IMPACT OF AGING METHOD AND PEF TREATMENT ON MEAT QUALITY AND STABILITY OF CONJUGATED LINOLEIC ACID IN VENISON

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Abstract – The effects of high and low pulsed electric field (PEF) treatments (7.5 kV, 50 Hz, 20 µs and 2.5 kV, 50 Hz, 20 µs) and aging method (dry vs wet) on the weight loss, shear force and CLA content of venison were investigated. The total weight loss (%) and CLA content were not different among all samples. The dry-aged high PEF treatment was significantly more tender than the wet-aged control and the heat-control samples.
Key Words – dry aging, PEF, venison.

I. INTRODUCTION

Pulsed electric field (PEF) is a novel technology that can induce cell electroporation under certain treatment conditions that differ among different types of cells [1]. The overall goals of such treatment are to improve the safety and/or modify the structure of the product. Several reports have suggested potential improvement in beef tenderness by PEF treatment that was dependent on the muscle type, the muscle state (pre-rigor vs post-rigor) and the PEF intensity [2-3]. These studies also demonstrated the potential of increased purge and drip loss in PEF-treated samples due to decreased restrictions on cellular material mobility as shown by increased conductivity. While increased mobility of moisture in PEF-treated meat can be problematic due to losses that can occur during storage, such phenomenon can be advantageous for dry aged meat products, where facilitating a faster rate of moisture loss will be an advantage for the stability of the product and to reduce the processing time. This study is reporting for the first time the impact of PEF treatment {low PEF (LPEF, 2.5 kV, 50 Hz and 20 µs) and high PEF (HPEF, 7.5 kV, 50 Hz and 20 µs)} and aging (wet and dry) on the quality and conjugated linoleic acid (CLA) of venison loin.

II. MATERIALS AND METHODS

Venison loins (*M. longissimus et lumborum*, LL) were obtained from 6 hinds with an average cold carcase weight of 98± 6.7 kg. The hinds were raised on pasture and slaughtered at Lorneville Plant, Alliance Group, Invercargill, NZ. The left and right loins were excised at 24 h post-mortem. Connective tissue and visible fat were removed from the loins that were then processed into blocks of 318± 11.6 g and treated as described by Khan et al. [4]. The blocks were randomly allocated to wet-aged control (WAC), dry-aged control (DAC), wet-aged low PEF (WALPEF), dry-aged low PEF (DALPEF), wet-aged high PEF (WAHPEF), dry-aged high PEF (DAHPEF), and wet-aged heated control (WAC). Total specific energy was approximately 1.93 $kJ.kg^{-1}$ for LPEF and 70.2 $kJ.kg^{-1}$ for HPEF. The samples were dry-aged in a refrigerator at 4°C and 80% relative humidity for 21 days. The pH and conductivity of the samples were measured before and after PEF treatment and after the aging step. The initial loss (caused by PEF, vacuum packaging or dry-aging), drip loss during vacuum aging, thawing loss, cooking loss and the total weight loss were calculated as % of the original weight. The shear force and the CLA ($mg.g^{-1}$ lipid) were determined on the final product as described by Mungure et al. [5] and by Prema et al. [6] respectively.

III. RESULTS AND DISCUSSION

Generally, there were no differences in all measured parameters between control and heated-control samples (Table 1 and Figure 1), except for the thawing loss (%) which was higher for the heated-control compared with control samples. PEF treatment affected the pH and conductivity of post-PEF values ($P < 0.001$), with the high PEF samples having significantly lower pH values compared to the rest of the samples and PEF-treated samples had higher ($P < 0.001$) conductivity compared to the controls. Significantly ($P < 0.001$) higher pH values were found in dry-aged samples compared to wet-aged samples. The dry-aged samples had higher ($P < 0.001$) % initial weight loss compared to wet-aged and the DAHPEF had higher % initial weight loss than dry control, but DALPEF samples were not different from both. Cooking loss (%) exhibited the opposite trend where wet-aged samples had higher cooking losses compared to dry-aged samples, but no differences were found due to PEF treatment. Overall, there were no differences in the total losses due to various treatments. The DAHPEF were the most tender, which was different only from wet heat-control and wet-control samples. No effect was found due to treatments on CLA content.

IV. CONCLUSION

PEF treatment accelerated the dry-aging of venison and the treatment did not have any detrimental effects on conjugated linoleic acid content, shear force or the total weight losses.

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Table 1. Changes in pH, conductivity and weight losses after PEF treatment and dry and wet aging.

Treatment		pH			Conductivity σ (mS/cm)			Initial loss (%)	Drip loss (%)	Thawing loss (%)	Cooking loss (%)	Total weight loss (%)
PEF	Age-ing	Pre-PEF	Post-PEF	Post-Aging	Pre-PEF	Post-PEF	Post-Aging					
Heated control	Wet	5.71	5.71ab	5.79ab	8.85	8.85b	11.95	-	2.11a	3.10a	30.20a	35.42
Control	Wet	5.74	5.74a	5.75ab	8.37	8.83b	12.22	3.81c	1.80a	1.62bc	23.97a	31.19
	Dry	5.71	5.71ab	5.79ab	8.85	8.27b	11.67	23.75b	0.65b	0.93bc	11.05b	36.39
Low	Wet	5.70	5.69ab	5.74b	8.60	10.70ab	12.07	3.92c	2.04a	1.97b	24.30a	32.22
	Dry	5.71	5.72a	5.81a	8.88	10.35ab	12.42	25.85ab	0.92b	0.58c	6.31b	33.37
High	Wet	5.70	5.64b	5.74b	8.13	11.62a	12.38	3.98c	2.09a	1.60bc	25.47a	33.14
	Dry	5.68	5.65ab	5.78ab	8.52	12.05a	11.40	28.47a	0.96b	0.66c	7.86b	37.94
	SEM	0.02	0.02	0.02	0.70	0.59	0.39	0.60	0.07	0.23	1.56	1.91

a-c means within each column that has different letters are significantly different at $P < 0.05$

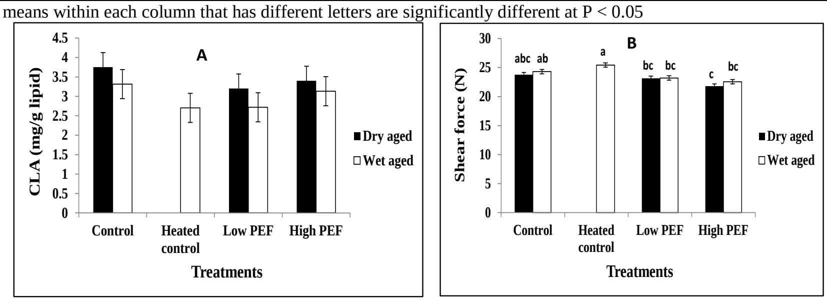

Figure 1. Effects of PEF treatment (low and high intensities), aging (dry and wet) on the CLA and shear force of venison.