TEMPERATURE DECLINE AT DIFFERENT SITES IN LAMB CARCASSES

David, Hopkins[1]; Roger, Hegarty[2] , David Stanley[1]
[1]NSW Agriculture, Centre for Sheep Meat Development, PO Box 129, Cowra, New South Wales 2794, Australia
E-mail: David.Hopkins@agric.nsw.gov.au
[2]NSW Agriculture, Armidale Beef Industry Centre, UNE, Armidale, New South Wales 2351 Australia

Background

The development of an eating quality scheme for sheepmeat in Australia has seen the derivation of pH/temperature windows for chilling so as to optimise eating quality. These windows have been established based on measurement at the caudal end of the m. *longmissius thoracis et lumborum* where the muscle meets the *gluteus medius*. For implementation of the scheme it is likely that processors will need to monitor temperature and pH decline during chilling. The site for the measurement of temperature in lamb carcasses was changed in 1995 with the launch of the Australian standards endorsed by ARMCANZ. These state that the surface temperature must be reduced to 7°C within 24 hours of stunning and before transport (ANON. 1995). A quick and effective method of measuring these temperatures is by use of an infrared non-contact thermometer (ANON. 1996). Usually temperature would be measured by a probe that penetrates into carcass meat, but if surface temperature could be used this would allow quicker and easier screening measurements allowing targeted pH measurement.

Objective

To establish the relationship between temperature decline measured at several different sites on lamb carcasses.

Methods

Carcass types and measures

Carcass data were obtained for 32 female lambs (Poll Dorest x Border Leicester x Merino). These lambs were equally represented across 2 slaughter days and 4 slaughter groups (2 per day). All animals were electrically stunned (head only) in a commercial abattoir and trimmed according to the specifications of AUS-MEAT (ANON, 1992). Hot carcass weights were recorded and the GR measured (total tissue depth over the 12th rib 110 mm from the midline) using a GR knife.

Sampling and meat quality measurements

At regular intervals after the commencement of chilling, pH and temperature (Ltemp) were measured in the left-hand portion of the m. *longmissius thoracis et lumborum* (LL) at the caudal end over the lumbar/sacral joint. A section of subcutaneous fat and the m. *gluetus medius* was cut away to expose the LL and after measurement the area was resealed with the overlaying tissue. pH was measured using a WPS meter with temperature compensation (TPS, WP-80, PTS Pty Ltd) and a polypropylene spear-type gel electrode (Ionode IJ 44), calibrated at ambient temperature. Temperature decline (Ptemp) was determined using Cox recorders (Belmont, NC, USA). Probes were inserted into the centre of the (LL) at the 12th/13th rib and recorded temperature every 10 mins. The surface temperature (Stemp) was measured with an infrared gun (non-contact thermometer; Raynger PM plus, Raytek inc.) on the opposite side of the LL to the pH measurement site. Thus from the commencement of chilling and the first measurements, temperature was monitored in each carcass for 5-6 hours, during the period of rapid temperature decline with four measures collected at each site. Lambs surveyed were representative of a larger slaughter group and 70 carcasses were present in the chiller on each day.

Statistical analysis

Ltemp, Stemp and Ptemp were regressed against each other (GENSTAT, 2002) and the effect of carcass weight, GR and slaughter day on these relationships was also examined. Each temperature was also regressed against chilling time (h). It is recognised that over a longer chilling period the relationship between temperature and time is non-linear, but this has not been examined in this paper.

Results

Carcasses were chilled at 4-5°C and 88% humidity. A summary of the various temperature measurements for the 32 carcasses is provided in Table 1.

Table 1. Summary statistics for surface temperature (Stemp), loin temperature (Ltemp) and loin temperature at the 12th rib (Ptemp)

	Stemp (°C)	Ltemp (°C)	Ptemp (°C)
Mean	12.7	19.6	14.5
Standard deviation	5.0	9.7	7.1
Coefficient of variation	39.6	49.6	49.0
Range	2.2-22.6	4.2-36.7	3.7-30.2

The coefficients for the regression models are shown in Table 2. All regression models were significant at the P = 0.001 level as was each slope coefficient in the models. These show that loin muscle temperatures measured at the 12th rib and lumbar sites decrease at a faster rate than surface temperature. Temperature measured at the 12th rib (Ptemp) declined at a slower rate compared to temperature at the pH measurement site (Ltemp) and had lower absolute levels throughout chilling. These declines are depicted in **Figure 1** where fitted temperatures are plotted against chilling time.

Both carcass weight and fatness (GR) had a significant effect ($P < 0.05$) on the prediction of Ltemp from Ptemp with regression coefficients of 0.27 kg/degree and –0.29 mm/degree respectively. Of particular interest was the finding that prediction of Ptemp from Stemp was significantly effected by the GR level of the carcass such that at a constant Stemp the predicted value of Ltemp increased as GR increased

with a regression coefficient of 0.36 mm/degree. Additionally slaughter day had an effect on this relationship. Using the first model shown in Table 2 the predicted temperature in the loin (Ltemp) at a surface temperature of 7°C would be 10.0°C.

Table 2. Regression relationships between surface temperature (Stemp), loin temperature at the 12th rib (Ptemp) and loin temperature (Ltemp)

Dependent variable	Intercept	Slope	R^2	r.s.d.
Ltemp	-1.64 (± 1.17)	1.67 (± 0.09) Stemp	0.75	4.88
Ptemp	-0.50 (± 0.94)	1.18 (± 0.75) Stemp	0.70	3.92
Ltemp	1.18 (± 0.73)	1.27 (± 0.05) Ptemp	0.86	3.61

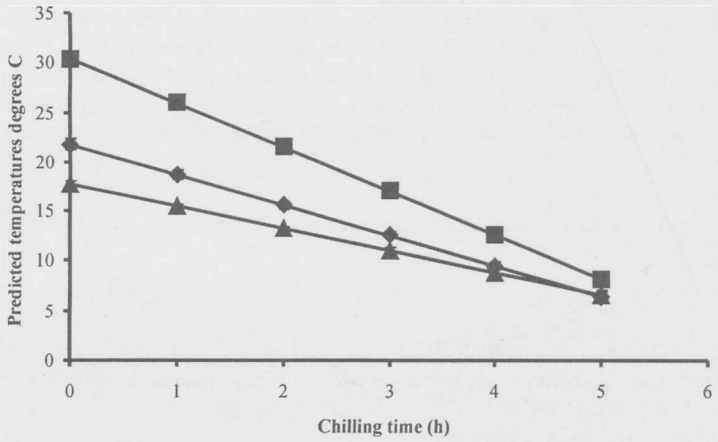

Figure 1. Relationship between surface temperature (Stemp; ▲), temperature at the 12th rib (Ptemp; ◆) and temperature at the lumbar site (Ltemp; %) and chilling time (h).

Discussion

Based on the results of SHAW et al. (1995) and using data for temperature at the 12th rib the chilling conditions in this experiment would be classified as medium ie <6°C after 8 hours of chilling even allowing for the fact that there was delay in measuring temperature after death in this experiment. Given this temperature regime the target surface temperature of 7°C was achieved within 5 hours of the first measurement, well within the time scale to allow a night load out. In previous work, surface temperature has been found to show large fluctuations when hot carcasses are introduced into a chiller (HOPKINS, 2002) and in this study slaughter day was also found to influence the relationship of this measurement to other temperature measures. This highlights the greater sensitivity of measuring temperature on the surface of the carcass. Using this measure as a quick monitoring method to indicate when deeper muscle temperatures and pH should be measured, would require very careful application and may in fact be impracticable. Of particular relevance to the development of an eating quality system was the difference in temperature between temperature measured at the loin pH site and temperature at the 12th rib, with the difference decreasing during chilling (**Figure 1**). This indicates that when setting a pH/temperature window as per MSA (THOMPSON, 2000) then the actual site of measurement must be specified even if measurement is in the loin and this needs to be carefully explained to industry and those who measure pH and temperature.

Acknowledgments

The assistance of Andrew Blakely (UNE) and Terry Farrell (NSW Ag.) in the conduct of this experiment is noted with appreciation. The co-operation of abattoir staff at Peel Valley Exporters (Tamworth) was also appreciated. Meat & Livestock Australia provided support for this work.

References

Anon. (1992). AUS-MEAT Language. 4th edn. Authority for Uniform Specification Meat and Livestock, Sydney, Australia.

Anon. (1995). Australian Standard for Hygienic Production of Meat for Human Consumption, SCRAM Report No. 54, (CSIRO, Melbourne, Australia).

Anon. (1996). Meat Technology Update No. 95/6, (AMT, Brisbane, Australia).

Genstat (2002). GENSTAT 6 Release 6.1, (Sixth edition, For Windows), Lawes Agricultural Trust (Rothamsted Experimental Station).

Hopkins, D.L. (2002). *Anim. Prod. Aust.* **24**, 93-96.

Shaw, F.D., Eustace, I.J., & Smith, D.R. (1995). *Proc. Aust. Meat Ind. Res. Conf.*, Gold Coast, Queensland, PP7-9.

Thompson, J.M. (2000). *Asian-Australasian J. of Anim. Sci.* Supplement July 2000, Vol B. **13**, 22-25.