Stress up to at least 3 hours before slaughter affects the meat texture

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Introduction

Physical stress prior to slaughter affects several meat quality traits (Grandin , 1980) but the effects of physical stress on tenderness are equivocal (Kuchenmeister et al. 2002; Kuchenmeister et al. 2005). Several types of physical stress may be relevant in relation to the quality of meat, and many experimental setups have been studied in order to elucidate relationships between stress and tenderness. In a paper by Pike et al. (1993) on the tenderness of beef it was discussed weather a quadric relationship between glycolytic rate and tenderness may be responsible for some of the contradictory results in this area of research. Physical stress prior to slaughter may occur immediately before slaughter or some hours before, and the aim of this experiment was to study effects of stress prior to slaughter in combination with varying resting times following the stress on the texture of meat.

Materials and methods

Ten litters of 4 female pigs were allocated to four treatment groups according to litter and body weight: control without stress exposure or treadmill exercise with stepwise increasing speed form 0.4 km/h to an average of 5.2 km/h with increments of 0.4 km/h every 2 minutes; in total 27 minutes (SEM=0.9). The exercise was followed by either 0, 1, or 3 hours rest before slaughter. Samples from M. *longissimus dorsi* (LD) and M. *biceps femoris* (BF) for texture analysis were dissected 24 h *post mortem*, conditioned at 4ºC for another 48 h, and frozen at -20ºC until analysis. Samples were thawed for 24 h at 4ºC, heated to a core temperature of 70ºC, cut into 5cm long 1x1cm blocks along the fibre direction on which 8 replicate shear force determinations were performed (Warner Bratzler).

Results and discussion

We chose to cut through the samples to get a full profile of the forces used at different stages of the cutting distance. These profiles gave us a number of parameters of which most indicated similar differences between treatments. Often the tenderness of meat is indicated by the peak force, which for BF and LD was 53.6N, 58.6N, 60.2N, 58.6N and 43.4N, 44.5N, 45.9N, 48.3N for meat of control pigs and pigs resting for 0, 1 or 3 h respectively. None of these data was significantly different between treatment groups, but as expected LD was more tender than BF. However, these results and most other parameters indicated an increasing force to cut the meat from stressed pigs as a whole, and this was even significant in LD samples, where meat from the control pigs required less force to cut through the shoulder compared to that of meat from exercise-stressed pigs allowed to rest for 3 h before slaughter.

Other meat quality parameters determined on this material including drip loss (Young et al. 2007) was increased in BF (similar trends for LD) from pigs slaughtered immediately after exercise, which corresponds well with the faster drop in pH in this group of pigs within the first hour *post mortem* (Figure 2). The results on drip loss and pH profiles the first h *post mortem* indicated that one hour of rest was sufficient to reduce the glycolytic rate and drip loss back to that of control pigs.

However, the results from the texture related data presented in this short paper does not seem to be related to the drip loss data as the force, although small, tended to increase in groups of pigs stressed before slaughter despite resting times of 1 or 3 h before slaughter.

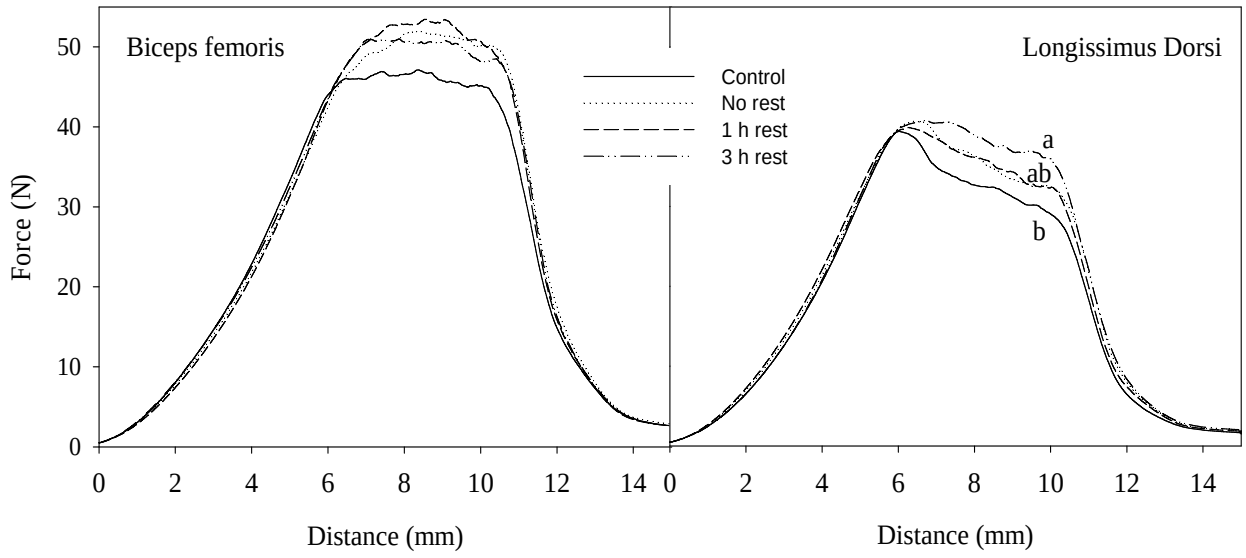

Figure 1. Mean profiles (n=10) of the force required to cut through the meat samples from pigs exposed to exercise-stress and left to rest for 0, 1, or 3 h before slaughter. Control pigs were not exercised.

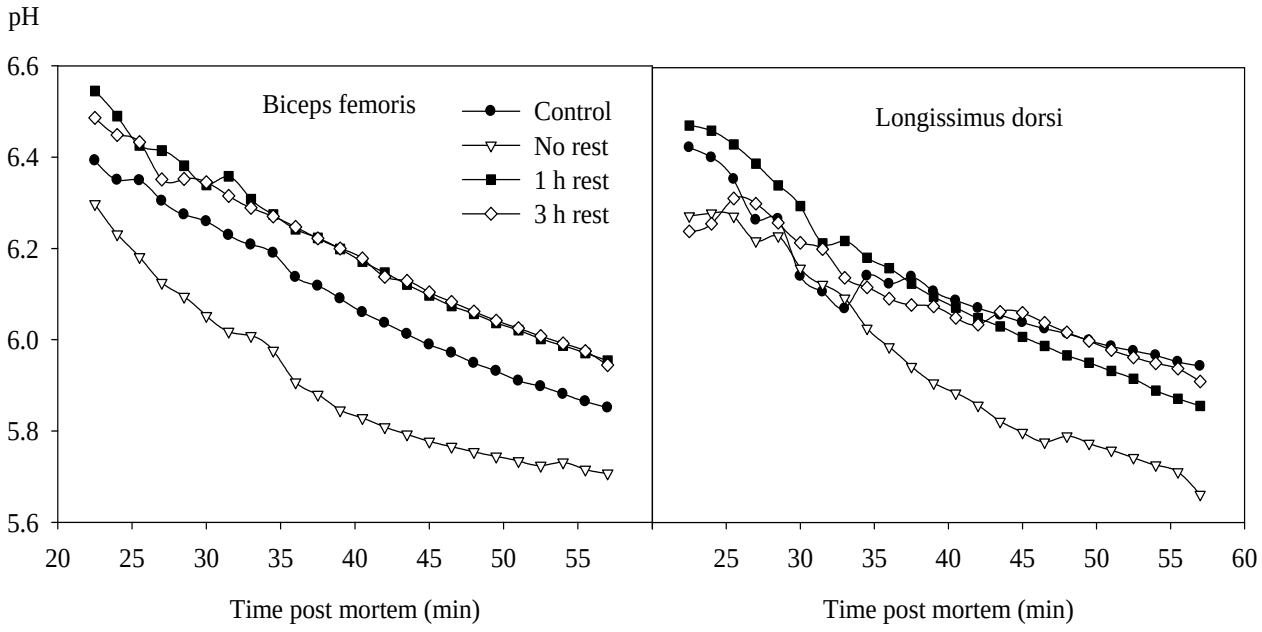

Figure 2. *Post mortem* pH of M. *longissimus dorsi* and M. *biceps femoris* of pigs exposed to exercise-stress and left to rest for 0, 1, or 3 h before slaughter. Control pigs were not exercised.

Conclusions

We conclude that stress up to 3 h before slaughter could affect the force required to cut meat samples, and that the quality characteristics drip loss and tenderness is not related when dealing with meat of exercise-stressed pigs.

Acknowledgement

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Disclaimer

References

Grandin, T. (1980). The effect of stress on livestock and meat quality prior to and during slaughter. International Journal for the Study of Animal Problems, 1: 313-337.

Kuchenmeister, U., Kuhn,G., and Ender,K. (2005). Preslaughter handling of pigs and the effect on heart rate, meat quality, including tenderness, and sarcoplasmic reticulum Ca2+ transport. Meat Science, 71: 690-695.

Kuchenmeister, U., Kuhn,G., Stabenow,B., and Ender,K. (2002). The effect of experimental stress on sarcoplasmic reticulum Ca2+ transport and meat quality in pig muscle. Meat Science, 61: 375-380.

Pike, M.M., Ringkob,T.P., Beekman,D.D., Koh,Y.O., and Gerthoffer,W.T. (1993). Quadratic relationship between early-post-mortem glycolytic rate and beef tenderness. Meat Science, 34: 13-26.

Young, J.F., Leoni,F., Straadt,I.K., Williams,J.H.H., and Oksbjerg,N. (2007). Heat shock proteins as markers for pre-slaughter stress and prediction of meat quality. Proceedings of 53rd International Congress of Meat Science and Technology, Beijing, China: 609-610.