

2010 AgResearch Meat Industry Workshop

Improving Beef Quality by Minimizing Oxidative and Protein Denaturing Conditions

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Farming, Food and Health. **First**™
Te Ahuwhenua, Te Kai me te Whai Ora. Tuatahi

Introduction

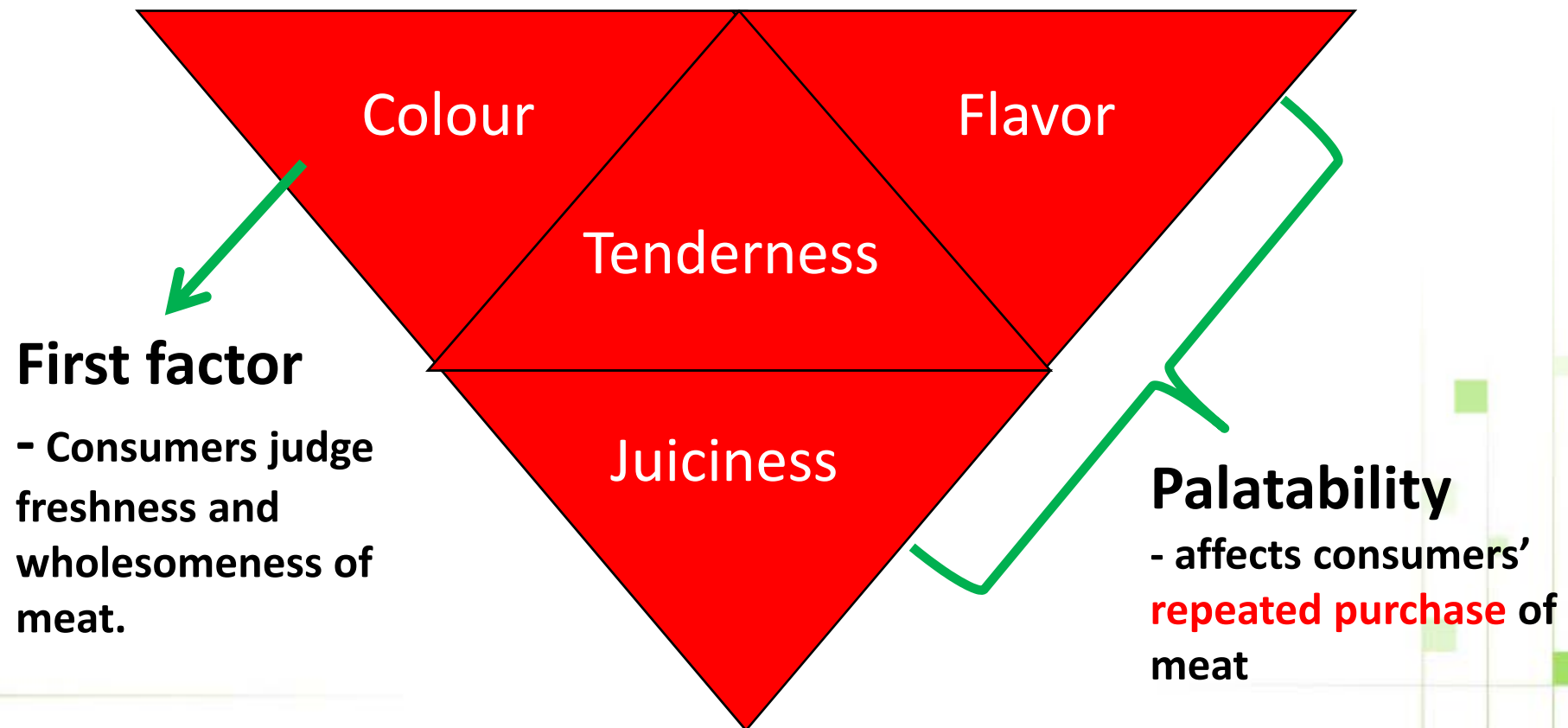


**Factors affecting
consumers' meat
purchase decision**



Meat Quality

- Consumers expect high quality meat, which should have desirable flavour, tenderness, and juiciness.



Beef; it's what's
for dinner!



Pop Quiz ??

A



B



High-Oxygen Modified Atmosphere Packaging (HiOx-MAP) System



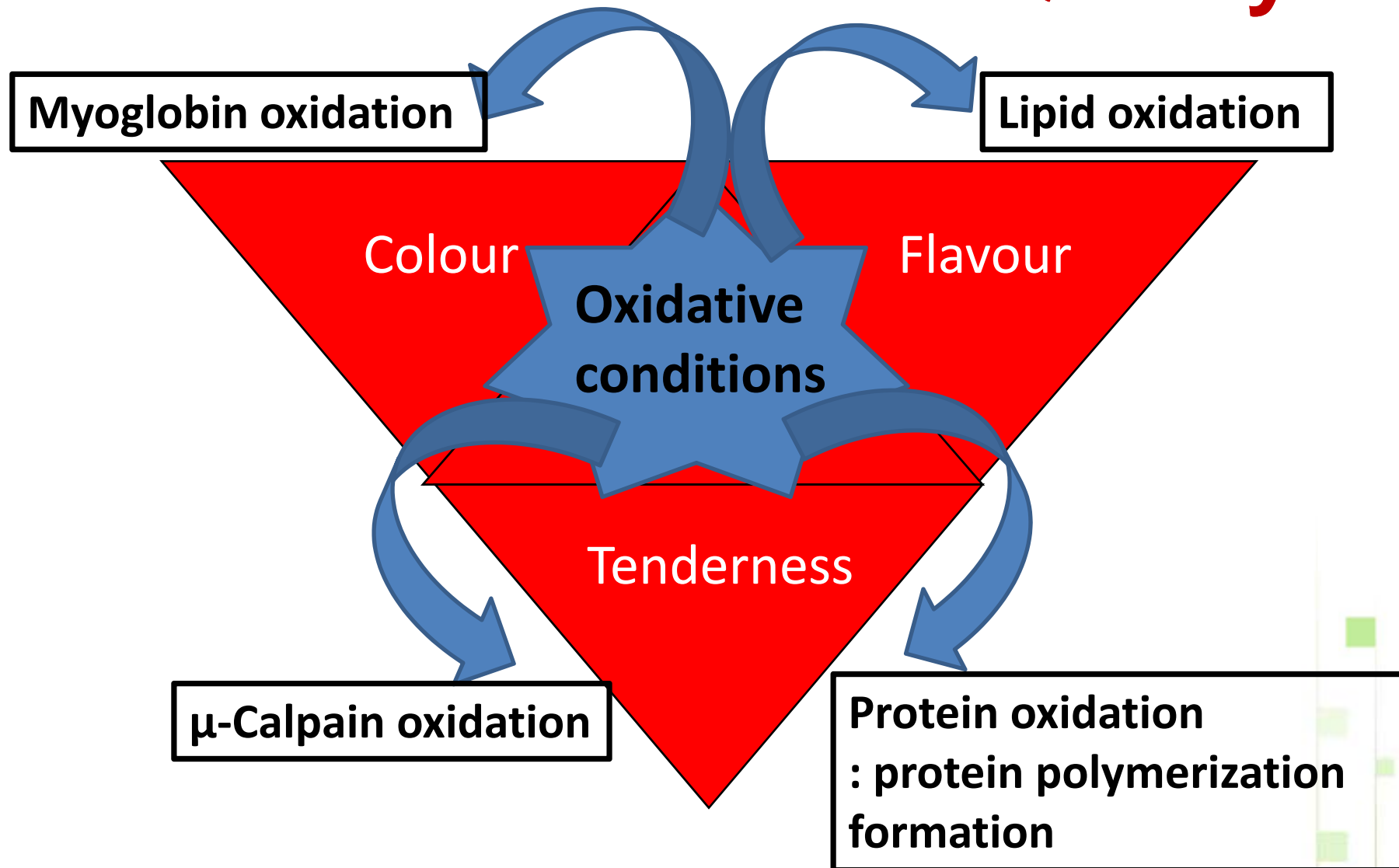
- HiOx-MAP (80% O₂ + 20% CO₂) allows
 - 1) more oxygen to penetrate into meat, consequently forming a higher percentage of oxymyoglobin and a **brighter cherry red meat colour**
 - 2) CO₂ to prevent **microbial growth**

HiOx-MAP system creates “oxidative conditions”



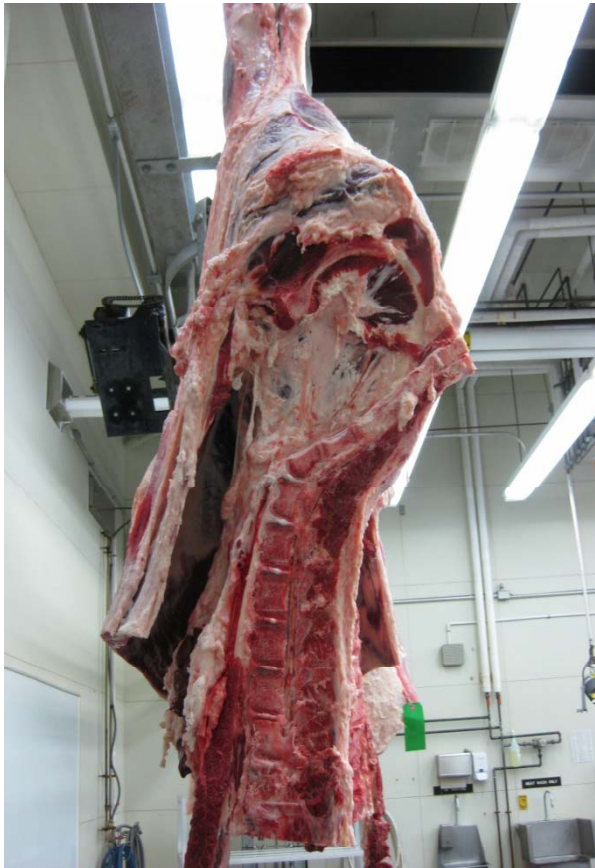
- HiOx-MAP (80% O₂ + 20% CO₂) are likely to increase the incidence of oxidative changes in the meat, and thus it may **negatively affect meat quality characteristics.**

Postmortem Meat Quality



Materials & Methods

Muscle selection: LD, SM, AD (N=10) @ 1 d p.m.



↓
Trim & cut a steak (2.54 cm)



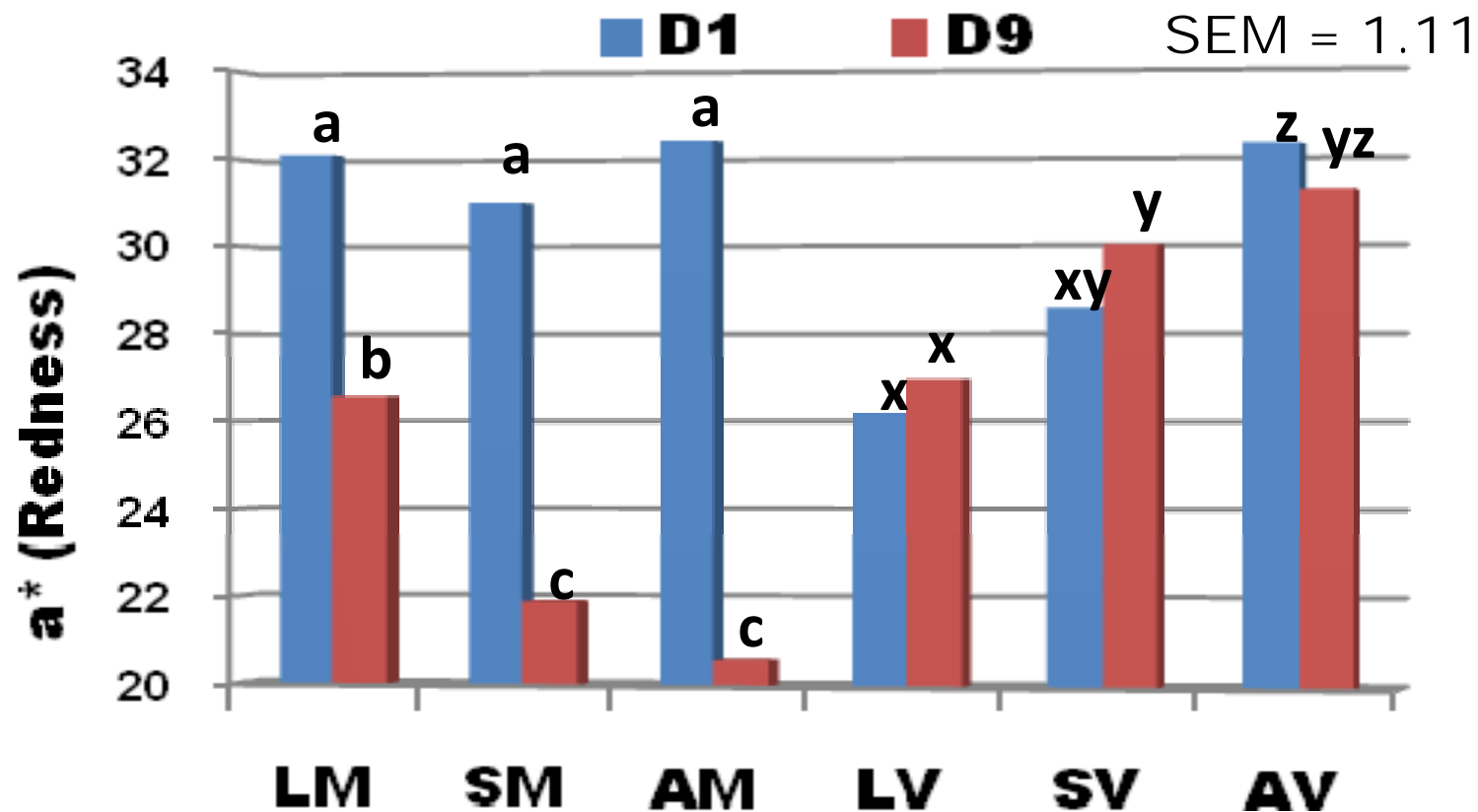
→ **HiOx-MAP**

→ **VAC**

→ **Displayed for
9d at 1°C**

- Instrumental colour, pH, TBARS,
sensory, biochemical analysis

Influence of different packaging types on surface redness



HiOx MAP

VAC

abc Means having different letters are different ($p < 0.05$).

xyz Means having different letters are different ($p < 0.05$).

Kim et al. (2010a) Meat Sci. 85: 759-767

HiOx MAP

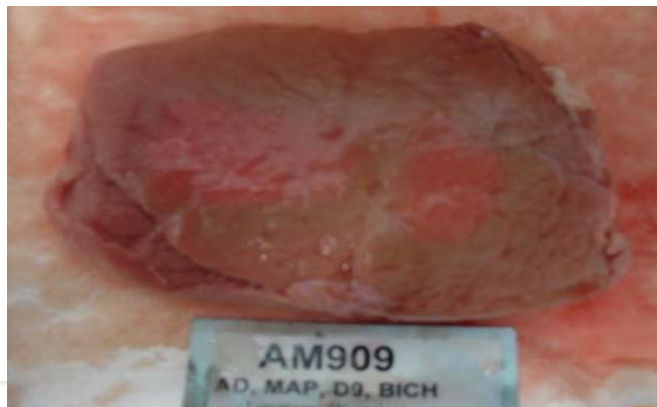
LD



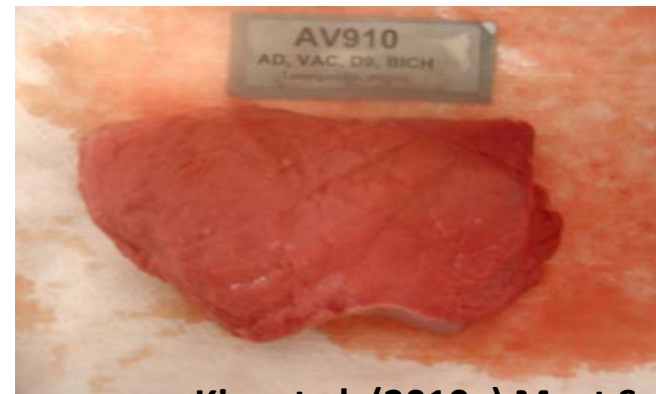
SM



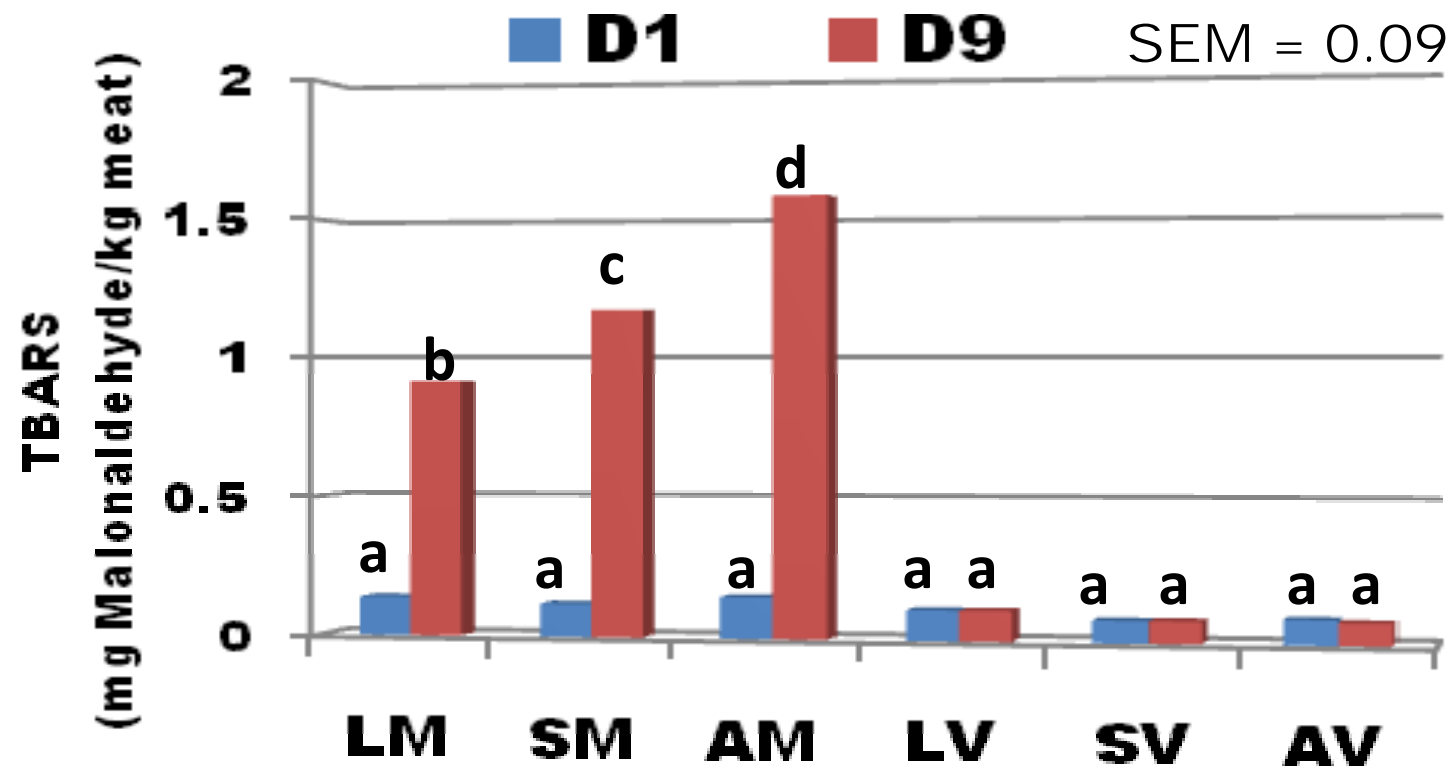
AD



VAC



HiOx-MAP increased lipid oxidation of beef steaks

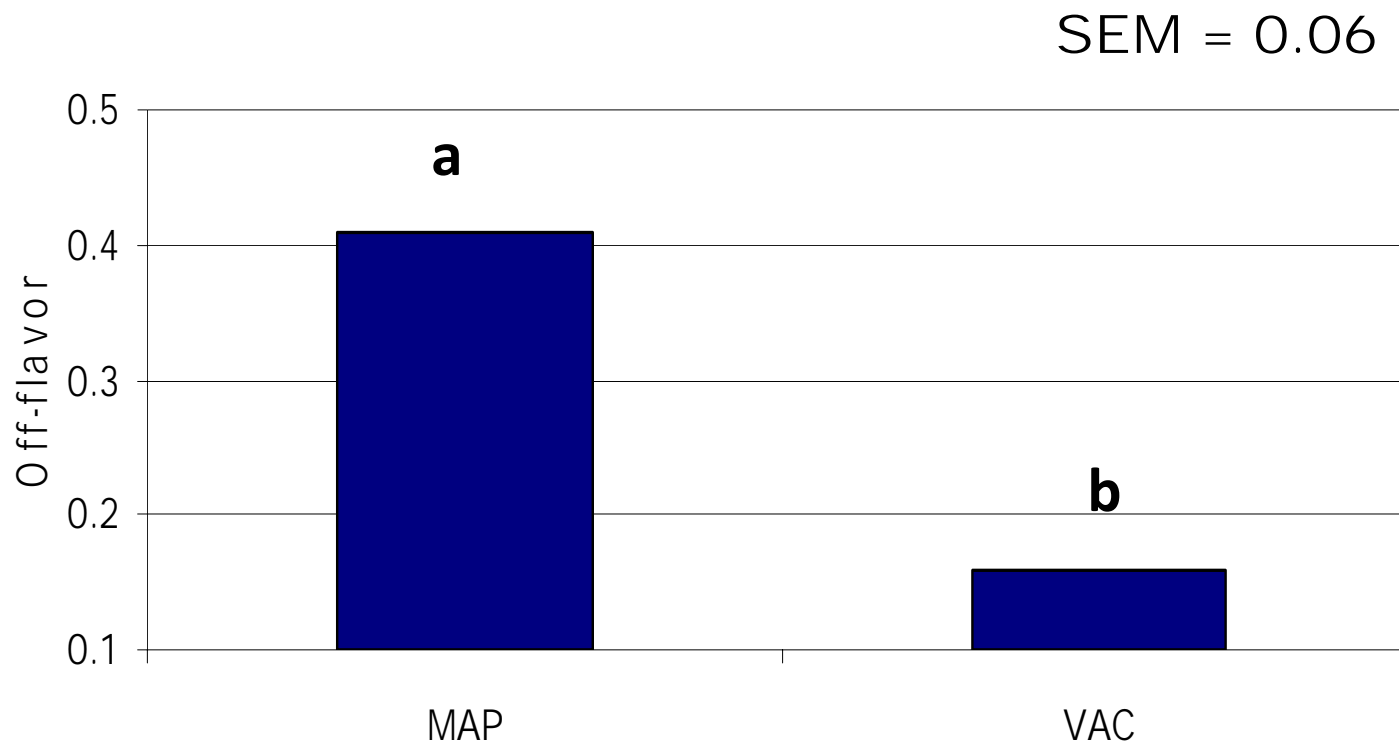


HiOx MAP

VAC

abcd Means with different letters are different ($p < 0.05$).

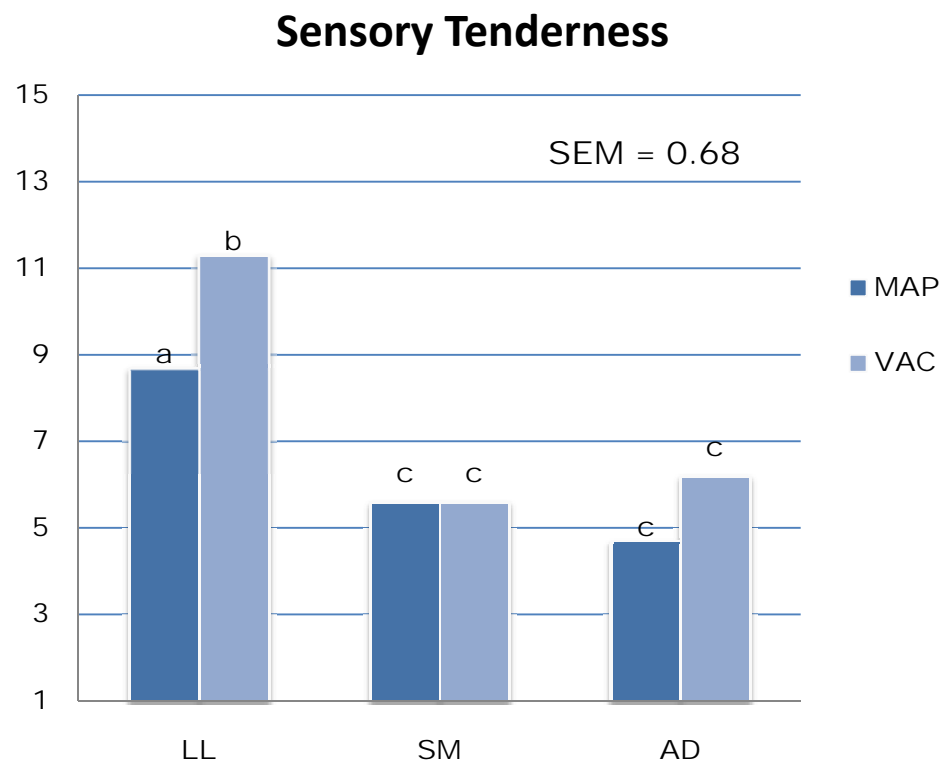
HiOx-MAP increased off-flavour of beef steaks after display for 9d



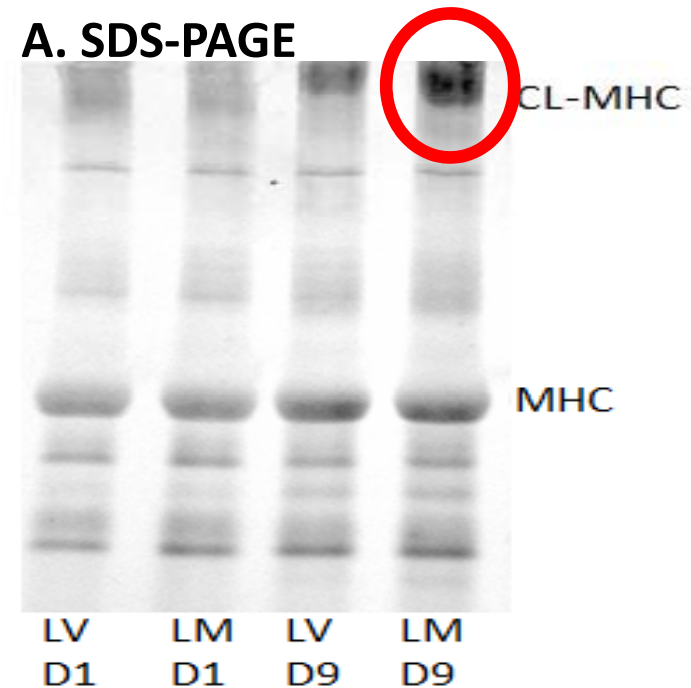
^{ab}Means with different letters are different ($p < 0.05$).

Kim et al. (2010a) Meat Sci. 85: 759-767

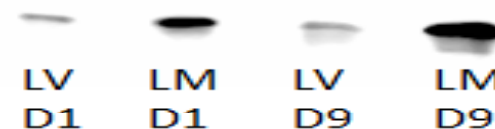
Oxidizing condition (HiOx-MAP) decreased meat tenderness



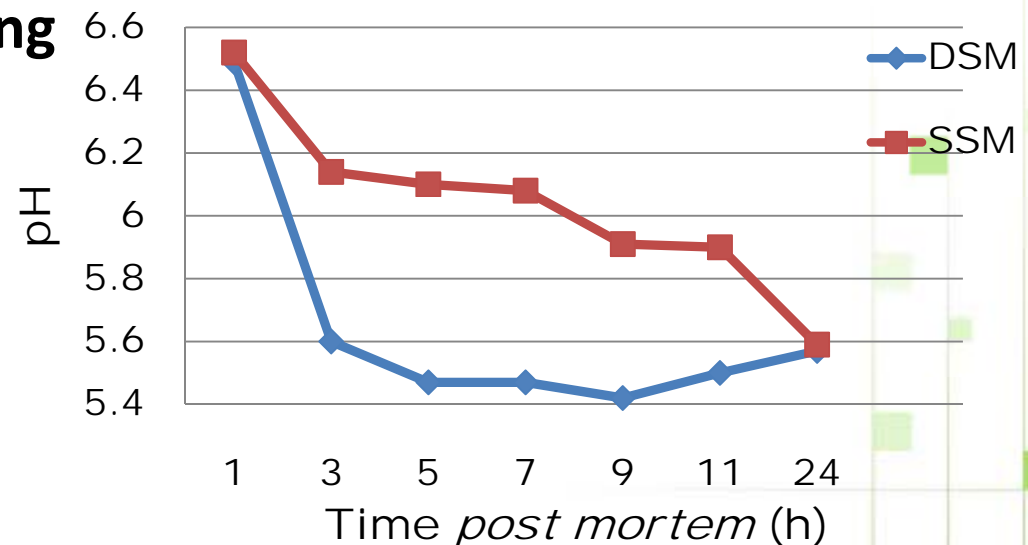
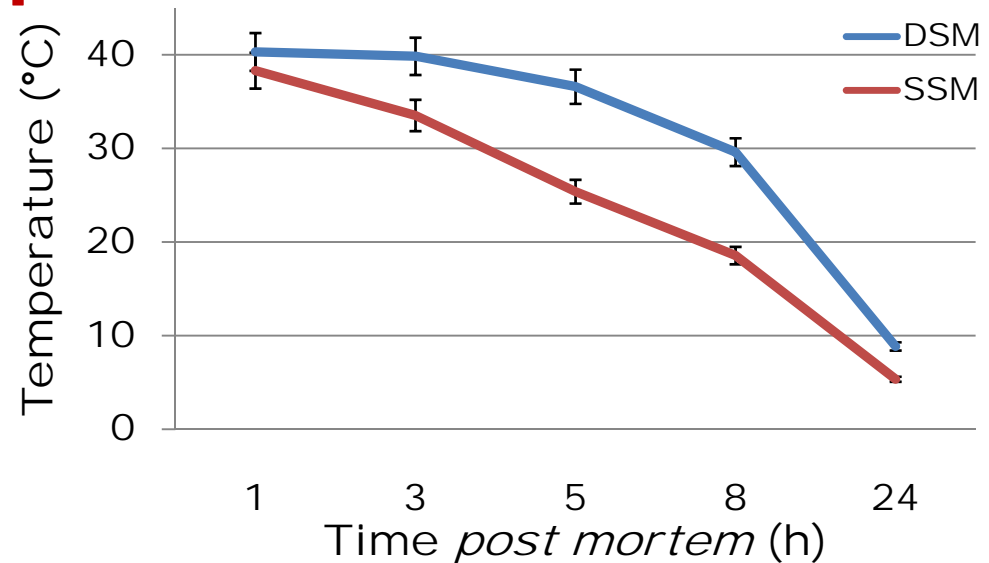
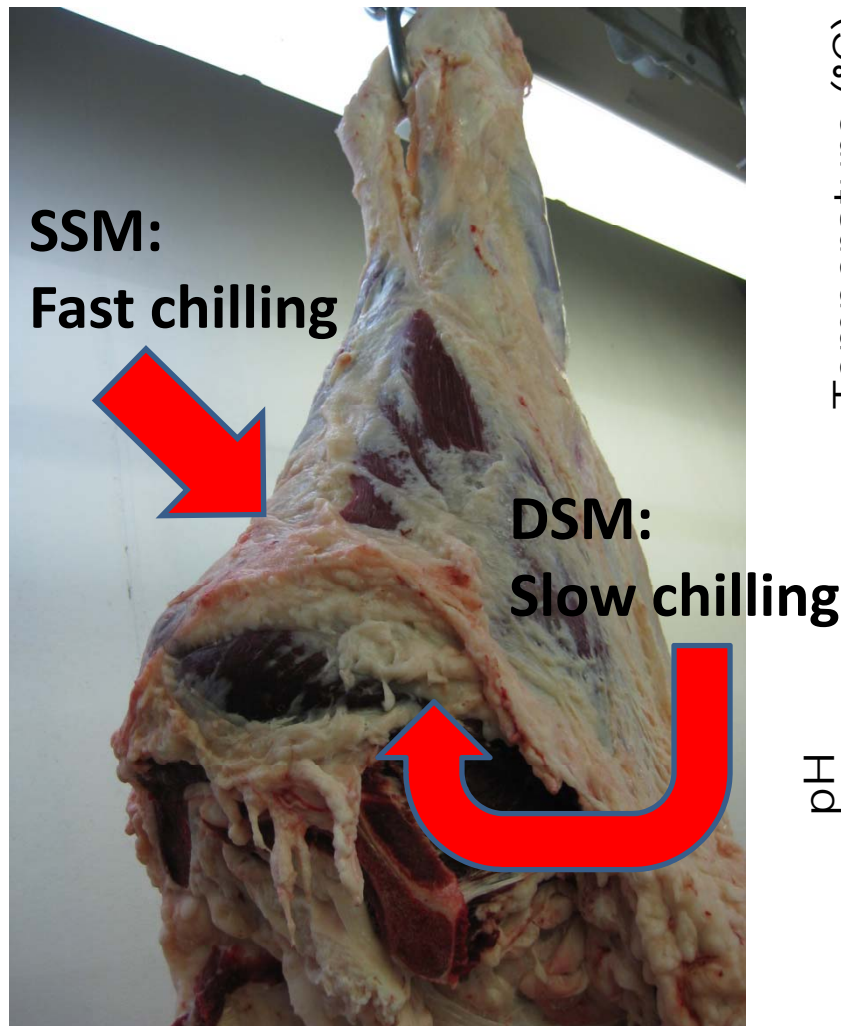
^{abc}Means having different letters are different ($p < 0.05$).



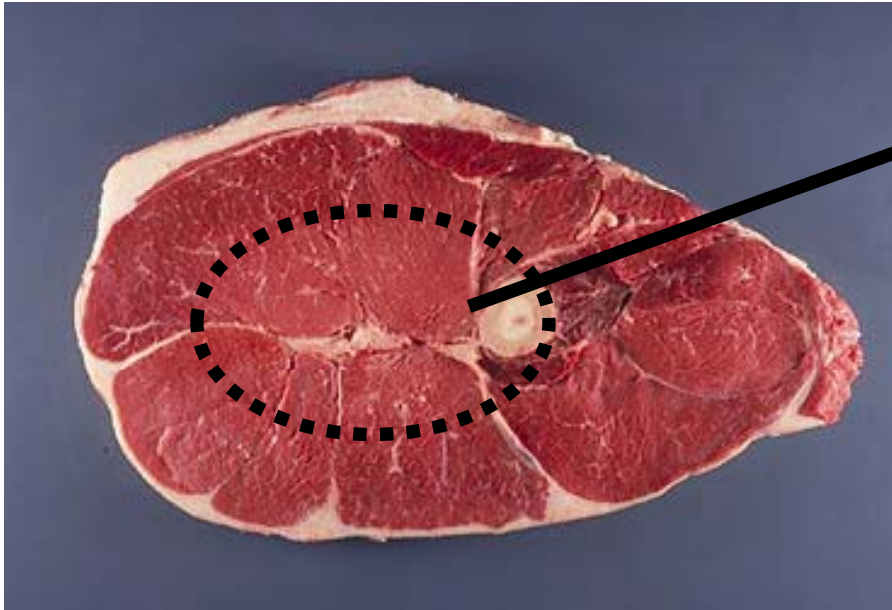
B. Western blot of X-linked MHC



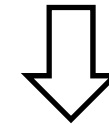
Due to the size, thickness, and location of the SM, the deep SM has a slower chill rate than the superficial SM



High temperature & rapid pH decline conditions result in protein denaturation

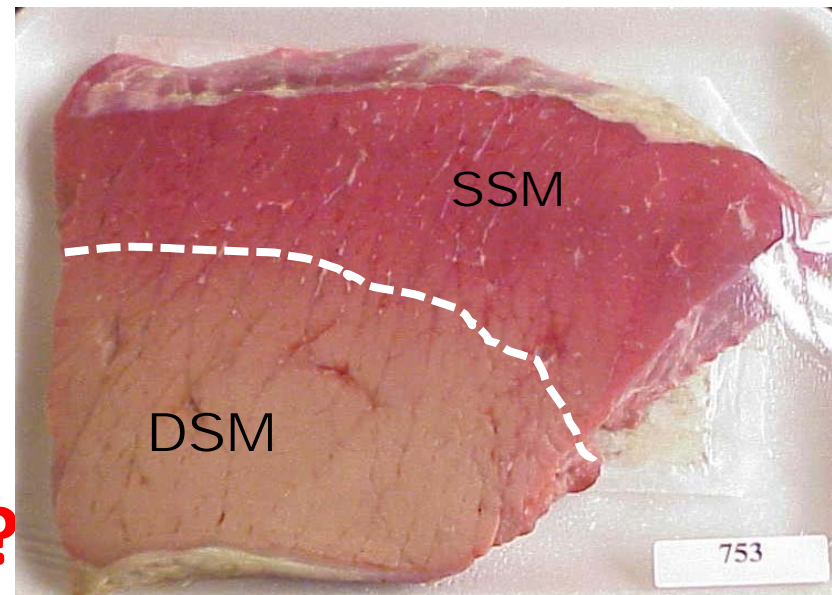


High Temp & fast pH decline conditions

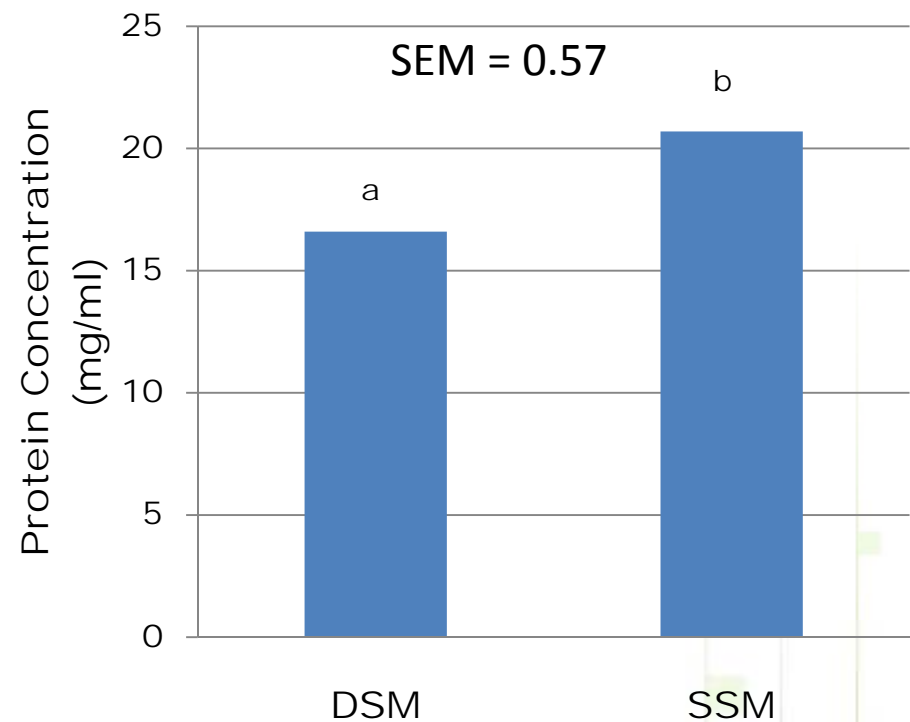
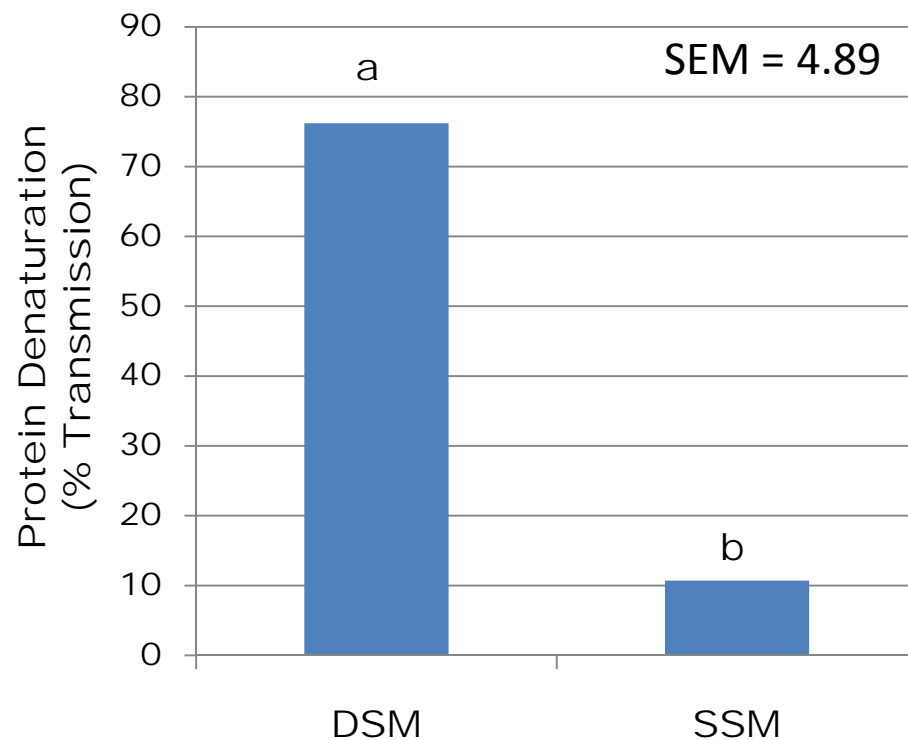


Protein denaturation
: myoglobin denaturation

How does protein denaturation condition influence P.M. meat tenderness development?



More protein denaturation & less protein concentration in DSM

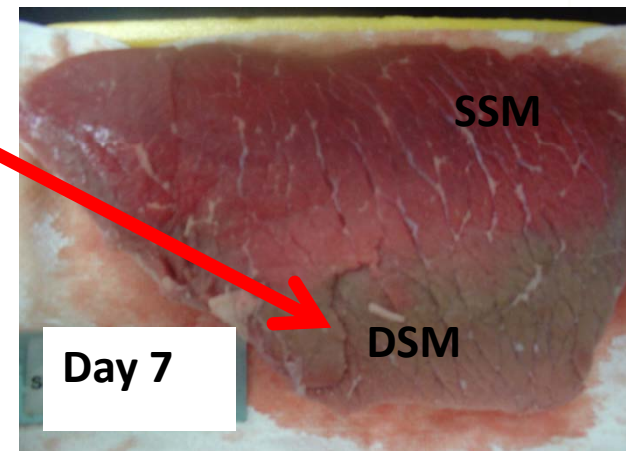
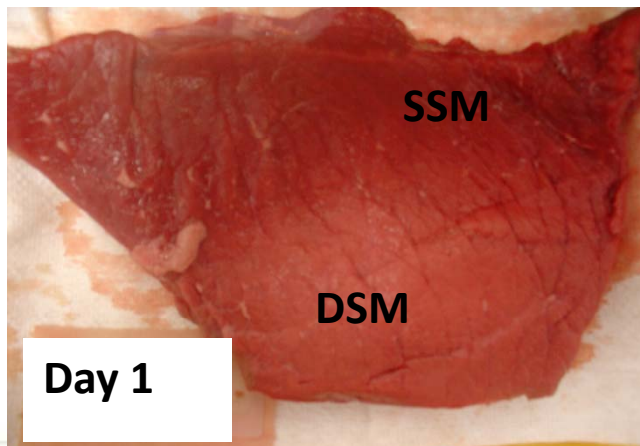


^{ab}Means having different letters are different ($p < 0.05$).

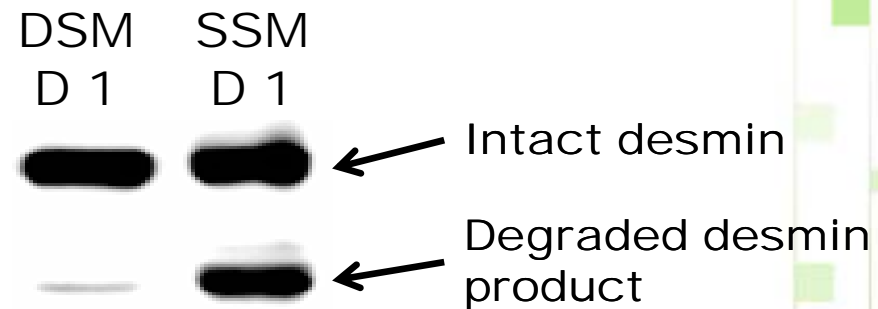
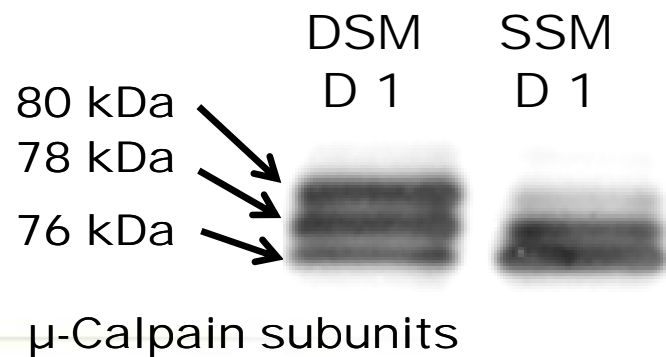
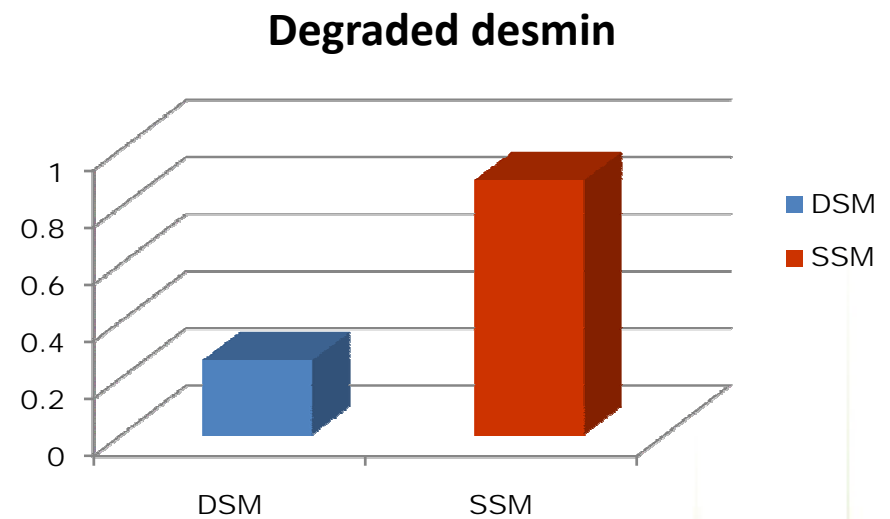
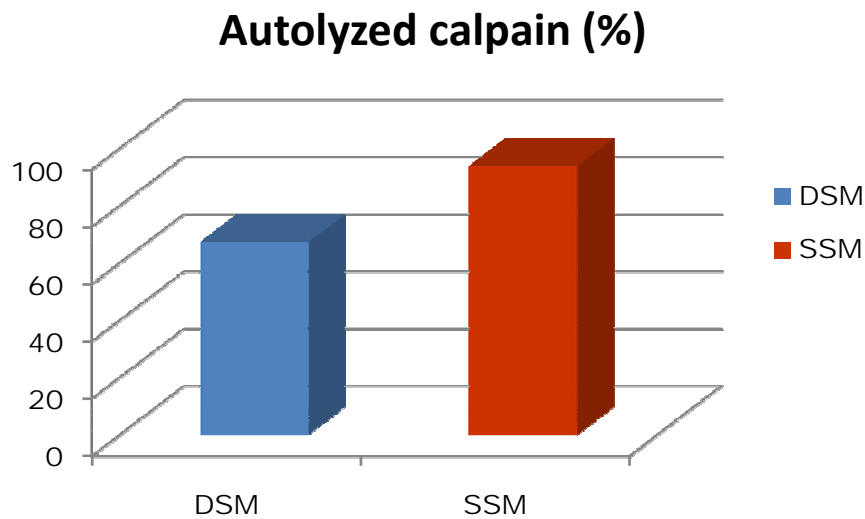
More discolouration of DSM during display time

	DSM	SSM	SEM
L*	46.5 ^a	40.3 ^b	0.9
a*	32.1 ^a	28.0 ^b	0.5
b*	24.4 ^a	19.6 ^b	0.5
Hue	37.1 ^a	34.9 ^b	0.3

Means in a row with different subscripts (a-b) are different (P < 0.05)

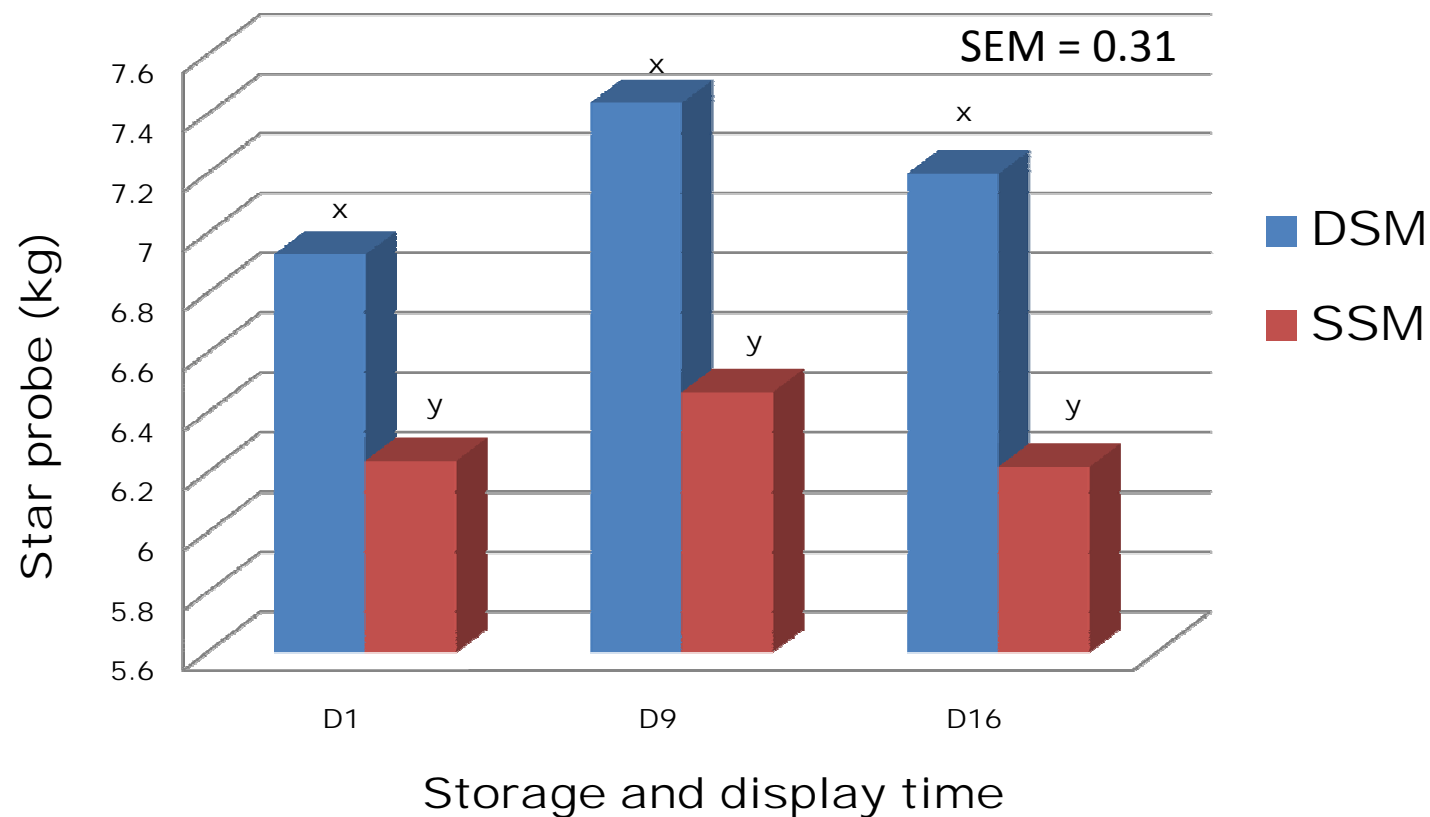


Less extent of μ -calpain autolysis and proteolysis in DSM



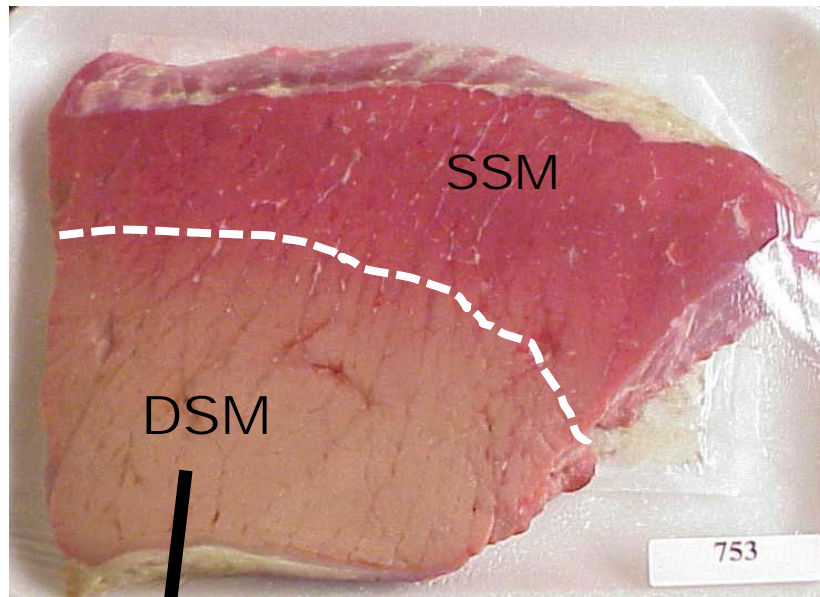
Kim et al. (2010b) Meat Sci. 86: 883-887

DSM had greater star probe values (tougher) than SSM

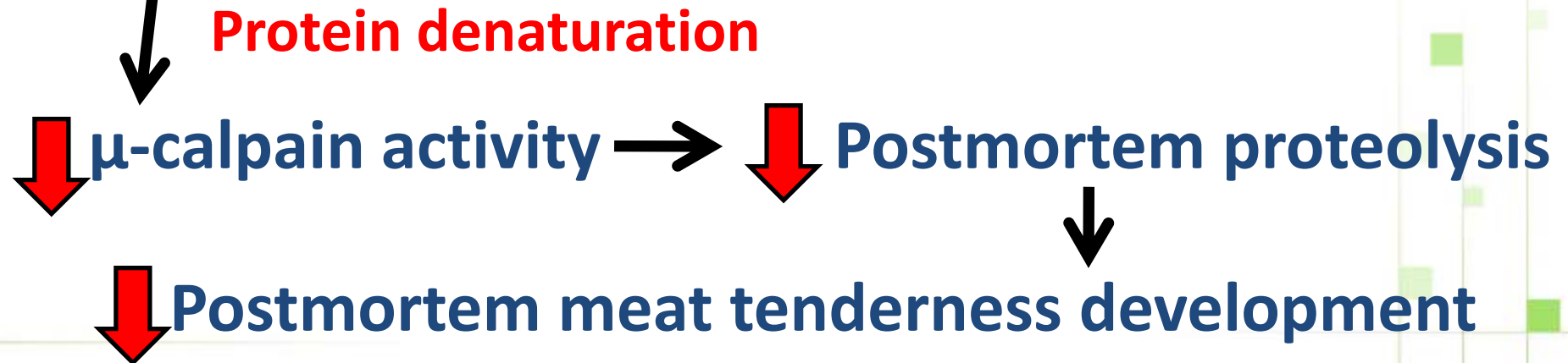


^{xy}Means having different letters within each day are different ($p < 0.05$).

Summary



The protein denaturing condition of DSM negatively influenced postmortem proteolysis by decreasing μ -calpain activity.



Conclusion

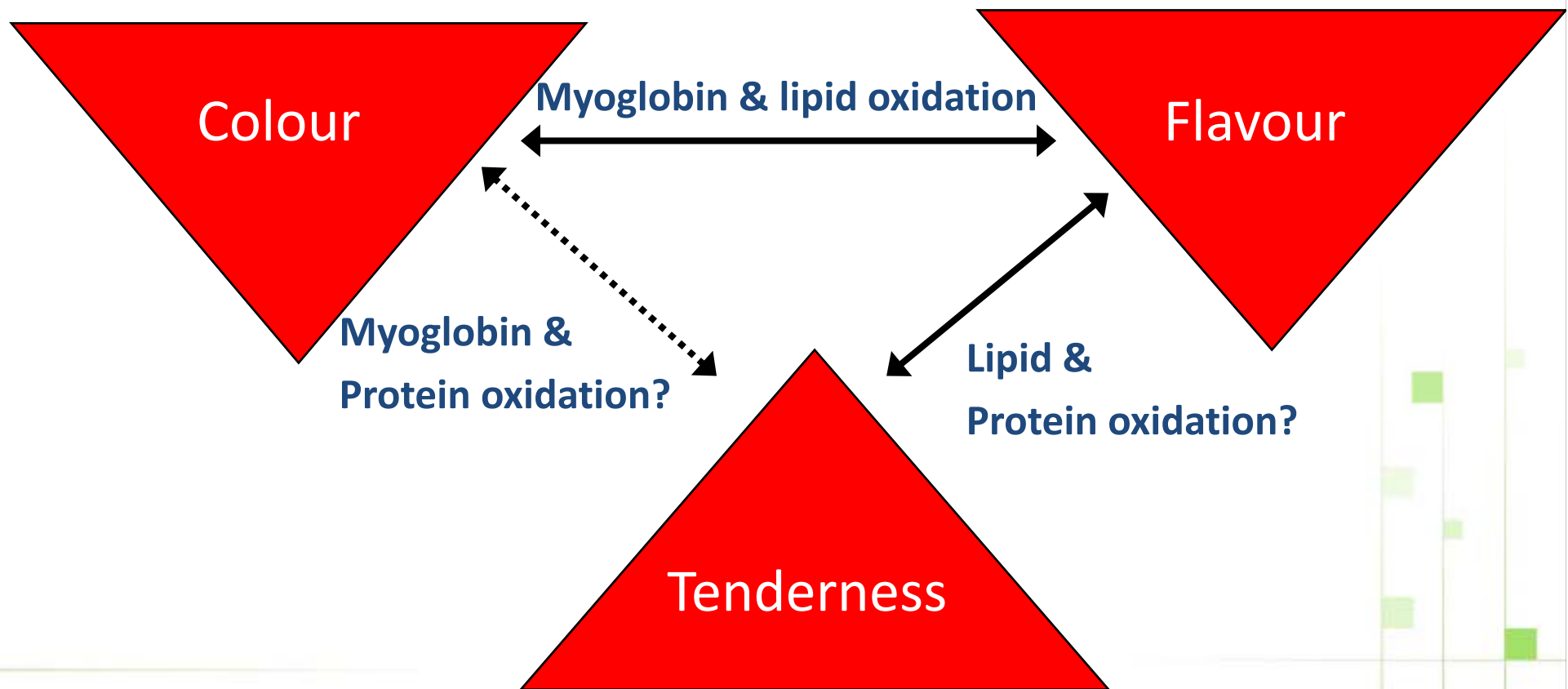
- **HiOx-MAP** system negatively affects meat quality characteristics by inducing lipid and myoglobin oxidation and cross-linking/aggregation of myosin by protein oxidation.

Conclusion cont'

- The **protein denaturing condition** of early postmortem muscle will negatively affect meat quality characteristics by inducing myoglobin oxidation and decreasing proteolysis due to less activity of μ -calpain.

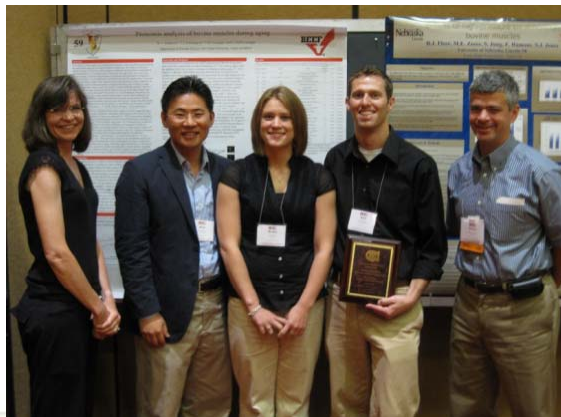
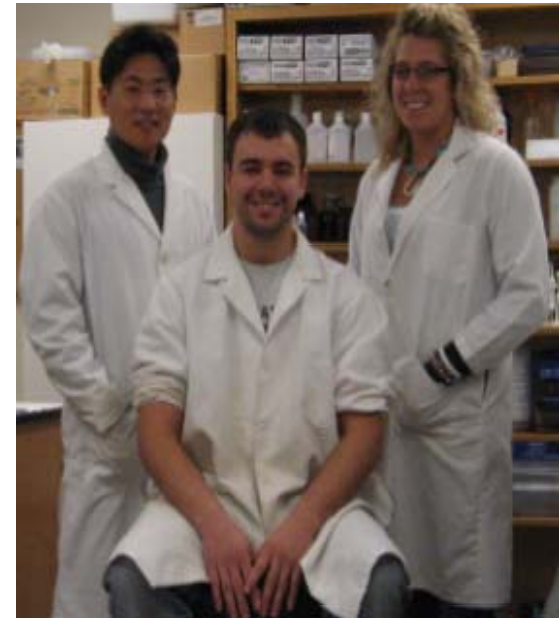
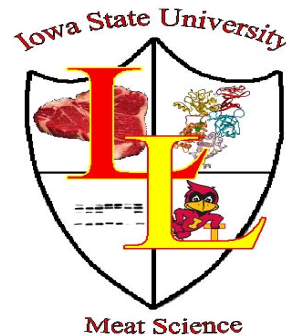
Further Research

- Relationship between **protein and lipid/myoglobin oxidation** in fresh meat under HiOx-MAP?
- Strategy to minimize/inhibit **oxidative and protein denaturing** conditions?



Acknowledgements

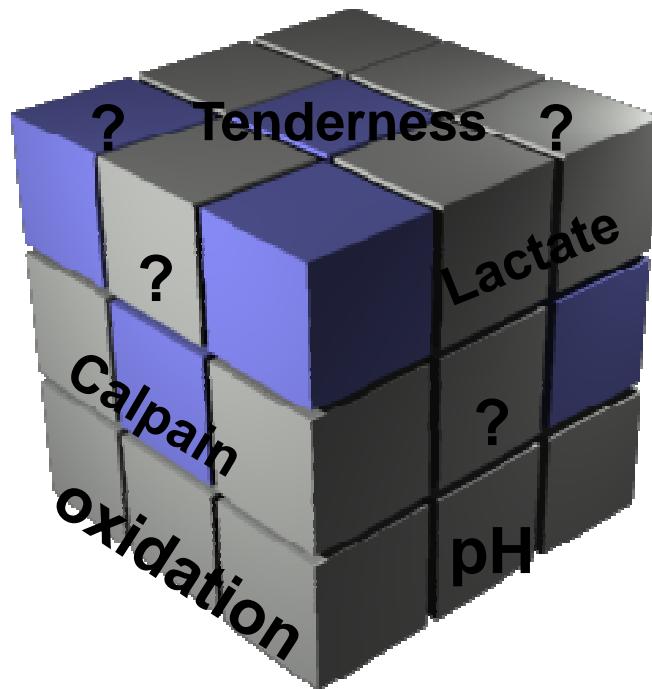
- National Cattlemen's Beef Association (NCBA, USA)
- Iowa Beef Industry Council



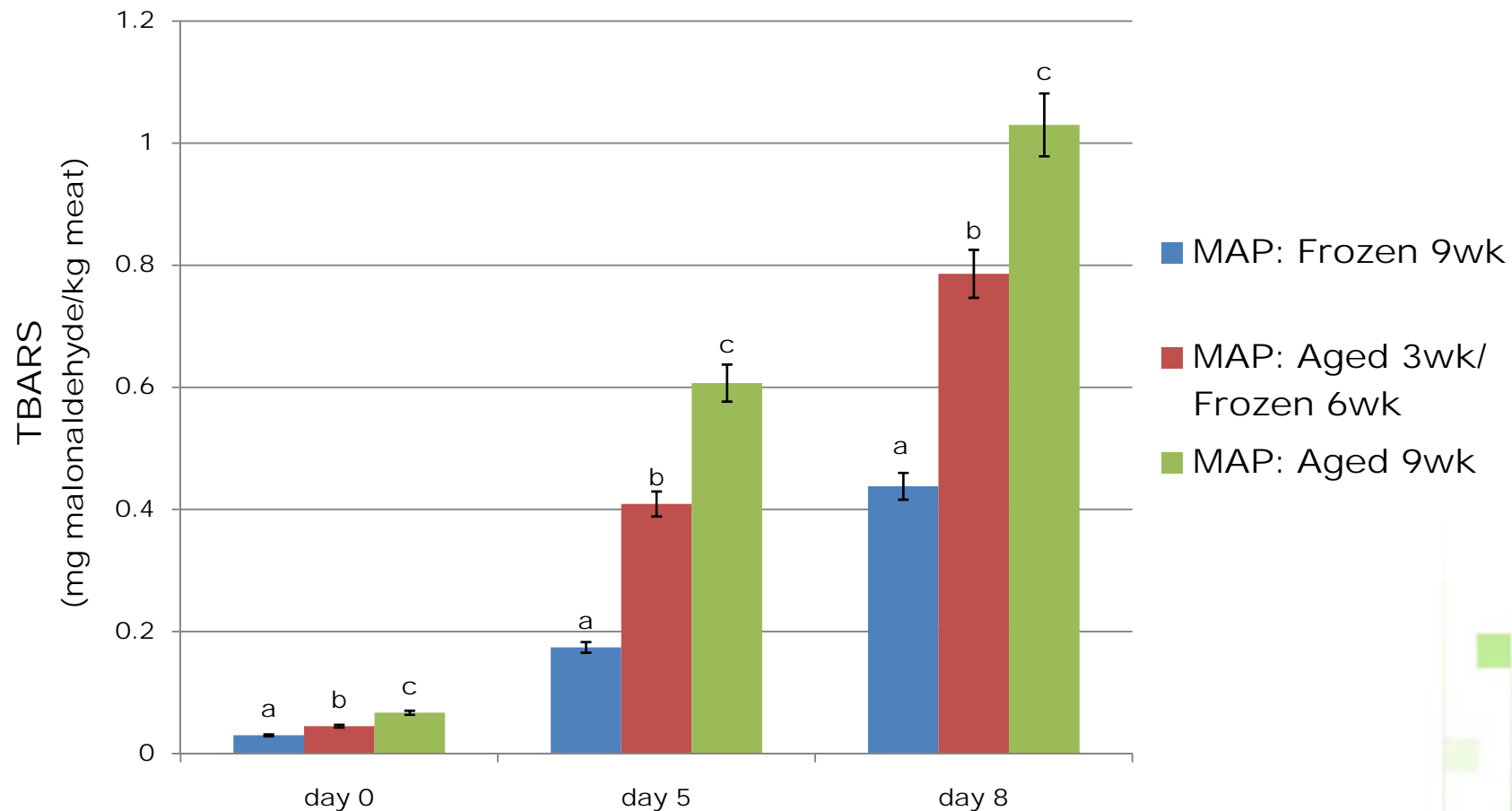
- Drs. Steven & Elisabeth Huff-Lonergan
- Mark, Rachel, Aaron, Justine, Trisha, Cathy, Tom & Betsy
- Matilde Frandsen

Not an oxidized
steak please!!

Questions



HiOx-MAP increased lipid oxidation of lamb chops



^{abc}Means with different letters are different within each day ($p < 0.05$).