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Possible Role of Myoglobin in Regulating Calpain-1 Activity in Postmortem Beef Muscle

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Objectives

Previous research revealed a relationship between meat color and beef tenderness and indicated that myoglobin can inhibit calpain-1 in solution. The objective of this study was to determine the extent to which myoglobin and beef color are associated with calpain activity and beef tenderness.

Materials and Methods

Beef *Longissimus dorsi* samples from the left side of Holstein beef carcasses (n = 21) were collected immediately post exsanguination on the processing floor for 0 h analyses. Muscle temperature and pH was measured at 0, 24, and 48 h postmortem. After USDA quality and yield grade determination, steaks (n = 6) were removed from the right side of each carcass (n = 21) at 48 h for analyses at 48 and 336 h postmortem. Color (L^*, a^*, and b^* values), surface myoglobin redox forms, metmyoglobin reducing activity (MRA), total myoglobin concentrations, slice shear force (SSF), Warner-Bratzler shear force (WBSF) were measured. Calpain-1 concentrations and autolysis were determined via Western blot at 0, 48, and 336 h.

Table 9. Correlations (P-values) between selected color and tenderness measurements (n = 21)

	WBSF 48 h	WBSF 336 h	SSF 48 h	Calpain 1 0 h	Calpain 1 48 h
Myoglobin 0 h			0.386 (0.084)		
Myoglobin 48 h				-0.476 (0.029)	
MRA 48 h	0.381 (0.088)				
MRA 336 h	0.457 (0.037)		0.372 (0.097)		
L* 48 h		0.469 (0.032)			
b* 48 h		0.469 (0.032)			
b* 336 h				0.472 (0.031)	0.397 (0.075)

Results

Decline in muscle pH was 6.4, 5.8, and 5.6 at 0, 24, and 48 h, respectively. Shear force values at 48 h were 73.19 N for WBSF and 384.21 N for SSF and at 336 h were 48.75 N for WBSF and 260.47 N for SSF. Myoglobin reducing activity at 336 h was positively correlated to WBSF at 48 h and negatively correlated to calpain-1 concentration at 0 h ($P < 0.05$; Table 9). Color measurements of L^* and b^* at 48 h were moderately correlated with WBSF at 336 h ($P < 0.05$; Table 9). The b^* measurement at 336 h showed a moderate relationship to calpain-1 concentration at 0 h ($P < 0.05$; Table 9).

Conclusion

Moderate correlations between color and tenderness measurements taken at 48 h with those taken at 336 h were discovered indicating that myoglobin may impact calpain-1 in vivo.