EFFECT OF DRY-AGING ON YIELD, MICROBIAL GROWTH AND STORAGE STABILITY OF BEEF LOIN FROM HANWOO

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Abstract – The objective of this study was to investigate changes in the yield, microbial growth, lipid oxidation, and protein oxidation of loin muscles from Hanwoo beef during four different dry-aging conditions (2–4°C, relative humidity 65–85%, 20–90 days). A total of 54 Hanwoo beef loins muscles at 2 days postmortem were assigned to four groups and hung in a dry-aging room at controlled temperature, humidity, and air velocity. The dry-aging of loin muscle at four different conditions resulted in decreased drying yield (%) and water activity and increased total aerobic counts, lipid oxidation, and protein oxidation as the aging period increased (p<0.05). However, the gradual increase in temperature and humidity did not promote microbial growth, lipid oxidation, or protein oxidation compared with that after storage at the same temperature and relative humidity. Our results in terms of drying loss, microbial contamination, storage stability indicated that T2 was the best condition for dry aging of bone-in and fat-covered loin muscle.

Key Words – aging condition, lipid oxidation, protein oxidation, total aerobic plate count.

I. INTRODUCTION

Dry aging is an aging process in which meat is unpacked and exposed directly to environmental conditions. Dry-aged beef is characterized by its unique and distinctive flavor and product quality [1]. The process has been successfully used by some high-end restaurants to meet the needs of consumers who prefer this unique product. Retailers are constantly searching for ways to differentiate beef products. However, the conditions used for dry aging are critical because of high shrinkage loss, trim loss, risk of contamination, and quality deterioration [2, 3]. Therefore, the objective of this study was to investigate changes in yields, microbial growth, lipid oxidation, and protein oxidation under four different dry-aging conditions.

II. MATERIALS AND METHODS

A total of fifty four Hanwoo beef loin (6^{th}~13^{th}, bone-in and fat cover) muscles from Hanwoo steer carcasses with 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, vacuum-packaged, and stored at 1°C for analysis of objective meat quality. For drying yield, each met samples were weighed before and after the assigned aging times, The weight loss percentage was calculated. Each sample was dry swabbed (5 cm x 5 cm, twice) on each sampling days using 3M™ Quick swabs and plated on 3M™ Petrifilm™ (3M Health Care) for aerobic plate count and E.coli count. 2-Thiobarbituric acid reactive substance (TBARS) content was measured [4]. Volatile basic nitrogen (VBN) content was analyzed [5]. Data were analyzed by the Student-Newman-Keuls' multiple comparison using the GLM Procedure of the SAS program [6].

III. RESULTS AND DISCUSSION

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.

All four dry aging treatments used in this study resulted in decreased drying yield (%) and water activity and increased total aerobic counts (TPC), lipid oxidation (TBARS), and protein oxidation (VBN) of bone-in loin with fat cover as the aging period increased (p<0.05). During a dry-aging period, the TPC on the surface of the loin sample increased from 1.68–2.53 log CFU/cm^2 on day 0 to 2.09–3.86 CFU/cm^2 on day 60 or 90 under the four different conditions. No *Escherichia coli* were detected during the dry-aging period (data not shown). The loin samples, prevented from coming into contact with air because of the surrounding rib bone and fat cover, had low lipid oxidation (TBARS<0.55 mg MA/kg meat) and protein oxidation (VBN<14.99 mg%) on day 90 of the dry-aging period. However, T1 and T2 had higher drying yield (%) on day 20 than the other treatments (p<0.05). T2 had lower TBARS and VBN values than the other treatments. Gradual increases in temperature and humidity, such as that under T1 conditions (2°C and 65% for 20 days, followed by 2°C and 75% for 20 days, and finally 4°C and 85% for 50 days), were found to provide better control of microbial growth, lipid oxidation, and protein oxidation than maintaining the same temperature and humidity, such as under T1 or T4 conditions.

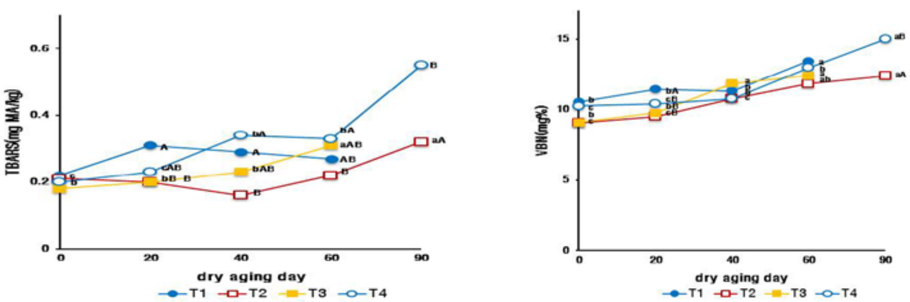
Table 2. Yield (%) for loin muscles at 4 different dry aging conditions

Condition	Dry aging period (day)				
	0	20	40	60	90
T1	-	95.47^{aA}±0.62	93.60^{a}±0.90	89.59^{b}±1.62	
T2	-	96.25^{aA}±0.43	94.37^{ab}±0.39	91.04^{b}±1.07	90.36^{b}±1.59
T3	-	93.24^{B}±0.76	92.10±0.15	90.73±1.23	
T4	-	87.98^{C}±0.64	94.24±2.04	91.49±1.41	90.29±1.10

Table 3. Water activity (A_w), total aerobic plate counts (TPC) of loin muscles at 4 different dry aging conditions

Items	Treatment	Dry-aging days				
		0	20	40	60	90
Aw	T1	0.98±0.00	0.98±0.00	0.97±0.00	0.97^{A}±0.00	
	T2	0.97^{a}±0.02	0.98^{a}±0.00	0.96^{a}±0.01	0.96^{aB}±0.00	0.93^{b}±0.01
	T3	0.97±0.01	0.97±0.01	0.97±0.00	0.96^{B}±0.00	
	T4	0.98^{a}±0.00	0.98^{a}±0.00	0.97^{b}±0.00	0.97^{bA}±0.00	0.95^{c}±0.01
TPC	T1	2.53±0.15	3.94^{A}±0.62	3.95^{A}±0.12	3.86^{A}±0.14	
	T2	1.68±0.44	2.17^{B}±0.16	2.55^{B}±0.16	1.38^{B}±0.43	2.22^{B}±0.12
	T3	2.29±0.17	1.82^{B}±0.29	1.63^{C}±0.15	2.09^{B}±0.32	
	T4	1.94±0.50	1.95^{B}±0.51	2.91^{B}±0.20	3.49^{A}±0.18	3.18^{A}±0.14

*Mean±SE. a-bMeans in the same treatment among the aging days within the same category with different letters are significantly different (p<0.05).
A-CMeans in the same aging day among 4 treatments within the same category with different letters are significantly different (p<0.05).



a-bMeans in the same treatment among the aging days within the same category with different letters are significantly different (p<0.05).
A-CMeans in the same aging day among 4 treatments within the same category with different letters are significantly different (p<0.05).

Fig 1. TBARS (mg malonaldehyde/kg meat) (left) and VBN (mg%) (right) values of loin muscles at 4 different dry aging conditions

IV. CONCLUSION

Our results in terms of drying yield, microbial growth, storage stability indicate that T2 was the best condition for dry aging of bone-in loin with fat cover. The future research is needed for the dry aged products to be given the benefits to the end processor with more economically feasible.

ACKNOWLEDGEMENTS

This work was carried out with the support of “Cooperative Research Program for Agricultural Science & Technology Development (Project No. PJ01202701)” Rural Development Administration, Republic of Korea.

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