# Quality at every step

New Zealand Chilled Lamb

# New Zealand lamb is produced to the highest standards in a totally natural way.

Every step in the production and processing of New Zealand lamb is designed to meet the needs of the discerning consumer while respecting the animal.

Decades of research and innovation into processing, storage and transport conditions ensure New Zealand lamb products reach markets in excellent condition and in a sustainable manner. All of this is underpinned by a strong regulatory system.

*This guide aims to provide a simple authoritative reference to how New Zealand produces aged, tender meat with a great colour and a long shelf-life, while preserving the delicate grass-fed taste.*


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Further information available from www.mia.co.nz

# Step by step

*Image courtesy of Beef + Lamb New Zealand*

Lambs graze ryegrass and clover pasture

Information is recorded about each carcass

## PASTURE-BASED FARMING

New Zealand sheep are raised naturally outdoors. Lambs are typically kept with their mothers from birth in August or September (the New Zealand spring) until 8-12 weeks of age. After weaning they graze pastures comprising ryegrass and clovers. They may be offered forage crops, such as brassicas.

From late October through the following September – when the farmer considers the lambs are of the desired weight and quality, they are sold and transported to processing companies. All steps are taken during transport to minimise stress to the animals, which would reduce meat quality. This is guided by a Government Animal Welfare Code of Practice and an Industry Transport Assurance programme.

## PROCESSING FOR QUALITY

New Zealand slaughter and processing techniques are backed by ongoing research and development undertaken by teams of world-leading scientists.

On arrival at the processing plant, each lamb is inspected by a Government-approved veterinarian for signs of disease or injury. Only lambs that appear to be fit and healthy are passed.

The company then selects the best-quality animals for chilled lamb processing. Lambs that have overly long wool or are dirty are not included as this can be a source of meat contamination.

Again, through this stage animals are handled carefully to reduce stress, which could reduce meat quality because it increases the pH level.

Each animal is then humanely stunned. This renders it insensible to pain and then the neck artery is severed and the animal is bled. This meets New Zealand animal welfare requirements, which have been approved as equivalent to European Union (EU) standards through a government-to-government agreement.

Electrical stimulation after slaughter is a common method of avoiding cold shortening – which results in irreversible toughness. The stimulation causes muscle contractions that

Imaging technology can be used to grade carcasses

Carcasses are chilled under carefully controlled conditions

use up muscle glycogen and convert it to lactic acid. This also leaves the meat tender.

At most meat processors, the pelt is removed while the carcass is in an inverted position, hung by the front legs. This helps produce carcasses with very clean meat.

Each dressed carcass, along with edible co-products such as kidneys, liver, tripe and sweetbreads, is then scrutinised by government meat inspectors for presence of food safety-related conditions. (This requirement is mandated by New Zealand's Animal Products Act, 1999.) In addition, meat processing companies may employ their own qualified quality inspectors to assess other product quality attributes.

Carcasses are then weighed and graded to industry-agreed standards – which are based on meat colour and fat cover. Carcass grading is carried out manually at many plants, but automated systems using objective technologies such as image analysis are becoming more common. These provide the processor with more information, which can be used to evaluate carcass quality and the suitability for various markets.

In addition, the carcass yield and quality information is fed back to farmers to help them evaluate their performance and adjust their management to better meet the requirements of the processor, retailer and consumer.

## CHILLING

Controlled carcass chilling maximises meat quality and shelf-life because low temperature limits microbiological growth.

It is also vitally important to ensure the meat has a good appearance and eating quality. Chilling also produces a firm carcass which is safer and easier to work with, resulting in well-presented and more appealing meat products.

Carcasses are cut and packed to customer specifications

The packs of cuts retain tracking information through chilling and transportation

## CUTTING AND PACKAGING

When the deep meat temperature has reached the desired minimum, usually after 16-24 hours refrigeration, the carcasses are moved to a cutting room, which is held at less than 12°C. This temperature balances product quality and worker comfort. Highly skilled butchers cut the carcasses to many different customer specifications.

The lamb is then packaged in a manner that excludes oxygen by either vacuum-packing to remove oxygen or by controlled atmosphere-packed – where oxygen is replaced with a gas such as carbon dioxide. The packaging includes a barrier to maintain the oxygen exclusion.

Within 30 minutes of having entered the cutting room, the packaged lamb is in cartons and back under refrigeration. This rapid processing minimises the chance for bacterial growth to occur.

## MAINTAINING THE COOL CHAIN

Cartoned lamb is chilled until its temperature has stabilised within the range –1.5 ± 0.5°C. This level of chilling minimises any bacterial growth. This is crucial as shipping container refrigeration units are able to maintain this temperature but do not have the capacity to reduce the temperature.

Chilled New Zealand lamb is generally transported to market by sea. The integrity, performance, condition and hygiene of the shipping container must be checked and certified for export. The container structure, insulation, door seals and fans, as well as refrigeration unit, must all be in good condition to meet the certification standard.

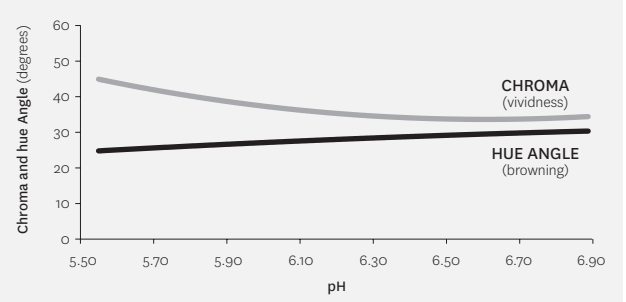
When kept at the optimal temperature during transport, the meat will slowly tenderise and will be fully aged by the time it reaches the marketplace.

For quality assurance, meat exporters monitor and retain records of product temperature from the commencement of chilling through to arrival in the marketplace. Many chilled lamb exporters include temperature loggers in the cartons with the product, which are retrieved.

# Meat characteristics

*Image courtesy of Beef + Lamb New Zealand*

Meat colour is mainly determined by the amount and form of myoglobin present




Chroma and Hue Angle of Lamb M. *longissimus lumborum* after 96 hours chilled retail display in an over-wrapped tray

## COLOUR

Colour is a very important quality attribute for a consumer making a purchase decision and therefore maintaining good colour is a consideration at every step.

Meat colour is mainly determined by myoglobin, the oxygen-carrying pigment in muscle. The higher the concentration of myoglobin found in a muscle, the darker its colour. Myoglobin content naturally increases with animal age.

The colour of a meat surface depends not only on the quantity of myoglobin present but also on the chemical state of the myoglobin molecule – which is related to the concentration of oxygen.

At moderate oxygen concentrations (above about 10%), a bright red form of myoglobin will predominate. When fresh meat is displayed for retail sale, for example, most of the surface myoglobin is in the bright red form of myoglobin.

Prolonged exposure to oxygen is avoided as this leads to the formation of a form of myoglobin that is brown in colour – even though this has no detrimental effect on the safety of the meat.

Meat colour is also closely linked to the pH of the meat. The higher the pH, the darker the meat appears.

To maximise colour stability of the meat, the temperature and time must be well managed. Even short-term increases in meat temperature, such as when the meat is removed from the container, for repackaging and distribution prior to retail sale, will have a significant impact on the colour stability of the product.

## ACIDITY

The pH of meat is an important determinant of taste, tenderness and shelf life.

A healthy and relaxed animal will have a high level of glycogen (a form of sugar) in its muscles and after slaughter this will be converted to lactic acid.

A higher level of lactic acid, which means a lower pH, produces better quality meat, with good colour. Lactic acid in meat also retards any bacterial growth, therefore giving a longer shelf life.

Conversely, if an animal is stressed it uses up the glycogen – and the lactic acid level in the meat after slaughter is lower, with reduced meat quality and shorter shelf life.

Vacuum packaging controls the presence of gases such as oxygen

## MINIMISING MICRO-ORGANISM RISK

Understanding how to minimise micro-organism risk is important for producing quality lamb with a long shelf-life.

At slaughter, with the skin on, meat is essentially sterile. Despite rigorous hygiene practices and stringent cleaning regimes there is the potential for bacterial contamination during processing.

Bacteria will generally increase as temperature rises, up to a certain optimum point. Micro-organisms also tend to be sensitive to the availability of oxygen, and as mentioned above, meat pH (acidity).

Most meat bacteria are harmless and have no detrimental effect on product quality when the storage conditions – in particular time and temperature – are within safe limits.

Which micro-organisms occur depends on the specific conditions.

Bacteria can be conveniently classified into groups according to the temperature ranges in which they are able to grow. Those of most concern in respect to food safety and preventing meat spoilage are the mesophiles which are unable to grow at chilled meat temperatures, and the psychrotrophs which can grow at temperatures as low as 0°C, although they usually grow best in the 20 to 30°C range.

The conditions required by the five most significant groups of spoilage bacteria found on chilled vacuum-packed meat are summarised in the table opposite.

In the case of vacuum-packaged meat, the meat surface is almost anaerobic (without oxygen) unless the evacuation and sealing have been ineffective.

The combination of a low oxygen concentration and the accumulation of carbon dioxide in the packaging atmosphere inhibits the growth of *Pseudomonas* species and other Gram-negative aerobes, allowing the growth of facultative anaerobic bacteria, such as the Enterobacteriaceae, *Shewanella putrefaciens* and *Brochothrix thermosphacta*, and the anaerobic but aerotolerant lactic acid bacteria species.

*Psychrotrophic* ("blown-pack") *Clostridia spp*. are rarely implicated in spoilage of New Zealand lamb. Spoilage is characterised by pack distension and a marked, characteristic "sweet sulphurous" odour.

Overall, New Zealand chilled lamb will have a different typical microbiological profile to other lamb. This is easily managed, and consumers can be confident New Zealand lamb is good and safe to eat.

SUMMARY OF CONDITIONS REQUIRED BY THE FIVE MOST SIGNIFICANT GROUPS OF SPOILAGE BACTERIA FOUND ON CHILLED VACUUM-PACKED MEAT:

| | Oxygen sensitivity | pH sensitivity | $CO_2$ sensitivity | Spoilage potential | General remarks |
|---|---|---|---|---|---|
| Lactic Acid Bacteria (LAB) | Aerotolerant anaerobe | High | Low | Low | Usually the dominant organisms of vacuum-packaged meat |
| *Pseudomonas* | Strict aerobe | High | High | High | Dominant in all aerobic spoilage floras |
| *Enterobacteriaceae* | Facultative anaerobe | Growth reduced significantly below pH 5.8 | Moderate | High | Major spoilage organisms of vacuum-packaged high-pH meat |
| *Brochothrix thermosphacta* | Facultative anaerobe | Growth reduced significantly below pH 5.8 | Moderate | High | Occasional major spoilage organism on vacuum-packaged meat |
| *Shewanella putrefaciens* | Facultative anaerobe | No growth below pH 6.0 | Moderate | Very high | Major spoilage organisms of high-pH meat |
| *Clostridia spp.* "Blown Pack" | Strict anaerobe | High | Low | Very high | Occasional major spoilage organism on vacuum-packaged meat |

Mills J, Donnison A, Brightwell G.. (2014) Factors affecting microbial spoilage and shelf-life of chilled vacuum-packed lamb transported to distant markets: A review. *Meat Science, 98: 71-80.*

# Why New Zealand Lamb?

## MAXIMISED QUALITY AND SHELF LIFE AS A RESULT OF:

- Naturally grass-fed and free-range animals with the highest standards of husbandry
- Selection and careful handling of animals
- Rapid processing with good hygienic practice at all stages, including control of temperature and moisture
- Continuous research to ensure evidence-based approaches and avoid risky external treatments
- Controlled atmosphere packing to exclude oxygen
- Carefully controlled shipping
- Underpinned by a strong regulatory system

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Meat Industry Association

Ministry for Primary Industries
Manatū Ahu Matua