AMPC/Sheep CRC/MLA Case Study

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Author:	AMPC, Sheep CRC, MLA
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Fact sheet – What is electrical stimulation?

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This is the first fact sheet in a series of three fact sheets about electrical stimulation.

Background

Electrical stimulation enhances meat quality by improving tenderness and meat colour by effectively controlling the rate of pH decline of a carcase post-slaughter.

What is electrical stimulation?

Electrical stimulation involves passing an electric current through a carcase which causes the muscles to contract or twitch. These muscle contractions burn up the remaining glycogen energy left in the muscle more quickly, creating lactic acid and dropping the pH more rapidly.

Even with rapid carcase chilling, pH 6 can be reached before the temperature reaches the range where there is a danger of cold shortening. Electrically stimulated muscles will reach a pH6 at a higher temperature than unstimulated carcasses.

Why are carcasses electrically stimulated?

Electrical stimulation was developed to accelerate post-mortem glycolysis, so that when muscle entered rigor excessive muscle shortening and toughness (cold shortening) was avoided.

Research by the Sheep CRC has indicated that most lamb carcasses in Australia undergo a fast chilling regime and thus to comply with the pH/temperature window, electrical stimulation is required. Cold shortened carcasses do not look different, even to an experienced butcher. Therefore, it is difficult to stop affected carcasses passing through trading channels and giving consumers unnecessarily tough meat.

pH and temperature decline

The muscle pH of a carcase declines post slaughter from 7.2 to about 5.5 due to the conversion of glycogen (muscle energy source) to lactic acid. If the pH decline is too slow by remaining high while the temperature of the carcase falls, cold shortening will occur (Figure 1).

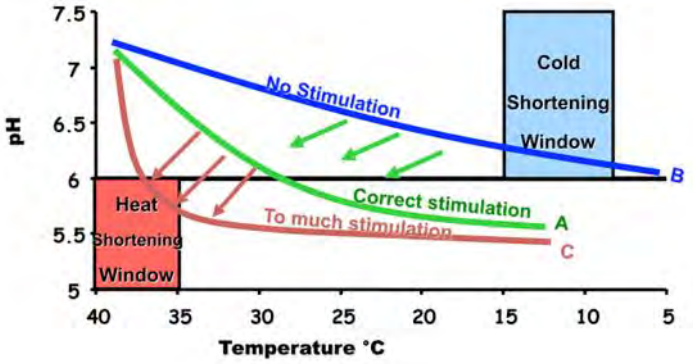

Figure 1: Graph showing the optimum 'window' of pH and temperature decline after slaughter (Path A). Carcasses suffer 'cold shortening' if their temperatures drop below 12°C before the pH has reached 6.0 (path B). Conversely they suffer 'heat toughening' if their pH drops under 6.0 while they are still above 35°C (Path C).

Cold shortening *occurs when the muscles react to the cold and tighten into an irreversible contraction before rigor occurs. It causes extremely tough meat (described as inedible) and may also be darker.*

Heat toughening *is the deactivation of the tenderising enzymes which reduces ageing potential of the meat making it tougher after extended ageing. It is caused by slow rates of cooling and fast pH decline.*

The eating quality window

The ideal 'window' is a specification used to describe the relationship between pH and temperature fall during chilling and the objective is to manipulate pH fall so it passes through the window.

The Sheep CRC and Meat and Livestock Australia (MLA) research has found hitting this window can significantly affect sheepmeat eating quality.

Hitting this window can shorten the ageing time of meat to reach consumer acceptable tenderness,

reduce the variation in tenderness and enhance meat colour.

How pH-temperature decline is measured

The rate of decline is commonly expressed in terms of the temperature at which the loin muscle of the carcase reaches pH 6 (Temp@pH6). Temperature and pH readings are taken at timed intervals using a combined pH/temperature meter during chilling. The data obtained is then used to calculate a rate of pH by temperature decline from which it is possible to predict the temperature at pH6.

Standard loin measurement *is taken at the lumbar-sacral junction, where overlaying fat is cut away to prevent fouling of the pH electrode.*

Optimal eating quality

Processors participating in the Meat Standards Australia (MSA) sheepmeat program are required to measure and control systems to achieve compliance with the pH-temperature guidelines (Table 1).

It is difficult to hit the window without methods to either slow the temperature decline (compromising food safety) or speed up pH decline.

Table 1: pH Temperature guidelines for sheepmeat

Ageing Period	Hanging system	Required Temp@pH6
Short: 5 days (domestic product)	Achilles hung	18-35°C
Short: 5 days (domestic product)	Tender stretch/ pelvic hung	8-35°C
Longer ageing period 10+ days	Achilles hung	8-35°C

There is a large variation in lamb tenderness across Australia, measured by shear force (Figure 2 – Normal variation). On average, only 14% of carcasses achieve targets of pH 6 between 18-35°C.

Stimulated carcasses, aged for 5 days (Figure 2 – Stimulated carcasses, aged for 5 days) are more tender, with 90% of carcasses meeting the pH/temperature target.

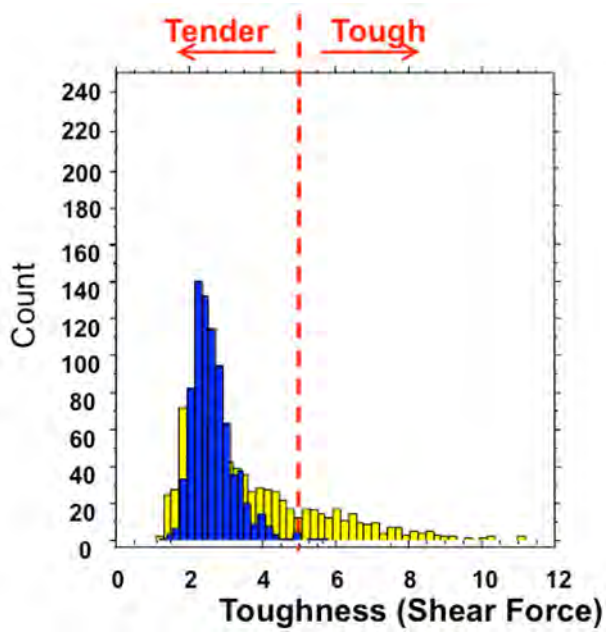

Figure 2. Lamb tenderness across Australia (1997-1998): Normal Variation (■), Stimulated carcasses, aged for 5 days (■).

Summary

Using electrical stimulation optimises the rate of pH and temperature decline and improves sheepmeat eating quality.

Meat Standards Australia (MSA) for sheepmeat requires meat processors to measure and control systems to 'hit' the pH temperature window.

Further information

For further information refer to Types of Electrical Stimulation and Optimising Electrical Stimulation.

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