



AMPC/Sheep CRC/MLA Case Study

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Fact sheet – Meat colour stability

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Supply chain factors affecting lamb meat colour

Factors important for colour stability are also important for bloom colour and are influenced at different points along the supply chain, including on-farm, processing and retail.

Lamb production factors

Vitamin E in finishing diet

Finishing diet is important in two ways. Firstly, vitamin E supplementation can increase the brightness of meat bloom colour as well as the stability of the red colour during shelf display. Secondly, vitamin E is a powerful antioxidant; however, its natural concentration in pastures and crop decreases dramatically as they dry off at the end of the season. The appearance of brown on the meat surface is an oxidative process, therefore vitamin E concentration in the muscle has an influence on meat colour.

Typically, lambs become deficient in vitamin E during the summer and autumn period in southern Australia (or when green feed is limited in other areas). Meat derived from lambs that are deficient in vitamin E at the time of slaughter will have poor shelf-life based on retail display colour.

This seasonal effect can be avoided by increasing the amount of vitamin E added to finishing diets. For lambs that have not grazed green feed for longer than six weeks, a higher rate of vitamin E than normally recommended for animal health and production is required. A nutritionist should be consulted and the cost considered before doing this.

Finishing diet energy

The energy content of the diet during the finishing period is important for meat colour as well as other meat quality attributes, as this determines the amount of glycogen stored in muscle. After slaughter, glycogen is converted to lactic acid and this will influence the pH

(pH₂₄) of the meat post mortem. Meat with low glycogen stores has a high pH causing it to be dark and less stable in colour.

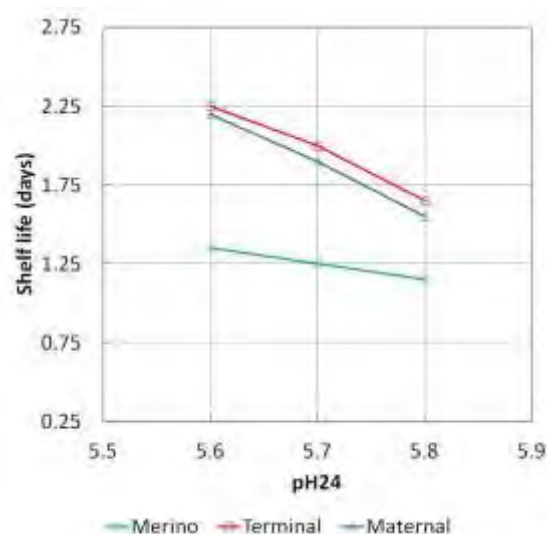


Figure 1: The effect of breed type and pH on the shelf life of lamb meat.

Stress prior to slaughter

The release of adrenaline due to stress and/or exercise reduces glycogen content of muscle prior to slaughter. Efforts to reduce stress and exercise intensity will limit this effect. Stress and extended periods without water during transport and/or curfew periods will contribute to dehydration. Lambs may not drink water when in foreign surroundings such as abattoir lairage yards, even when water is made available. Acclimatising lambs to water troughs prior to transport may encourage them to drink water in lairage.

Lamb age

Over the length of the annual lamb production cycle, lamb age increases from 'suckers' that are 4–6 months old to 'carry-overs' that are 8–12 months of age. Meat colour from carry-over lambs tends to be darker, more intense, less stable and more variable than meat from sucker lambs. These changes result from muscle pigment (myoglobin) increasing with lamb age,



however, they may also be due to changes in feed type as the seasons change.

Lamb genetics

Meat from merino lambs appears to be darker, less red in colour and less colour stable during retail shelf display than those from crossbred lambs of the same age (Figure 1).

Within a breed type, selection for other attributes particularly intramuscular fat concentration, growth rate and muscling has the potential to change the colour of lamb meat. Lambs from sires selected for muscling have been shown to have lighter coloured meat that is more stable in colour, although selection for intramuscular fat can reduce the colour stability. The new breeding values developed by the Sheep CRC and Sheep Genetics allow balanced selection for both muscle and intramuscular fat, thus maintaining colour stability.

Lamb retail factors

Cut

Some muscles change colour more quickly than others, both for bloom colour and colour stability. Generally, the redder the muscle, the less stable in colour is the muscle. Table 1 shows the stability of some common cuts.

Minced meat is less stable in colour than sliced meat due to the disrupted muscle cell structure, increasing the exposure of myoglobin to oxygen.

Table 1: Colour stability of cuts

Colour stability	Muscle	Commercial cut
Stable	<i>m. semitendinosus</i>	Eye round
	<i>m. biceps femoris</i>	Silverside
	<i>m. quadriceps femoris</i>	Knuckle
Intermediate	<i>m. longissimus thoracis et lumborum</i>	Loin
	<i>m. triceps brachii</i>	Shoulder
Unstable	<i>m. semimembranosus</i>	Topside
	<i>m. gluteus medius</i>	Rump

Packaging systems

A key aspect of the materials used for packaging is their permeability to oxygen. Non-permeable material is used for vacuum and modified atmosphere packaging (MAP). Vacuum-packaged meat keeps the myoglobin in a deoxygenated state and is more purple in colour. MAP meat colour will depend on the gas used in the head space above the meat. When high oxygen atmospheres are used, the meat will have a bright red colour due to oxygenation of the surface myoglobin.

Oxygen-permeable material is used for ‘overwrapped’ packaging systems. This allows passage of oxygen, but not water vapour. Therefore, meat will appear red in colour due to oxygenation of myoglobin at the surface. However, overwrapped meat is less colour stable than high oxygen MAP meat.

Storage temperature and light

Meat blooms more rapidly at low temperature. Low temperatures are also favourable for colour stability, although meat that has been frozen tends to be less colour stable than fresh meat. Exposure to light also reduces colour stability.



Producer check list to improve colour and shelf life

Management issue	Action	Reason
Finishing diet (the last 2–4 weeks prior to slaughter)	1. Ensure finishing diets have sufficient energy for a growth rate of at least 100 grams/head/day.	<ul style="list-style-type: none"> Lambs with low energy intake during finishing produce meat that is high in pH, which tends to be darker and less stable in colour.
	2. Supplement feedlot rations with vitamin E.	<ul style="list-style-type: none"> Vitamin E makes meat lighter and more stable in colour.
	3. Finish lambs as young as possible.	<ul style="list-style-type: none"> Meat from young lambs is lighter and more stable in colour.
Curfew and transport	<ol style="list-style-type: none"> Minimise curfew and transport periods prior to slaughter. Make water available during curfew. Acclimatise lambs to water troughs during finishing. 	<ul style="list-style-type: none"> Stress causes meat to have a high pH and the bloom to be dark in colour. Dehydration can cause meat to be darker in colour.
Lamb genotype	1. Finish merino lambs with a growth rate of at least 150 grams/head/day	<ul style="list-style-type: none"> Meat from merino lambs tends to be darker and less stable in colour, as well as being more susceptible to high pH.
	2. Be aware that some sire selection strategies may affect meat colour.	<ul style="list-style-type: none"> Meat from lambs sired by rams selected for muscling will be lighter and more colour stable. The new sheep genetics breeding values are designed to manage meat yield, eating quality and colour.

Retailer check list to improve colour and shelf life

Management issue	Action	Reason
Meat source	1. Source meat from processors with good process control, such as MSA.	<ul style="list-style-type: none"> Bloom colour and colour stability depends on lamb processing factors.
Cuts	2. Manage meat colour according to cut. Move unstable product more quickly.	<ul style="list-style-type: none"> Cuts with higher red muscle fibres are more unstable.
Packaging	3. Use packaging that suits the retail conditions.	<ul style="list-style-type: none"> Overwrapped meat has a shelf life of 2 days, high oxygen MAP 8 days.
Display cabinet conditions	4. Keep temperature as low and consistent as possible.	<ul style="list-style-type: none"> High temperature reduces colour stability.
	5. Keep light intensity as low as is possible.	<ul style="list-style-type: none"> Light reduces colour stability.



Further information

For further information refer to:

- Meat colour and shelf life fact sheet
- MLA: A producers' guide to production feeding for lamb growth
- MLA tips and tools: Vitamin E stabilises the colour of 'out of season' lamb meat
- MLA tips and tools: Dark cutting.

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