OPTIMISATION OF A NEW GENERATION PRE-DRESSING ELECTRICAL STIMULATION UNIT

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Introduction

The temperature at which a carcase enters rigor (pH 6.0) can be used to predict meat quality (Thompson *et al.*, 2005). If the carcase temperature falls too fast before the onset of rigor then cold shortening may result (Tornberg 1996) which can have adverse effects on meat tenderness. At the other end of the scale, slow rates of cooling can lead to heat toughening (Devine *et al.*, 1999) which may reduce ageing potential (Strydom *et al.*, 2005). Electrical stimulation has been identified in many studies as a useful processing technique to improve meat quality traits (e.g. Polidori *et al.* 1999) however few domestic abattoirs within Australia have adopted this method because of either the cost, safety considerations or a lack of space on the slaughter floor (Shaw *et al.*, 2005). Concerns about safety have been alleviated by development in Australia of new electrical stimulation technology that can be installed at either the start or end of a sheep chain and because current and pulse width are safe it requires minimal isolation from workers.

The Australian Sheep Meat Eating Quality (SMEQ) program identified various temperature ranges for optimal eating quality, depending on the market for the product. From this it was concluded that the target temperature range to achieve pH 6.0 should be 18-25°C for short aged meat destined for the domestic market (Thompson *et al.* 2005). However from a study by Toohey *et al.* (2006), which monitored three domestic Australian abattoirs, over 12 month, it was concluded that only 18.8 % of the 1197 carcases tested complied with the recommended pH-temperature window. Approximately 79 % of the carcases tested were at the cold end of the scale not reaching rigor (pH 6.0) by 18°C. This low compliance is also supported by data presented by Hopkins *et al* (2006) which show data from three other abattoirs which had a compliance rate from 0-16 %. This low compliance to the SMEQ window suggests that other processing techniques such as electrical stimulation need to be adopted.

The aim of the study was to optimise the current and pulse width of a new generation pre-dressing mid-voltage electrical stimulation unit, in order to maximise the number of carcases falling within the recommended SMEQ pH/temperature window (pH 6.0@18-25°C).

Materials and Methods

In total, 345 lambs from 14 different consignments were assessed. The lambs in the different consignments were of varying backgrounds and breed and represent lambs purchased by the company. Each consignment was exposed to different stimulation treatments having various levels of current and pulse width, using a pre-dressing mid voltage electrical stimulation unit. All treatments were applied for the same length of time (40 seconds). An outline of stimulation treatments, the number of consignments and the number of carcases sampled per treatment is shown in Table 1. Carcases were trimmed according to the specifications of AUS-MEAT. Hot carcase weights were recorded and the GR measured (total tissue depth over the 12th rib, 110 mm from the midline) using a GR knife. Carcase pH and temperature measurements were taken 30 min after death and then measured at every hour 5-7 times, depending on which day they were sampled. The carcases were stored in chillers with a mean temperature of 9.7°C and a range of 4-17.2°C. The pH and temperature measurements were taken in the left portion of the M. *longissimus thoracis et lumborum* (LL) muscle at the caudal end over the lumbar/sacral junction. A section of the subcutaneous fat and the M. *gluteus medius* was cut away to expose the LL and after each measurement the area was resealed with the overlaying tissue. Muscle pH was measured using a glass combination pH probe (potassium chloride) Ionode intermediate junction pH electrode, (TPS Pty Ltd., Brisbane, Queensland) attached to a data recording pH meter (TPS WP-80). Muscle temperature was measured using a stainless steel cylindrical probe attached to the same meter. The pH meter was calibrated before use and at regular intervals using buffers of pH 4 and pH 6.8 at room temperature.

Results and Discussion

There were some differences in both carcase weight and GR between treatments, where there was a recorded weight (Table 1). The predicted temperature at pH 6.0 was significantly different between treatments, but it should be noted that it was not possible to predict the temperature at pH 6.0 for all carcases. The greatest difference for predicted temperature at pH 6.0 was between the carcases in treatment 3 (14.9°C) and treatment 6 (24.5°C). Predicted pH at 25°C and 18°C were significantly different between treatment groups, with treatments 6 and 7 showing a lower pH for both. The percent of carcases that fell in the pH and temperature window varied between treatments. This was also the case for the proportion that had a pH less than 6.0 at 25°C and that had a pH greater than 6.0 at 18°C (Table 1).

Table 1: Predicted means (a.v. s.e.d.) of carcase weight (kg), GR (mm), predicted temperature at pH 6.0, predicted pH at 25°C,predicted temperature at 18°C, percent of carcases hitting the pH and temperature window, % with pH < 6.0 at 25°C and % with pH > 6.0 @ 18°C.

Treatment	1	2	3	4	5	6	7	8	9	av. s.e.d
Stim treat^	400x0.5	350x0.5	off	550x0.5	400x1.5	800x0.5	700x0.5	800x1.0	800x1.5	
Traits										
Animals	60	20	5	85	20	80	45	15	15	
Sampling days	3	1	1	5	1	5	3	1	1	
Consignments	3	1	1	9	1	11	7	3	3	
Weight	20.8ab	20.7ab	19.9a	20.4ab	n.a.	20.7ab	20.9ab	20.8ab	21.32b	0.65
GR*	9.8a	10.6abc	10ab	11.4abc	n.a.	12.2c	10.7abc	12.1bc	10.85abc	1.03
Predtemp@pH6#	18.7abc	20.5bcd	14.9a	21.6bcd	17.9ab	24.5d	23.7cd	17.7abc	17.32ab	2.66
Pred pH @ 25°C	6.26cd	6.20bc	6.38d	6.13abc	6.29d	6.00a	6.05a	6.07ab	6.12abc	0.072
Pred pH @ 18°C	6.00bcd	5.94abc	6.11d	5.92abc	6.04cd	5.82a	5.81a	5.88ab	5.94abc	0.079
%hit pH window	37	30	20	44	40	28	36	27	7	34 %+
%pH<6.0@ 25°C	3	0	0	28	5	54	47	20	20	28 %+
%pH>6.0@ 18°C	60	70	80	28	55	18	17	53	73	38 %+

Means followed by a different letter in a row (a,b,c,d) are significantly different ($P < 0.05$), ^ stimulation treatment is the current (milliamps) by the pulse width (milliseconds), *Adjusted to a hot carcase weight of 20.7kg, # predicted values for 317 animals, + Average % across treatment groups, n.a. not available.

Conclusions

The results obtain from the 345 carcases in this study indicate that it is complicated to find the optimum setting across all animals killed. Application of a low current, such as 400 milliamps will result in a large percentage of carcases having a pH > 6.0 at 18 °C and application of a higher current, such as 700 or 800 milliamps, will result in a large percentage of carcases within a pH < 6.0 at 25°C. In this study an effective response was achieved with a current of 700-800 milliamps and a pulse width of 0.5 milliseconds with a moderate proportion of carcases hitting the window, but only a small proportion achieving a pH > 6.0 at 18 °C. Avoiding the cold end of the window must take precedence over avoiding the hot end as results from the SMEQ program showed that a detrimental effect on eating quality was more likely at the cold end (Shaw *et al.*, 2005). At the abattoir sampled in this study it is also likely that in the future a faster chill will be applied and for these reason the higher currents are recommended.

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