Vitamin E stabilises the colour of ‘out of season’ lamb meat

What is meat colour stability?

Meat is said to be unstable in colour when it changes from red to brown quickly. The pigment myoglobin in meat largely determines its colour. Once meat has been sliced and packed on trays, myoglobin at the surface begins to oxidise to a form metmyoglobin. Metmyoglobin has a brown hue and cannot ‘bloom’ to a red hue in the way that myoglobin does at the surface of freshly cut meat.

Packaging affects the time period that meat is expected to remain red. This is about two days when overwrapped with oxygen permeable film and about eight days when packed with oxygen impermeable film in a modified atmosphere.

Why is meat colour stability so important?

Meat has to be displayed to be sold. Meat that has a red hue is perceived by consumers as fresh. To avoid meat changing colour and becoming undesirable to consumers a faster sale may be encouraged by using a price discount. Discounted meat represents a large reduction in product value to the retail sector of the lamb meat industry.

Lamb meat is less stable in colour than beef, pork and chicken. For example, loin meat from nearly half the lambs slaughtered from the Sheep CRC Information Nucleus Flock had a brown hue when overwrapped and displayed for two days (Figure 1). These lambs were sourced from a range of genotypes and finishing systems across Australia. Rump and topside are much less stable in colour than loin, so this is a very conservative estimate of the rate of browning for all cuts across the carcase.

Figure 1 - percentage of lambs with brown meat colour when fresh, after one day and two days of display (data from Sheep CRC INF slaughter lambs).

Key points

- The pigment myoglobin in meat largely determines its colour.
- Discounted meat represents a large reduction in product value to the retail sector of the lamb meat industry.
- Vitamin E is a powerful antioxidant that protects myoglobin in meat.
- Feed supplementation is the method of choice for improving the vitamin E content of meat.
The role of vitamin E in meat colour

Vitamin E is a powerful antioxidant that protects myoglobin in meat. Meat tends to brown rapidly when the vitamin E concentration is below a benchmark value of 3.5mg/kg. This happens particularly when meat has been aged prior to sale (Figure 2). Fresh lamb meat can often be aged for 10 days when sold domestically to optimise tenderness and for more than 30 days when exported chilled due to shipping times.

Other roles for vitamin E

Vitamin E also protects muscles against a specific form of white muscle disease. This disease occurs when uncontrolled oxidation in the muscle of live animals damages tissue. Selenium deficiency is a common cause of this disease but symptoms may occur when lambs have adequate selenium and insufficient vitamin E. Affected animals are stiff gaited, become recumbent and die due to other complications in severe cases. While vitamin E supplementation prevents ill health due to white muscle disease, research indicates no improvement in the growth rate of lambs deficient in vitamin E that don’t have symptoms of white muscle disease (Figure 3).

Figure 2 vitamin E supplementation improved the shelf life of topside aged for 5, 10, 20 and 30 days

Figure 3 short-term vitamin E supplementation improved blood levels but not the live weight of healthy lambs (supplementation rate = 250mg/kg)
Sources of vitamin E

Vitamin E occurs abundantly in green pasture but not in dry roughage or grains. Consequently feedlot rations can be deficient in vitamin E unless supplemented.

A recent study in Victoria demonstrated the effect of feed type on vitamin E levels in meat. Vitamin E concentrations in topside meat from feedlot lambs were below the critical level (3.5mg/kg) for colour stability. In contrast, meat from new seasons and carry over lambs finished on grass-slaughtered at the same abattoir on the same day-contained sufficient vitamin E (Figure 4). Levels can be expected to fall below the benchmark for colour stability within four weeks of pastures drying off. Interestingly, saltbush can be a good source for grazing animals with levels as high as 140 mg/kg DM of vitamin E during the dry period.

How to supplement vitamin E

Feed supplementation is the method of choice for improving the vitamin E content of meat. Injectable and oral drenching formulations are not recommended for this purpose. Supplementation via drinking water may be an alternative to feed supplementation, using specialised metering equipment. However, this method has not been trialled for stabilising meat colour in lambs. Vitamin E rates for water would need to be calculated using feed supplementation rates in accordance with expected levels of water intake.

Supplementation rates

The rate recommended depends on the length of the supplementation period, with lower rates needed for longer periods. Vitamin E accumulates in the muscles (Figure 5) during the supplementation period. There is no extra benefit gained by exceeding the benchmark level, so the most cost-effective strategy is to use the least amount of vitamin E possible. However, a minimum supplementation level of 50mg/kg is recommended, to prevent white muscle disease regardless of the length of the finishing period. Seek advice if mixing rations on farm and always read the label to check the concentration of active ingredient. Vitamin E feed additives for sheep generally contain 50% active ingredient. Table 1 shows the mixing rates for different feeding periods using products containing 50% vitamin E.

Why supplement with vitamin E

Typically meat retailers notice poor colour stability during the autumn winter period in meat from lambs finished on dry feed or feedlots. Research has shown that supplementing feedlot rations during the autumn winter period with vitamin E has two main benefits:

1. meat quality - extended shelf life with a lighter brighter colour
2. disease prevention- lambs are less susceptible to White Muscle Disease
### Cost of supplementation

The cost of the vitamin E ingredient is about 55 cents per lamb at the levels recommended, assuming the vitamin powder costs $35/kg and lambs eat 1.5kg of mixed feed per day. The cost remains the same per lamb for short, medium and long feeding periods because the supplementation rate is lower for the longer periods. For water supplementation, the cost of a dosing device should be considered in addition to the cost of the vitamin E ingredient. Suppliers should be contacted for estimates of this cost.

<table>
<thead>
<tr>
<th>Feeding period</th>
<th>Time (weeks)</th>
<th>Active ingredient (mg/kg)</th>
<th>Mixing rate 1 (kg/tonne of feed)</th>
<th>$ / tonne feed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short</td>
<td>&lt; 4 weeks</td>
<td>250</td>
<td>0.5</td>
<td>17.5</td>
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<tr>
<td>Medium</td>
<td>4-8 weeks</td>
<td>150</td>
<td>0.3</td>
<td>10.5</td>
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<tr>
<td>Long</td>
<td>&gt; 8 weeks</td>
<td>50</td>
<td>0.1</td>
<td>3.5</td>
</tr>
</tbody>
</table>

*Table 1 Mixing rates for feed supplementation of vitamin E*

### Benefits of supplementation

Prices for ‘out of season’ lamb may need to incorporate an incentive to account for this extra cost of adding vitamin E to rations at the rates recommended. While significant on a per head basis, the cost of vitamin E supplementation is equivalent to about 2.5¢ per kg of carcase. This makes vitamin E supplementation favourable when compared to the cost of meat at the retail level, and the potential loss in product value due to discount applied to prevent colour change before sale.

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**Further information**

Making More From Sheep website:  
www.makingmorefromsheep.com.au  