RELATIONSHIP BETWEEN FACTORS OF FRESHNESS AND TORRYMETER VALUE OF HANWOO BEEF STRIPLOIN DURING STORAGE

Hee-Jin Kim[1], Dongwook Kim[1], Hye-Jin Kim[1], and Aera Jang[1*]

[1]Department of Animal Products and Food Science, Kangwon National University, Chuncheon 24341, Korea
*Corresponding author email: ajang@kangwon.ac.kr

I.   INTRODUCTION

Beef is important and widely consumed meat in the meat industry, so that assurance of its meat quality and safety is most important. Freshness can be determined by these meat quality parameters. And it needs to insurance to assess meat quality and safety [1]. Torrymeter is based on physical–electrical measurements. Change in the electrochemical properties of muscle in the degradation process can be measured by means of torrymeter. The aim of this study was to determine spoilage point using freshness factors (pH, VBN, total microorganisms) and to analyze the correlation between freshness factors and torrymeter value in beef.

II.   MATERIALS AND METHODS

Hanwoo beef striploin (grade 1) was bought from local meat packing center (Chuncheon, Korea). Striploin samples were cut and wrapped aerobically with polyethylene film. Then, striploin was stored at 4°C for 18 days and quality traits were meas ured. The pH value of meat was determined using a digital pH meter. A micro-diffusion method described by Conway method was modified for the determination of VBN (Total volatile basic nitrogen) values in samples. TBARS (Thiobarbituric acid reactive substances) was determined using the methods described by Witte *et al* [2]. Total microorganisms were determined using 3M Petrifilm™. The color was measured on the striploin samples with a color meter. Sensory evaluation traits were meat color, off-odor, drip loss, and overall acceptability. All results of this experiment were analyzed using General Linear Model method using SAS program. The correlation coefficient was calculated using the Pearson's Correlation Coefficients option.

III.   RESULTS AND DISCUSSION

The of Hanwoo beef striploin quality, microbial and sensory properties of Hanwoo beef striploin during storage was shown in Table 1. During storage, pH, VBN, TBARS, total microorganisms, L* (lightness) and sensory properties (off odor and drip loss) of striploin shows a significant increase ($p<0.05$). The a*(redness), b* (yellowness), torrymeter value and sensory properties (color and overall acceptability) of the striploin was significantly decreased during 18 days. According to MFDS [3], spoiled meat shows over pH 6.20-6.30 and over 20mg% of VBN value. Also, total microorganisms in meat are recommended keeping under 5×10^6 CFU/g. In this study, pH exceeded 6.20 at day 15 (6.26), VBN values at day 15 (21.11 mg%) were over 20 mg% and total microorganisms count of striploin was more than 5x106 CFU/g at day 15. Overall acceptability scores also showed less than 5 at day 15. As the result of pH, VBN, total microorganism, and sensory evaluation, the striploin was considered as spoilt after day 15 of storage.

Table 1 Changes in pH, VBN, TBARS, total microorganisms, color, torrymeter value, and sensory properties of Hanwoo beef striploin during storage

Traits	Storage days						
	1	3	6	9	12	15	18
pH	5.54± 0.003^{de}	5.49± 0.008^e	5.59± 0.004^d	5.59 ±0.000^d	5.93± 0.026^c	6.26± 0.030^b	6.58± 0.034^a
VBN (mg%)	13.10± 0.451^f	14.41± 0.178^{ed}	13.32± 0.522^{ef}	15.24± 0.129^d	18.60± 0.168^c	21.11± 0.295^b	35.60± 0.639^a
TBARS (mg MDA/kg)	0.040± 0.002^d	0.055± 0.004^{cd}	0.082± 0.005^{cd}	0.107± 0.004^c	0.103± 0.007^c	0.329± 0.017^b	0.521± 0.042^a
Total microorganisms	2.79±	3.01±	3.81±	4.90±	5.66±	8.15±	8.78±

(log CFU/g)	0.027[g]	0.047[f]	0.069[e]	0.088[d]	0.076[c]	0.029[b]	0.059[a]
Color — L*	39.41±0.261[d]	40.68±0.130[cd]	40.78±0.197[c]	42.81±0.755[b]	42.81±0.439[b]	44.06±0.726[ab]	44.28±0.128[a]
Color — a*	21.68±0.233[a]	20.82±0.100[a]	18.42±0.436[b]	17.93±0.410[bc]	17.27±0.583[c]	13.69±0.119[d]	12.64±0.190[e]
Color — b*	14.25±0.317[a]	13.25±0.303[b]	11.37±0.075[cd]	11.69±0.082[cd]	11.97±0.077[c]	11.01±0.124[d]	9.75±0.633[e]
Torrymeter value	17.00±0.147[a]	16.53±0.165[a]	16.58±0.175[a]	15.93±0.025[a]	9.60±0.668[b]	6.78±0.506[c]	5.63±0.180[d]
Sensory Properties — Color	8.57±0.202[a]	7.29±0.184[b]	7.52±0.202[b]	6.00±0.309[c]	5.43±0.297[c]	2.00±0.309[d]	1.14±0.143[e]
Sensory Properties — Off odor	1.00±0.000[g]	2.43±0.297[f]	3.57±0.369[e]	4.43±0.297[d]	5.43±0.297[c]	7.29±0.184[b]	8.57±0.202[a]
Sensory Properties — Drip loss	1.29±0.286[e]	1.29±0.184[e]	2.00±0.488[de]	2.57±0.528[cd]	3.43±0.429[c]	5.57±0.297[b]	6.71±0.286[a]
Sensory Properties — Overall acceptability	7.86±0.261[a]	7.43±0.202[ab]	7.14±0.143[b]	5.71±0.184[c]	5.29±0.184[c]	3.00±0.000[d]	1.86±0.261[e]

[a-e] Means±S.E. within the same row with different letters differ significantly at $p<0.05$

The correlation among the VBN, pH, total microorganisms and the torrymeter value of Hanwoo beef striploin during storage is given in Table 2. The pH of striploin increased during storage because of accumulation and proteolysis degradation of metabolites from bacterial action on meat [4]. Therefore, the pH was highly related to the total microorganisms ($p<0.001$) which the correlation coefficients shows 0.9636. The torrymeter value has a correlation to the VBN ($p<0.05$), pH ($p<0.001$) and total microorganisms (P<0.001) with correlation coefficients of -0.8513, -0.9688, and -0.9552, respectively. The conductivity and permittivity of meat were decreased to the increase in spoilage [6]. Therefore, the torrymeter can be used to determine the freshness of meat by measuring.

Table 2 Correlation of VBN, pH, total microorganisms, torrymeter value in Hanwoo beef striploin during storage

Traits	VBN	pH	Total microorganisms	Torrymeter value
VBN	1	0.9352[**]	0.8643[*]	-0.8513[*]
pH		1	0.9636[***]	-0.9688[***]
Total microorganisms			1	-0.9552[***]
Torrymeter value				1

[*] $p<0.05$, [**] $p<0.01$, [***] $p<0.001$

IV. CONCLUSION

In this study, spoilage of striploin was determined by freshness factors (pH, VBN, and total microorganisms) at day 15. Freshness factors had a high correlation each other. Also, torrymeter value highly related to the freshness factors. Therefore, torrymeter value can be used as a freshness indicator of beef.

REFERENCES

1. Huang, L., Zhao, J., Chen, Q. & Zhang, Y. (2014). Nondestructive measurement of total volatile basic nitrogen in pork meat by integrating near infrared spectroscopy, computer vision and electronic nose techniques. Food chemistry, 145: 228-236.
2. Witte, V. C., Krause, G. F. & Baile, M. E. (1970) A new extraction method for determining 2-thiobarbituric acid values of pork and beef during storage. Journal of Food Science 35: 82-585.
3. MFDS (Ministry of Food and Drug Safety). (2014) Notice 2014-135.
4. Olivera, D. F., Bambicha, R., Laporte, G., Cárdenas, F. C. & Mestorino, N. (2013) Kinetics of colour and texture changes of beef during storage. Journal of Food Science and Technology 50: 821-825.
5. Bae, Y. S., Lee, J. C., Jung, S., Kim, H. J., Jeon, S. Y., Park, D. H., Lee, S. K. & Jo, C. (2014). Differentiation of deboned fresh chicken thigh meat from the frozen-thawed one processed with different deboning conditions. Korean Journal for Food Science of Animal Resources. 34: 73-79.