Using Vitamin E to Improve Colour Stability is Less Effective in Long Aged Lamb Meat

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Brown discolouration of lamb meat on retail display reduces consumer appeal, limiting the shelf life and value of the product. The rate of change in colour from red to brown, known as colour stability, is increased in short aged meat with high intramuscular fat (IMF) content (Calnan *et al* 2014). Therefore genotypic selection for IMF to improve sensory appeal may reduce lamb meat colour stability. Extended aging of lamb meat also reduces colour stability of lamb meat (Jose *et al*, 2008), a concern for chilled meat shipped for 35 - 70 days to distant markets. High intramuscular vitamin E (α-tocopherol) concentration, achieved by dietary supplementation, slows the loss of redness in lamb aged 5 - 10 days (Jose *et al*, 2008). Given that colour stability worsens with aging, the impact of α-tocopherol may be greater in long-aged and high IMF meat. We hypothesised that high muscle α-tocopherol concentration in lambs will retain redness during display of the *longissimus,* particularly in long-aged and high IMF meat.

Lambs (n=132) from 66 Terminal, Maternal or Merino sires with variation in estimated breeding values for IMF were selected from the Sheep Cooperative Research Centre's information nucleus experiment. One lamb from each sire (n=66) was fed a high α-tocopherol ration (275mg/kg feed), and the other fed an identical ration but low in α-tocopherol (30mg/kg feed) for a period of 8 weeks prior to slaughter at an average carcass weight of 21 kg. The *longissimus* muscle was measured for IMF and α-tocopherol concentration and 3 samples per lamb were vacuum packaged and aged at -1°C for 5, 35 and 70 days, before being re-sliced, re-packaged with oxygen-permeable film and placed under simulated retail display for 72 hours. Surface colour was measured using a Hunter lab reflectometer 24 hourly during display, with redness calculated as R630/R580. Redness was analysed using a mixed linear effects model (SAS), including aging period, sire type, dam breed and gender as fixed effects; display time, muscle IMF and α-tocopherol as covariates, and sire and dam as random terms. Non-significant interactions ($P > 0.05$) were removed.

At an IMF of 2.5%, increasing α-tocopherol from 1 to 3mg/kg increased ($P < 0.05$) the redness after 72 hours retail display in meat aged for 5, 35 and 70 days by 0.79, 0.90 and 0.33 units. Increasing IMF to 5.5% depressed this effect ($P < 0.05$), with increasing α-tocopherol 1 to 3mg/kg only increasing redness by 0.69, 0.59, and 0.16 units in 5, 35 and 70 day aged meat. In either case α-tocopherol was less effective in 70 day aged meat ($P < 0.05$). Irrespective of α-tocopherol concentration, increasing IMF from 2.5 to 5.5% reduced redness by 0.4 units in 5 day aged meat, and by only 0.02 units in 70 day aged meat after 72 hours display. The only outlier to this trend was in 5 day aged meat at high α-tocopherol concentrations, where IMF increased redness by 1.19 and 0.98 units at 0 and 24 hours of display.

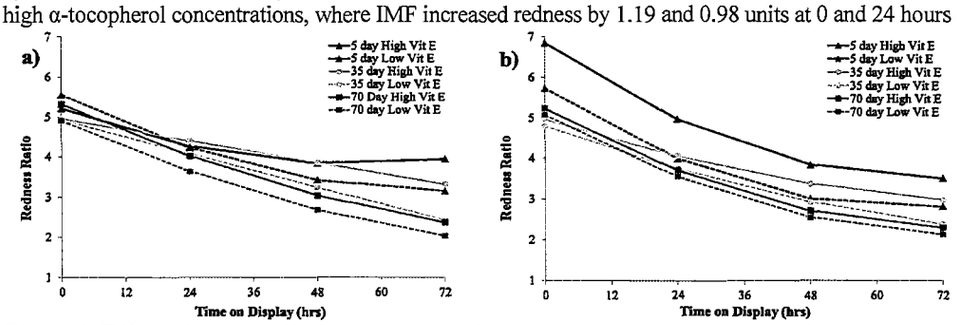

Figure 1. Effect of time on display (hours) on the redness ratios of lamb *longissimus*. Lines represent least square means for each aging period at High (3mg/kg) and Low (1mg/kg) muscle α-tocopherol (vitE) concentrations in meat with a) 2.5% IMF and b) 5.5% IMF levels.

Contrary to our hypothesis, the improvement in colour stability due to increasing muscle α-tocopherol concentration was less in long aged lamb *longissimus* compared to short aged meat, and further reduced by high IMF levels. Alternatively, IMF itself had relatively little impact on colour stability in long aged meat. This contrasted with the marked negative impact of IMF in short aged meat, a result attributed to increased lipid peroxidation in our earlier work (Calnan *et al* 2014). In short aged meat with high muscle α-tocopherol, high IMF meat was unexpectedly redder for up to 48 hours than low IMF meat, a result that is difficult to explain. Therefore while dietary vitamin E supplementation will be of limited use for enhancing colour stability in long aged meat it will be particularly beneficial in the domestic market where short aged high IMF lamb is valued.

Calnan, H, Jacob, R. Pethick, D. & Gardner, G. (2014), *Meat Science* 96, 1049
Jose, C., Gardner, G., Pethick D. & Jacob, R. (2008) *54th International Congress of Meat Science & Technology* p 149
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