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Intramuscular fat and muscle aerobicity reduce colour stability

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The brown discolouration of lamb meat reduces its appeal to consumers, costing the Australian Lamb industry considerably due to the discounting of product. Lamb meat browning is caused by the oxidisation of myoglobin pigments into the brown metmyoglobin form. The rate of this oxidisation is greater in more aerobic muscles (O'Keeffe and Hood 1982), with aerobicity quantified by the measurement of isocitrate dehydrogenase activity (ICDH). High intramuscular fat percentages (IMF) have been associated with high ICDH levels, so if industry moves to increase IMF we can hypothesise that there will be an ICDH linked increase in the brownness of lamb meat after 3 days of retail display.

Measures of ICDH, IMF and colour were obtained from 2194 lambs from five sites of the Information Nucleus Flock of the Sheep Cooperative Research Centre in 2007 and 2008. A red/brown colour ratio was calculated based on colour measurements taken using a Hunter Lab Miniscan reflectometer at 580 and 630 nm light reflectance (Hunt 1980) 72 hours into the meat display period. The lower the red/brown value the more brown and less red the colour of the meat. The red/brown ratio was analysed using a linear mixed effects model with fixed effects for site, year, kill group within site and year, sex, sire type and dam breed within sire type, and random terms for sire and dam. Using this model, ICDH and IMF were individually included as covariates to assess their phenotypic association with the red/brown ratio.

Increasing IMF content by 3 units reduced ($P<0.05$) the ratio by 0.23 units (Figure 1), while increasing ICDH by 4 units reduced ($P<0.5$) the ratio by 0.47 units (Figure 2).

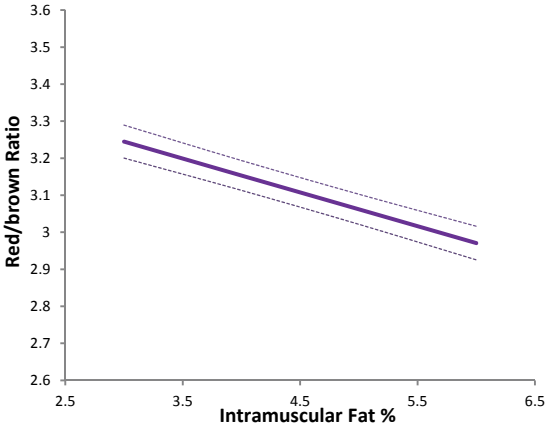

Figure 1 *IMF percentage and the red/brown ratio. Lines represent lsmeans±s.e.*

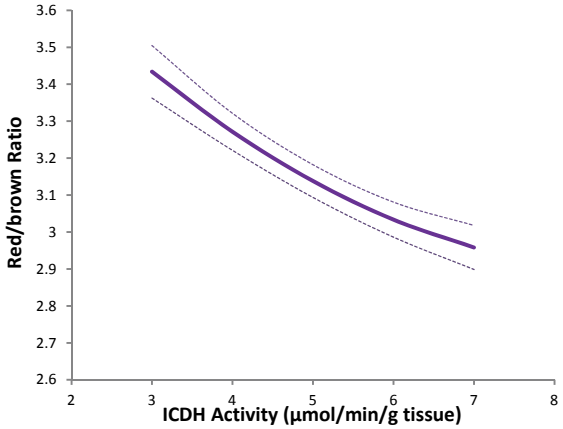

Figure 2 *ICDH activity and the red/brown ratio. Lines represent lsmeans±s.e.*

In line with the hypothesis, increased IMF and ICDH were associated with lower red/brown ratios after 3 days of display. The red/brown ratio changed more across the ICDH range compared to the IMF range suggesting that muscle aerobicity was the key driver of colour stability. The half unit increase in red/brown colour ratio seen over the ICDH range is estimated to provide an extra half day of retail display of lamb before browning forces discounting of the meat. Industry selection of IMF for eating quality purposes will need to be carefully managed to ensure that any resulting increase in muscle aerobicity does not worsen meat colour. This could include the use of vitamin E supplementation, modified atmosphere packaging or direct genetic selection for improved colour stability.

Hunt, M. (1980). "Meat colour measurements." *Reciprocal Meat Conference* **33**: 41-46.
O'Keeffe, M. and D. E. Hood (1982). "Biochemical factors influencing metmyoglobin formation on beef from muscles of differing colour stability." *Meat Science* **7**(3): 209-228.