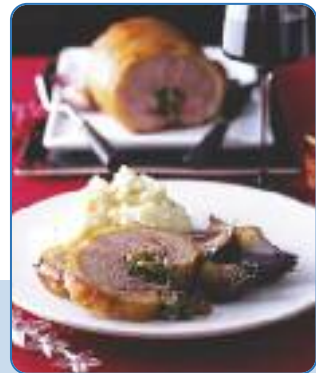


Better Returns from Meat



Meat quality and shelf life



Introduction

There is a wealth of information on how to profitably rear and raise sheep and cattle, while the recipe books and articles on cooking meat are endless. There is, however, less information available on issues such as selecting, handling, storing, packaging and presenting meat. Yet these are all critical for optimum quality, food safety, consumer satisfaction and better returns.

This booklet is the first in a series that will look to address these issues in straight forward ways to help those responsible for delivering meat to customers, whether through farm shops and box schemes or other local supply chains.

The information in this booklet was compiled by: Michael Richardson, Kim Matthews, Chris Lloyd and Katie Brian, EBLEX.

EBLEX is grateful to all those who have commented and contributed to this production.

Edited: Geoff Dodgson, Chamberlain.

While drawing on the extensive scientific and technical knowledge that exists, EBLEX's aim is to provide readable information and guidance on where to get more help.



A stylized, handwritten signature in pink ink, appearing to read 'John Cross'.

John Cross

**Chairman
EBLEX**

Disclaimer

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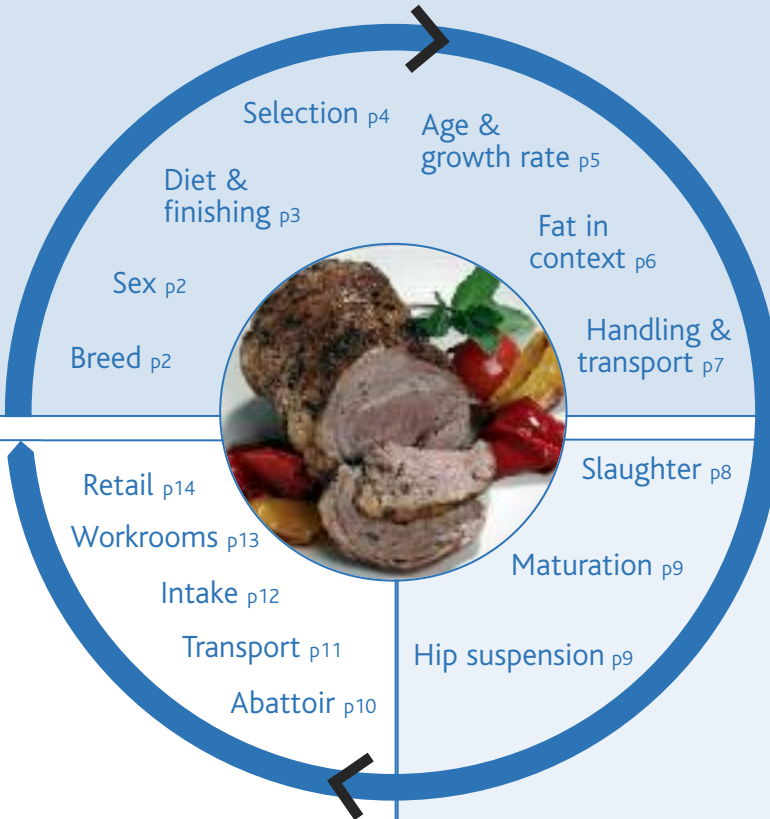
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PRODUCTION

Animals are reared to produce meat – lean muscle with associated bone and fat.

In its early life, an animal is producing mainly bone, then muscle and then fat is laid down. For better returns, feeding regimes seek to optimise muscle with the correct amount of fat for specific customer needs. Excess fat is both undesirable and costly in terms of feed.



CHILL CHAIN

The supply chain that stretches from abattoir to final retail display is critical to meat quality. Each step in the process from cutting carcasses to final packaging will affect meat quality for the consumer.

SLAUGHTER

During this process live muscle is converted to meat. Handling, stunning and post slaughter treatment, especially temperature play an important part in the final quality of meat produced.

Breed and sex

Choice of breed may attract heated debate, but when it comes to taste, the differences are quite small. Panel assessments have revealed that cattle or sheep breeds have relatively little effect on the quality and taste of meat.

It is more important to choose a breed that will fit in with your system and optimise resources on your farm. However, the choice between entire and castrated males can have implications for meat quality.

Beef

Sex

Choice of heifers or steers will affect carcass size, growth rates, etc. However, when it comes to meat quality – in terms of taste or tenderness – there is little difference between the two.

To optimise quality, limit the age of young bulls, aim for a maximum of 15 months.



Sheep

Sex

Fat within muscles varies with sex. Ewe lambs and wether lambs tend to have more fat than ram lambs, at a given carcass classification. There are no differences between sexes in terms of conformation at a given age.

Ram lambs develop a higher incidence of abnormal flavour – 'ram taint' – when finished beyond five months of age.



Diet and finishing

What an animal eats, as it is finished, affects meat quality, especially appearance and aroma, as well as fat level and colour. Matching diet to an animal's growth potential is important to optimise growth rate and tenderness.

BE AWARE Adding Vitamin E (300IU/kg dry matter) to beef or lamb concentrate finishing diets can extend shelf life and protect flavour..

Beef

UK consumers tend to prefer a 'stronger' meat flavour which is achieved by high forage diets. However, such diets can lead to a more yellow fat covering.



Sheep

Consumers prefer the stronger flavour of grass fed lamb. However, diet has little effect on tenderness.

BE AWARE Lamb flavour can be affected by feeding: legumes (especially lucerne), brassicas, oat pasture, maize silage, onions and soya or field beans.



[1](#) Beef BRP Manual 7: *Feeding growing and finishing cattle for Better Returns*

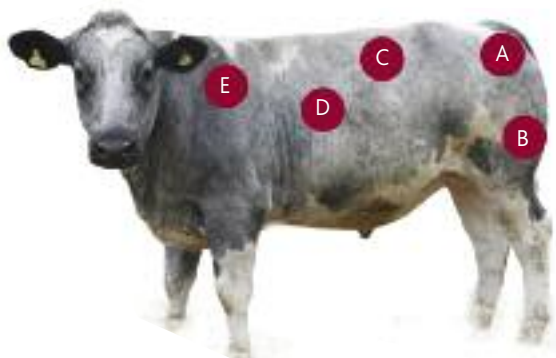
[2](#) Sheep BRP Manual 5: *Target Store Lambs for Better Returns*

Selection

Assessing whether an animal is ready for slaughter or not requires visual assessment and handling.

The ability to handle an animal is an essential skill for any sheep or beef producer. Combined with regular weighing, it has the added benefit of enabling progress to be monitored, and any illness or defect to be identified.

Beef



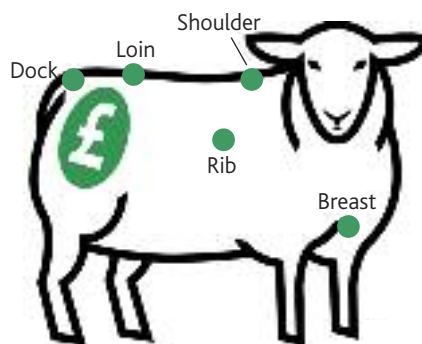
BE AWARE It is important to use correct handling points and ensure calm handling to avoid stress. Always handle the loin on the left hand side.

- A: Over the pin bones and on either side of the tail head
- B: The round (hindquarter)
- C: The transverse processes of the loin
- D: Over the ribs
- E: The chine and the shoulder blade ridge

Sheep

Assessing a lamb's level of condition is vital to determine the correct time to sell, and so maximise potential returns. Lambs should be sorted by handling once a fortnight as they approach market quality and every week for the final two or three weeks.

BE AWARE It is important to use correct handling points and ensure calm handling to avoid stress.



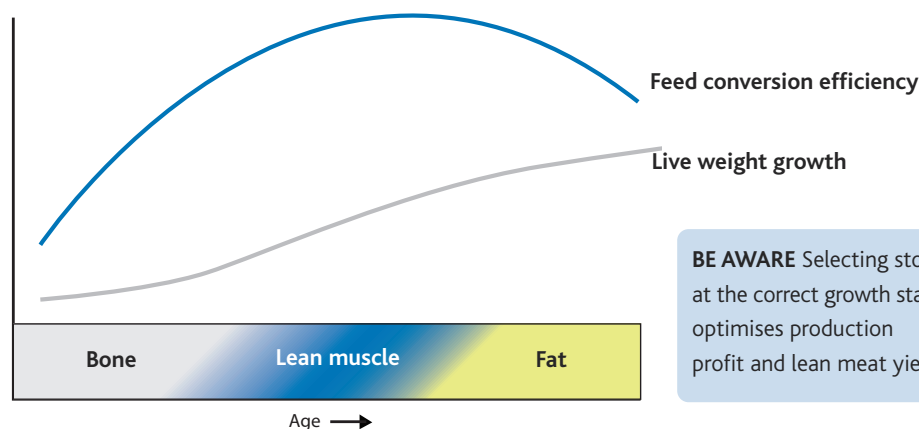
- 1 Beef BRP Manual 2: *Beef selection and handling for Better Return*
- 1 Sheep BRP Manual 1: *Target Lamb Selection for Better Returns*

Age and growth rate

Stock rearing to optimise meat production needs to take account of the different growth phases – rearing, growing and finishing.

Energy intake is first directed to bone growth, then lean muscle (meat). Once bone and muscle is formed, the animal stores energy as fat. Excess fat requires up to six times the energy needed to deposit lean meat and so is detrimental to returns.

Cost-effective livestock production matches the diet with lean meat growth



Beef

Meat from older cattle is generally tougher. To avoid undesirable toughness developing it is recommended that heifers and steers are finished under 30 months of age, while young bulls should ideally be less than 15 months of age.

Sheep

Older lambs are tougher and research has shown a seasonal decline in tenderness. Tenderness of meat from older lambs can be enhanced after slaughter by electrical stimulation or hanging for extended periods.

'Renaissance mutton' is meat from a traceable farm assured sheep, at least two years old, finished on a forage based diet and matured for at least two weeks post slaughter.

i Beef BRP Manual 7: *Feeding growing and finishing cattle for Better Returns*

i www.muttonrenaissance.org.uk

Fat in context – eating

Despite the popular perception that fat is a bad thing, some fat is necessary for optimum quality and consistency of any cooked meat.

Beef

While the eating quality of beef can be excellent at a very low level of fat, a minimum level of fat class 3 will ensure good eating quality.

A consistent eating quality can be achieved without having a high percentage of visual marbling.

BE AWARE Ultra lean carcasses can lead to poor eating quality.



Sheep

Perceived 'fattiness' is the main source of consumer criticism of lamb meat.

Lamb fat has a high melting point giving a 'sticky' feel in the mouth. It is therefore particularly important to avoid over-fat lamb. However, the extremely lean fat class 1 should be avoided.

BE AWARE Eating quality is reduced if animals are slaughtered too early, or too lean.



Handling and transport

How animals are delivered for slaughter can affect the look and composition of meat. Any bruising will always reduce carcass value.

Stock should be loaded to minimise stress. Well-designed stockyards, races and loading ramps will help greatly. Avoid any sharp corners that will bruise animals as they move.

Clean stock

With increasing focus on food safety and hygiene ensure stock:

- Is clean before slaughter.
- Is not fed in the period immediately prior to transport to the market or slaughterhouse.

Beef

Stress leads to 'dark cutting beef' or dark, firm and dry (DFD), which is to be avoided.

- Cattle do not like anything reflective or shiny in their path. Cattle handling areas should have smooth walls, no pools of water, non-slip floors and gradual ramps
- Take special care with bulls as they are more susceptible to stress
- Avoid mixing cattle from different groups
- Avoid use of sticks and goads
- Use vehicles that avoid overcrowding and have partitions to restrict movement
- Lairages should be clean with dry bedding and drinking water.



BE AWARE Poorly designed handling and loading facilities can lead to damaged carcasses. In addition to its abnormal colour, DFD meat has reduced keeping qualities and is prone to bacterial spoilage.

Sheep

Sheep bruise easily, especially young lambs, so it is important never to:

- handle/ move sheep by grabbing wool
- allow sheep to trample over each other in races
- allow sheep to be trampled during transport.



i Beef BRP *Understanding cattle and carcasses for Better Returns*

i Beef BRP Manual 3: *Improving cattle handling for Better Returns*

Slaughter

The various stunning options available do not affect meat quality.

Beef

Most cattle are slaughtered using captive bolt pistol. Alternatives include electric stunning and percussion stunning.

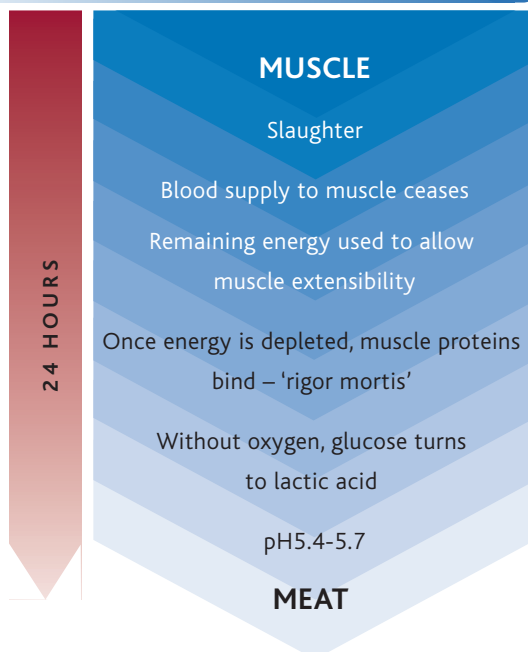
Sheep

Sheep are generally stunned electrically. There are two options:

- two electrodes to the head
- head to back stunning that normally applies two probes to the head and one to the back.

Post-slaughter factors

After slaughter, muscle undergoes changes that will affect both visual appeal and meat quality.



Electrical stimulation

Some meat plants use electrical stimulation, after slaughter, to improve eating quality.

Muscles stimulated to contract will use up energy, accelerate the onset of rigor mortis and so allow earlier chilling.

High voltage applied prior to chilling increases tenderness more effectively than

low voltage applied prior to dressing.

In beef, this method is less effective on tenderness than hip suspension.

BE AWARE Use pH monitoring to optimise the relationship between stimulation-induced pH change and chilling.

Hip suspension

While very effective, this technique is not commonly used. Suspending a carcass from the hip, rather than Achilles heel, stretches muscles and avoids contraction before rigor mortis leading to increased tenderness in leg and loin muscles.



Influence of post slaughter treatments on grilling and roasting cuts

Treatment	Beef	Lamb
Incorrect chilling (without electrical stimulation)	X	XX
Hip suspension	✓✓✓	✓✓✓
High voltage stimulation	✓✓	✓✓
Extended ageing (extra 7 days)	✓	✓

Chilling rate

Meat toughness increases if muscles contract before rigor mortis sets in. Cooling too fast, or too soon results in muscle 'shortening'.

As a general rule while chilling the carcass, avoid a muscle temperature below 10°C for 10 hours after slaughter. This is unlikely to occur in a fridge operating at 4°C except for smaller lamb carcasses. If electrical stimulation has been used, faster chilling is preferable.



Hanging time/maturation

Tenderness increases in extended storage as naturally-occurring enzymes break down protein in the meat. Maturation can occur in hung carcasses, unpackaged primals or vacuum packs.

Beef

Mature joints for grilling and roasting for up to 21 days. This will give benefits over 7-14 days maturation. Extending this to 28 days will have little additional benefit.

Sheep

Lamb joints benefit from ageing for up to 10 days. This should be limited to 7 days for cuts to be sold bone-in. Extending to 15 days will have some additional improvement but there is little benefit in extending maturation beyond that.

BE AWARE Avoid maturing parts intended for mince, and observe maximum legal limits.

The chill chain

Chilling – reducing carcase temperature and associated drying of the carcase surface restricts pathogen growth and spoilage micro-organisms (bacteria, yeasts and moulds) thus reducing deterioration. Chilling begins at the abattoir where carcasses are usually put in conditions of 0-5°C after slaughter until the deep muscle temperature reaches 7°C.

A well-managed chill chain is critical for preparing and selling fresh meat and meat products.

For food safety and product quality assurance a well managed chill chain maintains meat temperature within required specifications, that avoid any large increases (or decreases) of temperature.

BE AWARE Best practice is for primal and retail cuts to be stored between 0°C and +3°C.

The abattoir

The chill chain starts at the abattoir. Hygienic abattoir practices along with care in handling and storing carcase meat helps to extend shelf life considerably.

It is important that:

- animals are as clean as possible before slaughter to prevent contamination and pathogen growth
- hygienic dressing is carried out to minimise bacteria being transferred from gut, hide or fleece to meat.

Bacteria grow slowly, or not at all below 7°C, so for practical reasons legislation requires meat to be cooled to this temperature. Reducing temperature further prevents spoilage organisms growing.

All UK abattoir premises must be approved (licensed) by the Food Standards Agency (and comply with EU regulations). The regulations require carcase meat destined for human consumption to be chilled to a maximum of +7°C (+3°C for edible offal) before it leaves the abattoir. Under an abattoir license carcasses may be cut into half carcasses or quarters, and half carcasses into no more than three wholesale cuts.



However, rapid chilling of carcasses immediately after slaughter must be avoided as it can result in extremely tough meat – a problem known in the trade as 'cold shortening'. To avoid this, carcasses should be cooled at a controlled rate for the first 10 hours after slaughter. Alternatively, applying high voltage electrical stimulation to the carcase before chilling can be used.

After chilling fresh meat is ideally stored between 0°C and +3°C, with a relative humidity of 95-90%.

Hanging carcasses (sides or quarters) should be adequately spaced to enable, low speed, circulated air to chill without de-hydration.

If hygienically dressed, expected carcass storage life, under such conditions is:

Expected storage life*

Beef and veal	– up to 21 days
Lamb	– up to 15 days
Pigs	– up to 14 days
Offal	– up to 7 days

* hygienically dressed in correct storage conditions

Some carcasses and cuts are held for longer periods to meet specific maturation specifications and provide age-related quality improvements.



Transport

Delivery systems must maintain the chill chain and avoid large temperature variations at critical points such as loading and unloading.

Delivery vehicles/containers must be suited to transporting chilled carcasses (or boxed product). The refrigerated unit must be able to hold the consignment at a constant temperature of a maximum of +7°C for red meat (and +3°C for edible offal). Air circulation around the load is vital with airflow between carcasses or boxes ensuring even temperature distribution.

Boxed product (eg 25kg cardboard boxes of vacuum-packed strip loins) should be transported separately from naked meat, unless packaging material and method of transport (eg partitioned container) can avoid contamination of naked meat.

Transport of carcasses and primal cuts from abattoir to cutting plant can be direct (ie abattoir and cutting plant on same site) or via refrigerated delivery vehicle to a stand-alone plant.



Intake bays

Intake bays at cutting plants and smaller meat preparation facilities should ideally be fitted with a dock seal. Without such a seal, the bay should have a canopy or similar system to prevent airborne contamination. If product is held on the bay before moving to storage chill rooms, temperature control is needed to help to maintain the chill chain.

Separate storage chillers are needed for boxed and unwrapped product; maintain red meat at no more than +7°C and +3°C for edible offal.

In small premises suitably portioned chillers can be approved.

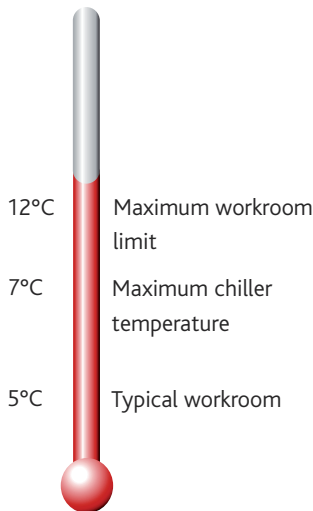
All such small facilities currently:

- must be registered with the local authority environmental health section
- are subject to Environmental Health Officer (EHO) inspection
- need a HACCP plan in place that is monitored and inspected by the EHO to same EU regulations governing larger plants.

There is no national or regional listing of such plants. While local authority EHOs hold the names, in practice many do not categorise these premises so butchers and farm plants can be mixed with all types of food service premises.



Work rooms



Air temperature within work rooms is to be maintained at a maximum of +12°C (required by legislation). The same temperature range should be maintained during cutting, boning, trimming, slicing, dicing, wrapping and packing. This air temperature prevents a rapid rise in product temperature and many commercial plants will maintain work room air below 5°C. Whatever air temperature is chosen if there is risk of the product temperature rising above +7°C it is recommended that it should be returned to the chill room to minimise the risk of bacterial growth or spoilage.

Packaged meat

Vacuum packed product should be held under chilled storage conditions to further extend its storage life (and must be below 3°C for extended storage). Storage temperature, type of bag used and any gases used in the pack all affect storage life. Under normal commercial conditions at 1°C, vacuum packed beef should have a storage life of at least 4 weeks.

After cutting, product is usually moved to a finished product chill room where the same temperature rules apply. Transport to the final point of sale also requires the same temperature.

The risk of "cold shortening" only applies to a hot carcass. Therefore, rapid chilling is commonly used for cut, diced or minced meat.

Freezing is necessary to store meat for longer periods than appropriate for chilled naked or vacuum packed product. Meat intended for freezing should be frozen without undue delay (after maturation), taking into account, where necessary, a stabilisation period before freezing.



BE AWARE The nature of the storage process whether in carcasses, on the bone, or in vacuum packs, and the length of time meat is held in this form before cutting for final sale, is a key part of the maturation or 'ageing' process, and this will affect the eating quality of the meat.

Retail packaging and shelf life

The shelf life of fresh meat is normally determined by the colour. Deep muscle and freshly cut meat is a deep purple red colour. This "blooms" to bright red when it is exposed to air, then gradually browns over time. Once cut into smaller portions shelf life declines more rapidly due to increased surface area exposed to air. When the browning becomes noticeable the product is considered at the end of the shelf life. It should be noted that this is a decision based on product quality (ie visual appearance) not on safety.

In a retail shop, meat needs to be stored under refrigeration to delay or retard both bacterial spoilage and colour deterioration.

- maintain refrigerated display counters at a steady temperature as near 0-3°C as practical.

Retail display options

Meat can be displayed unwrapped in chilled display cabinets. Cabinets with humidity control reduce drying out. A shelf life of 1-2 days is normal. Alternatively, meat is packaged for a variety of reasons:

- Over-wrapped - shelf life 1 to 2 days

Meat in trays overwrapped with a standard permeable film allows air to the meat to give a red colour but protects it from physical contamination. The meat browns in 1-2 days.

- Modified atmosphere packs shelf life 7 to 10 days

Meat is packed in trays with sealed lids which are impermeable to gases in air (usually transparent) and packed with a high-oxygen modified atmosphere. This keeps the meat red for longer but it browns eventually, usually with a rapid change from red to brown.



- Vacuum packed - shelf life of up to 10 days
- Meat is maintained in the absence of air so remains a purple-red colour. Shelf life is determined by spoilage and food safety requirements and limited to 10 days, although the colour remains unchanged.

Prolonged pre-retail storage of meat is possible in vacuum pack but only if the temperature is maintained at less than 3°C.

BE AWARE For extended shelf life meat needs to be frozen.

Cutting plants

All UK premises involved in cutting meat must be approved by the Food Standards Agency (and operate according to EU regulations including temperature requirements). However, to allow food manufacture by small/local companies, EU regulations provide exemptions for what are primarily retail establishments. In practice this includes facilities such as those servicing a farmers' market stall, or direct consumer sales (eg mail order or box schemes).

Exemptions

The main exemption is for retail (and /or small scale) establishments that supply food of animal origin to the final consumer, or supply other establishments (including caterers) on a 'marginal, localised and restricted' basis (see 853/2004 Article 1 Scope point 5).

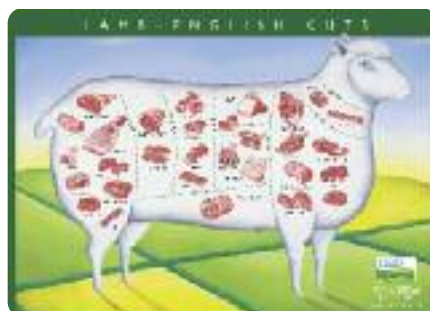
The UK is interpreting the terms 'marginal', 'localised' and 'restricted' in relation to meat as follows:

- *'Marginal': supply of food of animal origin:*
 - (i) *Up to a quarter of the business in terms of food; or*
 - (ii) *In relation to: fresh or processed meat, (but not wild game meat) up to 2 tonnes a week, subject to the establishment having a genuine retail outlet supplying the final consumer with part of its production of meat; and*
- *'Localised': supply of food of animal origin within the supplying establishment's own county plus the greater of either the neighbouring county or counties or 50 km/30 miles from the boundary of the supplying establishment's county; and*
- *'Restricted': supply of food of animal origin is limited to certain types of products or establishments. In the meat sector, the restrictions are in relation to the amounts of meat supplied and the requirement for a 'genuine' retail outlet (see 'marginal' above).*

Note: This also allows a butcher to cut meat on a farmer's behalf and return it to the farmer for onward sale, provided this is a marginal part of that butcher's business and the farmer being supplied is local.

Further information sources

EBLEX produces a range of material to support retail trade and direct sales outlets



For more information go to:

www.simplybeefandlamb.co.uk

www.eblexretail.co.uk

www.eblexfoodservice.co.uk

Tel: 0870 606 3030

Email: georginae@eblex.org.uk



Checklist

Production

- Select correct breed and sex for your market needs
- Select stock for slaughter at correct weight and finish to meet your market requirements
- Avoid older stock to ensure meat quality
- Consider extended hanging periods for older sheep
- Avoid stock that is too lean or too fat
- Ensure stock is clean before slaughter
- Prevent bruising or stress with well designed handling systems

Slaughter

- Consider electrical stimulation post slaughter for improved eating quality
- Avoid cooling meat too quickly to avoid toughness
- Choose maturation time for optimum quality

Chill chain

- Ensure hanging carcasses are adequately spaced
- Avoid large variations in temperature along the chill chain
- Prevent contamination on loading bays through door seals or canopies
- Ensure work room temperatures do not exceed 12°C
- Match packaging to intended shelf/ storage life of meat
- Extend chill chain to retail presentation



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