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Author:	Thomson, K.; Baudoux,P.; Gardner, G.; Simmons, N.; Daly, C.; Thompson, J.M.
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The impact of length of exposure to high temperatures post-rigor on ageing rate of beef

K. Thomson[1], P. Baudoux[1], G. Gardner[2], N. Simmons[3], C. Daly[3] and J.M. Thompson[1]

Australian Sheep Industry CRC

[1]School of Rural Science and Agriculture, UNE, Armidale, NSW 2351, Australia; [2]School of Veterinary and Biomedical Sciences, Murdoch University, Murdoch, WA, 6150, Australia; [3]AgResearch, MIRNZ Centre, Hamilton, New Zealand

Heat toughening conditions (HTCs) where muscles experience the combination of high body temperatures (above 35ºC) in increasingly acidic pH environments. It is known to jeopardise the post *mortem* (PM) ageing potential of products through the early depletion of the proteolytic enzymes responsible for improving tenderness during ageing (Simmons *et. al.* 1996; Geesink et al. 2000, Devine *et. al* 2002). Whilst many studies have focussed on the biological mechanisms responsible for the reduction in ageing potential, the impact of length of exposure to HT conditions remains unclear. This has implications for the development of optimisation procedures for both conventional and hot boning techniques. This experiment tested the hypothesis that detrimental effects caused by prolonged exposure of post *rigor* meat to HT conditions are proportional to the length of exposure.

Post-slaughter, the *m. longissimus thoracis et lumborum dorsi* were removed from 15 non-stimulated beef carcases (215 ± 14.6kg carcase weight), divided into anterior and posterior samples, wrapped tightly in plastic and held at 15ºC until rigor to minimise shortening and prevent confounding of treatment and pH during pH decline At pH 5.6 samples were divided into steaks (3-4 cm thick) and elevated temperature treatments (0, 25, 85, or 205 min in a 37ºC waterbath) were imposed. Vacuum-packed steaks were then aged at 1ºC for 1, 3, 7, 12 and 21 days and shear force was measured for each steak. An additional steak was tested across ageing periods to determine the degradation of muscle proteins desmin and troponin-t (SDS-Page and Western blotting techniques) and to determine average myofibril length.

Shear force, myofibril length and desmin degradation declined exponentially, and the appearance of troponin-T products (< 30Kda) increased exponentially with ageing. Natural log transformation of the dependent variable allowed this decline to be modelled as a linear function. The appearance of troponin-T products (< 30Kda) showed an exponential increase and data was transformed to an exponential decline prior to analysis. Mixed model tests contained effects for time in the water bath (0, 25, 85, 205 min), other design effects, ageing (days PM) as a continuous variable and appropriate first order interactions.

Shear force ($P<0.001$) and the accumulation of troponin-T degradation products ($P<0.01$) showed significant ageing*time in water bath interactions, with longer exposure to elevated temperatures showing a trend towards a linear reduction in ageing potential. Whilst there was a significant ageing effect ($P<0.05$) for myofibril length and the disappearance of desmin, the ageing*time in water bath interaction was not significant ($P>0.10$).

Ageing potential was dependant upon the length of exposure to elevated temperatures in acidic environments (<pH 5.6) and that future processing strategies must focus on minimising the length of time cuts are exposed to elevated temperatures. In the future, with the development of hot boning technologies that prevent muscle fibre shortening, it will be possible to individually chill primal cuts to optimise rate of PM ageing and improve the quality and consistency of meat products.

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