THE EFFECT OF LOW-TEMPERATURE LONG-TIME *SOUS VIDE* COOKING ON TENDERNESS IN BEEF *BICEP FEMORIS* AND *SEMITENDINOSUS MUSCLES*

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I. INTRODUCTION

Tenderness is the most important quality trait and a key determinant of consumer acceptability and marketability of red meat. Apart from variation due to genetics and pre-slaughter environment, processing and cooking techniques need to be optimized for different muscles in terms of their significant role in determining meat tenderness. *Sous vide* is an emerging cooking technique currently employed at both commercial and domestic scales. This technique involves cooking raw meat in vacuum-sealed heat-stable bags under precisely controlled temperature and time followed by rapid cooling (1). Studies (2,3,4) have reported improved tenderness as a result of *sous vide* cooking in meat from different livestock species. Despite this research, there is a lack of understanding on the combined effect of low-temperature long-time *sous vide* cooking and the aging process on tenderness in different muscles from both young and old animals. Therefore, this study was designed to investigate the effect of low-temperature long-time *sous vide* cooking and aging on tenderness in low-value beef muscles from young and old cattle.

II. MATERIALS AND METHODS

This study comprised of *bicep femoris* (BF) and *semitendinosus* (ST) muscles (n=48) from two different age groups (young, less than 18 months, n=12 vs old, 3.5 years; n=12), two aging periods (2 vs 15 days), 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 (Multivac-C100) and randomly allocated to a cooking treatment. Cooking occurred in temperature-equilibrated water baths (Julabo-F38) and internal temperature was monitored by thermocouples attached to a Grant data logger (SQ 2020/2040 series). After cooking, samples were cooled overnight at ~2°C. Each cooked sample was subdivided into four equal blocks approximately 1.0 cm × 1.0 cm × 5.0 cme ensuring the muscle fibers ran parallel to the long portion of the block and the blade sheared perpendicular to the longitudinal orientation of the fibers. Warner Bratzler shear force (WBSF) was determined with a Warner Bratzler V-shaped cutting blade fitted onto a texture analyser (Lloyd-Model AMETEK LS5). The WBSF data were analysed by fitting a linear mixed model, (REML estimation method) with blocking, using Genstat 18th edition. Due to non-homogeneity of variance, data was transformed using log transformation. REML was conducted on transformed data and the the separation of means using SED's, shown in Table 1, was done using the SED's from transformed data, prior to back-transformation. Analyses were conducted separately for each ageing period and age category within each muscle.

III. RESULTS AND DISCUSSION

Interactions were seen between cooking temperature, time and aging of the meat, or age of the animal, on WBSF in both muscles for both ageing times, and from young and old animals, respectively (P<0.001 for all; Table 1). The WBSF values in young animals were comparatively lower than those for old animals, in agreement with a previous study (5). The WBSF values decreased with both increasing cooking temperature and cooking time. However, the differences in WBSF values between young and old animals were smaller with an increase in cooking temperature and cooking time. The aging process should enhance tenderness and our results confirmed a decrease in WBSF with ageing in both muscles for short cooking times and lower cooking temperatures. It is well-known that improved tenderness during aging process is due to the proteolytic changes in meat (6).

IV. CONCLUSION

Positive associations of both cooking time and temperature with meat tenderness supported the hypothesis that low-temperature long-time *sous vide* cooking is a useful processing technique to make low-value tough meat into higher value tender meat.

Table 1. Effect of age of the animal (young vs old), ageing of the meat (Fresh, 2 days aged vs Aged, 15 days aged), cooking temperature (55, 65 or 75°C) and cooking time (1, 8 or 18 hours) on the Warner-Bratzler shear force (Newtons) of semitendinosus (ST) and bicep femoris (BF). Superscripts (letters a-m) refer to significant differences (P<0.05) in mean WBSF values within each block of 2 rows within 'young and old' cattle or 'fresh and aged'. The separation of means was done using the SED's from transformed data, prior to back-transformation.

Time	55°C			65°C			75° C		
Temperature	1 h	8 h	18 h	1 h	8 h	18 h	1 h	8 h	18 h
Semitendinosus									
Young	42.2^{ki}	34.4^{gij}	23.6^{ab}	39.7^{hki}	32.8^{dgi}	29.1^{cef}	40.2^{hki}	28.7^{ce}	24.3^{ab}
Old	64.7^{m}	38.0^{ik}	36.0^{fghik}	42.6^{ji}	32.4^{efgh}	25.7^{bc}	46.1^{i}	26.7^{bcd}	22.1^{a}
Fresh	55.9^{m}	40.0^{ij}	31.1^{eg}	45.7^{kl}	34.0^{gh}	30.9^{defg}	44.8^{kl}	33.5^{gh}	27.9^{cdf}
Aged	48.8^{lm}	32.7^{g}	27.3^{de}	37.0^{hi}	31.2^{fg}	24.1^{bc}	41.3^{jk}	22.8^{b}	19.3^{a}
Bicep femoris									
Young	30.6^{efghj}	27.7^{bdef}	22.9^{ac}	38.9^{ilm}	32.3^{ghjk}	31.1^{efghi}	38.9^{ilm}	33.3^{ghjk}	24.3^{abcd}
Old	52.8^{m}	50.3^{m}	33.1^{fhi}	51.9^{m}	43.3^{kl}	30.4^{cdefghi}	41.3^{jkl}	27.7^{cdeg}	21.5^{ab}
Fresh	42.9^{ef}	38.9^{ef}	28.1^{b}	51.6^{g}	38.5^{ef}	32.2^{bcd}	43.7^{f}	32.7^{cd}	28.3^{bc}
Aged	37.7^{def}	35.8^{de}	27.0^{bc}	39.1^{def}	36.3^{def}	29.4^{bc}	36.8^{def}	28.3^{bc}	18.5^{a}

V. REFERENCES

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