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Effects of post-bleeding vascular infusion of cattle with a solution of sugars, sodium chloride, and phosphates with or without vitamin c on carcass traits, Warner-Bratzler shear forces, and patalability

Abstract

Two groups of grain-finished, crossbred Charolais steers were utilized to determine the effects of post-bleeding vascular infusion on dressing percentages, USDA quality and yield grades, Warner-Bratzler shear force values, and flavor. Nine steers from one group of 18 were infused with a solution containing sugars, sodium chloride, and a phosphate blend (MPSC), and the remaining nine steers served as noninfused controls. Nine in the second slaughter group of 18 were MPSC-infused, and nine were infused with the MPSC solution plus 500 ppm vitamin C (MPSC+C). The MPSC cattle had a 2.9% higher mean dressing percentage ($P<.05$) than control cattle. Vascular infusion had no effect ($P>.05$) on Warner-Bratzler shear force or USDA quality and yield grades. Results from a descriptive flavor profile sensory panel showed some significant differences in flavor profile characteristics, but these differences were small and inconsistent. Vascular infusion with MPSC or MPSC+C increased carcass weights, had few effects on USDA quality or yield grades or shear force, and had no consistent effects on flavor profile characteristics of cooked beef.

Keywords

Cattlemen's Day, 1999; Kansas Agricultural Experiment Station contribution; no. 99-339-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 831; Beef; Vascular infusion; Flavor profile analysis

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EFFECTS OF POST-BLEEDING VASCULAR INFUSION OF CATTLE WITH A SOLUTION OF SUGARS, SODIUM CHLORIDE, AND PHOSPHATES WITH OR WITHOUT VITAMIN C ON CARCASS TRAITS, WARNER-BRATZLER SHEAR FORCES, AND PATALABILITY

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Summary

Two groups of grain-finished, crossbred Charolais steers were utilized to determine the effects of post-bleeding vascular infusion on dressing percentages, USDA quality and yield grades, Warner-Bratzler shear force values, and flavor. Nine steers from one group of 18 were infused with a solution containing sugars, sodium chloride, and a phosphate blend (MPSC), and the remaining nine steers served as noninfused controls. Nine in the second slaughter group of 18 were MPSC-infused, and nine were infused with the MPSC solution plus 500 ppm vitamin C (MPSC+C). The MPSC cattle had a 2.9% higher mean dressing percentage (P<.05) than control cattle. Vascular infusion had no effect (P>.05) on Warner-Bratzler shear force or USDA quality and yield grades. Results from a descriptive flavor profile sensory panel showed some significant differences in flavor profile characteristics, but these differences were small and inconsistent. Vascular infusion with MPSC or MPSC+C increased carcass weights, had few effects on USDA quality or yield grades or shear force, and had no consistent effects on flavor profile characteristics of cooked beef.

(Key Words: Beef, Vascular Infusion, Flavor Profile Analysis.)

Introduction

Vascular infusion near the end of bleeding is a relatively new technique developed to improve and reduce variation in meat quality. The process involves stunning and bleeding by severing the jugular veins and then infusing substrates through the right carotid artery, using a pumping system at pressures slightly below the blood pressure of resting live cattle.

Vascular infusion has increased tenderness, decreased carcass weight loss, accelerated postmortem pH decline, and allows faster chilling in several studies. None of the vascular infusion studies have evaluated the effects of incorporating an antioxidant such as vitamin C on flavor profiles of cooked beef. Antioxidants delay the onset of lipid oxidation and prevent off-flavors, such as warmed-over flavor. Therefore, our objectives was to determine dressing percentages, carcass traits, Warner-Bratzler shear force, and flavor profile characteristics of cooked ground beef and steaks from cattle that had been infused with or without vitamin C.

Experimental Procedures

Two groups of 18 grain-finished, crossbred Charolais steers were slaughtered using conventional means. Nine from one group were infused via the carotid artery immediately after jugular vein bleeding, at 10% of live weight with a solution containing 98.52% water, .97% sugars, .23% sodium chloride, and a .28% phosphate blend (MPSC, Inc. Eden Prairie, MN). The remaining nine served as noninfused controls (Con). Steers in the second group of 18 were infused after bleeding with either the MPSC solution (n=9) or the MPSC solution + 500 ppm vitamin C (MPSC+C) (n=9). Carcasses

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were chilled conventionally in a spray chill cooler.

Carcasses were evaluated at 24 and 48 hours postmortem for USDA quality and yield grades and fabricated 48 hours postmortem. Sections of the longissimus lumborum (LL) and semitendinosus (ST) were vacuum packaged and aged at 35EF in a research cooler until 14 days postmortem. Steaks 1 in. thick were cut from the LL and ST, vacuum packaged, and frozen until evaluation. Quadriceps muscles were vacuum packaged, frozen, and later thawed and combined with subcutaneous fat for fabrication into ground beef with 15% fat.

Steaks were cooked to an internal temperature of 150EF in a Blodgett gas oven and cooled for 2 hr; then ½-in.-diameter cores (parallel to muscle fibers) were evaluated for Warner-Bratzler shear force by an Instron universal testing machine.

Cooked steaks and ground beef patties were held at 36EF for 3 days after cooking, then reheated in a Blodgett gas oven at 325EF to an internal temperature of 150EF for steaks or 160EF for ground beef. A highly trained flavor profile sensory panel evaluated both freshly cooked and warmed over LL, ST, and ground beef for beef flavor identification, brown-roasted, bloody/serumy, metallic, soapy/chemical, cardboard, oxidized/painty, and fishy flavors, using a 15 point scale (0 = none, 15 = very intense).

Results and Discussion

The MPSC-infused cattle had a 2.9% higher mean dressing percentage (P<.05) than Con cattle. Vascular infusion had no effect on USDA quality and yield grades or Warner-Bratzler shear force. The flavor profile sensory panel determined that beef flavor identification and soapy/chemical flavor were more apparent (P<.05) for the freshly cooked LL from MPSC-infused cattle than for that from Con. Beef flavor identification, bloody/serumy flavor, and cardboard flavor were more perceptible (P<.05) and soapy/chemical flavor was lessened (P<.05) in the warmed-over LL from MPSC-infused cattle than in that from Con (Table 1). The freshly cooked ST from MPSC-infused cattle had less (P<.05) soapy/chemical flavor than that from Con, and the warmed-over ST from MPSC-infused cattle had less (P<.05) cardboard flavor than that from Con (Table 2). The ground beef from MPSC-infused cattle had less (P<.05) soapy chemical flavor than that from Con.

Incorporation of vitamin C into the MPSC solution had no effect (P>.05) on Warner-Bratzler shear force. Freshly cooked ST from MPSC-infused cattle had less (P<.05) soapy/chemical flavor than ST from MPSC+C infused cattle (Table 2). Warmed over ST from MPSC-infused cattle had more (P<.05) beef flavor identification than that from MPSC+C. Warmed over ground beef from MPSC-infused cattle had more (P<.05) brown roasted flavor, less (P<.05) oxidized/ painty flavor, and more (P<.05) soapy/ chemical flavor than that from MPSC+C infused cattle (Table 3).

Vascular infusion with the MPSC solution or MPSC+C had no effects on Warner-Bratzler shear force and USDA quality and yield grades. Vascular infusion with either the MPSC or MPSC+C solution resulted in some inconsistencies in flavor profile but increased dressing percentage.

Table 1. Effects of Vascular Infusion with the MPSC Solution (MPSC) and the MPSC Solution plus Vitamin C (MPSC+C) on Warner-Bratzler Shear Force and Descriptive Flavor Profile Analysis Scores for the Longissimus Lumborum Muscle

Item	MPSC[a]	Control[a]	SE	MPSC[b]	MPSC+C[b]	SE
Warner-Bratzler shear, kg	3.7	4.0	.26	3.8	3.4	.18
Freshly Cooked						
Beef flavor identification	10.7[c]	10.2[d]	.15	9.8	9.7	.42
Brown roasted flavor	8.5	8.4	.13	7.9	8.0	.33
Bloody/serumy	4.1	4.0	.14	3.0	3.0	.18
Metallic	3.7	3.8	.11	3.2	3.3	.17
Soapy/chemical	2.2[c]	1.2[d]	.20	1.1	1.4	.19
Cardboard	0.0	0.0	.10	0.0	0.0	.13
Oxidized/painty	0.0	0.0	.15	0.0	0.0	.08
Fishy	0.0	0.0	.06	0.0	0.0	.00
Warmed Over						
Beef flavor identification	8.6[c]	8.3[d]	.14	7.9	8.0	.42
Brown roasted flavor	7.8	7.6	.13	7.5	7.5	.34
Bloody/serumy	1.8[c]	1.5[d]	.15	1.4	1.3	.18
Metallic	2.3	2.3	.12	2.4	2.3	.17
Soapy/chemical	1.5[d]	2.3[c]	.21	1.5	1.8	.18
Cardboard	2.9[d]	2.7[c]	.10	3.3	3.3	.13
Oxidized/painty	0.4	0.3	.14	0.2	0.2	.07
Fishy	0.1	0.0	.06	0.0	0.0	.00

[a]Comparison of MPSC-infused and control treatments only. [b]Comparison of MPSC-infused and MPSC + vitamin C infused treatments only. [c,d]Means in the same row within the MPSC-infused and control treatments with different superscript letters are different (P<.05).

Table 2. Effects of Vascular Infusion with the MPSC Solution (MPSC) and the MPSC Solution plus Vitamin C (MPSC+C) on Warner-Bratzler Shear Force and Descriptive Flavor Profile Analysis Scores for the Semitendinosus Muscle

Item	MPSC[a]	Control[a]	SE	MPSC[b]	MPSC+C[b]	SE
Warner-Bratzler shear, kg	4.4	4.2	.26	4.4	4.6	.14
Freshly Cooked						
Beef flavor identification	10.0	9.9	.13	10.1	9.9	.42
Brown roasted flavor	8.2	8.2	.13	8.0	7.9	.33
Bloody/serumy	3.8	3.8	.14	3.2	3.2	.18
Metallic	3.7	3.8	.11	3.1	3.2	.17
Soapy/chemical	1.5[d]	2.1[c]	.20	1.1[f]	1.9[e]	.18
Cardboard	0.0	0.0	.09	0.0	0.0	.13
Oxidized/painty	0.0	0.0	.14	0.0	0.0	.07
Fishy	0.0	0.0	.05	0.0	0.0	.00
Warmed Over						
Beef flavor identification	8.5	8.2	.13	8.5[e]	8.3[f]	.51
Brown roasted flavor	7.8	7.7	.13	7.8	7.6	.41
Bloody/serumy	1.4	1.4	.14	1.4	1.3	.21
Metallic	2.1	2.2	.11	2.4	2.2	.20
Soapy/chemical	1.8	1.6	.20	1.5	1.5	.19
Cardboard	3.0[d]	3.3[c]	.10	3.0	3.2	.15
Oxidized/painty	0.2	0.4	.14	0.0	0.2	.08
Fishy	0.0	0.0	.05	0.0	0.0	.00

[a]Comparison of MPSC-infused and control treatments only. [b]Comparison of MPSC-infused and MPSC+vitamin C treatments only. [c,d]Means in the same row within the MPSC-infused and control treatments with different superscript letters are different (P<.05). [e,f]Means in the same row within the MPSC-infused and MPSC + vitamin C treatments with different superscript letters are different (P<.05).

Table 3. Effects of Vascular Infusion with the MPSC Solution (MPSC) and the MPSC Solution plus Vitamin C (MPSC+C) on Descriptive Flavor Profile Sensory Panel Scores for Ground Beef

Item	MPSC[a]	Control[a]	SE	MPSC[b]	MPSC+C[b]	SE
Freshly Cooked						
Beef flavor identification	8.4	8.3	.13	8.3	8.2	.51
Brown roasted flavor	8.0	7.9	.13	7.8	7.7	.40
Bloody/serumy	2.2	2.2	.14	2.2	2.3	.21
Metallic	2.5	2.4	.11	2.8	2.6	.20
Soapy/chemical	1.6[d]	2.2[c]	.20	1.8	1.8	.19
Cardboard	0.0	0.0	.10	0.0	0.0	.15
Oxidized/painty	0.0	0.0	.14	0.0	0.0	.08
Fishy	0.0	0.0	.05	0.0	0.0	.00
Warmed Over						
Beef flavor identification	6.3	6.3	.13	6.9	6.6	.53
Brown roasted flavor	6.4	6.4	.13	6.9[e]	6.7[f]	.42
Bloody/serumy	2.2	1.5	.14	1.3	1.3	.22
Metallic	2.0	2.0	.11	1.9	1.9	.21
Soapy/chemical	2.1	2.1	.20	2.1[e]	1.6[f]	.20
Cardboard	3.9	3.9	.10	3.0	3.2	.16
Oxidized/painty	3.2	3.0	.14	2.4[f]	2.9[e]	.09
Fishy	0.3	0.3	.05	0.0	0.0	.00

[a]Comparison of MPSC-infused and control treatments only.

[b]Comparison of MPSC-infused and MPSC + vitamin C only.

[c,d]Means in the same row within the MPSC-infused and control treatments with different superscript letters are different (P<.05).

[e,f]Means in the same row within the MPSC-infused and MPSC+C treatments with different superscript letters are different (P<.05).