

**DARK STORAGE OF ENHANCED
DARK-CUTTING BEEF IN NITRITE-
EMBEDDED PACKAGING
INCREASED METMYOGLOBIN
FORMATION UPON REPACKAGING**

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PROCESSING

- USDA Low-Choice (n = 6) and dark-cutting (n = 8) strip loins transported from Creekstone Farms LLC on ice
- Dark-cutting loins bisected and randomly assigned to non-enhanced (DC) and enhanced (DCE)
- DCE loins pumped to 110% of the green weight
 - 0.5% glucono delta-lactone
 - 0.1% rosemary (Herbalox oleoresin)
- DCE and DC loins were divided in three sections and were randomly assigned to 3, 6 or 9 d in dark storage
- Steaks (1.91 cm) sliced from anterior end of the strip loins

RETAIL DISPLAY & COLOR

- White-coffin-style case under continuous LED lighting at $2 \pm 1^{\circ}\text{C}$ for 6 d
 - Instrumental color was evaluated every 12 h for 6 d in duplicate
 - HunterLab 4500L MiniScan EZ Spectrophotometer

RETAIL DISPLAY & COLOR

Metmyoglobin formation

$$\text{Metmyoglobin} = \frac{572 \text{ nm}}{525 \text{ nm}}$$

Delta E

Change in color from hr 0
to hr 12 of display

$$\Delta E = \frac{[(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2]}{2}$$

STATISTICAL ANALYSIS

- Fixed effects include enhancement treatment, storage time in dark storage, display time in PVC and their interactions
 - Loin was a random effect
- Least squares means were determined using the MIXED procedure of SAS and considered significant at $P < 0.05$
- Using the PDIFF options, least squares means were separated and significant at $P < 0.05$

Table I: Least squares means for metmyoglobin formation (dark storage time × enhancement × hour of retail display) of steaks displayed for 144 h (Normal-pH n = 6, DC/DCE n = 8)

			Display Hour						
	Storage Time	Enhancement	0	12	24	72	84	132	144
SEM = 0.04	3 d	Normal-pH	0.75 ^{a,x}	0.75 ^{a,x}	0.76 ^{a,x}	0.78 ^{a,x}	0.78 ^{a,x}	0.81 ^{a,x}	0.82 ^{a,x}
		DC	0.77 ^{a,x}	0.77 ^{a,x}	0.76 ^{a,x}	0.80 ^{abc,x}	0.79 ^{ab,x}	0.82 ^{a,x}	0.83 ^{ab,x}
		DCE	0.79 ^{a,x}	0.96 ^{b,y}	1.01 ^{b,y}	0.96 ^{cd,y}	0.94 ^{bc,xy}	1.00 ^{bc,y}	0.98 ^{bc,y}
	6 d	Normal-pH	0.78 ^{a,x}	0.78 ^{a,x}	0.78 ^{a,x}	0.78 ^{a,x}	0.79 ^{a,x}	0.82 ^{a,x}	0.85 ^{ab,x}
		DC	0.75 ^{a,x}	0.76 ^{a,x}	0.76 ^{a,x}	0.79 ^{ab,x}	0.79 ^{ab,x}	0.88 ^{abc,x}	0.88 ^{ab,x}
		DCE	0.79 ^{a,x}	1.00 ^{b,y}	1.06 ^{b,y}	1.00 ^{d,y}	0.97 ^{c,y}	0.96 ^{abc,y}	0.95 ^{abc,y}
	9 d	Normal-pH	0.81 ^{a,x}	0.79 ^{a,x}	0.80 ^{a,x}	0.81 ^{abc,x}	0.81 ^{abc,x}	1.02 ^{c,y}	1.07 ^{c,y}
		DC	0.78 ^{a,x}	0.78 ^{a,x}	0.78 ^{a,x}	0.81 ^{abc,x}	0.83 ^{abc,x}	0.86 ^{ab,x}	0.81 ^{a,x}
		DCE	0.82 ^{a,x}	0.97 ^{a,xy}	0.96 ^{b,xy}	0.94 ^{bcd,xy}	0.97 ^{c,xy}	1.04 ^{c,y}	1.04 ^{c,y}

^{a-d}Least squares means within a column with different letters are significantly different (P < 0.05).

^{xy}Least squares means within a row with different letters are significantly different (P < 0.05).

Higher number indicates more metmyoglobin formation.

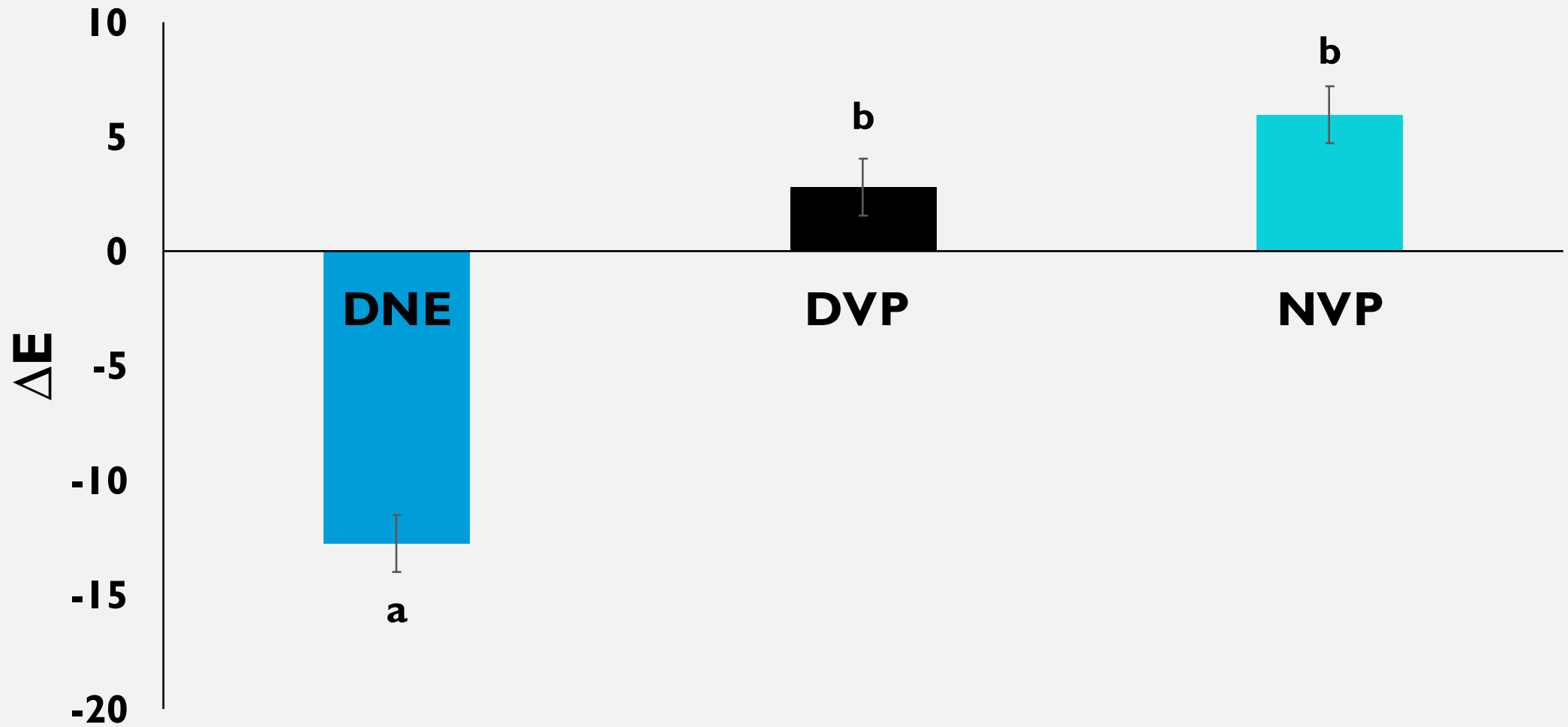


Figure 1: Effects of enhancement on ΔE (Normal-pH $n = 6$, DC/DCE $n = 8$). ^{ab}Least squares means with different letters are significantly different ($P < 0.05$). SEM = 1.24. A negative number indicates a decline in color during retail display.

CONCLUSION

- Repackaging enhanced nitrite-embedded packaged steaks in PVC
 - Decline in red appearance
 - Increase in discoloration
- Repackaging enhanced dark-cutting steaks not an option to improve color
- Nitrite-embedded packaging in combination with acidification can improve color of dark-cutting steaks but exposure to air reduced color stability
- Further research should evaluate the extension of color stability after repackaging nitrite-embedded packaged steaks



Enhanced dark-cutting steaks



Nonenhanced dark-cutting steaks