EFFECT OF PULSED ELECTRIC FIELD ON THE CALPAIN ACTIVITY AND PROTEOLYSIS OF BEEF *SEMIMEMBRANOSUS* MUSCLE

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I. INTRODUCTION

Considered as a very promising non-thermal technique of preserving foods and improving food quality, pulsed electric field (PEF) has recently attracted the attention of meat scientists and technologists due to its ability to modify membrane structure and enhance mass transfer. Several studies have confirmed the potential of pulsed electric field for improving meat tenderness, however, there is a high degree of variability between studies and the underlying mechanisms are not clearly understood. While some studies have suggested physical disruption as the main cause of PEF induced tenderness, enhanced proteolysis seems to be the most plausible mechanism [1]. Several studies have suggested the potential of PEF to mediate the tenderization process due to its membrane altering properties causing early release of calcium ions and early activation of the calpain proteases [1]. Recent studies have also reported increased post-mortem proteolysis in PEF treated muscles during aging [2; 3]. However, no information is available in the literature about the effect of PEF processing on the calpain activity and digestibility of meat proteins and this needs immediate scientific attention.

II. MATERIALS AND METHODS

Beef *semimembranosus* muscle (topsides) was obtained from six carcasses of dairy cows from Silver fern farms, Christchurch, New Zealand. The average hot carcass weight was 202.83 ± 7.10 kg. The topsides were excised at 12 h post-mortem, vacuum packaged, stored at 4±1 °C and were treated with PEF at 30 h postmortem. The samples were cut into blocks (13 x 8 x 5 cm) and randomly allocated to PEF treatment combinations i.e. 5 kV (90 Hz) and 10 kV (20 Hz) plus a non-treated control. The samples were aged for a period of 14 days at refrigeration temperature (4±1 °C) and were analyzed on day 1, day 7 and day 14 of aging for shear force, myofibrillar fragmentation index (MFI), calpain activity, proteolytic patterns of desmin and troponin T. Weight loss, temperature and conductivity values were measured pre- and post-treatment. The shear force was determined using a MIRINZ tenderometer and calpain activity was measured by the method described by Ilian et al. [4]. The data generated was compiled and analyzed using SPSS (version 16.0) and reported as means ± standard error. A two-way ANOVA was performed and Duncan's multiple range tests, at the 0.05 level of significance, were used for comparing the means to find out the effect of treatment and aging period [5].

III. RESULTS AND DISCUSSION

The shear force of the muscle was significantly affected by the aging period ($P<0.05$) and was unaffected by the PEF treatment ($P>0.05$). The samples treated with PEF showed a tendency towards reduced shear force, but it was not significant. A similar trend was observed in other parameters; MFI, calpain activity and proteolysis of desmin and troponin T which also showed no significant impact of the PEF treatment (Fig. 1 and Fig. 2). The present results agreed with the findings of O'Dowd et al. [6] and Arroyo et al. [7] who also observed no significant effect of PEF treatment on the beef tenderization process.

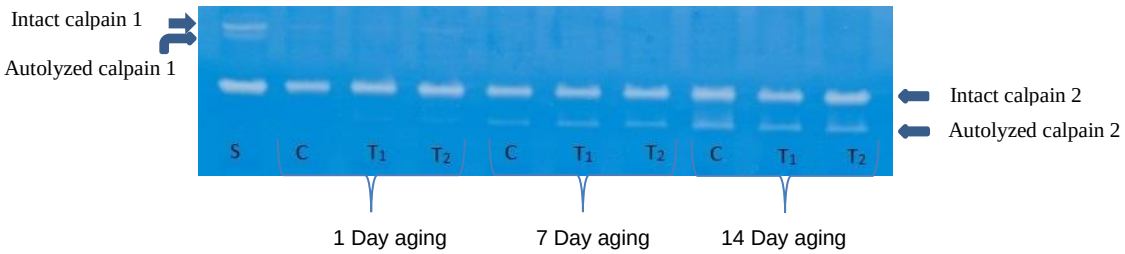

Fig. 1. Effect of PEF on calpain activity of beef *semimembranosus* muscle [C = control, T_1 = 5 kV (90 Hz), T_2 = 10 kV (20 Hz), S = standard]

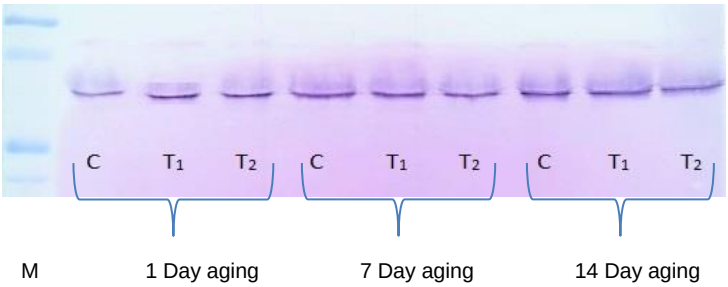

Fig. 2. Effect of PEF on the proteolytic pattern of desmin of beef *semimembranosus* muscle [C = control, T_1 = 5 kV (90 Hz), T_2 = 10 kV (20 Hz), M = marker]

IV. CONCLUSION

In the present study, pulsed electric field was observed to have no significant impact on tenderness, calpain activity and proteolytic patterns of desmin and troponin T. Future studies should focus on exploring the possibilities of achieving irreversible cell membrane changes, which would possibly affect the early release of calcium and activation of calpains.

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