Project Title: Supplementation of Fed Steers with an Anionic Compound to Improve Beef Tenderness

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Background

Feeding calcium to cattle has been shown to improve beef tenderness by stimulating specific enzymes to break down muscle fiber structures. As a result, researchers have investigated methods to achieve a higher concentration of calcium (Ca+2) in muscles before or after harvest. One method has been supplementation of various products that influence absorption and circulation of calcium. Feeding anionic salts is one method that has been shown to enhance blood calcium concentrations. In the dairy industry, feeding cows a negative dietary cation-anionic balance (DCAB) diet during the pre-partum period to induce a mild metabolic acidosis increases plasma calcium concentrations around the time of parturition. This practice has been used as a means to reduce the incidence of milk fever.

There has been little research done in feeding a negative DCAB diet to feedlot steers. In the three trials summarized in this report, researchers from Colorado State University sought to determine if supplementing feedlot steers a negative dietary cation-anion balance (DCAB) diet could increase beef tenderness by increasing calcium concentrations.

Methodology

Trial 1
British and Continental cross steers (n = 120) were divided into two treatment groups. The experimental group was given an anionic compound supplement (Biovance Technologies, Inc., Omaha, Neb.) as part of a total mixed ration. The remaining steers were fed the same feedlot ration without the anionic compound supplement. Feedlot performance data were collected over the course of the 14-day trial. Urine samples were also collected on the twelfth day from one randomly selected steer per pen.

Trial 2
Steers (n = 410) from a large commercial feedlot were identified 113 days before harvest. Steers were randomly assigned to either an experimental or control group. The anionic compound was supplemented to the experimental group as part of a total mixed ration and feed samples were collected to confirm that a negative dietary cation-anion balance was achieved.

Trial 3
Steers (n = 557) from a commercial feedlot were randomly assigned to an experimental or control group. The experimental group was fed the anionic compound as part of a total mixed ration. Feed samples were collected to ensure that a negative dietary cation-anion balance was achieved and urine samples were also randomly collected from three steers per pen.

Cattle from all three trials were harvested at a commercial facility and were tracked individually through the harvest process. Following carcass chilling (36 hours for Trial 1 and Trial 2; 48 hours for Trial 3), research personnel collected actual and adjusted preliminary

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yield grades; marbling scores; lean and skeletal maturity scores; estimated percentage of kidney, pelvic and heart fat; hot carcass weight and USDA yield and quality grade. In Trial 1, ribeye areas were measured using a Computer Vision System (Research Management Systems, Fort Collins, CO). In Trials 2 and 3, research personnel measured ribeye areas.

Carcass data were collected for all 120 steers in Trial 1. Strip loins were collected from the left side of 59 carcasses and were fabricated into steaks for subsequent Warner Bratzler shear force (WBSF) evaluation. The steaks were aged for three, seven, 14, 21 or 28 days prior to shear force evaluations. In Trial 2, 104 carcasses were randomly subsampled for carcass and Warner Bratzler shear force values. Steaks used for WBSF evaluations were aged for seven or 14 days. In Trial 3, 104 carcasses were randomly subsampled from the original population to determine carcass traits and WBSF values. Steaks used for shear force evaluations were aged for seven, 14 and 21 days.

Findings

Trial 1
An initial analysis of shear force values included aging periods of three, seven, 14, 21 and 28 days in the model, and resulted in no differences between the supplemented steers versus the controls. The initial analysis revealed that differences in Warner Bratzler shear force values between treated and untreated steers increased at postmortem aging periods beyond three days; a subsequent analysis was conducted in which steaks aged for three days were omitted. This evaluation revealed an overall treatment effect in which steers supplemented with the anionic compound generated steaks with lower shear force values than the control steers.

Trial 2
Warner-Bratzler shear force values differed by USDA quality grades, however there were no effects on beef tenderness among the supplemented and control animals. Due to the discrepancy in results from Trial 1 to Trial 2, the researchers investigated the ration samples and found that in Trial 2, a negative dietary cation-anion balance was not achieved and that the potential for improved postmortem tenderness may not have been possible.

Trial 3
There was a difference in shear force values between the treated and control carcasses, however the differences were not statistically different. Trial 3 was significantly different than the first two trials as it was conducted in a large commercial feedlot with a much more diverse cattle population representing a wider range of individual animal weights. These factors may have influenced the rate of consumption of the DCAB ration, as well as its utilization. Further analysis revealed that cattle with hot carcasses ranging from 363 kilograms to 408 kilograms showed a significant difference between the treatment groups.

Table 1. Effects of supplementing an anionic compound on Warner-Bratzler shear force values for all aging periods within each of the three trials.

	Supplemented WBSF (kilograms)	Negative Control WBSF (kilograms)
Trial 1	3.64^{z}	3.99^{y}
Trial 2	3.84^{z}	3.62^{z}
Trial 3	3.70^{z}	3.82^{z}

y,z Means, within row, lacking a common superscript letters, differ (P<0.05).

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Implications

Within the three trials, the researchers saw mixed results on beef tenderness when a negative dietary cation-anion balance was achieved. In Trial 1, supplementation with the anionic compound increased beef tenderness without adverse effects on live animal performance. Even though a negative dietary cation-anion balance was achieved, which should have increased plasma and muscle calcium concentrations, there was no effect on beef tenderness. A subsample of these animals indicated that the amount of supplement ingested by the cattle may have had some effect on its utilization. The researchers concluded that further investigation is needed to determine the mechanism for which a negative DCAB affects cellular calcium. Any potential negative effects, especially on lighter weight cattle should also be examined to discover the relationship of a negative dietary cation anion balance and possible improvement in beef tenderness.

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