P-08-22

The effect of low-temperature long-time *sous vide* cooking on texture and juiciness in low valued meat from young and old cattle (#487)

Zahra B. Naqvi[1], Peter Thomson[2], Minh Ha[3], David McGill[3], Robyn Warner[3]

[1] Charles Sturt University, Faculty of Science, School of Animal and Veterinary Sciences, Wagga wagga, Australia; [2] The University of Sydney, School of Life and Environmental Sciences, Sydney, Australia; [3] The University of Melbourne, Faculty of Veterinary and Agricultural Sciences, Melbourne, Australia

Introduction

Sous vide is a popular cooking method in restaurants and catering industry globally, It has allowed low-valued tough meat cuts to be transformed into tender servings, enabling uniform texture and juicier meat compared to traditional cooking methods. Previous research has reported improved textural properties as a result of *sous vide* cooking in different livestock species (Del Pulgar et al., 2012; Roldán et al., 2013). The present study was designed to investigate the effect of low-temperature long-time *sous-vide* cooking on texture properties and juiciness in low-valued tough meat cuts from young and old cattle.

Methods

This study comprised of *bicep femoris* (BF) and *semitendinosus* (ST) muscles (n=24) from two age groups (young, less than 18 months, n=12 vs old, 3.5 years; n=12), three heating temperatures (55°C, 65°C and 75°C) and three heating times (1 h, 8 h, 18 h). Each muscle was cut into nine steaks weighing approximately 167 ± 10 g (mean ± SD). All steaks were weighed, vacuum-packed and randomly allocated to a cooking treatment. Cooking occurred in temperature-equilibrated water baths and internal temperature was monitored by thermocouples attached to a Grant data logger. After cooking, the bags were immediately immersed in an ice bath for 15 minutes to cool the samples to room temperature. The percentage of cooking loss was calculated by using the method described by Domínguez et al. (2014). The hardness, cohesiveness, and chewiness of cooked meat samples were calculated as described by Channon et al. (2014). The data were analysed by fitting a linear mixed model using Genstat 18th edition.

Results

Interactions were seen between cooking temperature and time on cooking loss (CL%) for both muscles BF and ST ($P < 0.001$). Results from each muscle shows the greater cooking loss in the meat from young animals as compared to meat from older animals. Cooking loss increases with increasing cooking time as well as temperature (Table 1). A substantial cooking loss was found with increasing cooking time from 1 to 8 hours whereas the difference reduced between 8 and 18 hours. Previous studies demonstrate that the cooking losses in meat is largely determined by heat-induced structural changes in myofibrillar proteins during cooking (Hughes et al., 2014). Most of the water in muscles is located in the myofibrils. Increasing the temperature causes shrinkage, denaturation and in some cases solubilisation of muscle proteins. The basis for selecting the three temperatures is that between 53°C and 63°C, collagen proteins denatures, denaturation of myofibrillar proteins, mainly myosin, takes place at 40-60°C, subsequent gelation of collagen fibre is at 60-70°C followed by denaturation of actin at 70-80°C (Purslow, Oiseth, Hughes, & Warner, 2016).

Compression analysis determined the contribution of connective tissue to the tenderness of cooked meat. Hardness, chewiness and cohesiveness were influenced by cooking temperature and time. A significant interaction was found between temperature and time in both muscles. Hardness was greater in meat from older animals compared to the younger animals. A substantial reduction in hardness was observed at 75°C for 18 h cooking in both BF (Table 2) and ST (Table 3) muscles and interestingly, a minor difference was seen in young and old animals at this temperature. Similar patterns were found for chewiness and cohesiveness. Decreasing hardness in muscles with high collagen contents from old animals or even from young ones cooked at high temperature and for a prolonged time could be due to higher temperature increasing the collagen solubility and decreasing connective tissue strength leading to reduced toughness in meat (Christensen et al., 2011).

Conclusion

Sous-vide cooking technique improves the textural characteristics in meat regardless of the age of the animal but is particularly beneficial for meat from old animals. Although decreased meat toughness is achieved through appropriate temperature-time combination, associated cooking loss might cause a negative impact on mouthfeel experience of consumers. Further investigations on consumer sensory perceptions and acceptance of low-valued beef meat particularly from old animals cooked under *sous vide* would be required.

Notes

Table 1. Means of cooking loss (CL) in BF and ST cooked at 55° C, 65° C and 75°C for 1, 8 and 18 hours in young and old animals. Superscripts (letters *a-h*) refer to significant differences ($P < 0.05$) in mean CL within each block of two rows within 'young and old' cattle. The separation of means was done using Fisher LSDs.

Temperature	55° C			65° C			75° C		
Time	1 h	8 h	18 h	1 h	8 h	18 h	1 h	8 h	18 h
				Biceps femoris					
Young	16.28^{b}	24.35^{c}	27.36^{d}	27.85^{d}	33.64^{ef}	37.40^{g}	36.61^{g}	41.00^{h}	41.33^{h}
Old	12.70^{a}	19.10^{b}	22.90^{c}	25.20^{cd}	31.40^{e}	35.30^{fg}	34.70^{fg}	40.80^{h}	41.40^{h}
				Semitendinosus					
Young	17.85^{a}	24.78^{bc}	27.75^{d}	27.36^{d}	34.21^{ef}	35.81^{ef}	36.28^{f}	38.50^{gh}	40.16^{h}
Old	16.00^{a}	22.60^{b}	24.40^{bcd}	25.20^{cd}	32.30^{e}	35.50^{fg}	35.30^{fg}	39.70^{h}	40.10^{h}

Means of cooking loss (CL%) in BF and ST

Table 3 Mean of hardness (N), chewiness and cohesiveness of *semitendinosus* (ST) muscle. Superscripts (letters *a-m*) refer to significant differences ($P < 0.05$) in mean hardness, chewiness and cohesiveness values within each block of two rows within young and old animals. The separation of means was done using LSDs.

Temperature	55°C			65°C			75°C		
Time	1 h	8 h	18 h	1 h	8 h	18 h	1 h	8 h	18 h
Hardness (N)									
Young	33.35^{cdefg}	31.60^{cdef}	23.88^{b}	44.97^{ij}	34.67^{efg}	30.51^{cd}	48.09^{ij}	30.63^{cd}	21.24^{a}
Old	43.99^{i}	38.17^{gh}	35.62^{dfg}	44.75^{i}	41.55^{hi}	35.48^{dfg}	51.99^{j}	32.07^{ce}	22.69^{ab}
Chewiness									
Young	9.39^{fgh}	8.22^{efg}	4.83^{b}	11.88^{ij}	8.51^{efg}	6.17^{cd}	12.87^{ijk}	6.48^{cd}	4.05^{a}
Old	17.78^{l}	10.33^{gi}	7.71^{df}	16.26^{kl}	12.35^{hj}	6.49^{ce}	17.18^{kl}	7.46^{cdef}	4.38^{ab}
Cohesiveness									
Young	0.28^{fg}	0.26^{bde}	0.20^{ac}	0.26^{def}	0.25^{de}	0.20^{a}	0.27^{de}	0.21^{ac}	0.19^{a}
Old	0.40^{i}	0.27^{ef}	0.22^{ab}	0.36^{hi}	0.30^{ef}	0.18^{a}	0.33^{gh}	0.23^{cd}	0.19^{a}

Means of hardness(N), chewiness and cohesiveness in ST

Table 2 Mean of hardness (N), chewiness and cohesiveness of BF muscle from young and old aged animals Superscripts (letters *a-m*) refer to significant differences ($P < 0.05$) in the mean hardness, chewiness or cohesiveness values within each block of two rows within 'young and old' cattle. The separation of means was done using Fisher LSDs.

Temperature	55°C			65°C			75°C		
Time	1 h	8 h	18 h	1 h	8 h	18 h	1 h	8 h	18 h
Hardness (N)									
Young	31.16^{cd}	28.50^{c}	25.20^{b}	42.18^{ghij}	38.82^{eghi}	32.69^{d}	48.57^{k}	33.18^{df}	17.00^{a}
Old	39.92^{fh}	35.55^{deg}	32.66^{cde}	49.45^{jk}	46.29^{ijk}	35.80^{deg}	47.89^{ijk}	32.75^{cde}	17.98^{a}
Chewiness									
Young	9.17^{efgij}	6.23^{cd}	4.88^{b}	11.42^{hklm}	8.93^{efgi}	6.49^{cd}	11.70^{hlm}	7.13^{cdf}	2.40^{a}
Old	13.65^{lm}	9.24^{fghik}	8.43^{dfgh}	15.00^{m}	11.12^{ijkl}	6.67^{bce}	12.65^{ilm}	6.80^{ce}	3.26^{a}
Cohesiveness									
Young	0.29^{ijk}	0.22^{bcdefg}	0.19^{b}	0.27^{hij}	0.23^{cdefgh}	0.20^{bcd}	0.24^{efgh}	0.21^{bcdef}	0.14^{a}
Old	0.34^{k}	0.26^{fghij}	0.26^{fghi}	0.30^{jk}	0.24^{defghi}	0.19^{bc}	0.26^{ghij}	0.21^{bcde}	0.18^{b}

Means of hardness(N), chewiness and cohesiveness in BF

Notes