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QUALITY SHEEP MEAT—ACHIEVING TARGET PH AND TEMPERATURE DECLINES TO IMPROVE MEAT QUALITY

Optimising the rate of pH and temperature decline improves sheep meat eating quality.

Meat Standards Australia (MSA) for Sheep Meat will require meat processors to measure and control systems to achieve the optimum pH-temperature window.

To determine the proportion of carcases hitting the window, four times each year, processors should select and monitor four consignments with 25 carcases per consignment.

pH should be recorded 20 to 30 minutes post slaughter and again when the carcase is close to 18°C.

Introduction

Recent work jointly funded by the Australian Sheep Industry Cooperative Research Centre (Sheep CRC) and Meat and Livestock Australia has found that the rate of pH and temperature decline of a carcase can significantly affect eating quality. The muscle pH of a carcase declines post-slaughter from 7.2 to about 5.5 due to the conversion of muscle glycogen to lactic acid. If the rate of pH decline is too slow (high pH at low carcase temperature), cold shortening may occur. Cold shortened meat is tough or even inedible.

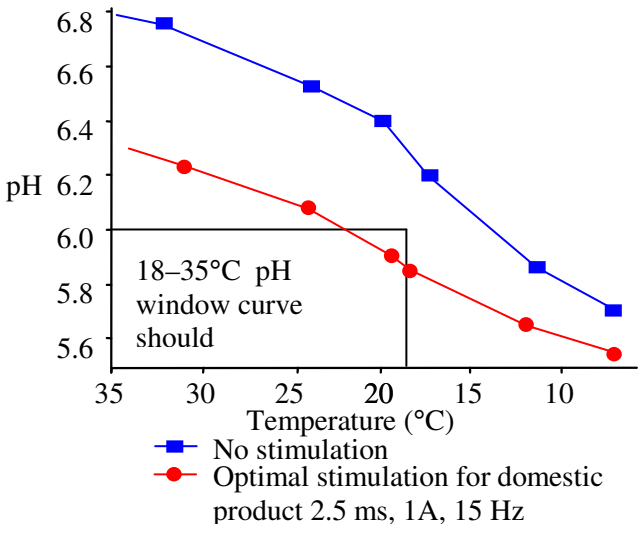

Figure 1. pH-temperature decline in lambs

The ideal window is the 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. Hitting the window can shorten the ageing time of meat to reach consumer acceptable tenderness, reduce the variation in tenderness and enhance meat colour. By boosting the perception of lamb in the market place and increasing overall lamb consumption, farmers, processors and consumers all benefit.

Processors participating in the Meat Standards Australia (MSA) program for Sheep Meat will be required to measure and control systems to achieve the pH-temperature window. The evidence says that sheep and lamb processors cannot hit the window without methods to either slow temperature decline or speed up pH decline. The former approach can compromise food safety; the latter can be achieved with electrical stimulation of the carcase.

How is pH-temperature decline measured?

The rate of decline is commonly expressed in terms of the temperature at which the loin muscle of the carcase reaches a pH of 6. Temperature and pH readings are taken at timed intervals using a combined pH/temperature meter during chilling. Using the standard location for measurement is very important; this is found at the lumbar-sacral junction and overlaying fat is cut away to prevent fouling of the pH electrode.

Figure 2. Measuring pH at the loin using a pH meter.

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.

What are the new pH-temperature guidelines for sheep meat?

MSA research has identified that for optimal eating quality of sheep meat destined for specific markets the targets in Table 1 should be met.

Table 1. pH-temperature guidelines for sheep meat

Ageing Period	Hanging System	Required Temperature @ pH6
Short ageing period of 5 days (domestic product)	Achilles hung	18–35°C
Short ageing period of 5 days (domestic product)	Tender stretch/pelvic hung	8–35°C
Longer ageing period 10 days	Achilles hung	8–35°C

What compliance rates can be achieved?

Under commercial conditions there is considerable variation between carcases and it is difficult to get all carcases within the window. Results from abattoirs around Australia show that the percentage of carcases that can achieve a pH of 6 at 18 to 35°C, without electrical stimulation, is 15%. This will vary from plant to plant.

With the use of an optimal electrical stimulation setting this can be increased to over 80% depending on the chilling regime of the abattoir (Table 2). The pH-temperature range has expanded from the previous 18–25°C (Achilles hung, aged for 5 days), as recent research has suggested that it is possible to increase the maximum temperature to 35°C without any detriment to eating quality. This change will increase the number of animals that will meet the guidelines (in this example from 60% of carcases to 80%) with no cost to meat quality.

Reasons for non-compliance include animal variability, fast chilling rate, low muscle glycogen levels due to stress or poor nutrition pre-slaughter and variation in stimulation units between abattoirs.

Table 2. Percentage of carcases achieving pH-temperature guidelines

	% of Carcases		
	Compliance	Non-compliance	
	pH 6 between 18-35°C	pH <6 at 35°C	pH>6 at 18°C
No stimulation	15	0	85
Optimal setting for domestic market (2.5ms, 1A, 15Hz)	80	2	18

How are compliance rates audited?

Processors should independently audit their plants to determine compliance rates of carcases hitting the optimum pH-temperature window. If only a low percentage is achieved, 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.

The process for determining compliance rate is:

- Processors should randomly select 4 consignments per day that reflect the variation in carcases being processed over the day.
- Within each consignment 25 carcases should be measured (i.e. 100 sheep per day).
- The pH and temperature of each carcase should be recorded at 20 to 30 minutes post-slaughter (on entry to the chiller) and then again when the carcase is approximately 18°C.

This data should then be used to calculate the temperature at pH 6 using the following equation. The temperature should be in the range of 18 to 35°C for the carcase to hit the pH-temperature window.

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

Where:
Temp*A* and pH*A* represent the first temperature and pH measurement taken 20 to 30 minutes post-slaughter (usually above pH6).
Temp*B* and pH*B* represent the measurement taken when the carcase is around 18°C (usually below) pH6).

- This process should be completed a minimum of 4 times per year and include a variety of seasons.
- To regularly test whether the stimulator is working, 5 carcases from each of 4 lots can be measured on entry to the chiller.
- Consultation with Sheep CRC researchers is possible to assist processors with data interpretation.

What are the take home messages?

- Optimising the rate of pH and temperature decline improves sheep meat eating quality.
- Meat Standards Australia (MSA) will require meat processors to measure and control systems to achieve the pH-temperature window.
- Four times per year, processors should select four consignments per day and 25 carcases per consignment to determine the number of carcases hitting the window.
- pH should be recorded 20 to 30 minutes post slaughter and again when the carcase is close to 18°C.
- To regularly test whether the stimulator is working properly, five carcases from each of four lots can be measured on entry to the chiller.

Further information

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- Dr David Hopkins, NSWDPI on (02) 63499722 or email david.hopkins@dpi.nsw.gov.au

A fact sheet titled 'Quality Sheep Meat - Electrical stimulation for improved eating quality and occupational health and safety' is available and can be found at the Sheep CRC website www.sheepcrc.org.au

This is the second in a series of Practical Wisdom notes available from the Sheep CRC aimed at improving the quality of Australian sheep meat. Other titles discuss a wide range of innovations and improvements that industry can profitably adopt.

Acknowledgements

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