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Effect of Controlled Temperature-Time Variation during the Chilled Storage of Beef on Tenderness Characteristics

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Objectives

The objective of this project is to provide industry with temperature-time management strategies for ageing beef by establishing the effects of temperature range, ageing duration, and their combination, on beef tenderness.

Materials and Methods

Beef loins (n = 40; M. *longissimus lumborum*) were randomly selected from commercially processed carcases typical of prime grass-fed cattle in Australia from the boning room of a commercial abattoir. Loins were divided into 8 equal portions, vacuum-packaged and assigned to 1 of 72 temperature-time combinations (TTC), using ageing temperatures set at 0.5°C (control; average 0.62 ± 2.08°C), 3°C (average 5.04 ± 1.27°C), 5°C (average 5.86 ± 0.95), 7°C (average 8.2 ± 1.11°C) and ageing time intervals of 4d, 6d, 8d, 10d, 12d, and 14d (control). Each sample's temperature remained constant over each interval with at most one variation of treatment temperature within the total time. At 6d, 8d, 10d, 12d, 14d, samples were analyzed for particle size (PS); a determination of myofibrillar degradation using laser diffraction peak, ultimate pH (pHu), and cooked to an internal temperature of 71°C for shear force analysis (SF); measured in Newtons, and). SF and PS data were analyzed with pHu as a covariate, using a linear mixed model fitted with the fixed effects of TTC and random effects of repeat and loin, as well as their interactions with TTC.

Results

The only significant contrast was between temperatures within 6 d aging time for PSA. Table 1 shows the distribution of the predicted means (adjusted for carcass variation) of temperature-time combinations (mean, min, max, standard deviation) for each time interval. The distribution of predicted means is similar across ageing times (including Controls), with the exception of 6 d for PSA, which has a higher mean than other intervals (Table 1).

Table 1. Mean, standard deviation and range of ageing time intervals with regards to particle size (PS) and shear force (SF), including pH as a covariate. Lower PS indicates higher tenderness; lower SF indicates higher tenderness.

		Time Interval, d				
Trait		6	8	10	12	Control
PS, µm	Mean, ± sd	163 (35.1)	144 (31.6)	140 (31.0)	139 (28.0)	138 (15.8)
	Range, min-max	111–212	97–198	90–207	88–213	122–154
SF, N	Mean, ± sd	37 (3.6)	35 (4.1)	36 (5.6)	36 (7.1)	39 (4.4)
	Range, min-max	30–42	29–41	27–50	22–55	35–43

Conclusion

The decreasing particle size over ageing until 10 d is evidence of proteolysis reinforcing the importance of ageing in the tenderisation of beef. The lower shear force means indicate that beef subjected to temperature time combinations were marginally more tender than the controls, but the overall differences would not be of practical significance. These findings suggest that alternative temperature time combinations result in the same level of shear force as observed in typical practice. Overall, the results suggest that it may be possible to age high quality prime beef for shorter periods without negatively impacting tenderness, primarily observed by comparison of the shear force treatment means with shear force control means.

