EFFECT OF DRY-AGING ON PHYSICO-CHEMICAL QUALITY PROPERTY OF BEEF LOIN FROM HANWOO

Soohyun Cho[1*], Sun Moon Kang, Pilnam Seong, YunSeok Kim, Hyun-Woo Seo, Youngchun Kim, Jinhyung Kim and Beomyoung Park

[1]Animal Products Utilization Division, National Institute of Animal Science, RDA, South Korea.

*Corresponding author email: shc0915@korea.kr

Abstract – The objective of this study was to investigate the effects of different dry aging conditions (2–4°C, relative humidity of 65–85%, 20–90 days) on pH, meat color, cooking loss, water holding capacity (WHC), and Warner-Bratzler (WB) shear force for bone-in beef loins from Hanwoo. A total of 54 Hanwoo beef loins (bone-in, 6th–13th) at 2 days postmortem were assigned into four groups and hung in a dry-aging room at controlled temperature, humidity, and air velocity. During the dry-aging period, the moisture content, meat color (CIE *L, *a**, *b**), and WB-shear force values were decreased significantly as the aging period increased for all treatments ($p<0.05$). The cooking loss (%) was not significantly different during aging by all four treatments. However, among the four treatments, T1 and T4 showed significantly higher cooking loss (%) than the other treatments at day 60 ($p<0.05$). The WHC (%) and pH increased as the aging period increased; however, T1 resulted in significantly lower WHC than the other treatments at day 60 ($p<0.05$).**

Key Words – aging condition, Hanwoo beef, meat quality

I. INTRODUCTION

Dry aging is typically carried out to produce premium meats under critically controlled ambient conditions of temperature, relative humidity, and airflow without packaging [1]. The control of parameters is important to inhibit microbial growth and minimize weight loss, while producing meats of excellent eating quality resulting from tenderization and enhanced flavor [2]. Although several studies of dry aging have been conducted to date, most of these studies have focused on the effects of aging relative to differences in quality grade, wet versus dry aging, or the use of highly moisture permeable aging bag; few studies have evaluated the impact of dry-aging condition on meat quality attributes. Therefore, the objective of this study was to investigate the effects of different dry-aging conditions on physico-chemical quality property for beef loins from Hanwoo.

II. MATERIALS AND METHODS

A total of fifty four beef loin (bone-in, 6th~13th) muscles from Hanwoo steer carcasses (quality grade 1) at 2 days postmortem were obtained from a local meat processing plant. They were randomly assigned into 4 groups and hung in the dry-aging room as Table 1. On each sampling day, the loin *(longissimus lumborum*, LD) muscles were separated for analysis. Protein, fat, moisture, and collagen content were analyzed using the Food Scan™ Lab 78810 [3]. Color values (CIE *L**, *a**, *b**) were measured using a CR-301 chroma meter [4]. Water-holding capacity (WHC) was measured using the method of Ryoichi *et al.* [5]. The cooking loss was expressed as a percentage of the initial sample weight [6]. WB-shear force was measured according to the method of Wheeler *et al.* [7]. Data were analyzed by the Student-Newman-Keuls' multiple comparison using the GLM Procedure of the SAS program [8].

III. RESULTS AND DISCUSSION

During the dry-aging period, only the moisture content of loin muscle was significantly decreased, and the contents of fat, protein, and collagen were not significantly changed for all four treatments (data not shown). Results of meat quality analysis are presented in Table 2. In meat color analysis, CIE *L**, *a**, and *b** values were decreased significantly as the aging days increased for all treatments ($p<0.05$). At day 20, T1 had higher CIE *L**, *a**, and *b** values than those of the other treatments ($p<0.05$). The cooking loss (%) was not significantly different on various aging days for all four treatments. Among the four treatments, T1 and T4 showed significantly higher cooking loss (%) than the other treatments on day 60 ($p<0.05$). The WB-shear force values of all treatments were significantly decreased as the aging period increased ($p<0.05$). Among the four treatments, there were no significant differences in WB-shear force values. The WHC (%) and pH were also increased as the aging period increased; however, T1 had a significantly lower WHC than the other treatments at day 60 ($p<0.05$).

Table 1. Dry-aging conditions (n=54)

Treatment	Condition	Sampling day	Note
T1	2℃, 85%, 60 d	0, 20, 40, 60	Maintain same temp. & humidity.
T2	2℃, 65%, 20 d + 2℃, 75%, 20 d + 4℃, 85%, 50 d	0, 20, 40, 60, 90	Increase temp. & humidity by 3 stage
T3	2℃, 75%, 20 d + 4℃, 85%, 40 d	0, 20, 40, 60	Increase temp. & humidity by 2 stage
T4	4℃, 85%, 90 d	0, 20, 40, 60, 90	Maintain same temp..& humidity.

Table 2. Meat color, cooking loss, Warner-Bratzler shear force, water holding capacity and pH at 4 different dry aging conditions

Item		Treatment	Dry-aging period (days)				
			0	20	40	60	90
CIE meat color	Lightness *(L*)*	T1	38.27^{a}±1.59	36.39^{aA}±3.84	22.60^{b}±0.33	22.77^{b}±0.56	
		T2	37.38^{a}±1.64	23.22^{bB}±0.10	24.39^{b}±0.86	24.94^{b}±1.10	25.04^{b}±2.11
		T3	39.61^{a}±1.59	22.51^{bB}±0.23	21.96^{b}±0.79	23.15^{b}±1.77	
		T4	36.90^{a}±0.10	26.39^{bB}±0.51	22.92^{b}±1.01	23.52^{b}±1.73	22.41^{b}±0.60
	redness *(a*)*	T1	23.34^{a}±0.51	9.50^{bA}±1.18	4.38^{c}±0.66	4.44^{c}±0.57	
		T2	23.61^{a}±1.51	5.57^{bB}±0.61	4.43^{b}±0.42	4.51^{b}±0.93	4.14^{b}±0.77
		T3	23.74^{a}±0.92	3.88^{bB}±0.14	4.34^{b}±0.39	4.22^{b}±0.69	
		T4	24.42^{a}±1.18	6.49^{bB}±1.02	5.54^{b}±1.27	6.24^{b}±1.54	5.54^{b}±0.98
	yellowness *(b*)*	T1	12.37^{a}±0.34	6.13^{bA}±0.65	2.78^{c}±0.53	3.31^{c}±0.53	
		T2	12.62^{a}±0.77	3.04^{bBC}±0.70	2.66^{b}±0.21	3.92^{b}±0.54	3.81^{b}±0.42
		T3	13.37^{a}±0.46	1.77^{bC}±0.04	3.06^{b}±0.22	3.61^{b}±0.79	
		T4	13.04^{a}±0.66	3.95^{bB}±0.27	3.61^{b}±0.45	4.76^{b}±0.90	3.60^{b}±0.08
Cooking loss(%)		T1	30.27±0.59	29.35±0.48	29.52±0.26	28.42^{A}±0.33	
		T2	26.94±1.70	28.88±2.34	25.53±0.28	23.47^{B}±1.23	23.32±1.51
		T3	25.13±0.75	25.19±1.11	25.87±1.52	25.31^{AB}±1.08	
		T4	28.71±2.09	27.14±0.26	26.62±1.03	27.54^{A}±1.09	26.44±0.28
WB-Shear force (WBS, kg)		T1	3.18^{a}±0.14	2.50^{b}±0.17	2.44^{b}±0.16	2.25^{b}±0.14	
		T2	3.37^{a}±0.19	2.87^{b}±0.05	2.41^{c}±0.11	2.01^{d}±0.02	1.41^{e}±0.05
		T3	3.37^{a}±0.15	2.88^{a}±0.25	2.17^{b}±0.06	1.76^{b}±0.17	
		T4	3.16^{a}±0.17	2.46^{b}±0.11	1.76^{b}±0.38	1.78^{b}±0.07	1.69^{b}±0.13
Water holding capacity (WHC, %)		T1	55.98±0.66	54.51±1.91	56.58±1.46	55.63^{B}±0.19	
		T2	52.82^{c}±0.24	55.71^{b}±0.58	55.51^{b}±0.79	58.10^{abA}±0.37	58.47^{a}±1.06
		T3	55.51^{b}±0.18	54.68^{b}±0.21	57.75^{a}±0.51	58.55^{aA}±0.67	
		T4	55.10^{c}±0.17	56.96^{b}±0.40	58.32^{b}±0.40	56.85^{bAB}±0.55	60.21^{a}±0.57
pH		T1	5.43^{b}±0.03	5.47^{b}±0.04	5.44^{bB}±0.07	5.58^{aB}±0.02	
		T2	5.40^{c}±0.03	5.50^{c}±0.02	5.67^{bA}±0.02	5.76^{abA}±0.06	5.85^{aA}±0.05
		T3	5.45^{b}±0.04	5.47^{b}±0.02	5.64^{aA}±0.02	5.61^{aAB}±0.03	
		T4	5.38^{b}±0.03	5.49^{a}±0.02	5.51^{aAB}±0.12	5.54^{aB}±0.02	5.56^{aB}±0.02

*Mean±SE. $^{a-e}$Means in the same treatment among the aging days within the same category with different letters are significantly different ($p<0.05$). $^{A-C}$Means in the same aging day among 4 treatments within the same category with different letters are significantly different ($p<0.05$).

IV. CONCLUSION

The application of different dry-aging conditions for bone-in beef loins resulted in decreased meat color (CIE *L**, *a**, *b**), and increased tenderness, WHC (%), and pH as the aging days increased. Further research is needed to determine the effects of dry aging condition on storage shelf-life and desirable eating qualities.

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