Stepwise in-bag dry-ageing of lean beef

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I. INTRODUCTION

Beef is commonly dry-aged out-of-bag in a refrigerated room for 21 to 28 days at 0-2°C and 60-85% relative humidity, with an air flow of 0.5-2.5 m/s. Dry-ageing (D) enhances tenderization and flavor of beef [1] though a close monitoring and adjustment of processing parameters are required to minimize microbial growth and weight loss. Increasing the air velocity may accelerate the moisture loss from beef to speed up the dry-ageing process. However, the resultant quality of the dry-aged beef has not been explored fully. Recently, Li *et al.* [2] attempted to use water-permeable bags for dry-ageing and has reported lower thawing and cooking losses than D with no negative effects on sensory or other quality attributes. Kim *et al.* [3] combined dry-ageing with wet-ageing as a stepwise ageing process to produce equivalent and/or improved qualities in beef compared to using a single ageing method. The aim of this study was to determine the effect of stepwise in-bag dry-ageing (BD) on the quality and acceptability of lean beef for BD for one week at higher air velocities, followed by additional two weeks of wet ageing time compared to BD only for three weeks as a control.

II. MATERIALS AND METHODS

A total of 30 striploins from 15 beef carcasses (bull; ≈ 2 yr olds) were randomly assigned to 4 different ageing regimes after 24hr postmortem: (1). BD for 21 days at 0.5 m/s air velocity (BD21, Control, n=6); (2)-(4). BD for 7 days at 0.5/1.5/2.5 m/s air velocity (n=8), respectively, followed by 14 days of wet ageing. All ageing was performed at 2°C and relative humidity of 75%. Weight loss, pH and lipid oxidation (Thiobarbituric Acid Reactive Substances; TBARS) [4] were measured. Cook loss was measured using 6 cm thick steaks cooked individually in a boiling water bath to an internal temperature of 70°C. Cooked meat samples with 10mm x 10mm cross section were analyzed for shear force using MIRINZ tenderometer. All measurements were taken in triplicate. An in-house consumer panel (n=45) determined the acceptability of the steaks. Steaks from the 4 treatments were cooked in an oven to internal temperature of 70°C and cut into 1.27 × 1.27 × 2.54cm pieces and placed in a closed plastic container labelled with a random 3-digit code. The samples were held at 50°C (less than 10min) before serving to the panelists. Panelists evaluated the aroma, texture, tenderness, juiciness, flavor, and overall liking of the cooked steaks on a scale of 0 to 100, where 0 = dislike extremely, and 100 = like extremely. Data was analyzed using one-way ANOVA and Tukey's honest significant difference was used to separate the means at $P<0.05$.

III. RESULTS AND DISCUSSION

Approximately 20% of moisture was lost from control BD bull beef striploin. Increase of air velocity increased the weight loss from samples that were BD for 7 days. Dry-ageing process significantly ($P<0.05$) increased pH values and cook loss of samples from all treatment combinations. pH significantly ($P<0.05$) decreased with the increase of air velocity of the ageing process. Total aerobic microbial counts (data not shown), cook loss, shear force and TBARS were not affected by air velocity and treatment combinations ($P>0.05$), but they were affected by ageing time. With the increase of ageing time, shear force significantly decreased ($P<0.05$) and cook loss significantly increased ($P<0.05$) regardless of the ageing treatment. Lipid oxidation (TBARS) increased with BD ageing time for samples dry-aged at higher air velocities. Due to the low lipid content of the sample (<1%), the level of lipid oxidation was overall low. For sensory, there was no difference ($P>0.05$) found in all attributes between the four treatment combinations. Therefore, BD for 7 days followed by 14 days of wet-ageing could produce beef of similar sensorial quality to those BD for 21 days, regardless of air velocity.

Table 1. Effects of treatment combinations on the quality and consumer acceptance of in-bag dry-aged lean beef.

		0.5 m/s (21d BD, C)	0.5 m/s (7d BD+14d W)	1.5 m/s (7d BD+14d W)	2.5 m/s (7d BD+14d W)	SED	P-treatment
% Weight loss	21d	20.5^{ay}	9.8^{b}	10.9^{bc}	11.5^{c}	0.01	<0.01
	P-ageing	<0.01	0.22	0.71	0.72		
pH	0d	5.3^{x}	5.3^{x}	5.4^{x}	5.3^{x}	0.03	0.79
	21d	5.66^{ay}	5.62^{aby}	5.64^{ay}	5.58^{by}		0.03
	P-ageing	<0.01	<0.01	<0.01	<0.01		
% Cook loss	0d	$18.9\%^{x}$	$17.3\%^{x}$	$19.4\%^{x}$	$17.1\%^{x}$	0.02	0.66
	21d	$27.8\%^{y}$	$27.7\%^{y}$	$26.0\%^{y}$	$28.7\%^{y}$		0.20
	P-ageing	<0.01	<0.01	<0.01	<0.01		
Shear force (kg F)	0d	13.5^{x}	11.9^{x}	13.4^{x}	11.6^{x}	1.27	0.57
	21d	7.4^{y}	7.3^{y}	7.0^{y}	7.2^{y}		0.92
	P-ageing	<0.01	<0.01	<0.01	<0.01		
TBARS (mg MDA/kg meat)	0d	0.3	0.2	0.3^{x}	0.3^{x}	0.06	0.19
	21d	0.4	0.3	0.4^{y}	0.4^{y}		0.48
	P-ageing	0.41	0.06	0.01	0.16		
Consumer sensory 21d	Aroma	56.5	55.6	55.8	56.6	2.81	0.98
	Texture	58.1	52.9	49.1	58.1	4.24	0.11
	Tenderness	53.6	48.7	45.8	55.0	4.88	0.22
	Juiciness	54.4	53.6	48.4	47.8	4.12	0.24
	Flavor	44.8	44.8	41.9	42.9	4.35	0.88
	Overall liking	59.8	58.2	52.9	57.2	3.33	0.22

Different letter "a, b, c" within same row means results are significantly different from each other.
Different letter "x, y, z" within same column means results are significantly different from each other.

Figure 1. Photos taken from BD process: (a) striploins laid out in the controlled chamber; (b) Striploin BD for 7d; (c) Cut surface of the BD striploin (21d); (d) BD loin steak (21d); (e) Cooked BD steak (21d)

IV. CONCLUSION

Increased air velocity during BD of bull beef striploin increased moisture loss, but had no effect on pH, cook loss, shear force, lipid oxidation (TBARs) and consumer acceptance of the beef. Current ageing strategies using stepwise ageing process could produce quality equivalent dry-aged lean beef to those BD only for same period of time, but with lower weight loss.

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