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Influence of Beef Production System Technology on Calpain-1 Autolysis and Troponin-T Degradation

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Objectives

Beef production systems utilize implants and β-agonists to improve beef cattle feed efficiency and promote muscle growth. Warner-Bratzler shear force values can be greater in strip loin steaks from cattle treated with implants or β-agonists. Calpain-1 degrades myofibrillar proteins post-mortem, thus altering calpain-1 activation or autolysis which can influence meat tenderness and proteolysis. The objective of this study was to determine the impact beef production system technologies on calpain-1 autolysis and troponin-T degradation as an indicator of tenderness formation and postmortem proteolysis.

Materials and Methods

From a larger study, beef striploins ($n = 16$, $n = 4$/treatment) from cattle finished utilizing four different production systems were collected for analysis: 1) no antibiotics (NA; receiving no technology); 2) non-hormone treated cattle (NHTC; fed 300 mg monensin and 90 mg tylosin during the finishing phase); 3) implant (IMPL; same technologies as NHTC and administered a series of three implants including a low- potency calf implant [36 mg zeranol], a moderate-potency initial feedyard implant [80 mg trenbolone acetate and 16 mg estradiol], and a high potency finishing implant [200 mg of trenbolone acetate and 20 mg estradiol]; and 4) all previous technologies plus fed a β-agonist (IMBA; same technologies as IMPL and fed 200 mg ractopamine hydrochloride per steer per d). Striploins were vacuum packaged, aged for 7 d, and frozen. Western Blots were conducted for calpain-1 autolysis and troponin-T degradation (30 kDa). Abundance of calpain-1 bands and troponin-T degradation product was normalized by a reference on each gel. Treatments were evaluated in PROC MIXED of SAS 9.2 where least squares means and SEM were computed and separated using least significant differences (PDIFF) when tests for fixed effects were significant at $P < 0.05$ and trending $P \leq 0.10$.

Results

Calpain-1 autolysis differed ($P < 0.05$) in the IMPL group compared to the NHTC group for both active, 78 kDa band, and the fully autolyzed, 76 kDa band. The IMPL group had a greater percentage ($P = 0.0048$) of active calpain-1 and a lower percentage ($P = 0.0048$) of fully autolyzed calpain-1 compared to the NHTC group. Also, a trend was detected when comparing both the active, 78 kDa band, and fully autolyzed, 76 kDa band, in the IMBA and IMPL group where the IMPL group had a greater percentage ($P = 0.0727$) of active calpain-1 and a lower percentage ($P = 0.0727$) of fully autolyzed calpain-1. Production system did not influence ($P > 0.05$) 30 kDa troponin-T product abundance.

Conclusion

These data indicate level of technology may play a role in the activation and autolysis of calpain-1 from the 80 kDa inactive form to the 78 kDa active product and finally to the 76 kDa autolyzed product. Calpain-1 autolysis was not measured; however, these data suggest calpain-1 autolysis in the IMPL group may be limited compared with NHTC and IMBA groups. Consequently, calpain-1 may remain in the 78 kDa active form in the implanted cattle, actively degrading myofibrillar proteins. However, production system did not influence troponin-T 30 kDa degradation products. Further analysis of the rate of calpain-1 autolysis and troponin-T degradation at different days of postmortem aging could provide further evidence that different beef production technologies impact calpain-1 autolysis and postmortem proteolysis.

