

January 2016

Freezing Strip Loin and Top Round Steaks Improves Warner-Bratzler Shear Force

R. McEwan

Kansas State University, Manhattan, rmcewan@k-state.edu

J. A. Unruh

Kansas State University, Manhattan, junruh@k-state.edu

T. A. Houser

Kansas State University, Manhattan, houser@k-state.edu

See next page for additional authors

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Recommended Citation

McEwan, R.; Unruh, J. A.; Houser, T. A.; O'Quinn, T. G.; Bloedow, N.; Vahl, Christopher; and Stroda, S. (2016) "Freezing Strip Loin and Top Round Steaks Improves Warner-Bratzler Shear Force," *Kansas Agricultural Experiment Station Research Reports*: Vol. 2: Iss. 1. <https://doi.org/10.4148/2378-5977.1164>

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Abstract

Postmortem aging of steaks is a common practice used to improve tenderness of beef steaks. The impact of proteolysis and improvement in tenderness due to aging varies among muscles. When designing research protocols, samples for Warner-Bratzler shear force (WBSF) are often frozen for later analysis because of convenience and time limitations. Freezing stops postmortem aging and allows for storage until meat can be cooked for WBSF and/or sensory analysis. However freezing meat may cause damage to cell membranes resulting in lower Warner-Bratzler shear force (improved mechanical tenderness), lower water holding capacity, and greater moisture loss during cooking. Several researchers have indicated that freezing strip loin (*Longissimus* muscle) steaks may lower Warner-Bratzler shear force (improve tenderness) compared with those not previously frozen and sheared fresh. However, these results have been inconclusive for steaks from other muscles. Therefore, the objective of this study was to determine the effects of postmortem aging time and freezing on Warner-Bratzler shear force of six muscles from the beef hindquarter.

Keywords

tenderness, freezing, aging

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Authors

R. McEwan, J. A. Unruh, T. A. Houser, T. G. O'Quinn, N. Bloedow, Christopher Vahl, and S. Stroda

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*R. McEwan, J. Unruh, T. Houser, T. O'Quinn, N. Bloedow, C. Vahl,
and S. Stroda*

Introduction

Postmortem aging of steaks is a common practice used to improve tenderness of beef steaks. The impact of proteolysis and improvement in tenderness due to aging varies among muscles. When designing research protocols, samples for Warner-Bratzler shear force (WBSF) are often frozen for later analysis because of convenience and time limitations. Freezing stops postmortem aging and allows for storage until meat can be cooked for WBSF and/or sensory analysis. However freezing meat may cause damage to cell membranes resulting in lower Warner-Bratzler shear force (improved mechanical tenderness), lower water holding capacity, and greater moisture loss during cooking. Several researchers have indicated that freezing strip loin (*Longissimus* muscle) steaks may lower Warner-Bratzler shear force (improve tenderness) compared with those not previously frozen and sheared fresh. However, these results have been inconclusive for steaks from other muscles. Therefore, the objective of this study was to determine the effects of postmortem aging time and freezing on Warner-Bratzler shear force of six muscles from the beef hindquarter.

Key words: tenderness, freezing, aging

Experimental Procedures

Choice strip loin (Institutional meat purchase Specifications # 180), tenderloin (Institutional Meat Purchase Specifications # 189A), top sirloin butt (Institutional Meat Purchase Specifications # 184), inside round (Institutional Meat Purchase Specifications # 168), eye of round (Institutional Meat Purchase Specifications # 171C), and round flat (Institutional Meat Purchase Specifications # 171B) subprimals (18 each) with a common slaughter date were purchased from a commercial processing facility. *Longissimus lumborum* (LL), *psaos major* (PM), *gluteus medius* (GM), *semimembranosus* (SM), *semitendinosus* (ST), and *biceps femoris* (BF) muscles from these respective subprimals were each fabricated into four 1-inch steaks, placed in vacuum bags, sealed, and assigned to treatments of status (fresh or frozen), and 7 or 21 days of aging. Fresh treatment steaks were cooked in a convection oven to 158°F after their designated aging time of 7 or 21 days. At the end of the designated aging time of 7 or 21 days, frozen treatment steaks were blast frozen at -40°F for one week before thawing for 12 hours in refrigerated (37 ± 2°F) storage before cooking in a

convection oven to 158°F. Cooked steaks were stored overnight in refrigerated storage ($32 \pm 2^\circ\text{F}$) before eight cores were taken per steak and cores were sheared using an Instron Universal Testing Machine fitted with a Warner-Bratzler shear force blade. Total moisture loss was calculated as a combination of moisture loss due to purge in the vacuum package and cooking.

Results and Discussion

As expected, extended aging (21 vs 7 days) increased tenderness as shown by a lowered Warner-Bratzler shear force of steaks ($P < 0.05$; Figure 1), but increased ($P < 0.05$) total moisture losses (Figure 2). Aging is known to improve tenderness through proteolysis and deterioration of the sarcomere structural proteins.

A muscle by status interaction ($P = 0.002$) was observed for percentage total moisture loss (Figure 3). Fresh steaks from the BF, ST, GM, LL, and PM had ($P < 0.05$) lower total moisture losses than those previously frozen. Moisture losses due to freezing can be attributed to disruption of cellular integrity and ability to hold water. For fresh steaks, LL steaks had ($P < 0.05$) the lowest total moisture losses; PM steaks had ($P < 0.05$) lower total moisture losses than GM, SM, ST, and BF steaks; and BF steaks had ($P < 0.05$) the highest total moisture losses. For previously frozen steaks, LL steaks had ($P < 0.05$) the lowest total moisture loss; PM steaks had ($P < 0.05$) lower total moisture loss than SM, ST, GM, and BF steaks; and SM steaks had ($P < 0.05$) lower total moisture loss than ST, GM, and BF steaks.

A muscle by status interaction ($P = 0.02$) was detected for Warner-Bratzler shear force (Figure 4). Previously frozen LL and SM steaks had ($P < 0.05$) lower Warner-Bratzler shear force than fresh LL and SM steaks, respectively. For fresh steaks, PM steaks had ($P < 0.05$) the lowest WBSF; LL steaks had ($P < 0.05$) lower Warner-Bratzler shear force than GM, ST, SM, and BF steaks; and GM steaks had ($P < 0.05$) lower Warner-Bratzler shear force than ST, SM, and BF steaks. For previously frozen steaks, PM steaks had ($P < 0.05$) the lowest Warner-Bratzler shear force; LL steaks had ($P < 0.05$) lower Warner-Bratzler shear force than GM, SM, ST, and BF steaks; and GM and SM steaks had ($P < 0.05$) lower Warner-Bratzler shear force than ST and BF steaks.

Previous research has been mixed as to the effects of freezing on Warner-Bratzler shear force. Most have reported shear force to decrease when LL steaks were previously frozen, with other muscles yielding very mixed results. Our study supports other research that freezing has a consistent impact of lowering the Warner-Bratzler shear force of the LL. In this study the SM also had a lower Warner-Bratzler shear force due to freezing. It is interesting to note that these two muscles were also two muscles with minimal moisture loss leading to the possible conclusion that both aging and freezing may disrupt the cellular structure, but if moisture loss can be controlled an improvement in Warner-Bratzler shear force can be obtained.

Implications

When designing research protocols and reporting results, it should be recognized that freezing steaks may improve tenderness (lower Warner-Bratzler shear force) for the

strip loin (LL) and top round (SM) muscles, but has little impact on WBSF for the other hindquarter muscles.

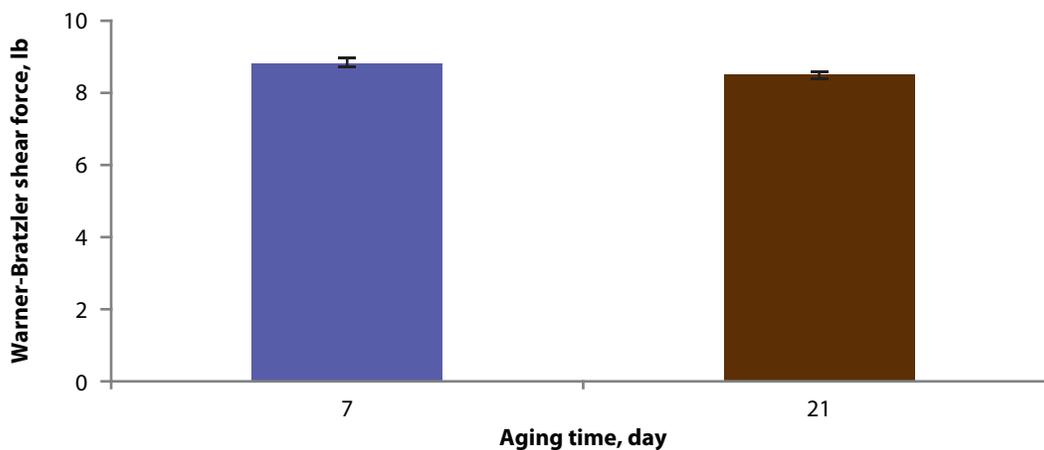


Figure 1. Main effect of aging time for Warner-Bratzler shear force.
(Standard error = 0.114)

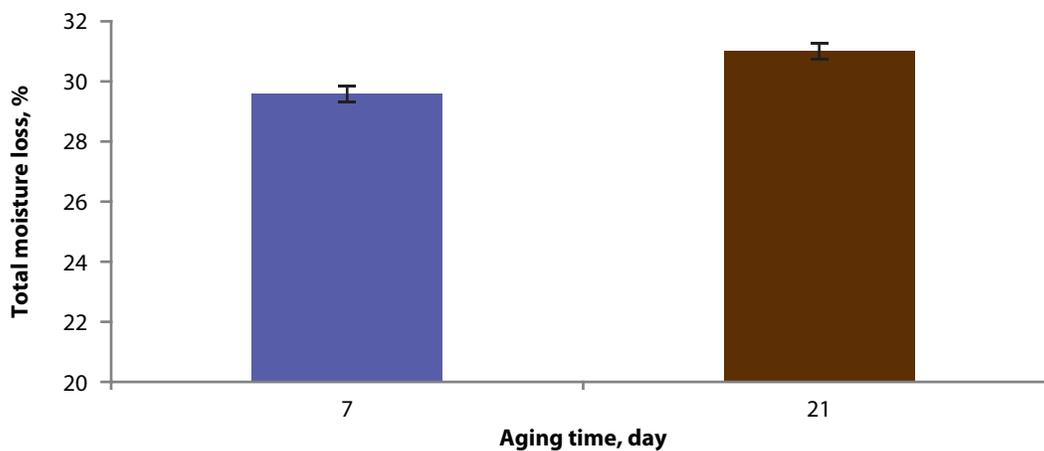


Figure 2. Main effect of aging time for percentage of total moisture loss.
(Standard error = 0.239)

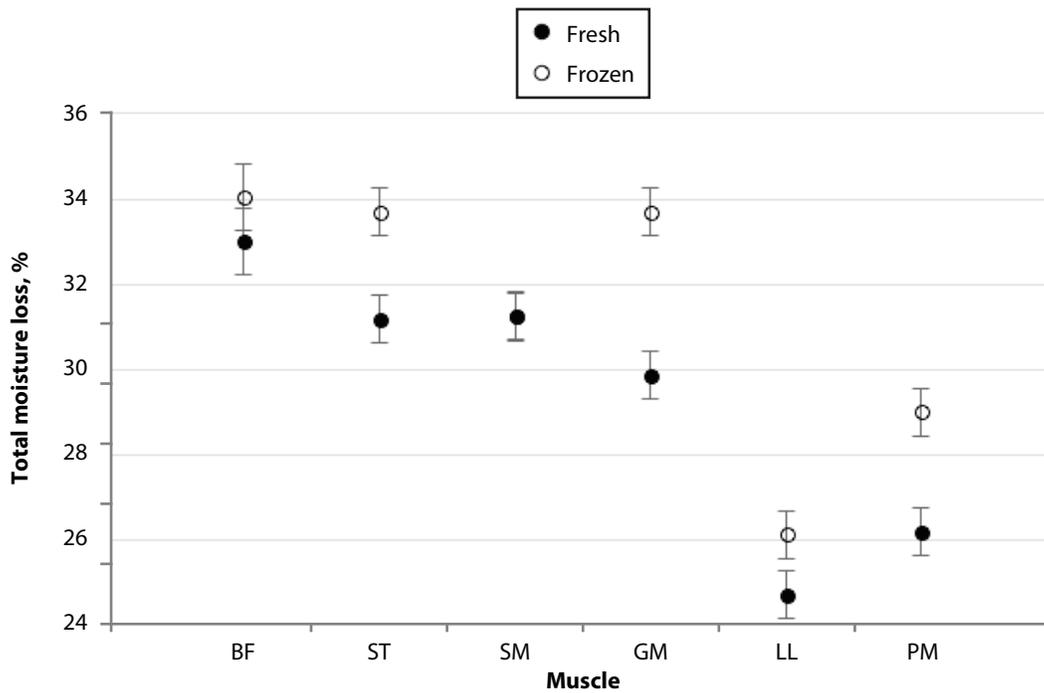


Figure 3. Muscle by Status interaction for percentage of total moisture loss for beef steaks. [Standard error = 0.774 (BF), 0.541 (GM, LD, PM, SM, ST)] (BF = *biceps femoris*, ST = *semitendinosus*, SM = *semimembranosus*, GM = *gluteus medius*, LL = *longissimus lumborum*, PM = *psoas major*)

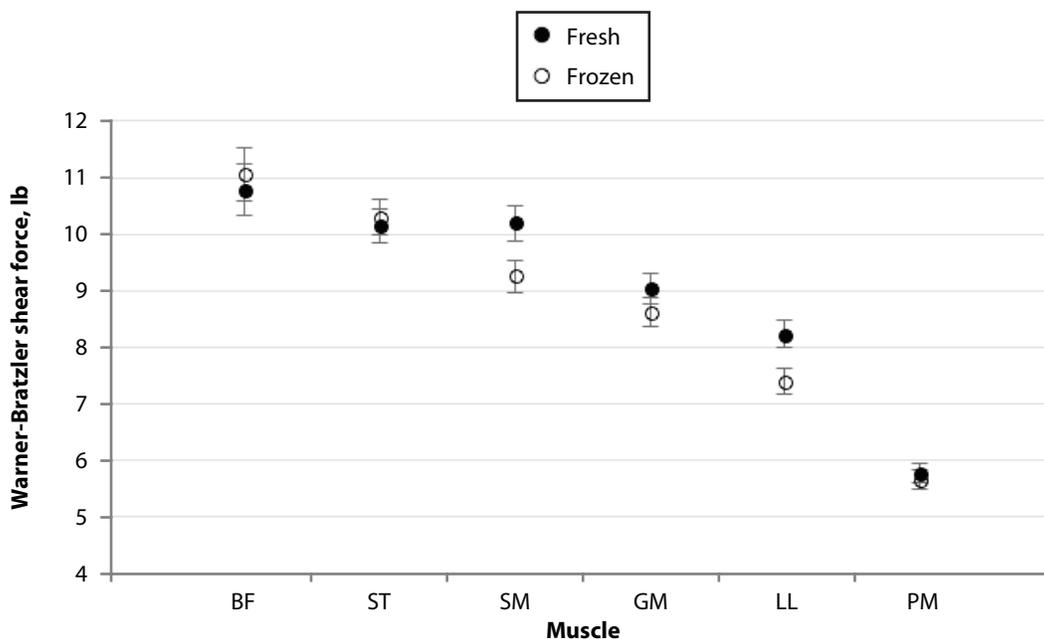


Figure 4. Muscle by Status interaction for Warner-Bratzler Shear Force for beef steaks. (Standard error = 0.077 to 0.207; BF = *biceps femoris*, ST = *semitendinosus*, SM = *semimembranosus*, GM = *gluteus medius*, LL = *longissimus lumborum*, PM = *psoas major*)