THE SIGNIFICANCE OF DIET AND AGING TIME ON PORK COLOUR AND COLOUR STABILITY

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Introduction

Consumers relate the colour of the meat to the freshness and good quality. Meat is often pre-packed prior to display in retail. During extended retail display, discoloration of the meat takes place and thus changes the surface of the meat from bright red to greyish-brown. Any accumulation of the oxidized meat pigment, metmyoglobin (MetMb), which gives rise to the greyish-brown colour on the surface of the meat, will have an impact on consumer perception as they associate this change in colour with non-fresh products. Recent studies have shown that strategic finishing feeding of pigs with diets low in digestible carbohydrates alters glycogen stores within the muscle and the subsequent progress in *post mortem* processes which results in a darker and less intense colour of *M. longissimus dorsi* (LD) (Tikk et al. 2006; Rosenvold et al. 2001). Considering that even small differences in *post mortem* pH/temperature process have been reported to affect colour characteristics by influencing the activity of oxygen-consuming/metmyoglobin-reducing enzymes and denaturation of proteins/enzymes (Lindahl et al. 2006c), choice of feeding regime may have a strong potential in improving and/or controlling meat colour.

Materials and methods

Forty crossbred slaughter pigs (Duroc boars and Danish Landrace x Danish Yorkshire sows) originating from 20 litters, with one female and one castrate in each litter, were reared at the experimental farm at the University of Aarhus, Research Centre Foulum. Twenty control pigs were given a standard grower-finishing diet (control diet), which mainly consisted of barley (55%), soybean meal (20%), wheat (20%) and sugar beet molasses (1%), and 20 experimental pigs were given a diet with a low content of digestible starch (experimental diet), which consisted of high levels of grass meal (24%), rape seed cake (36%), dried sugar beet pulp (25%), soybean meal (7%) and animal and vegetable fat (6%).

pH and temperature were measured 45 min and 24 h *post mortem* inside *M. longissimus dorsi* (LD) and in the deep portion of *M. semimembranosus* (SM). Moreover, muscle glycogen content 1 min *post mortem* was determined together with driploss from LD. LD (12 cm of the loin, 19-31 cm from the last rib in the cranial direction) and SM were removed from the carcass, and a 2 cm thick sample from each LD and SM was cut and bloomed with no surface covering for 1 h at 4°C prior to colour measurement (1 day *post mortem*). The remaining part of each LD and SM was vacuum-packed and stored at 4°C before measuring the colour according to the procedure described above for 2, 4, 8 and 15 days *post mortem*. The colour after vacuum-aging was measured after 1 h blooming on each aging day on a newly cut surface. Moreover, the colour stability of meat from each vacuum-packed aging day was evaluated during subsequent 6 days of storage in air.

Results and discussion

In the present study, the experimental diet resulted in a lower drip loss and lower *post mortem* temperature 45 min and 24 h (1°C) in LD and SM. In contrast no difference in *post mortem* pH (45 min and 24 h) and muscle glycogen content 1 min *post mortem* was registered between treatments. The effect on the water-holding capacity and temperature decline confirms the results of Rosenvold et al. (2001).

Aging of the meat in vacuum has been reported to increase the blooming ability of the meat due to progressive inactivation of the inherent oxygen-consuming enzyme systems without substantial weakening of the MetMb reducing ability (metMbRA) of the meat (Lindahl et al. 2006a; Lindahl et al. 2006b). This was confirmed in SM in the present study and more pronounced in pork from control group compared to the experimental group, where the extent of blooming after vacuum-aging continued to increase for up to 8 days *post mortem* with a simultaneous increase in redness, yellowness and chroma, which can be considered an improvement in pork colour. In contrast, the effect of diet and aging time in vacuum on the extent of blooming was the opposite in LD from pigs fed an experimental diet, i.e., lower redness and higher hue angle from 1 to 4 days *post mortem*. These observed differences in the extent of blooming after vacuum-aging between two muscles and the initial decrease of blooming in LD can be related to the response of the temperature/pH sensitivity of inherent enzyme systems.

A significant interaction between diet, aging and days of storage in air on redness (a*value) and hue angle was found in both muscles (Figure 1). A slightly higher redness and lower initial hue angle during air storage of

meat from the control group was found and might be explained by differences in temperature decline early *post mortem* of pigs of two feeding groups. The higher initial temperature in the control group may be speculated to result in a higher enzyme inactivation that allows higher oxygen penetration to the meat, and subsequently a more pronounced red colour. Furthermore, the effect was more pronounced in SM compared with LD. However, in both muscles, the discoloration - expressed as lower redness and higher hue angle - occured faster in meat from the control group compared with the experimental group after extended aging in vacuum and subsequent storage in air. Faster discoloration rate is caused by higher accumulation of MetMb on the meat surface due to exhausted MetMb-reducing systems during prolonged storage of meat (Zhu & Brewer, 1998).

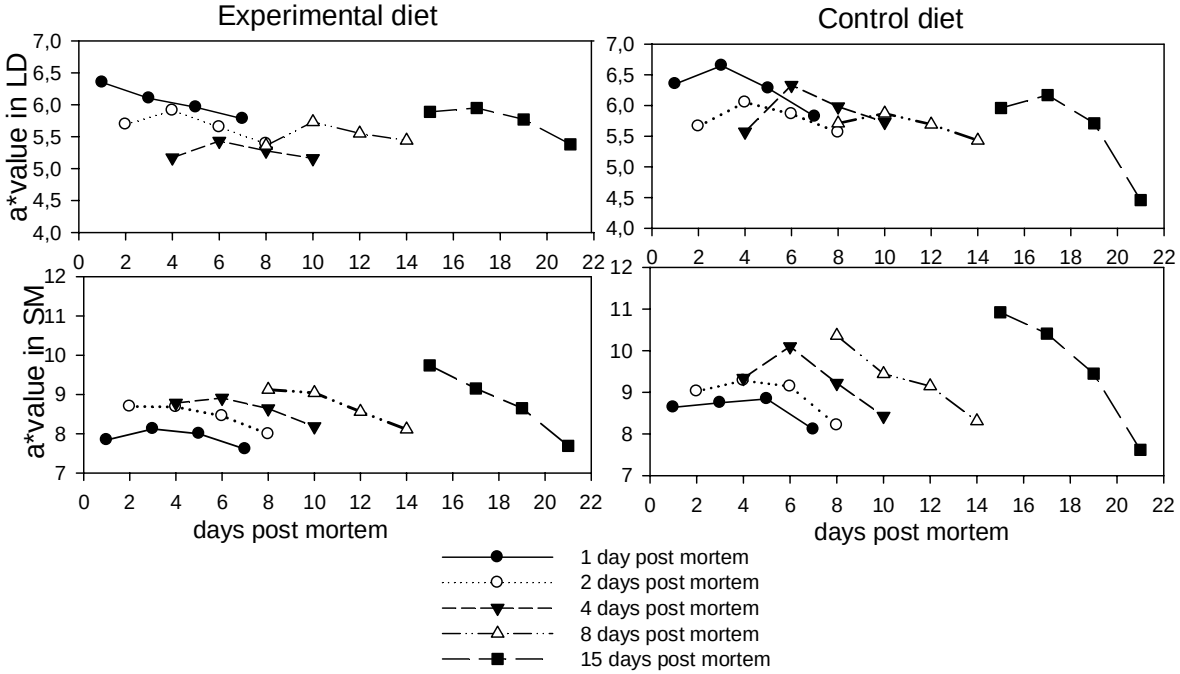

Figure 1. Effect of diet on the change in colour parameters during blooming and subsequent storage in air of *M. Longissimus dorsi* and M. *semimembranosus* aged for 1, 2, 4, 8 and 15 days *post mortem*.

Conclusions

In the present study the dietary treatment and aging had an effect on post mortem colour and colour stability progress. The extent of blooming decreased during the first 2 to 4 days *post mortem* in LD with the effect being most pronounced in meat from pigs fed strategic finishing feeding compared to the meat from control group. In contrast this effect was not seen in SM and a gradual increase of the extent of blooming during aging was taking place. Pork from the control group discoloured faster compared with the experimental group after extended storage post mortem. The discoloration rate was expressed as faster decrease of a*value and higher increase of hue angle. Furthermore, the effect was more pronounced in SM compared to LD. This clearly shows that the diet composition can be used as a tool to have a control over meat colour and colour stability.

References

1. Lindahl, G., Enfält, A.C., Andersen, H.J., & Lundström, K. (2006a). Impact of RN genotype and aging time on colour characteristics of the pork muscles longissimus dorsi and semimembranosus. *Meat Science*, 74, 746-755.
2. Lindahl, G., Karlsson, A.H., Lundström, K., & Andersen, H.J. (2006b). Significance of storage time on degree of blooming and colour stability of pork loin from different crossbreeds. *Meat Science*, 74, 603-612.
3. Lindahl, G., Henckel, P., Karlsson, A.H., & Andersen, H.J. (2006c). Significance of early post mortem temperature and pH decline on colour characteristics of pork loin from different cross-breeds. *Meat Science*, 72, 613-623.
4. Rosenvold, K., Lærke, H.N., Jensen, S.K., Karlsson, A.H., Lundström, K., & Andersen, H.J. (2001). Strategic finishing feeding as a tool in the control of pork quality. *Meat Science*, 59, 397-406.
5. Tikk, K., Tikk, M., Karlsson, A. H., & Andersen, H.J. (2006). The effect of a muscle-glycogen-reducing finishing diet on porcine meat and fat colour. *Meat Science*, 73, 378-385.
6. Zhu, L.G., & Brewer, M.S. (1998). Metmyoglobin reducing capacity of fresh normal, PSE and DFD pork during retail display. *Journal of Food Science*, 63, 390-393.