EFFECT OF DIETARY VITAMIN E SUPPLEMENTATION ON MEAT QUALITY OF HANWOO(KOREAN NATIVE CATTLE) BEEF DURING RETAIL DISPLAY

Sung-Ki Lee[1], Yong-Sun Kim[2], Cheng-Yun Liang[1] and Ju-Yong Kim[1]

[1]Department of Animal Food Science and Technology, [2]Institute of Animal Resources, Kangwon National University, Chunchon, 200-701, South Korea.

Background

Color of fresh meat is an important quality attribute which determines whether the consumer will purchase the product. Discoloration in retail meats during conditions may occur as a combined function of muscle pigment oxidation and lipid oxidation occurring in membrane phospholipids(Sherbeck et al., 1995). It is now well established that vitamin E acts as a powerful lipid-soluble antioxidant in cell membranes(Morrissey et al., 1994), hence, one of the main purposes of dietary supplementation of animal diets with vitamin E is to delay lipid oxidation in muscle foods(Liu et al., 1995). Although the relation between lipid oxidation and pigment oxidation is not fully understood, it has been shown in beef that vitamin E retards the oxidation of myoglobin, and thus the loss of attractive color(Faustman et al., 1989).

Objective

The objective of this study was to determine the effects of dietary vitamin E supplementation on the color stability and lipid oxidation of Hanwoo(Korean native cattle) beef during refrigerated storage in a retail display case.

Methods

Sample preparation. Hanwoo(Korean native cattle) steers were divided into two groups. Group 1(n=3) was fed a common basal diet with a vitamin E of 200 IU/head/day(Control group) for six months before slaughter. Group 2(n=4) was fed a supplemented concentrate diet with a vitamin E supplement of 1,000 IU/head/day(E1000 group). The *Longissimus* muscle(control group; pH 5.4, E1000 group; pH 5.43) and *semimembranosus* muscle(control group; pH 5.4, E1000 group; pH 5.50) were removed about 24 hr after slaughter. Muscles were sliced(1.2 cm thickness), then overwrapped in polyethylene wrap film(oxygen transmission rate 35,273 $cc/m^2/24hr/tm$, thickness 0.01 mm). Samples were then stored in a retail display case at 3±1℃ for 7 days under fluorescent lighting(1,200 lux).

Analytical procedures. CIE L^*(lightness), a^*(redness), and b^*(yellowness) values for Illuminant C were measured by a color difference meter(CR-310, Minolta Co., Tokyo, Japan). Also, chroma(C^*) and hue-angle(h^o) values were calculated as $C^*=(a^{*2}+b^{*2})^{1/2}$, and $h^o= \tan^{-1}(b^*/a^*)$, respectively. The relative content of myoglobin, metmyoglobin and oxymyoglobin at the meat surface was calculated by the method of Kryzwicki(1979) using reflectance at 473, 525, 572, and 730 nm. Reflectance readings were converted to absorbance[2-log(%reflectance)] and used in the equation(Demos et al., 1996). The pH value was determined by homogenizing 10 g sample with 100 ml distilled water for 1 min. Thiobarbituric acid reactive substances(TBARS) was measured according to the modified method of Sinnhuber & Yu(1977). Peroxide value(POV) was measured according to the method of Shantha & Decker(1994). Total reducing ability(TRA) was measured as described by Lee et al.(1981). Data were analyzed as a 2(muscle) by 5(storage time) by 2(diet condition) factorial design using the General Linear Model procedure. The relationships between the measured variables were assessed by Pearson correlation coefficients.

Results and discussions

No significant 3-way interactions occurred. Main effect of muscle was significant for L^*, a^*, b^*, h^0 values and TRA only. Main effects of storage time and diet condition were significant for most of the values. As shown in Table 1, L^* value was significantly($p<0.05$) higher in E1000 group(1,000 IU/day) than in control group(200 IU/day). *Semimembranosus* muscle had a higher L^* value, consequently, a lighter color. In contrast, a^*, b^* and chroma(C^*) values were significantly($p<0.05$) higher in control group.

As shown in Table 2, TBARS and POV which represent fat rancidity were significantly($p<0.05$) higher in control group than in E1000 group. Vitamin E supplementation significantly delayed lipid oxidation measured by TBARS and POV, whatever the muscle. E1000 group had higher total reducing ability(TRA) than control group, then gradually decreased over time.

As shown in Figure 1, metmyoglobin(%) of the meat surface was significantly($p<0.05$) lower in E1000 group than in control group, oxymyoglobin(%) was significantly($p<0.05$) higher in E1000 group. Metmyoglobin(%) increased during refrigerated retail display, these increased more rapidly in *Semimembranosus* muscle. TRA(total reducing ability) positively correlated with oxymyoglobin(r= 0.6041), also TRA inversely correlated with metmyoglobin(r= - 0.6133), TBARS(r= - 0.5971) and POV(r= - 0.4280).

Conclusions

The meat from vitamin E-supplemented Hanwoo was more resistant to lipid oxidation than was the control meat. And dietary vitamin E supplementation reduced myoglobin oxidation. However, vitamin E supplementation had no positive effect on color(CIE a^*, b^* and C^*) of meat during refrigerated retail display.

Table 1. Effects of dietary vitamin E supplementation on surface color in Hanwoo beef

Color	Storage days	M.*Semimembranosus*		M. *Longissimus*	
		Control	E1000	Control	E1000
L*	0	$40.84^{c\,B}$	$41.84^{b\,A}$	$38.90^{b\,A}$	$40.47^{b\,A}$
	1	$41.84^{bc\,A}$	$42.47^{ab\,A}$	$41.08^{a\,A}$	$40.79^{b\,A}$
	3	$40.71^{c\,B}$	$42.96^{ab\,A}$	$40.92^{a\,A}$	$43.01^{a\,A}$
	5	$42.02^{b\,A}$	$42.73^{ab\,A}$	$40.91^{a\,A}$	$41.34^{b\,A}$
	7	$44.52^{a\,A}$	$43.76^{a\,A}$	$38.74^{b\,B}$	$43.41^{a\,A}$
a*	0	$22.38^{a\,A}$	$20.96^{ab\,A}$	$21.47^{cd\,A}$	$21.83^{b\,A}$
	1	$23.65^{a\,A}$	$21.70^{a\,B}$	$24.05^{a\,A}$	$22.92^{a\,A}$
	3	$22.87^{a\,A}$	$20.40^{bc\,B}$	$23.64^{ab\,A}$	$21.54^{b\,B}$
	5	$22.64^{a\,A}$	$19.62^{cd\,B}$	$22.61^{bc\,A}$	$21.14^{b\,A}$
	7	$20.08^{b\,A}$	$18.98^{d\,A}$	$21.08^{d\,A}$	$20.86^{b\,A}$
b*	0	$11.17^{b\,A}$	$11.18^{bc\,A}$	$10.34^{b\,A}$	$10.93^{b\,A}$
	1	$12.05^{a\,A}$	$12.29^{a\,A}$	$11.55^{a\,A}$	$11.80^{a\,A}$
	3	$12.23^{a\,A}$	$11.37^{b\,A}$	$12.17^{a\,A}$	$11.21^{b\,B}$
	5	$11.96^{a\,A}$	$11.79^{ab\,A}$	$11.45^{a\,A}$	$10.92^{b\,A}$
	7	$10.78^{b\,A}$	$10.48^{c\,A}$	$9.73^{b\,B}$	$10.82^{b\,A}$
C*	0	$25.01^{b\,A}$	$23.76^{b\,A}$	$23.83^{bc\,A}$	$24.41^{b\,A}$
	1	$26.54^{a\,A}$	$24.93^{a\,B}$	$26.67^{a\,A}$	$25.78^{a\,A}$
	3	$25.94^{ab\,A}$	$23.36^{b\,B}$	$26.59^{a\,A}$	$24.28^{b\,B}$
	5	$25.60^{ab\,A}$	$22.89^{b\,B}$	$25.34^{ab\,A}$	$23.79^{b\,A}$
	7	$22.79^{c\,A}$	$21.69^{c\,A}$	$23.21^{c\,A}$	$23.50^{b\,A}$
h°	0	$26.47^{b\,A}$	$28.08^{b\,A}$	$25.63^{bc\,A}$	$26.54^{b\,A}$
	1	$26.97^{ab\,B}$	$29.46^{b\,A}$	$25.57^{bc\,B}$	$27.18^{ab\,A}$
	3	$28.07^{a\,A}$	$29.09^{b\,A}$	$27.20^{a\,A}$	$27.47^{a\,A}$
	5	$27.80^{ab\,B}$	$30.99^{a\,A}$	$26.77^{ab\,A}$	$27.32^{ab\,A}$
	7	$27.80^{ab\,A}$	$28.80^{b\,A}$	$24.67^{c\,B}$	$27.38^{ab\,A}$

Table 2. Effects of dietary vitamin E supplementation on TBARS, POV and TRA in Hawoo beef

	Storage days	M. *Semimembranosus*		M. *Longissimus*	
		Control	E1000	Control	E1000
TBARS[e]	0	$0.22^{d\,A}$	$0.16^{c\,A}$	$0.14^{b\,A}$	$0.18^{c\,A}$
	1	$0.27^{c\,A}$	$0.17^{c\,B}$	$0.17^{b\,A}$	$0.23^{bc\,A}$
	3	$0.29^{bc\,A}$	$0.25^{b\,A}$	$0.40^{a\,A}$	$0.25^{b\,B}$
	5	$0.33^{b\,A}$	$0.30^{a\,A}$	$0.43^{a\,A}$	$0.32^{a\,B}$
	7	$0.53^{a\,A}$	$0.34^{a\,B}$	$0.44^{a\,A}$	$0.34^{a\,B}$
POV[f]	0	$0.015^{c\,A}$	$0.016^{b\,A}$	$0.016^{c\,A}$	$0.015^{c\,A}$
	1	$0.021^{b\,A}$	$0.020^{a\,A}$	$0.021^{bc\,A}$	$0.022^{b\,A}$
	3	$0.025^{b\,A}$	$0.020^{a\,B}$	$0.025^{ab\,A}$	$0.021^{b\,A}$
	5	$0.025^{b\,A}$	$0.020^{a\,A}$	$0.025^{ab\,A}$	$0.022^{b\,A}$
	7	$0.037^{a\,A}$	$0.023^{a\,B}$	$0.028^{a\,A}$	$0.029^{a\,A}$
TRA[g]	0	$0.36^{a\,B}$	$0.41^{a\,A}$	$0.34^{a\,A}$	$0.34^{a\,A}$
	1	$0.34^{b\,A}$	$0.35^{b\,A}$	$0.33^{a\,A}$	$0.34^{a\,A}$
	3	$0.29^{c\,B}$	$0.33^{bc\,A}$	$0.31^{ab\,A}$	$0.34^{a\,A}$
	5	$0.25^{d\,B}$	$0.33^{bc\,A}$	$0.27^{ab\,A}$	$0.29^{a\,A}$
	7	$0.25^{d\,B}$	$0.31^{c\,A}$	$0.18^{b\,A}$	$0.29^{b\,A}$

[a-d]Means in the same column with different superscripts are significantly different($p<0.05$).

[A-B]Means in the same row within a muscle with different superscripts are significantly different($p<0.05$).

[e]Thiobarbituric acid reactive substances(mg/kg)

[f]Peroxide value(meq peroxides/kg)

[g]Total reducing ability

[a-d]Means in the same column with different superscripts are significantly different($p<0.05$).

[A-B]Means in the same row within a muscle with different superscripts are significantly different($p<0.05$).

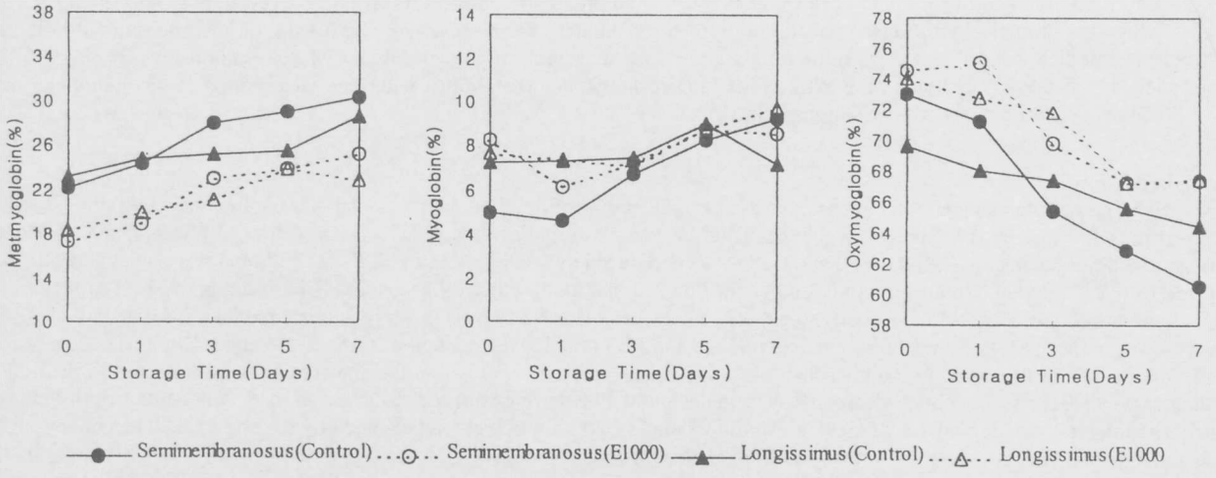

Figure 1. Effects of dietary vitamin E supplementation on metmyoglobin, myoglobin and oxymyoglobin according to muscles in Hanwoo(Korean native cattle) beef surface during storage at 3± 1℃.

Pertinent literature

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