APPLICATION OF IRRADIATION ON AGING OF BEEF WITH DIFFERENT TEMPERATURES

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Abstract – The objective of present study was to determine the effects of irradiation and aging temperature on microbial and physicochemical properties of beef (*M. semimembranosus*) during aging period. The beef samples were irradiated at 0 and 5 kGy using electron-beam (EB) and X-ray (XR). Then, the samples were aged for 14 days at 4 and 14°C, respectively. EB and XR reduced the initial total aerobic bacteria counts and maintained during storage. The a^* value of beef showed lower in irradiated sample initially but not after storage for 14 days. Shear force of beef showed no difference among treatments throughout the aging period (P<0.05). In conclusion, irradiation can be used in beef prior to aging in order to control microbial growth during high temperature aging (14°C) for shortening aging time.

Key Words – accelerated beef aging, meat quality, non-thermal technology

I. INTRODUCTION

In meat industry, aging is widely used to improve the meat palatability [1]. High temperature can accelerate aging and shorten the aging period but it could result in a deterioration of beef quality as well as growth of microorganisms [2]. Therefore, it is required to accelerate aging and control the microorganisms during aging. Irradiation is the most effective non-thermal technology in the elimination of microorganisms [3]. In the present study, each electron-beam (EB) and X-ray (XR) irradiation was applied on beef prior to aging and microbial and physicochemical properties were evaluated during aging at different temperatures (4 and 14°C).

II. MATERIALS AND METHODS

Sample preparation and irradiation processing

After 4 h post mortem, beef (*M. semimembranosus*) were vacuum-packaged and irradiated at 0 and 5 kGy using EB and XR. The samples were aged for 0, 3, 7, and 14 days at 4 and 14°C, respectively.

Microbial analysis

Total aerobic bacteria (Log CFU/g) in beef samples were conducted according to Yong *et al*. [3].

Physicochemical properties

Shear force (N) of beef sample (0.5 × 1.0 × 1.5 cm^3, height × width × length) was analyzed using a texture analyzer (TA1, Lloyd Instruments Ltd., UK). Surface color (L^*, a^*, and b^* values) was measured using a spectrophotometer (CM-5, Konica Minolta Co., Ltd., Japan).

Statistical analysis

Statistical analysis was performed by one-way analysis of variance and significant differences were identified with the Tukey's multiple range test using SAS software (SAS 9.3, SAS Institute Inc., USA).

III. RESULTS AND DISCUSSION

Microbial analysis

Both EB and XR led to significant decrease in total aerobic bacteria of beef samples regardless of aging temperatures during entire period (Table 1). These results indicate that both irradiations can control microbial growth of beef during aging period.

Physicochemical properties

EB and XR did not affect the shear force values in beef samples during 14 days of storage at 4 and 14°C (Table 1). On the other hand, shear force values were decreased in beef as increasing temperature and aging periods (P<0.05). At 0 day, XR treated beef showed the lowest L^* values among the irradiation treatment and EB and XR treated beef had lower a^* values compared to control (P<0.05**;** data not shown). However L^* and a^* value of beef showed no significant difference among the irradiation treatments after 7 days of the storage (data not shown).

Table 1. Effect of different aging temperature and irradiation on total aerobic bacteria and shear force

Traits	Temperature (°C)	Irradiation treatment[1)]	Aging period (days)				SEM[3)]
			0	3	7	14	
Total aerobic bacteria (Log CFU/g)	4	Control	4.73^{bx}	4.99^{bx}	5.17^{bx}	6.15^{ax}	0.170
		EB	3.33^{by}	3.40^{by}	3.79^{aby}	4.06^{ay}	0.105
		XR	2.66^{y}	2.96^{y}	3.25^{y}	3.60^{y}	0.242
		SEM[2)]	0.159	0.240	0.168	0.140	
	14	Control	4.73^{cx}	6.57^{bx}	8.16^{ax}	8.41^{ax}	0.204
		EB	3.33^{cy}	4.24^{bcy}	4.98^{by}	7.31^{axy}	0.277
		XR	2.66^{cy}	3.40^{bcy}	4.50^{by}	6.37^{ay}	0.286
		SEM[2)]	0.159	0.253	0.223	0.357	
Shear force (N)	4	Control	90.73^{a}	89.92^{a}	75.59^{b}	69.18^{b}	3.040
		EB	92.15^{a}	94.35^{a}	79.28^{b}	71.76^{b}	1.825
		XR	96.96^{a}	94.82^{a}	79.19^{b}	71.15^{c}	1.717
		SEM[2)]	1.816	2.041	2.979	2.086	
	14	Control	90.73^{a}	84.43^{a}	65.98^{b}	49.65^{c}	2.396
		EB	92.15^{a}	85.64^{a}	65.39^{b}	53.86^{c}	2.473
		XR	96.96^{a}	87.20^{b}	66.16^{c}	54.96^{d}	1.555
		SEM[2)]	1.816	1.848	2.925	1.940	

[1)]Control, non-irradiation; EB, electron beam irradiation; XR, X-ray irradiation.
[2)]Standard error of the means (n=9), [3)](n=12).
[a-d]Values with different letters within the same row differ significantly (P <0.05).
[x,y]Values with different letters within the same column differ significantly (P <0.05).

IV. CONCLUSION

Irradiation (both EB and XR) can be used in beef prior to aging in order to control microbial growth during high temperature aging for shortening aging time.

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