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Sarcoplasmic Reticulum Membrane Instability Caused by Dietary Fat Source May Affect Early Postmortem Tenderization of Beef

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Objectives

We hypothesize that high concentrations of polyunsaturated fatty acids (PUFA) in the sarcoplasmic reticulum (SR) membrane could cause the membrane to quickly lose integrity due to increased oxidation potential, leading to early postmortem release of previously sequestered calcium. The free calcium could then interact with calpains and accelerate early postmortem protein degradation, making meat more tender. Therefore, this research was conducted to determine if a shift in dietary fat source could affect the beef tenderization mechanism early post-mortem.

Materials and Methods

Steers ($n = 320$) were fed for 134 d on either corn, or a diet containing 40% full-fat modified distillers grains plus solubles (MDGS), 40% de-oiled MDGS, or 38% de-oiled MDGS plus 2% corn oil. Twenty-four USDA Choice carcasses (3 head/pen) were selected within each dietary treatment ($n = 96$) and strip loins (*Longissimus lumborum*) from both sides were collected and aged for 2, 9, 16, or 23 d. Steaks from each aging period were placed under retail display (RD) conditions for 0 and 7 d and Warner-Bratzler shear force was evaluated. Sarcomere length (via laser diffraction), SR membrane fatty acids (via gas chromatography), free calcium concentration (via inductively coupled plasma spectroscopy), and troponin-T degradation (via immunoblotting) were analyzed only at d 2 postmortem with no RD exposition. Tenderness data were analyzed as a split-plot design with dietary fat source as the whole-plot and aging period as the split-plot. All other variables evaluated at d 2 postmortem were analyzed as a completely randomized design. Pen was considered the experimental unit and data were analyzed using the PROC GLIMMIX procedure of SAS (SAS Inst. Inc., Cary, NC). All means were separated with the LS MEANS and DIFF functions ($\alpha = 0.05$).

Results

No differences in marbling scores were found among dietary treatments ($P = 0.78$). Feeding MDGS decreased ($P < 0.05$) concentrations of 18:1V, increased ($P < 0.05$) concentrations of linoleic acid (18:2) and tended to increase ($P = 0.06$) total PUFA in the sarcoplasmic reticulum (SR) membrane. Steaks from cattle fed MDGS had greater free calcium concentration than steaks from cattle fed corn 2 d postmortem ($P = 0.05$). Steaks from steers fed de-oiled MDGS and de-oiled MDGS plus corn oil had lower Warner-Bratzler shear force values ($P = 0.03$) than steaks from cattle fed corn at 2 d of aging with 0 d RD. However, no differences in WBSF values among dietary treatments were found within aging periods when RD time was extended to 7 d ($P > 0.05$). Extended aging beyond 2 d mitigated the tenderness effects, as there were no significant differences in tenderness among dietary treatments on samples aged for 9 ($P = 0.38$), 16 ($P = 0.73$) or 23 d ($P = 0.96$). There were no differences among dietary treatments for sarcomere length ($P = 0.92$) and troponin-T degradation 2 d postmortem ($P = 0.60$).

Conclusion

Results suggest that feeding de-oiled and de-oiled plus oil MDGS may increase early post-mortem release of free calcium due to increased 18:2 and PUFA concentration in the SR membrane, which could result in increased beef tenderness at 2 d postmortem when compared to cattle fed corn.

