THE POTENTIAL OF MUSCLE IRON CONCENTRATION ON ALLEVIATING DARK CUTTING INCIDENCE IN SHEEP

Eric N. Ponnampalam[1,2*], Matthew I. Knight[2], Matthew G. Kerr[2] and Kym L. Butler[2,3]

[1,2]School of Agriculture and Food, The University of Melbourne, Parkville, Victoria, Australia

[2]Animal Production Sciences, Agriculture Victoria Research, DEECA, Victoria, Australia

[3]Animal Welfare Science Centre, Melbourne Veterinary School, The University of Melbourne, Victoria, Australia

*Corresponding author email: eponnampalam@unimelb.edu.au

I. INTRODUCTION

The incidence of dark cutting in lamb and adult sheep carcasses has been reported to be higher than the estimated 10% in cattle. The measurement of ultimate pH of meat (24 h pH) is being used as a threshold for the assessment of dark cutting in cattle and sheep, since muscle glycogen is related to meat 24 h pH. Muscle glycogen drives the extent to which the post-mortem muscle acidifies and, below a pH of 5.7, myoglobin can maintain its oxygenation and confer a bright red color in the meat [1]. However, a review by Ponnampalam *et al*. [2] indicated that the iron concentration in muscle (myoglobin) tissues on meat colour post-slaughter, especially redness, might warrant investigation. Bekhit *et al*. [3] proposed that the status of myoglobin can determine the brightness and fading of meat colour at retail display. This study investigated the association of muscle iron concentration, in addition to meat pH, on dark meat formation in lambs and yearlings fed forage-based diets.

II. MATERIALS AND METHODS

Eighty Maternal Composite (Comp) wether lambs weighing 28-38 kg and 80 Merino wether yearlings weighing 37-43 kg were finished on three pelleted diets (*Camelina sativa* (L.) Crantz forage- and meal-based diets and standard forage-based diet) in an animal house experiment. Animals were slaughtered in similar numbers after 8, 9 or 10 weeks of feeding, and at 24 h post-slaughter, ultimate pH of muscle *longissimus lumborum* (LL) was recorded. Muscle LL samples, from each animal, were maintained at -0.5 ℃ for 0 (fresh), 45- and 90-days, then displayed under simulated retail conditions (3–4 ℃) for 1 hour, before measurement of redness (*a**-value) of meat by a HunterLab colorimeter. An additional LL sample was used for determination of muscle iron concentration. A parallel multiple regression with terms for ultimate pH and muscle iron, and separate intercepts for each slaughter, was fitted to each measurement. The appropriateness of this model was confirmed by examining deviations from the model, including quadratic terms, interactions, treatment effects and random pen effects.

III. RESULTS AND DISCUSSION

The redness of meat for 45- and 90-day of storage time were higher than the fresh meat at 1 h display, regardless of animal type (Figure 1A). There was no large association between pH and iron within each breed (Figure 1B). After adjusting for the effects of slaughter date and ultimate pH, increased iron concentration was strongly associated with an increase in redness of meat, irrespective of storage time (Figure 1C for fresh meat and Figure 1D for 90 days storage, 45 days storage not shown). Each increase in muscle iron concentration of 1 mg/kg resulted in an increase of meat redness (*a**-value) of about 0.3 units in fresh meat and 0.25 units in 45- and 90-day stored meat. The study shows that dark meat formation still occurs when primal (LL) cuts are displayed as fresh or vacuum-packed cuts. Based on thresholds of ultimate pH at 5.7, 5.8 and 6.0, the incidence of dark cutting in the current study (averaged over breeds) was 25%, 12% and 4%. Also, the results clearly show that, apart from the influence of ultimate pH on dark cutting, increased muscle iron concentration was strongly associated with increased redness of meat at immediate retail display (i.e., lower incidence of dark cutting).

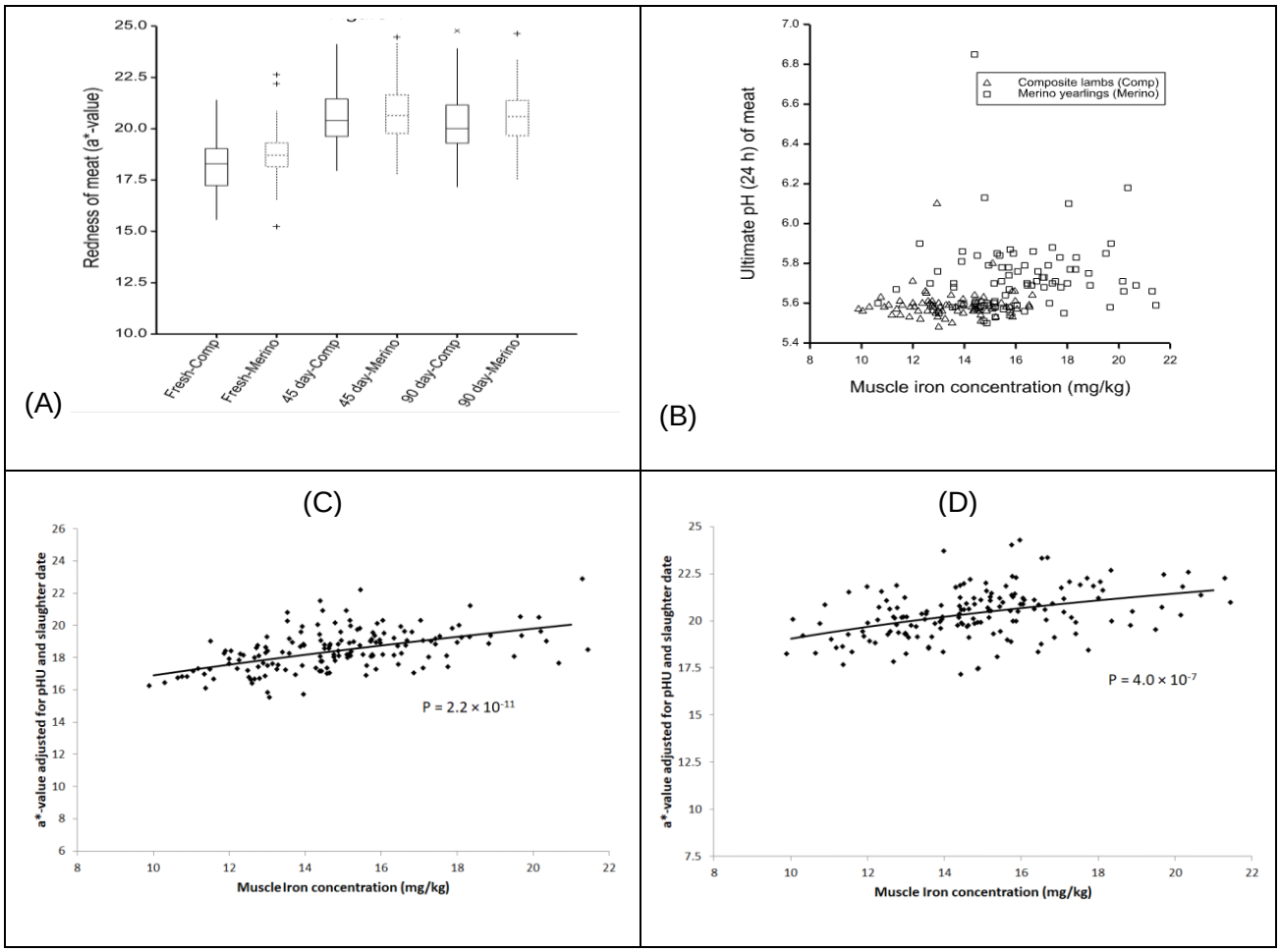

Figure 1. The impact of muscle iron concentration and storage time (Fresh, 45- and 90-days) on the redness of meat on Composite (Comp) and Merino sheep. (A) The impact of storage time on meat redness. (B) The relationship between muscle iron concentration and ultimate pH. (C,D) The relationship between muscle iron concentration and redness of meat for fresh meat and meat stored for 90 days at -0.5 ℃

IV. CONCLUSION

The effect of iron concentration in meat redness cannot be neglected because for each milligram increase in iron concentration, the *a**-value (meat redness) increases by about 0.2-0.3 units for sheep at the same 24 h pH. Therefore, it may be desirable to measure muscle iron concentration, in addition to the usual measurement of ultimate pH for classifying dark cutting carcasses.

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