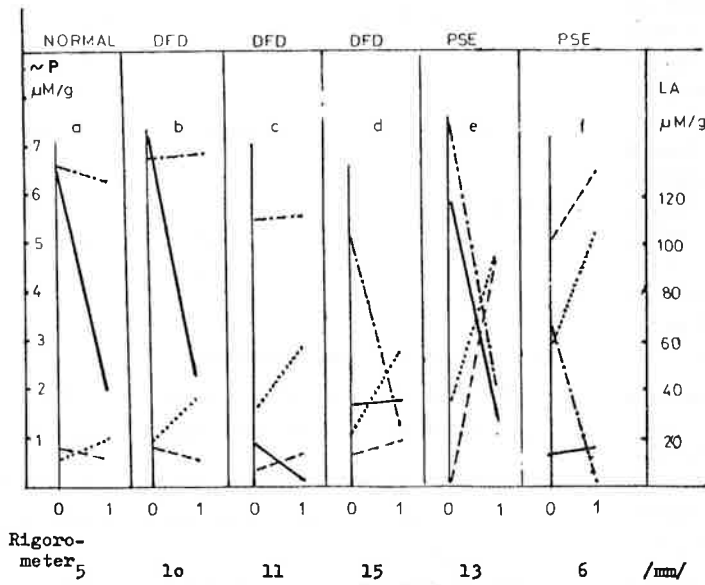


Fig. 5. CrP, ATP, IMP and lactate content of GM muscles at the time of death and at 45 min pm 0 = the time of death; 1 = 45 min pm; — = CrP; -.-. = ATP; = IMP; = lactate

the biochemical background of differences in rigidity measured at 45 min pm. Depending on the amount of initial CrP and ATP rapid or slow metabolism can take place (Fig. 5 b-d) (Vada et al. 1982). Similarly to normal meat, DFD can be shifted to early onset of rigor by slaughter procedure applied (Fig. 3). Regarding the mechanical effect during hanging it is not clear whether nervous stimuli are involved.

REFERENCES

- Fisher, K., Augustini, Chr. (1981). Proceedings 27th European Meeting of Meat Research Workers p.93.
- Hohorst, H.J. (1970). In Bergemyer H.U.: Methoden der enzymatische Analyse Band II. p.1425.
- Honikel K. (1976). *Die Fleischwirtschaft* 56:1143.
- Kremmer, T., Boldizar, M., Holczinger, L. (1987). *Journal of Chromatography* 415:53.
- Larsen K. (1983). In Stunning of animals for slaughter Ed. Eikelenboom CEC Seminar, Zeist. p.64.
- Troeger, K., Woltendorf, W. (1986). Proceedings Kulmbacher Woche p.9.
- Vada, M., Csiba, A., Nagy-Nemeth, A., Saska, J. (1982). Proceedings 28th European Meeting of Meat Research Workers p.94.
- Van der Wal P.G. (1978). *Meat Science* 2:19.