VASCULAR RINSE & CHILL EFFECTS ON MEAT QUALITY AND SHELFLIFE OF BEEF

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I. INTRODUCTION

Beef originating from culled dairy cows accounts for approximately 12% of domestically produced beef in the United States [1]. However, bruising, yellow colored fat, undesirable lean color, dark lean, tenderness issues and off-flavors are the main problems observed in carcasses and meat from cull dairy cows. Rinse & Chill® (RC) is a process applied to the carcass immediately after the exsanguination that infuses a chilled substrate solution into the carotid artery which also facilitates the removal of blood. This process was developed with the aim of more rapidly chilling carcasses but also to improve tenderness and meat color [2]. Recent studies have shown the application of RC in bison carcasses reduced toughness by 24% [3]. In a lamb study, Fowler et al. [4] reported an improvement in fresh meat color as well as a significant reduction in shear force (11 newtons) as a result of RC application. Therefore, the aim of our study was to determine the effect of vascular RC on meat quality and shelf life of cull dairy cows in comparison to conventional carcass harvest procedures.

II. MATERIALS AND METHODS

Two treatments were randomly implemented on lean cows (LC) and grain-finished cows (GF). Ten LC carcasses were conventionally chilled (CC, plus application of high voltage electrical stimulation, ES) and twelve LC were chilled using Rinse and Chill® technology (RC; MPSC Inc., Hudson, WI) without ES. Six GF were conventionally chilled (plus ES) and other six GF were chilled with RC (without ES). The carcass treatments were applied in a commercial packing plant. The RC process involved vascular rinsing out residual blood early postmortem using a chilled isotonic solution (98.5% water; balance: glucose, phosphates, and maltose). The pH and temperature at 1, 4, 8, 12, and 24 h postmortem were determined on each carcass. At 24 h postmortem (PM) carcass swabs on LC were taken for total aerobic plate count (APC). Lean ground beef (10% fat) from only LC was made from a composite of the quadriceps femoris (round tip), longissimus muscle (LM, strip loin) and triceps brachii (shoulder clod). Fat ground beef (20%) was made from GF fat trim (navel) that was blended with LC lean from their respective carcass treatments. Moisture and fat percentages were determined in ground beef samples (model SMART Trac II, Matthews, North Carolina). Warner-Bratzler shear force and cooking loss were measured using two steaks (aged postmortem: 14 d, LC; 10 d, GF) according to AMSA guidelines. Steaks were cooked on a grill to 71 ºC and after cooling cores (1.27 cm diameter) were sheared perpendicular to the muscle fibers. Color (CIE L*, a*, b*) was measured on LM steaks, semimembranosus (SM) steaks, and ground beef displayed (1, 4, 7 d) under continuous lightning (40 watt, F40/CWX, Sylvania Cool White Deluxe, Danvers, MA) that provided approximately 1076 lux. The chemical states of myoglobin were measured (UV-2501, Shimadzu) estimating the following reflectance (R) wavelength combinations: deoxymyoglobin (DMb, %R 474 nm / %R 525 nm), metmyoglobin (MMb, %R572 nm / %R525 nm), and oxymyoglobin (OMb, %R610 nm / %R 525 nm) on ground beef (4 d PM, displayed 1, 4, 7 d). Microbial analysis was determined on 7 d (APC, enterobacteriaceae, lactic acid bacteria; log CFU). Animal served as the experimental unit and data were analyzed using PROC MIXED model (SAS Institute).

III. RESULTS AND DISCUSSION

Vascular RC resulted in a greater dressing percentage for LC ($P<0.05$), but was not significantly different for GF cows (Table 1). Similar findings were observed by Yancey et al. [5] in Charolais cattle carcasses vascular infused. RC resulted in lower ($P<0.05$) APC on the surface of LC carcasses compared to the control. Although higher values for lactics were found for RC ($P<0.05$) no differences were observed for APC and Enterobacteriaceae in ground beef. LC RC resulted in a higher ($P<0.05$) LM pH than C (differences of 0.16 at 4 h; 0.20 at 8 h PM), but no differences were found in pH at 24h PM. LC RC had a lower ($P<0.05$)

Table 1. Least square means of carcass and meat quality traits of two cow types[1]

Dependent variables[2]	LC			GF		
	CC	RC	S.E.	CC	RC	S.E.
Dressing (%)	48.6[b]	51.3[a]	1.09	56.2[a]	61.6[a]	1.30
Carcass APC (log)	0.93[a]	0.40[b]	0.21	-	-	-
WBS (kgf)	3.25[ab]	3.61[a]	0.259	4.77[a]	3.57[b]	0.421
Moisture (%)	69.04[a]	69.34[a]	0.744	62.32[a]	61.76[a]	1.20

[1]Carcass chilling treatment: CC=control, RC=rinse and chill; Cow type: Lean cow (LC), grain-finished cow (GF) [2]Dependent variables: Dressing percent, total aerobic plate count (log APC), Warner-Bratzler Shear (WBS; aged postmortem: 14 d, LC; 10 d, GF) and Moisture content. [a-c]Means within a row with unlike superscript letters are different (P<0.05).

temperature in the LM and SM at 1 h PM than C. RC did not affect the moisture or fat content in LC ground beef. Shear force varied depending upon cow type and PM age (LC d 7 not different, d 14 RC less tender, 0.6 kgf difference; GF RC more tender, 1.2 kgf difference). Mickelson and Claus [3] also reported lower shear force values in bison carcasses processed using RC. Cooking losses associated with LC were not different but were higher for RC in ground beef from GF carcasses. RC LC ground beef on 7 d display had higher CIE a* (15.75 vs 13.06), higher DMb (1.29 vs 1.12), and lower MMb (0.94 vs 1.11). LM steaks had higher CIE b* (8.85 vs 7.92) on 4 d and higher CIE L* (42.09 vs 40.70) on 7 d for RC LC. Hunt et al. [6] reported RC resulted in higher CIE L* values on the longissimus lumborum steaks, lighter cherry red initial color scores and higher CIE b* values for all muscles analyzed. There were no differences in the chemical states of myoglobin on any of the display days for the LM. RC GF ground beef had higher CIE a* values on 7 d (15.88 vs 12.80), higher DMb (1.18 vs 1.11) and lower MMb (0.99 vs 1.19). The GF steaks had higher CIE a* (23.55 vs 20.88) and CIE b* (10.99 vs 8.63) values on 1 d.

IV. CONCLUSION

Rinse & Chill® technology has potential to improve meat quality and shelf life of cull dairy cows, but results may be influenced by cow type.

ACKNOWLEDGEMENTS

Authors are grateful to the Wisconsin Beef Council, American Foods Group LLC, and MPSC Incorporated for supporting this research.

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