Carcass Chilling Method Effects on Color and Tenderness of Bison Meat

THE UNIVERSITY of WISCONSIN MADISON

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OBJECTIVE

- To determine the effects of early postmortem carcass vascular rinsing and chilling on color and tenderness of bison meat in comparison to conventional carcass chilling.

CONCLUSIONS

- Rinse and Chill technology has commercial potential to positively impact bison steak tenderness. Consideration should be given to the type of meat and packaging method used relative to the effect of this technology on meat color.

INTRODUCTION

- Post-exsanguination vascular infusion has been studied to determine the effects on postmortem metabolic changes, water holding capacity, meat color, and palatability [1].
- Some of the research focused on infusing $CaCl_2$ in lamb, grain-fed Hereford x Angus steer beef, and Brahman-cross beef as a means to enhance proteolysis [2,3,4].
- Others investigated infusion with a solution of saccharides, sodium chloride, phosphates, and vitamin C to influence the flavor profile of beef [5].
- This study focused on the effect of early postmortem carcass vascular rinsing and chilling on color and tenderness of bison bull meat in comparison to conventional carcass chilling.

MATERIALS & METHODS

Animals

- Bison (n=9 per chill method), age 28 mo., grain finished bulls (ave. hot carcass weight, 231. 9 kg).

Carcass Chilling Methods

- Conventional air chilling (C)
- Rinse and Chill® technology (RC; MPSC Inc.)
  - -Vascular rinsing of residual blood early postmortem
  - -Using isotonic substrate solution (3 °C)
    - 98.5% water; balance: glucose, polyphosphates, glycerine, and maltose

Meat Cut Processing and Storage

- *Longissimus lumborum* (LL) muscles->steaks (25.4 mm thick)
  - -Polyvinyl chloride overwrapped (PVC)
  - -Vacuum packaged (VAC)
- *Triceps brachii* (TB) individually ground (2 d P.M.)
  - -Packaged (PVC, VAC)

Display/Storage

-PVC: displayed (3 °C), cool white deluxe lighting, 1615 lux
-VAC: stored in the dark (3 °C).
-Days (1, 4, 7 d, except PVC ground TB excluded day 7)

Color Determinations and Dependent Variables

- Color measurements (CIE L*a*b*; reflectance estimators of chemical states of myoglobin; AMSA 2012[6])
  - -Oxymyoglobin (OMb, %R610 nm/%R525 nm)
  - -Deoxymyoglobin (DMb, %R474nm/%R525nm)
  - -Metmyoglobin (MMb, %R572nm/525nm)
- Purge (2 d postmortem)-whole muscle
- pH
- Sarcomere length (SL; Cross et al. 1981)
- Warner-Bratzler shear (WBS; 1-cm wide strips)
- Cooking loss (CL), steaks removed grill 68 °C)

Statistical Analysis

- Data were analyzed with PROC MIXED model (factorial 2 x 2, chill methods by packaging, with a storage day split plot factor). Animal served as experimental unit (replications= 9)

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RESULTS

- Chilling method did not influence (P> 0.05) pH or sarcomere length in either muscle.
- RC resulted in greater purge (2 d PM) than C in both muscles, although the difference was only 0.38% for the LD and 0.51% for the TB
- Slightly greater cook loss (1.7%) associated with RC compared to C
- RC decreased (P<0.05) WBS by 24% on steaks aged 10 days postmortem.

Table 1. Least square means on the effects of carcass chilling treatment on two muscles[1].

Dependent variables[2]	LL		TB		
	C	RC	C	RC	SED
pH	5.44[b]	5.43[b]	5.63[a]	5.64[a]	0.012
Purge (%)	0.50[b]	0.88[a]	0.18[c]	0.69[ab]	0.107
SL (μ)	1.77[ab]	1.80[a]	1.61[b]	1.66[ab]	0.059
CL (%)	12.74[b]	14.43[a]	na	na	0.574
WBS (kgf)	4.33[a]	3.28[b]	na	na	0.294

[1]Carcass chilling treatment: C=control, RC=rinse and chill; Muscles: LL= M. Longissimus et lumborum, TB= M. Triceps brachii.
[2]Dependent variables: pH, on raw samples; SL, sarcomere length; CL, cooking loss; WBS, Warner-Bratzler Shear.
[a-c]Means within a row with unlike superscript letters are different (P<0.05). SED, standard error of the difference.

Table 2. Least square means of carcass chilling treatment effects on CIE a* and reflectance estimators of the chemical states of myoglobin on refrigerated packaged bison *M. Longissimus et lumborum* steaks under continuous lighting display (PVC) and non-displayed (vacuum packaged) conditions[1].

- In PVC, RC steaks compared to C
  - Less red day 7
  - Lower estimated OMb day 4 and 7
  - Higher estimated MMb day 7
- In VAC, RC steaks compared to C
  - Higher estimated DMb day 7

Storage Day	PVC C	PVC RC	VAC C	VAC RC
		CIE *a**		
1	19.37[a]	19.47[a]	14.92[bc]	15.34[b]
4	16.42[b]	15.84[b]	15.60[b]	16.02[b]
7	13.63[c]	11.39[d]	16.00[b]	16.43[b]
		Oxymyoglobin		
1	2.27[a]	2.37[a]	1.62[e]	1.52[de]
4	2.01[b]	1.82[c]	1.65[de]	1.58[de]
7	1.69[cd]	1.52[e]	1.63[de]	1.61[de]
		Deoxymyoglobin		
1	1.12[de]	1.13[d]	1.47[c]	1.49[c]
4	1.10[de]	1.09[de]	1.50[bc]	1.53[ab]
7	1.09[de]	1.08[e]	1.49[c]	1.56[a]
		Metmyoglobin		
1	0.81[de]	0.79[e]	0.85[d]	0.84[de]
4	0.86[cd]	0.90[c]	0.82[de]	0.79[e]
7	0.95[b]	1.03[a]	0.83[de]	0.79[e]

[1]Carcass chilling treatment: C=control, RC=rinse and chill. Dependent variables: CIE a*, larger number more red; Reflectance (R) estimators of myoglobin chemical states: oxymyoglobin (%R610nm/%R525nm), deoxymyoglobin (%R474nm/%R525nm), metmyoglobin (%R572nm/%R525nm), larger values indicate more of that state.
[a-e]Means within a dependent variable with unlike superscript letters are different (P<0.05). Standard error of difference: CIE a* = 0.601, oxymyoglobin = 0.0643, deoxymyoglobin = 0.0150, and metmyoglobin = 0.0177

Table 3. Least square means of carcass chilling treatment effects on CIE a* and reflectance estimators of the chemical states of myoglobin on refrigerated packaged ground bison *M. Triceps brachii* under continuous lighting display (PVC) and non-displayed (vacuum packaged) conditions[1].

- In PVC, RC ground bison compared to C
  - -More red on day 4
  - -Lower estimated MMb
- In VAC, RC ground bison compared to C
  - -More red on day 1 and 4
  - -Higher estimated deoxymyoglobin content on day 1 and 4

Storage Day	PVC C	PVC RC	VAC C	VAC RC
		CIE *a**		
1	15.41[d]	15.97[cd]	15.40[d]	16.85[ab]
4	9.54[f]	10.34[e]	16.15[bc]	17.02[a]
		Oxymyoglobin		
1	1.93[a]	1.95[a]	1.51[c]	1.58[bc]
4	1.48[c]	1.53[c]	1.68[b]	1.67[b]
		Deoxymyoglobin		
1	1.11[e]	1.11[e]	1.46[d]	1.52[c]
4	1.08[f]	1.08[f]	1.57[b]	1.59[a]
		Metmyoglobin		
1	0.92[b]	0.91[b]	0.85[c]	0.83[cd]
4	1.17[a]	1.16[a]	0.80[de]	0.79[e]

[1]Carcass chilling treatment: C=control, RC=rinse and chill. Dependent variables: CIE a*, larger number more red; Reflectance (R) estimators of myoglobin chemical states: oxymyoglobin (%R610nm/%R525nm), deoxymyoglobin (%R474nm/%R525nm), metmyoglobin (%R572nm/%R525nm), larger values indicate more of that state.
[a-f]Means within a dependent variable with unlike superscript letters are different (P<0.05). Standard error of difference: CIE a* = 0.360, oxymyoglobin = 0.0143, deoxymyoglobin = 0.0068, and metmyoglobin = 0.0123

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