mla
MEAT & LIVESTOCK AUSTRALIA

tips&tools

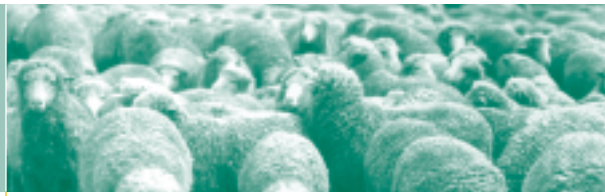
MEAT STANDARDS AUSTRALIA

# Meat Standards Australia sheepmeat information kit

# contents

mla
MEAT & LIVESTOCK AUSTRALIA

tips&tools



MSAS1

MEAT STANDARDS AUSTRALIA

# What is MSA sheepmeat?

**Meat Standards Australia (MSA) is a valuable asset to the Australian sheepmeat industry, providing opportunities to differentiate products in the market. MSA sheepmeat is a supply chain management program designed to improve the eating quality of all sheepmeat categories (lamb, hogget and mutton).**

A complex series of factors which all affect the eating quality of sheepmeat are taken into account during the production process. This solves the long-standing consumer problem of selecting sheepmeat and choosing an appropriate cooking method.

In 1997, an Australia-wide audit of retail lamb showed that 20% of loins were unacceptably tough.

Today consumers expect quality – attributes such as flavour, juiciness, tenderness and overall liking should not fall below a minimum value.

In 2000, Meat & Livestock Australia (MLA), with the support of research partners and the industry, designed a Sheepmeat Eating Quality (SMEQ) research program to define best practice procedures through the identification of critical control points for eating quality. This research covered all aspects of the supply chain on behalf of producers, processors, retailers and foodservice operators. The results provided tools to monitor and improve product quality and match customer requirements in a practical and cost-effective way.

## Consumer research

A total consumer focus has been the foundation of SMEQ research and development. The target has been to accurately establish and satisfy consumer set standards. Since 2000, over 45,000 consumer taste tests of lamb and sheepmeat products have been completed.

The tests required consumers to score samples based on tenderness, liking of flavour, juiciness and overall liking. Consumers also scored products into eating quality grades as either unsatisfactory, good everyday or better than everyday eating quality.

## Key points

- MSA sheepmeat involves all sectors of the production supply chain, from farm to plate, with the end result being a guaranteed eating quality product.
- MSA sheepmeat standards are created from the analysis of 45,000 consumer test results, combining tenderness, juiciness, flavour and overall liking scores.
- MSA sheepmeat labels advise the correct cooking method for every cut of sheepmeat and guarantees an eating quality result.

## Reducing variability

Pastoral production involves a variety of sheep breeds raised under variable seasonal, regional and climatic conditions. Whilst sheep have remarkable biological mechanisms to cope with and minimise the effects of drought, flood, heat, cold, and fly strike, the risk of compromised and variable eating quality is always present.

Variables throughout the supply chain include:

- stress caused by mustering and the time between mustering and slaughter
- processing procedures such as time between slaughter and retail sale
- conditions under which sheepmeat is displayed

By understanding and controlling these factors through the identification of SMEQ critical control points, and the translation of these control points into practical steps, the industry has the potential to improve average eating quality and reduce variability.

Reduced variability and a more consistent and better average eating quality in sheepmeat products will result in increasingly effective competition with other protein products. This does not mean that all sheepmeat will end up the same. Rather, different products – lamb loins,

hogget legs, mutton racks – can achieve their optimum quality and individually contribute to increased industry returns. Further, suppliers can make more informed choices about where to position their product for consumer satisfaction, risk, price and quality.

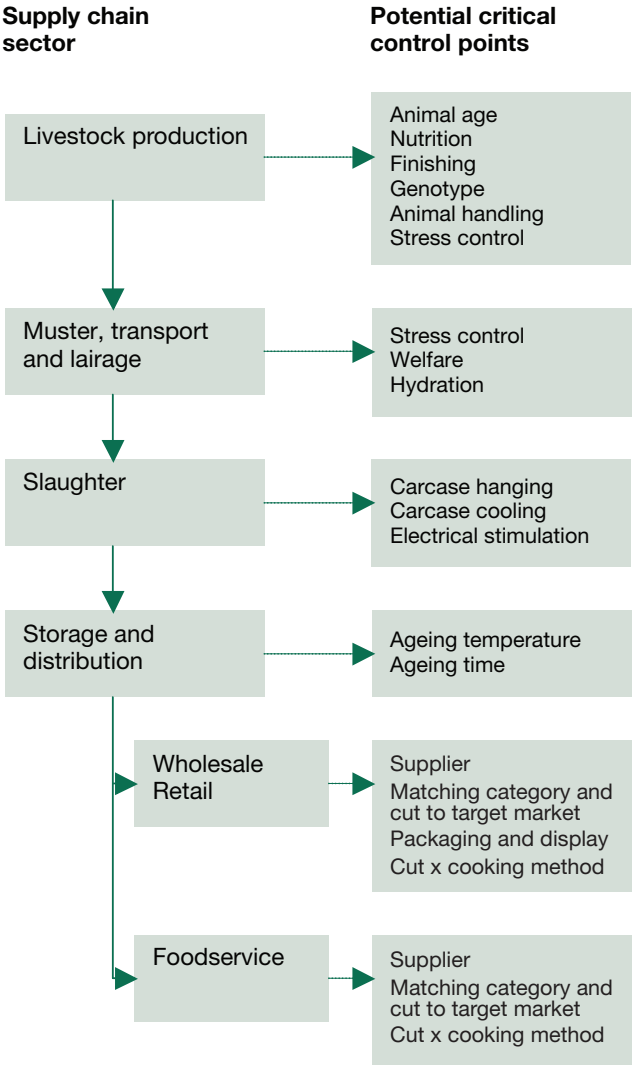
## Sheepmeat eating quality critical control points

Research was based on identifying where critical control points occur in the supply chain (see figure 1) and where they impact on eating quality outcomes. By minimising the impact in these areas, improvement in eating quality of sheepmeat products is achieved.

Industry participants should benchmark their own processes against the critical control points to determine whether their current practices could improve to meet the eating quality needs of customers.

Benchmarking requires measurement of factors such as temperature, time and pH. In most cases little or no expense is required. A low cost base model MSA sheepmeat assurance system, with provision for a third party audit, has been developed and effectively tested as a commercialisation component of this research.

*Figure 1: Potential critical control points for eating quality*

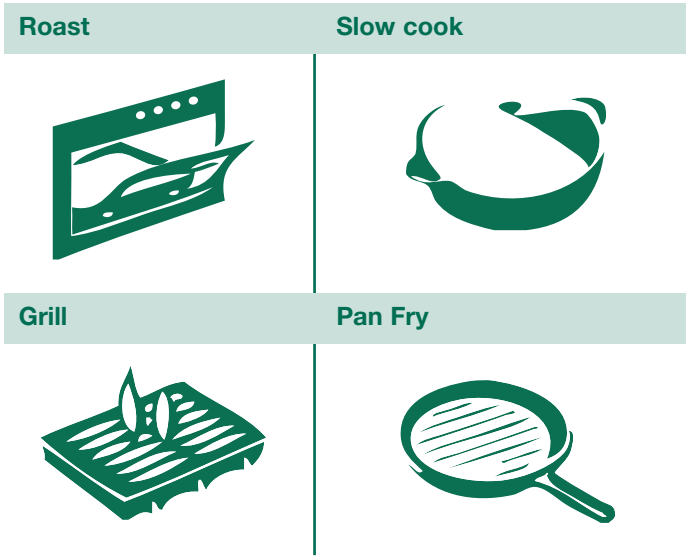



## MSA sheepmeat purchasing by trade

The MSA sheepmeat label provides trade with a guarantee of eating quality and recommends appropriate cooking methods. This is all the consumer needs to know to purchase and prepare sheepmeat products with confidence. Application of the MSA program encourages and rewards production participants and drives positive change in trading systems and consumer acceptance.

## Cooking method labels used in MSA

The following cooking methods are recommended as part of MSA. Where MSA is used to underpin a brand, that brand can have its own cooking label but the corresponding cooking method for the cut will be displayed.




## The consumer guarantee

MSA product is guaranteed. If a consumer purchases MSA product and cooks it as labelled, it is guaranteed to provide an acceptable eating quality standard.

### For more information

www.msagrading.com or 1800 111 672


MEAT & LIVESTOCK AUSTRALIA

Level 1, 165 Walker Street
North Sydney NSW 2060
Ph: +61 2 9463 9333
Fax: +61 2 9463 9393
www.mla.com.au



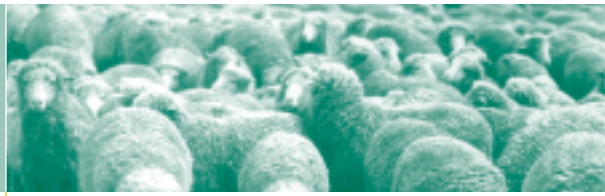
Reprinted March 2007
ISBN: 1 74036 801 0



ABN 39 081 678 364

mla
MEAT & LIVESTOCK AUSTRALIA

tips&tools



MSAS2

MEAT STANDARDS AUSTRALIA

# The effect of nutrition and growth on sheepmeat eating quality

## Nutrition and finishing

Good nutrition and finishing are critical in defining sheepmeat eating quality in the period leading up to slaughter. Given the potential for good eating quality cuts from all sheepmeat categories (lamb, hogget and mutton), it is important those animals are well nourished and managed.

During periods of active growth, the 'turnover' of collagen (the structural protein that dominates connective tissue) increases. For this reason, the hardening of connective tissue is slower. With reduced hardening, the background toughness in meat will be reduced.

## Growth and weight gain

For best eating quality, animals should be gaining weight up until slaughter. The growth rate in the two weeks prior to slaughter should be a minimum of 100g per day. Good feeding is particularly important for Merino meat production and in the two weeks prior to slaughter, Merino sheep and lambs should be growing at a minimum of 150g per day.

Good finishing optimises the amount of muscle, leading to tender meat. Muscle tissue comprises soft muscle fibres surrounded by stronger connective tissue fibres, which increase in toughness as the animal ages. Poorly nourished animals that are losing weight will use muscle fibres to nourish the rest of the body, but the connective tissue fibres remain unchanged. Consequently, poorly finished sheep are likely to produce tougher meat.

## The effect of finishing on sheepmeat eating quality

Research has shown that the type of finishing system has little effect on eating quality, provided sheep are gaining weight before slaughter and they are finished to a fat score of 2 or above. The exception is diets that are very high in cereal grains fed for long periods (eight weeks), which may cause eating quality problems.

### Key points

- For optimum eating quality results, lambs should be gaining at least 100g/day for crossbreds and 150g/day for Merinos.
- The type of finishing system has little effect on eating quality, provided that sheep are gaining weight before slaughter.
- Diets that result in weight loss in the weeks before slaughter cause meat quality problems.
- Stress prior to slaughter can reduce levels of muscle glycogen.
- Reduced glycogen will increase muscle pH and cause dark cutting meat.

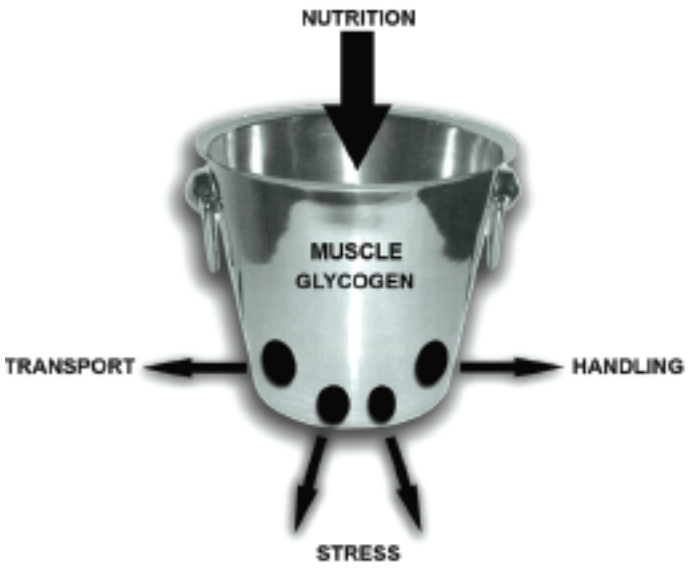
Good finishing guarantees adequate intramuscular fat levels. If intramuscular fat falls below 3%, consumers will rate meat as dry and lacking flavour. Typically, the loin of a prime lamb finished to a fat score of 2 or 3 has around 4–5% intramuscular fat, which is considered a balanced level.

## Good finishing optimises muscle glycogen

Glycogen is animal starch or sugar and is held in reserve for vigorous muscular activity. Good finishing optimises muscle glycogen levels at slaughter leading to better colour, flavour and shelf life. Optimising glycogen is a combination of good pre-slaughter nutrition and reducing stress in the immediate pre-slaughter period.

Every animal has a certain amount of energy contained in its muscles in the form of glycogen. Once the animal is dead, the muscle glycogen is converted to lactic acid, which causes pH to fall. The glycogen bucket diagram in figure 1 shows this relationship.

*Figure 1: Glycogen bucket*




Nutrition provided for the animal is the energy that goes into the bucket. The holes in the bucket represent the factors that use up energy, such as exercise or stress. These factors will always be present in some form, but it is important to minimise their impact. That is, to keep the 'holes' in the bucket as small as possible.

Low levels of muscle glycogen in the live animal cause high pH meat, which lacks flavour, is visually unattractive, tougher, takes longer to cook, and does not keep as well as low pH meat.

Good nutrition reduces the risk of slaughter animals developing high pH. Nutrition, sufficient to reduce the risk of the high pH condition in sheep, can be defined as a weight gain of at least 100g per day (150g per day for Merinos), and results in a high and normal concentration of glycogen in lean muscle tissue. The normal and ideal concentration in sheep is around 1.5g/100g of lean muscle weight.

## How is glycogen lost?

If the concentration of glycogen in lean muscle tissue falls below a threshold concentration (around 0.8g/100g), the pH of the resulting meat becomes higher than normal.

Poor nutrition and stress as a result of poor handling during mustering, yarding and transport will increase the rate of glycogen loss.

This will result in dark cutting meat, which is unattractively dark in appearance, has variable eating quality, and does not keep well when stored chilled. The importance of good nutrition is that it keeps the glycogen 'bucket' topped up (figure 1) and therefore reduces the chance of low concentrations at the time of slaughter. This acts as a buffer against losses that occur through 'holes' in the bucket (namely stress related factors) around the time of slaughter.

## For more information

www.msagrading.com or 1800 111 672

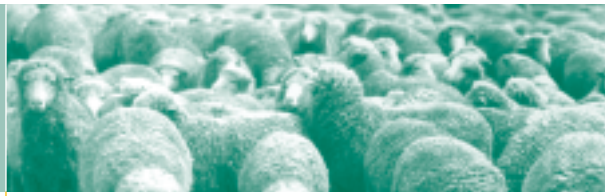
MEAT & LIVESTOCK AUSTRALIA

Level 1, 165 Walker Street
North Sydney NSW 2060
Ph: +61 2 9463 9333
Fax: +61 2 9463 9393
www.mla.com.au

Reprinted March 2007
ISBN: 1 74036 802 9

mla
MEAT & LIVESTOCK AUSTRALIA

tips&tools



MSAS3

MEAT STANDARDS AUSTRALIA

# MSA requirements for handling sheep

## How sheep handling can affect eating quality

An important element contributing to predictable eating quality is the management of sheep on-farm or at a feedlot prior to slaughter. For this reason MSA has produced guidelines to optimise the eating quality potential of the animal.

The long period of care and investment in producing an animal with high eating quality potential is most at risk in the two weeks prior to slaughter and the first few hours post slaughter. The best carcase can be reduced to a low quality, unacceptable product by inappropriate handling pre-slaughter.

The damage is caused by changes in muscle glycogen (blood sugar) levels. Glycogen is the energy reserve of the muscle. The glycogen level in muscle is increased by feeding (a process taking several days) and rapidly reduced by stress (which may only take minutes) or activity in the live animal. After stunning, the glycogen in muscle is converted to lactic acid that steadily decreases the pH of the muscle.

## Reduce stress pre-slaughter

Poor handling in the days and hours prior to slaughter can compromise the eating quality of even the best finished animals. Sheep and lambs are susceptible to stress and this must be minimised between mustering and slaughter. Some ways to consider reducing stress include:

- Minimising the use of dogs during mustering prior to loading.
- Adjust trucking times to match favourable weather conditions. Dramatic changes in temperature during transport, such as a cold snap or heavy rain, will cause undue stress.
- For product consistency from saleyards, producers and processors should aim to reduce the time between muster and slaughter, where practical. Transport and lairage principles for meat quality focus on two factors – minimising stress and reducing the time until slaughter.

A compromise between minimising carcase weight loss in transport and processor requirements for clean stock should be made.

A minimum of two weeks between shearing and slaughter is required to manage stress occuring as a result of the shearing process.

## Reduce dehydration pre-slaughter

Dehydration can reduce muscle weight and eye muscle area, with preliminary data suggesting a possible 3% loss in carcase weight. Therefore, to maintain quality, it is important to ensure stock have access to water during curfew, transport and lairage periods.

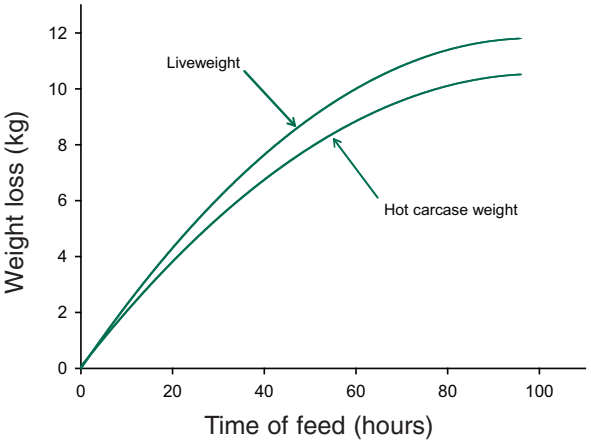
### Key points

- Unweaned or sucker lambs are more susceptible to stress caused by handling than carryover lambs.
- Allow a minimum of two weeks off shears (wool length >5 mm) before slaughter.
- Minimise the time between mustering and slaughter.
- Allow a minimum of two weeks at consignment property before dispatch.
- Total time off feed should not be greater than 48 hours (for on-farm curfew, transport and lairage), until slaughter.
- Minimise stress during curfew, transport and lairage.
- Access to water should be available during on-farm curfew and lairage.

## Maintain carcase weight

Once sheep are taken off feed they have the potential to lose carcase weight and condition. Losses are not immediate because many hours pass before the digestive system is food free. However, the longer the period between mustering and slaughter, the greater the chance that losses in carcase weight will occur (figure 1).

*Figure 1: Weight loss with time off feed*




## Agreed curfew for fasting animals

Processors typically require that sheep be held off feed for a minimum of 12 hours before being presented for slaughter, as manure contains immense concentrations of microbes, which present contamination risks during trucking, lairage and the preliminary stages of slaughter.

To accommodate food safety concerns of processors and maintain high dressing percentages, animals are held for a minimum of 12 hours or up to a maximum of 48 hours without access to feed before slaughter. The minimum time will depend on feed type, weather, and processor food safety requirements.

Requirements from processors vary in each state. Producers, stock agents and transporters should contact processors prior to transport to understand their individual curfew requirements.

## Measure appropriate lairage times

It is recommended that slaughter take place between 4 and 24 hours after the start of lairage. Sucker lambs have been shown to suffer pH problems from tailgate slaughtering (straight from truck to slaughter floor), so it is recommended that these lambs have a short resting period pre-slaughter. Tailgate slaughter for carryover lambs and older sheep is not detrimental.

Lairage should be limited to 24 hours to minimise carcase weight loss and meat pH problems. In lairage, provided that stress is avoided, muscle glycogen will not decrease for several days. Eating quality will not be affected either. The major problem with extended lairage is a decline in carcase weight (as seen in figure 1), which leads to lower carcase value.

## For more information

www.msagrading.com or 1800 111 672

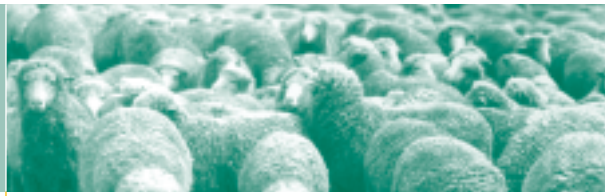
MEAT & LIVESTOCK AUSTRALIA

Level 1, 165 Walker Street
North Sydney NSW 2060
Ph: +61 2 9463 9333
Fax: +61 2 9463 9393
www.mla.com.au

Reprinted March 2007
ISBN: 1 74036 803 7

mla
MEAT & LIVESTOCK AUSTRALIA

tips&tools



MSAS4

MEAT STANDARDS AUSTRALIA

# The effect of breed and age on sheepmeat eating quality

## The effect of breed on eating quality

Research shows sheepmeat eating quality is not greatly affected by breed. The apparent exception is the Merino, which is more susceptible to the high pH condition. Due to the historical success of the wool industry, around 70% of Australian sheep genetics are Merino. Other breeds are increasingly promoted for meat production because they generally have better growth rates, better reproductive performance and more heavily muscled carcases which are better suited to meat production.

The eating quality of Merino lambs can be as good as other breeds, but they do require more careful pre-slaughter management than other breeds, with key factors being good nutrition and stress minimisation prior to slaughter. More information on the requirements for reducing stress when handling sheep can be found in other MSA Tips & Tools in this booklet.

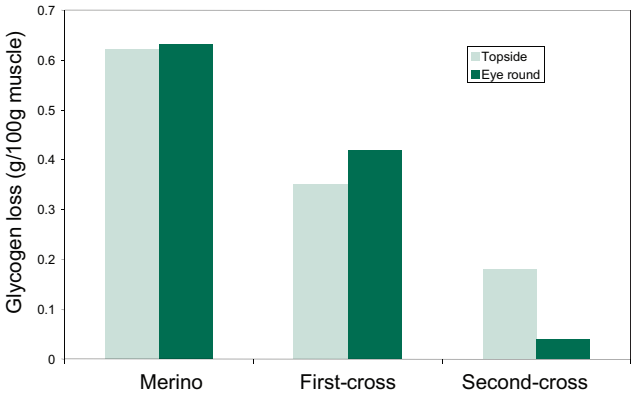
The Merino breed sensitivity extends to Merino crosses, when stressed. This is shown in figure 1 where the loss of muscle glycogen between farm and post-slaughter is compared between two cuts for three genotypes handled under identical conditions. Merinos suffered more than the other two genotypes and the first-cross suffered proportionately.

Provided that nutrition is adequate and animals are finished to a minimum fat score of 2, the intramuscular fat concentration of Merinos is either the same or higher than that of other breeds. Recent research has shown that if Merino producers select rams with a positive estimated breeding value for the 'yearling eye muscle depth' trait, this will help reduce the incidence of high pH syndrome. It seems that animals selected for muscle potential actually look after muscle better.

## Key points

- Sheepmeat eating quality is not greatly affected by breed.
- Merinos require more careful pre-slaughter management to reduce effects associated with stress.
- Research has shown that processing regimes can improve eating quality and consistency of all classes of sheepmeat.
- Lamb has the best sheepmeat eating quality when comparing like-for-like (eg same cuts, same processing method, same cooking method).
- Mutton loin can have a similar eating quality to hogget loin.

*Figure 1: Loss of muscle glycogen between farm and slaughter for Merinos and crossbreeds*



## The effect of animal age on eating quality

Research found that lamb remains the premium product and has the best sheepmeat eating quality when comparing like-for-like (eg same cuts, same processing methods). Some cuts of hogget and mutton also show potential for high eating quality.

Hogget loin cuts, when processed under optimal conditions, have only slightly lower eating quality than lamb loins.

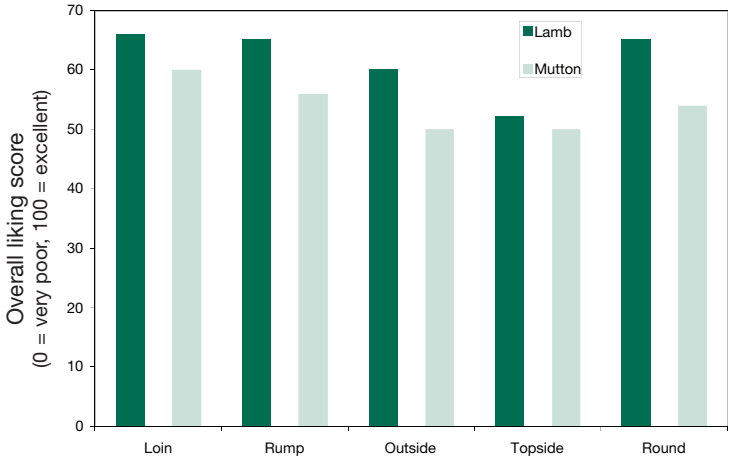
The eating quality differences between lamb, hogget and mutton are based on:

- the toughening of connective tissue
- adverse flavours accumulating in fat as a result of age
- the darkening of meat colour with age

Connective tissue is visible as sinew, 'silverskin' and 'gristle' within meat. As the animal ages, this invisibly permeates muscle. In older animals, 'tougher' connective tissues do not melt as easily with cooking, so are more easily detected as the 'background toughness' in meat.

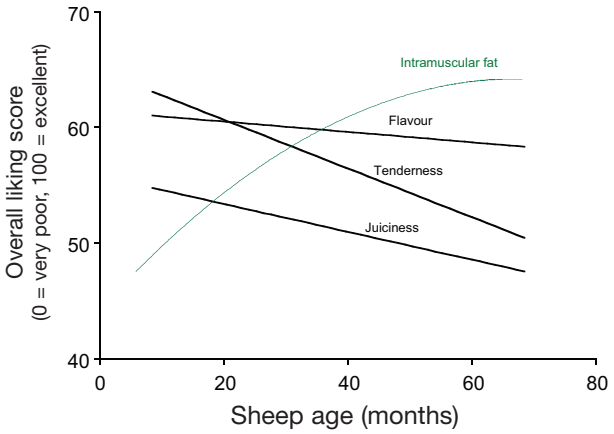
This effect is shown in figure 2, which summarises data from large numbers of Australian consumers who tested grilled cuts from lamb and mutton. Better cuts of meat, like eye of loin, have less connective tissue but these also become tougher as sheep get older.

*Figure 2: 'Overall liking' of eating quality of five grilled cuts from lamb and mutton*




*Note: Optimal processing used: stimulation + five days ageing; no stimulation + 10 days ageing; or tenderstretch + five days ageing)*

*Figure 3: Change in eating quality attributes with sheep age*




Flavour and juiciness are particularly dependent on intramuscular fat. As seen in figure 3, the intramuscular fat content of meat increases with age in ewes, which explains why flavour and juiciness scored relatively better with increasing age.

## For more information

www.msagrading.com or 1800 111 672


MEAT & LIVESTOCK AUSTRALIA

Level 1, 165 Walker Street
North Sydney NSW 2060
Ph: +61 2 9463 9333
Fax: +61 2 9463 9393
www.mla.com.au



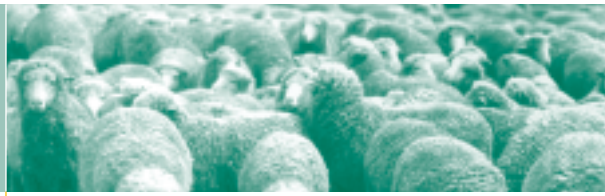
Reprinted March 2007
ISBN: 1 74036 806 1



ABN 39 081 678 364

mla
MEAT & LIVESTOCK AUSTRALIA

tips&tools



MSAS5

MEAT STANDARDS AUSTRALIA

# The effect of pH on sheepmeat eating quality

## The effect of pH on eating quality

Every animal has a certain amount of energy contained in its muscles in the form of glycogen. Once the animal is dead, the muscle glycogen is converted to lactic acid that causes the pH to fall. If there is not enough glycogen available in the animal, insufficient lactic acid will be produced and the pH will remain high, resulting in dark cutting. The main point to consider is that adequate glycogen levels need to be maintained to deliver the ultimate pH required for eating quality.

If the concentration of glycogen falls below a threshold concentration (around 0.8g/100g) because of poor nutrition or other factors such as poor handling and stress, the pH of the resulting meat becomes higher than normal (figure 1) and will result in high pH and dark cutting.

No matter how well lambs and sheep are prepared by the producer, poor practice in the days and hours leading up to slaughter can cause dark cutting. Dark cutting meat is characterised by a darker colour, coarse texture, reduced tenderness and a stronger flavour in sheep. At the retail level, consumers are likely to reject this meat on the basis of appearance. Dark cutting meat results from stress in the live animal; the outcome is sheepmeat with a pH higher than the normal 5.6. At higher pH bacteria grow more rapidly and will have a shorter shelf life.

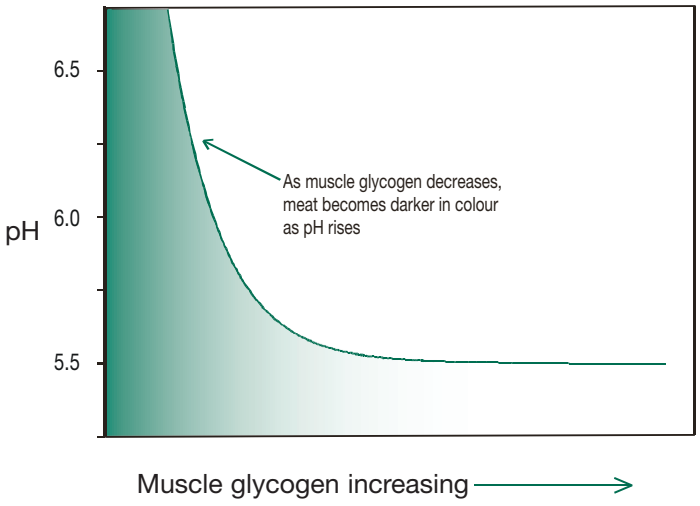
## pH decline

The temperature at which a carcase enters rigor (pH 6) can significantly affect meat quality. If the carcase temperature falls too quickly before the carcase enters rigor (pH 6), then cold shortening may result, often leading to toughness.

## Key points

- Glycogen levels prior to slaughter will determine the ultimate pH.
- Electrical stimulation can be used to ensure carcases enter rigor (pH6) at the desired temperature.
- Tenderstretch carcases hung by the pelvis have a wider temperature window and can enter rigor between 8°C and 30°C, in combination with five days ageing.
- Aggressive chilling regimes (ie high air speed, low temperature) can increase toughness.

*Figure 1: Muscle glycogen and pH of resulting meat*



## Electrical stimulation

Electrical stimulation provides a method for accelerating the fall of pH. When properly applied, electrical stimulation will ensure muscles enter rigor (pH 6) at a temperature that will avoid cold shortening and hence maximise eating quality. It will guarantee better consistency in all sheepmeat categories.

## Key principles of electrical stimulation

- Electrical stimulation is a useful tool for processors to control rigor onset. For continuous effectiveness, it is critically important that stimulator systems are monitored and that treated product is temperature-pH measured.
- Electrical stimulation is not necessary if meat is chill-aged for at least 10 days before consumption and a temperature window of 8–18ºC at rigor is achieved.
- The optimum period for electrical stimulation can be determined by regularly checking carcases with a calibrated pH probe and a temperature meter.
- There are no adverse eating quality effects from correctly applied electrical stimulation. However, if incorrect electrical stimulation results in carcase rigor above 25ºC, then drip loss and meat colour stability problems may occur.
- Electrical stimulation of sheepmeat does not increase or decrease contamination of carcases by micro-organisms. Electrical stimulation can in fact improve shelf life by enabling more rapid chilling.
- Measurements are made at various times after slaughter and results are assessed to determine the temperature at which the eye of loin pH reaches 6.0 and the pH at which rigor develops.

The electrical current stimulates the conversion of glycogen to lactic acid so that muscle pH drops rapidly during current application (figure 2). Electrical stimulation of carcases causes an early and rapid fall in pH so that muscles enter rigor (pH 6) sooner and at a higher temperature.

*Figure 2: The effect of electrical stimulation on pH*

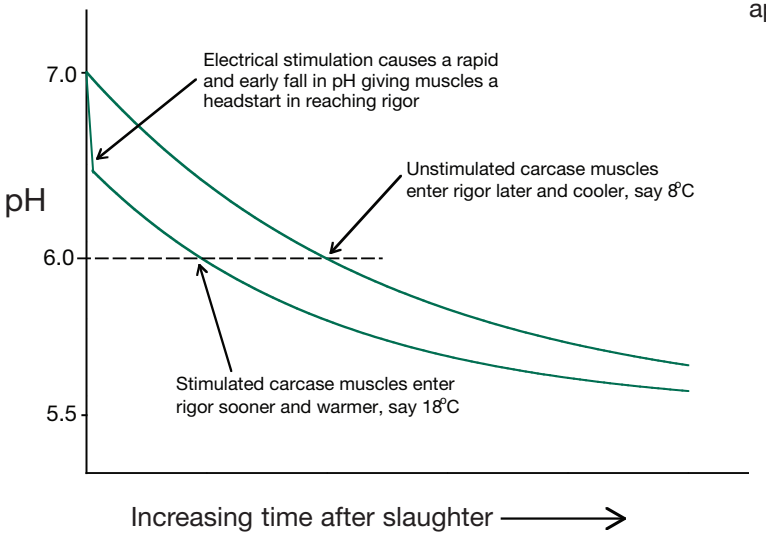
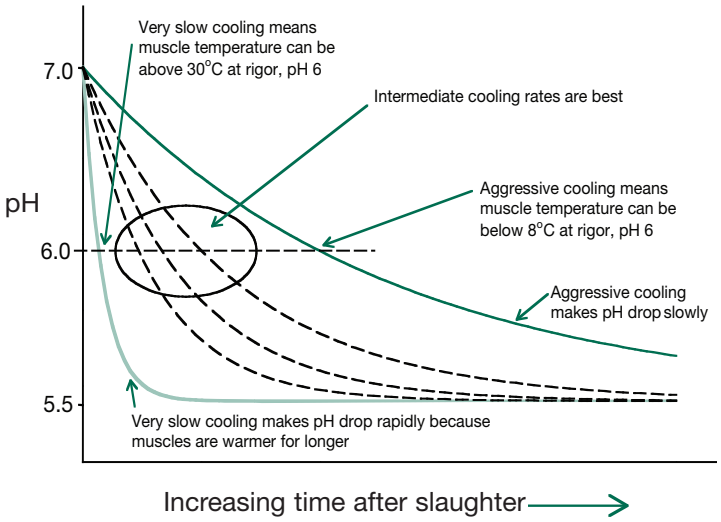



*Figure 3: Impact of carcase cooling on pH*




## Carcases cooled too quickly

If carcases are cooled too quickly, temperature decline exceeds the pH decline and follows the upper line shown in figure 3. If rigor onset occurs below 8°C, the muscles tend to cold shorten and ageing is slowed. In addition, the display colour of meat will often be darker than usual.

In extreme cases, fast cooling leads to permanent toughening and, at the very least, it causes slow ageing. The ideal balance is to cool carcases between the two extremes; this is illustrated by the three dashed curves in figure 3. However some processors, when considering specific markets, may choose to operate to the lower or upper curve.

## Carcases cooled too slowly

If carcases are cooled too slowly (eg because of inadequate chilling capacity), muscle pH falls rapidly (see the lowest line in figure 3) because the chemical reactions in the muscle will have been accelerated.

If the temperature of the muscles is above 30°C at the onset of rigor (pH 6), the muscles will be inclined to heat shorten. Other quality problems occur under these conditions, such as excessive drip, and the meat can appear paler than normal when displayed.

Figure 4 shows that electrical stimulation maximises the frequency of satisfactory eating experiences particularly when products are eaten soon (two days) after slaughter. However, further ageing in all treatments will continue to improve eating quality.

Under any treatment, the importance of sufficient ageing time for the development of optimum eating quality cannot be overemphasised.

*Figure 4: Effect of electrical stimulation on overall eating experience*

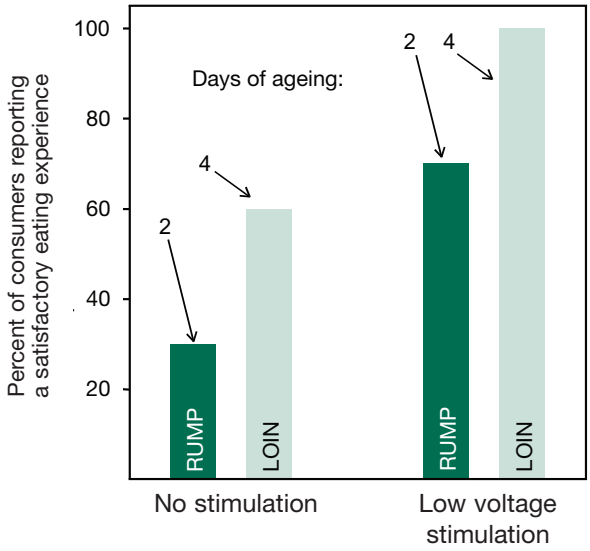



*Table 1: Processing and ageing conditions for optimum eating quality in different markets*

| Target market | Domestic chilled trade | | Domestic or export chilled trade | Frozen |
|---|---|---|---|---|
| *Hanging method* | Tenderstretch | Achilles | Achilles | Achilles |
| *Electrical stimulation needed* | No | Yes | No | Yes |
| *Enter rigor (pH 6) at:* | 8–35°C | 18–25°C ** | 8–18°C | 18–25°C |
| *Minimum ageing period* | 5 days* | 5 days* | 10 days | 5 days before freezing |
| *Storage temperature* | 1°C | 1°C | -1°C | 1°C then -18°C |

* This is the optimum time to maximise sheepmeat eating quality. For most domestic/short markets, this is not feasible. Optimum quality will take five days.

** Provisional results. Lower limit may be reached.

## Types of stimulation

When purchasing or upgrading electrical stimulation equipment, consideration should be given to the newer types of lower cost, low voltage/high frequency systems. These are as effective as high voltage systems. Medium voltage systems can be installed to operate during the bleeding process or, alternatively, post evisceration.

Researchers consider the time and processes between stunning and chilling to be the most crucial element in eating quality. Sheepmeat eating quality can be maximised for individual situations by using a combination of processing tools as follows:

- electrical stimulation;
- hanging method;
- temperature at which the carcase enters rigor (pH 6);
- minimum ageing period; and
- storage temperature.

Table 1 summarises the processing and ageing recommendations for optimum eating quality relevant to specific markets.

There are specific processing regimes known to optimise the consistency and eating quality of all classes of sheepmeat for any market.

## Optimum conditions for pre-slaughter pH management

Glycogen levels prior to slaughter will determine ultimate pH. The following points list optimum conditions for reducing animal stress therefore maintaining glycogen levels prior to slaughter.

**1. Livestock receival**

- Unloading areas are easily accessible to transport operators.
- Trucks move immediately to unloading area and are unloaded without delay.
- Trucks arrive in good condition, with non-slip flooring and at recommended loading densities.
- Trained stockmen are used to unload animals.
- Use of electric goads and dogs are minimised. Flappers or other goads used.
- Sheep are moved directly to lairage pens.
- 'Downer' or injured sheep are assisted to their feet prior to unloading and treated accordingly.
- There are no obstructions in the unloading operation.
- Familiar sheep are left in their groups, and not mixed as they arrive.
- Ramp facilities are of a correct design.

**2. Lairage facilities and livestock**

- Animals are inspected by trained handlers upon arrival. Injured sheep are separated and treated accordingly.
- Sheep are placed in the same lairage pen which will house them for the entire period before killing.
- Trained stockmen are used to move or redraft animals.
- Canvas or leather flappers, soft polythene pipes or rattlers are used in preference to electric prodders.
- Pens are situated well away from unloading area to minimise disturbance to resting sheep.
- Animals are maintained in their consignment group.
- Lairage pens are well drained, sheltered and/or shaded.
- Sheep are given adequate time to rest in lairage prior to slaughter.
- Clean fresh water is available in the pens.

**3. Assembling for slaughter and pre-slaughter practices**

- Sheep move easily into laneways without disturbing other pens of sheep.
- Laneways are wide enough to avoid pushing and interaction between sheep.
- There are no sharp corners, obstructions or distractions in laneways and races.
- Trained stockmen are used to draft and move sheep through laneways, races and ramps.
- Non-slip flooring is used.
- Grooved stair steps are used on concrete ramps.
- A level surface is provided at the top of the ramp prior to the stunning box entry.
- There are no sheep on ramps during breaks and stoppages.
- Electric prodders are only used on animals which are baulking and have a clear path ahead.

**4. Stunning**

- Fully trained personnel with sheep handling skills are used for stunning
- The entrance to the knocking box is inviting to sheep. Goads are used appropriately for entry into the box.
- The knocking box is solid underfoot and quiet in operation.
- The knocking box uses a well designed head restraint.
- The stunning device provides an effective stun and is easily positioned.
- There are no distractions to the sheep in the knocking box.
- Stunning is not delayed, nor sheep held in the box during stoppages or breaks.

**5. Monitoring of individual lots through lairage**

Individual lots are assessed in the following areas to ensure best practice for optimal eating quality outcomes:

- Consignment number and number and type of sheep
- Source (place, private/saleyard)
- Time and date of arrival
- Unloading process (difficulties, downers, delays and dogs or other goads)
- Time to be allocated to resting pen, and pen number
- Ease of movement to pen (drafting required, goads used)
- Conditions in pen (conducive to settling, boggy, other stock mixed in same pen, access to watering points)
- Date and time of assembling for slaughter (taken from pen)
- Ease of movement along laneways (drafting required, goads used)
- Washing of sheep (restlessness during washing, time in wash yard)
- Movement up ramp to slaughter floor (time on ramp, goads used)
- Movement into knocking box (ease)
- Time of stunning
- Stun to stick time
- PH temperature declines performed as routine monitoring.

## For more information

www.msagrading.com or 1800 111 672

MEAT & LIVESTOCK AUSTRALIA

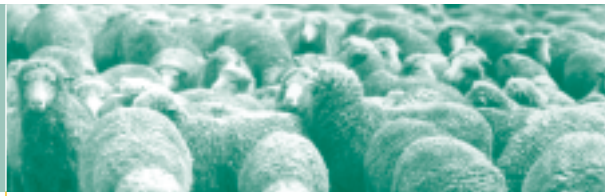
Level 1, 165 Walker Street
North Sydney NSW 2060
Ph: +61 2 9463 9333
Fax: +61 2 9463 9393
www.mla.com.au

Reprinted March 2007
ISBN: 1 74036 807 X

mla
MEAT & LIVESTOCK AUSTRALIA

tips&tools

MSAS6 MEAT STANDARDS AUSTRALIA



# The effect of hanging method on sheepmeat eating quality

Traditionally, sheepmeat carcases are suspended or hung from the Achilles tendon. An alternative hanging method that can improve eating quality performance is the 'tenderstretch' method. For achieving sheepmeat of good eating quality, tenderstretch hanging provides an alternative. It is particularly beneficial for improving the tenderness of loin and hindquarter cuts.

## Key points

- Tenderstretch hanging improves eating quality of the loin and hindquarter cuts.
- Tenderstretch can be used as an alternative for electrical stimulation.

## Achilles hanging method

The traditional method of hanging sheep or lamb carcases is by gambrels inserted behind the Achilles tendon. In the Achilles-hung carcase, the spine is curved and the hindquarter muscles have less tension on them. As a result, when these large hindquarter muscles go through rigor mortis they can contract. When this occurs, the muscle fibres overlap resulting in slightly tougher meat.

If Achilles-hung meat is cooled to achieve the pH/temperature target of 18–25°C, and the meat is stored for five days at 1°C before retail sale, the eating quality of all cuts will be consistently good when they are cooked in the recommended way. The best way of attaining this pH/temperature target is with electrical stimulation. A process regime along these lines would be suitable for a processor selling lamb, hogget or mutton into the domestic market.

## Tenderstretch hanging method

Tenderstretch hanging involves sheep carcases being suspended by the pelvic or aitchbone, so that the leg drops down at a 90° angle. As a result, a number of muscles are held in a stretched position so they cannot contract during rigor mortis. Tenderstretch is most effective in the hindquarter and has a varying effect on each cut.

*Figure 1: Conventional Achilles hanging (left) and tenderstretch hanging*

## Advantages of tenderstretch-hung carcases

When tenderstretch hung, hindquarter muscles assume a more 'life-like' posture. Muscle shortening is prevented and improved eating quality will be attained. Although tenderstretch hanging requires some additional labour, it does have some significant advantages to eating quality:

- Ageing will occur more rapidly in tenderstretch carcases compared to Achilles-hung equivalents
- Tenderstretch is an alternative to electrical stimulation for optimising eating quality, and is particularly beneficial for improving loin and most leg cuts

Another advantage of tenderstretch lies in the uniformity of eating quality between cuts. If older sheep are Achilles hung, there are marked differences in quality between the different cuts, to an extent not seen with lamb. However, if older sheep are tenderstretch hung, the differences between cuts are minimised.

It should be noted that tenderstretch hanging will alter the shape of several of the leg cuts (see figure 3). Cuts are more evenly distributed around the bone than in Achilles-hung carcases. This even distribution is well suited to the foodservice industry and the 'evenness' of the eating quality throughout the leg cuts is a bonus for consumers. However, adoption of tenderstretch hanging requires changes to operations that will not suit everyone.

*Figure 2: Tenderisation kinetics during ageing for Achilles-hung and tenderstretch carcases*

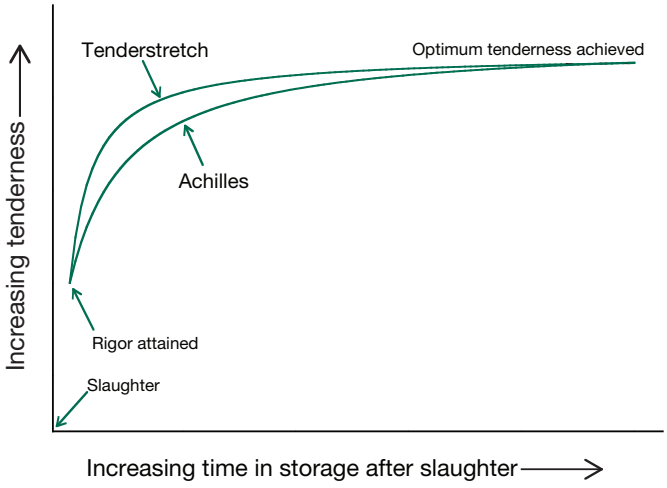



Figure 2 compares the tenderisation kinetics of Achilles-hung with tenderstretch carcases. Tenderstretch clearly yields acceptably tender meat more quickly, although, when given sufficient ageing, Achilles-hung sheepmeat ultimately achieve the same degree of tenderness.

The tenderstretch effect varies for each muscle according to the muscle's position in the carcase and the degree of stretching. Although the tenderstretch effect is slightly negative in the tenderloin (which is stretched in an Achilles-hung carcase), it is strongly positive in most other hindquarter cuts and largely neutral in forequarter cuts.

Tenderstretch hanging provides an alternative to electrical stimulation for achieving sheepmeat of good eating quality and is particularly beneficial for loin and hindquarter cuts when compared with electrical stimulation. This method is well suited to the domestic market where rapid tenderisation is important and electrical stimulation is not a valid option.

*Figure 3: Tenderstretched hindquarters*

## For more information

www.msagrading.com or 1800 111 672

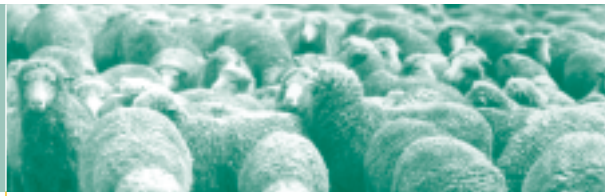
MEAT & LIVESTOCK AUSTRALIA

Level 1, 165 Walker Street
North Sydney NSW 2060
Ph: +61 2 9463 9333
Fax: +61 2 9463 9393
www.mla.com.au

Reprinted March 2007
ISBN: 1 74036 808 8

mla
MEAT & LIVESTOCK AUSTRALIA

tips&tools



MSAS7

MEAT STANDARDS AUSTRALIA

# The effect of cut and cooking method on sheepmeat eating quality

## How cooking method affects eating quality

The cut and cooking method combination is a vital factor in optimising sheepmeat eating quality. The various muscles of a carcase will have different recommended cooking methods.

Muscle is made up of muscle fibre groups surrounded and supported by connective tissue, which contains collagen fibres. Collagen fibres form cross-links to stabilise and strengthen muscles. Different muscles have varying amounts of connective tissue related to the muscle position and function within the body.

For example, muscles that are used constantly will have a high connective tissue content. The collagen and connective tissue can be partially broken down through casserole cooking using low heat and moisture over a period of time. This cooking method will optimise the eating quality of these cuts.

Muscles that do little to no work will contain almost no connective tissue and are therefore inclined to be more tender. An example is the loin, which is situated on the inside of the spine. Loin cuts would not be suitable for the casserole cooking method, as the structure would be completely broken down. These cuts would be best suited to pan frying, grilling or roasting.

## Key points

- The eating quality of grilled cuts is (in descending order): loin > round and rump > silverside > topside.
- Recommended cooking methods can optimise eating quality.
- There is some potential for mutton loin products to be marketed as a good quality grilling meat although its eating quality will be more variable than that of lamb and hogget loin.
- To avoid pronounced mutton flavours, heavily trim the fat (denude) from the meat of older animals.

*Table 1: 'Overall liking' score for grilled and roasted lamb cuts from lamb and mutton*

| | Lamb | | Mutton | |
|---|---|---|---|---|
| **Cut** | **Grill** | **Roast** | **Grill** | **Roast** |
| Loin | 66 | 68 | 60 | 54 |
| Serratus ventralis (rib) | 68 | 63 | 56 | 52 |
| Knuckle | 70 | 65 | 54 | 59 |
| Rump | 65 | 68 | 56 | 56 |
| Silverside | 60 | 60 | 50 | unsatisfactory |
| Topside | 52 | 59 | 50 | unsatisfactory |

*Table 2: Recommended cooking methods for boneless lamb, hogget and mutton cuts*

| Category | Cut | | | | |
|---|---|---|---|---|---|
| | **Loin** | **Rump** | **Silverside** | **Topside** | **Round** |
| Lamb | *Grill/roast | Grill/roast | Grill/roast | Roast | Grill/roast |
| Hogget (yearling) | Grill/roast | Grill/roast | Roast | Roast/casserole or wet cook | Grill/roast |
| Mutton† | Grill/roast | Roast | Roast | Roast/casserole or wet cook | Casserole or wet cook |
| Cooking method | * Grill includes barbecue and panfry<br>† Mutton (in particular) should be denuded of fat | | | | |

## Eating quality of different cuts from lamb, hogget and mutton

Table 1 shows the 'overall liking' score for grilled cuts of lamb and mutton after optimal processing and ageing. As noted earlier, the higher the score, the lower the risk of a poor eating experience.

In table 1 it can be seen that for lamb, all grill cuts – except topside – scored highly. When grilled, lamb cuts clearly outscored the mutton cuts, as would be expected. It can be concluded that when grilled, and with the exception of the topside, lamb performs well across all cuts.

Also in table 1, all lamb cuts score highly when roasted. In comparison, mutton silverside and topside cuts, when roasted, fail to satisfy consumer expectations. However, cuts such as mutton knuckle and rump, although not scoring as highly as lamb, can deliver a satisfactory eating experience when roasted. There is also opportunity to successfully market mutton loins as grilling cuts.

## Recommended cooking methods

Collective research provided the following cooking recommendations. These recommendations may provide an initial basis for product labelling and recommendation. The chances of disappointment can be significantly reduced when appropriate cooking methods are applied.

## The cooking method labels used in MSA sheepmeat

The following cooking methods are recommended as part of MSA sheepmeat. Where MSA is used to underpin a brand, that brand can have its own cooking label but the corresponding cooking method for the cut must be displayed.

### Casserole or 'slow cook'

Cuts displaying this cooking method should be cooked in sauce or gravy on low heat for two hours. The product is prepared in 20mm cubes.

### Grill (BBQ/pan fry)

Loins, rumps and tenderloins displaying either of these symbols are suitable for cooking in a pan, grill or BBQ.

### Oven roast

Cuts displaying this symbol are suitable for roasting in a moderate oven (180°C). Accurate cooking is best determined using a meat thermometer. Internal temperatures should be as follows for the different degrees of doneness:

Rare 35°C
Medium rare 45°C
Medium 55°C
Medium well 65°C
Well done 75°C

When the roast is removed from the oven, allow it to rest for 10 minutes prior to carving.

### Stir-fry

Cuts suitable for this cooking method should be cut into strips approximately 6mm wide and 75mm in length. The product is cooked in small batches on high heat.

## The consumer guarantee

MSA product is guaranteed. If a consumer purchases MSA product and cooks it as labelled, it is guaranteed to provide an acceptable eating quality standard.

## For more information

www.msagrading.com or 1800 111 672

mla
MEAT & LIVESTOCK AUSTRALIA

Level 1, 165 Walker Street
North Sydney NSW 2060
Ph: +61 2 9463 9333
Fax: +61 2 9463 9393
www.mla.com.au

Reprinted March 2007
ISBN: 1 74036 809 6

ABN 39 081 678 364


Level 1, 165 Walker Street,
North Sydney NSW 2060
Ph: +61 2 9463 9333
Fax: +61 2 9463 9393
www.mla.com.au