AMPC/Sheep CRC/MLA Case Study

Document ID:	SheepCRC_27_1
Title:	The process to optimise Electrical Stimulation
Author:	AMPC, Sheep CRC, MLA
Key words:	sheep; electrical stimulation;

It should be cited as:

AMPC, Sheep CRC, MLA (2015) – *The process to optimise Electrical Stimulation*

THE PROCESS TO OPTIMISE ELECTRICAL STIMULATION

AMPC AND SHEEP CRC COLLABORATION

INTRODUCTION

Electrical stimulation enhances meat quality by improving tenderness and meat colour and as a process employed on the slaughter floor, assists Australian processors to consistently deliver quality sheep meat.

AMPC, MLA and the Sheep CRC have invested in a range of programs and projects in order to further investigate the optimum levels of electrical stimulation and the resultant impacts on meat quality.

A number of electrical inputs are available to improve meat quality:

- Medium voltage electrical stimulation units at the start and the end of the chain can improve tenderness and meat colour by increasing the rate of pH decline.
- High frequency immobilisation at the start of the chain reduces animal movement and improves occupational health and safety.
- Low or medium voltage electrical stimulation at the start of the chain can increase the amount of collectable blood and also reduces waste.

THE SHEEP CRC/AMPC PROGRAM TO APPLY ELECTRICAL STIMULATION AT PROCESSING PLANTS

More recently, the focus of investment on behalf of industry has been to work with lamb and sheepmeat processors to assist them in refining the use of their electrical stimulation systems.

Ongoing work, particularly when lambs from the Sheep CRC's Information Nucleus flocks have been slaughtered, has been used to investigate the functioning of electrical stimulation systems, with follow-up assistance provided in the field.

Properly functioning electrical stimulation systems are an important contributor to allow processors to deliver within the *Meat Standards Australia (MSA)* lamb and sheepmeat program.

Australian research has previously demonstrated that the rate of pH and temperature decline of a carcase can significantly affect sheepmeat eating quality.

The ideal (or optimum) range in which the relationship between pH and temperature fall during chilling is optimum (Figure 1). Remaining within this optimum will ensure shorter ageing time of meat to reach consumer acceptable tenderness, reduce the variation in tenderness and enhance meat colour. This further benefits the eating quality of the product and overall lamb consumption.

The optimum range is described in Figure 1 (below) which identifies the optimum range in which pH and temperature should fall within:

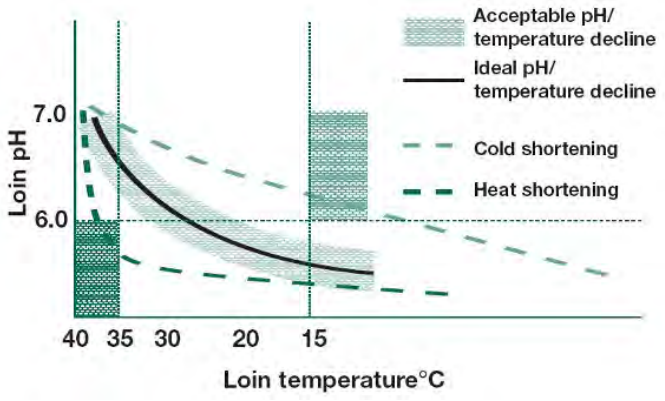

Figure 1: Optimum range for pH and temperature

Processors participating in the MSA program for sheepmeat will soon be able (and required) to measure and control systems to fall within the optimum pH temperature window. MSA lamb and sheepmeat research has identified optimal eating quality pH/temperature targets for specific markets the targets).

Table 1: pH Temperature guidelines for sheep meat

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

This is described in the table above, which provides some further detail on where the optimum range for pH and temperature is required to be to meet specific product and category specifications:

Challenges in remaining within the optimum range include the absence of processing methods to either slow temperature decline (compromising food safety) or to speed up pH decline, both of which are achieved through well managed electrical stimulation of the carcase. The rate of pH-temperature decline is commonly expressed in terms of the temperature at which the loin muscle of the carcase reaches a pH of 6. To calculate the temperature at pH 6, pH and temperature readings are taken at timed intervals using a combined pH/temperature meter during chilling (Figure 2). Using the standard location for measurement is very important. The standard pH measurement location is found at the lumbar-sacral junction, overlaying fat is cut away so as to prevent fouling of the pH electrode.

Figure 2: Standard pH measurement location (for spot measures)

If data is collected at the correct standard pH measurement location, at the suggested timed intervals, then these data can be utilised to calculate a rate of pH by temperature decline. Once this is calculated, it is possible to predict the temperature at pH 6 which provides indication of whether the product is within the optimum range and whether the product meets the required quality specifications. Being within the optimum range is considered to provide some confidence that the product will not be subject to cold shortening or heat toughening.

In practice, it has been demonstrated that there is considerable variation between carcases (as a result of several variables described further below). On this basis, it was recognised that it is difficult in a commercial setting to ensure all carcases to measure within the optimum range for pH and temperature decline.

Results from abattoirs in different locations around Australia show that the number of carcases which can achieve this optimum range (a pH of 6.0) at 18-35°C, without electrical stimulation, is about 15% nationally. This of course, varies from plant to plant as aforementioned.

These data were basis for the Sheep CRC program with AMPC that focused on working with processors to integrate measures of pH and temperature decline with the application of electrical stimulation, in order to enhance processor measure of the optimum ranges and thereby improved eating quality. In other words the application of electrical stimulation through the R&D carried out within the current Sheep CRC/AMPC program has resulted in reducing the wide number of carcases with quality variations as a consequence of falling outside the optimum range for pH and temperature decline.

With these data, processor can then manipulate their electrical stimulation rates of application and determine the right degree of manipulation to the carcase for optimal eating quality within their specific customer and market specifications.

R&D results to date have indicated that with the use of an optimal electrical stimulation setting optimum pH and temperature ranges can be increased to over

80% of carcases depending on the chilling regime of the abattoir.

Variation in these results is generally due to differences in animal variability, fast chilling rate, low muscle glycogen levels due to pre-slaughter stress impacts or nutrition and variation in stimulation application process and/or technological units between abattoirs.

HOW PROCESSORS CAN OPTIMISE AND MEASURE THE EFFECTIVENESS OF E-STIMULATION COMMERCIALLY

Processors can review and/or independently verify the performance of the electrical stimulation process in relation to achieving the optimum range for pH and temperature decline against their specific customer and market specifications.

To verify and review the performance and functionality of the electrical stimulation process, the steps are as follows and should be repeated quarterly for ongoing measurement of product quality:

- Select 4 consignments and 25 animals within each, on a random basis (e.g. 100 sheep per day), that are reflective of the "normal" variation observed at the plant (e.g. typical lots).
- Record the pH and temperature 20-30 mins post slaughter, on entry to the chiller. Record this again when the carcase has reached a core temperature of 18°C (measured in the loin at the standard measurement site).
- This data is then applied within the following equation to calculate the temperature at pH 6:

$$\text{Temp at pH6} = \text{Temp}A - \frac{\text{pH}A - 6}{(\text{pH}A - \text{pH}B)/(\text{Temp}A - \text{Temp}B)}$$

TempA and pHA *represent the first temperature and pH measurement taken 20-30 mins post slaughter (usually above pH6).*

TempB and pHB *represent the measurement taken when the carcase is at around 18°C (usually below pH6).*

In the event a low percentage of carcases meet the optimum range, then a number of alterations can be made including the use of electrical stimulation, which accelerates the rate of pH decline, varying the stimulation time and setting or adjusting the chilling regime.

Alternatively, in the event that the electrical stimulation unit is not ensuring that carcasses reach pH6 before 18°C, the electrical stimulation inputs can be further modified to suit a particular plant processing regime or process. This is recommended to be achieved in consultation with Sheep CRC researchers where possible to gain assistance for specific data interpretation.

In summary, the key messages from the program studies of the Sheep CRC/AMPC include:

- That e-stimulation enhances meat quality by improving tenderness and meat colour.
- That e-stimulation can be practically and effectively applied in processing plants to consistently deliver quality sheep meat.
- That there is a need for processors to consider methods such as e-stimulation, to optimise the rate of pH and temperature decline.
- That the effectiveness of e-simulation as a method to enhance eating quality may be regularly measured by processors in a commercial setting
- That measurement and monitoring of the optimum range for pH and temperature decline provides processors with the ability to identify variation in product quality and enhance their ability to meet customer and market specifications, including future integration with MSA.

For further information, contact AMPC (www.ampc.com.au) or the Sheep CRC (www.sheepcrc.org.au).