

**Iowa Beef Industry Council Checkoff Research Program
Final Report Review**

Project Title: Injectable vitamin C prior to transit and transit duration effects on feedlot performance and the oxidative stress response in muscle of beef cattle

Investigators: Dr. Stephanie L. Hansen Aubree M Beenken

Primary Institution: Iowa State University

Award Amount: \$70,666

Reviewer: Dr. James Russell

Date: May 5, 2021

Project Objectives:

- To determine the effects of transit duration (8 vs 18 hours) on feedlot performance and inflammation as well as muscle fatigue, degradation, and oxidative stress in beef cattle.
- To determine how feedlot performance and inflammation as well as muscle fatigue, degradation, and oxidative stress are impacted by an injection of vitamin C prior to transit.

Final Report Summary

Nontechnical Summary:

Title: Injectable Vitamin C prior to transit and transit duration effects on feedlot performance and the oxidative stress response in muscle of beef cattle.

Lead Project Director:

Stephanie L. Hansen, PhD, Professor, Dept. of Animal Science, Iowa State University, 313F Kildee Hall, Ames, IA 50011 Phone: 515-294-7326 Fax: 515-294-3795 Email: slhansen@iastate.edu

Transportation is unavoidable in the U.S. beef industry due to its segmented nature. Previous research funded by the Iowa Beef Industry Council observed steers that received an injection of vitamin C (VC) immediately prior to an 18-h transit event had a 22 lb. advantage in body weight (BW) 56-days post-transit compared to steers that did not receive a VC injection, suggesting injectable VC could be a practical strategy to add value to and increase demand for Iowa-origin cattle. A follow-up study conducted by Iowa State University sought to determine the effects of injectable VC prior to transit and transit duration on feedlot performance, VC status, inflammation, and muscle fatigue in beef cattle. One hundred thirty-one, Angus-cross steers (901 ± 10 lb.) were stratified by BW to a 2×2 factorial: intramuscular injection (INJ; 20 mL/steer) immediately before transit of VC (250 mg sodium ascorbate/mL) or saline (SAL) and transit duration (DUR) of 8 h (8; 452 mi) or 18 h (18; 1,100 mi). All steers were housed in partially covered concrete pens equipped with one GrowSafe bunk per pen to measure daily individual feed intake for 55 days post-transit for collection of performance data and blood samples. As expected, steers given an injection of VC had a 38% increase in plasma VC concentrations immediately post-transit (d 1) and returned to initial concentrations by d 2. Antioxidant capacity was decreased 9.4% post-transit compared to pre-transit values, but steer antioxidant capacity was greater for VC-18, intermediate for steers transported for 8 hr. regardless of INJ, and lowest for SAL-18 (INJ $\times$ DUR $P = 0.02$). This suggests administration of a potent antioxidant prior to long-haul

transit did positively affect antioxidant capacity. Steers transported for 18-h had a 37% increase in serum lactate immediately post-transit compared to a 10% increase for 8-h steers, indicating steers transported for a longer duration experienced greater muscle fatigue. Steers transported for 18-h also had greater inflammation markers. There was no difference in shrink due to transit duration (8 = 6.5%, 18 = 6.8%). Within the first week post-transit, 18-h steers had recovered all BW lost during transit while 8-h steers had not, and this was reflected in average daily gain; 18-h steers gained ~2 lb./day more than 8-h steers from d 1 to 7. While not as dramatic, this trend continued for the study duration and steers transported for 18-h were ~30 lb. heavier than 8-h steers at the end of the 55-d post-transit period. Steers receiving a VC injection had decreased overall dry matter intake (~0.8 lb./d) compared to steers given saline, but injection did not affect other performance measures. In contrast to previous work, VC did not improve post-transit performance. Although longer transit duration increased muscle fatigue and inflammation indicators post-transit, receiving period performance was positively influenced.

Impacts:

- The improved feedlot performance of 900 lb. steers transported for longer duration periods implies that heavy weight feeder cattle from Iowa may be transported for longer distances without hindering feedlot performance.
- The practicality of vitamin C injections is questionable in heavy weight feeder cattle.
 - But the increased post-transit antioxidant capacity resulting from pre-transit vitamin C injection may have value in lighter weight feeder cattle.

Conclusion:

- Compared to 900 lb. steers that were transported for 8 hours, comparable size steers transported for 18 hours had:
 - Greater markers of muscle fatigue and inflammation.
 - Greater bodyweights, average daily gain and feed efficiency
- Injection of 5 gm of vitamin C into 900 lb. steers prior to transit increased post-transit antioxidant capacity, but did not affect subsequent feedlot performance.

Technology transfer:

Graduate student theses or dissertations:

None reported

Refereed journal publications:

One manuscript planned

Reviewed abstracts:

Deters, E.L., A.M. Beeken, and S.L. Hansen. 2020. 392 Vitamin C and transit in beef cattle. J. Anim. Sci. 98(Supplement 4):168.

Extension/Outreach publications:

None reported

Scientific presentations:

Beenken, A.M., E.L. Deters, and S.L. Hansen. 2021. Injectable vitamin C prior to transit and transit duration effects on feedlot performance, inflammation, and muscle fatigue of beef steers. American Society of Animal Science Midwest Section Annual Meeting, Virtual. March 8-10, 2021.

Extension/Outreach presentations:

Beeken, A.M., E.L. Deters, and S.L. Hansen. Injectable vitamin C prior to transit and transit duration effects of feedlot performance and muscle fatigue in beef steers. Plains Nutrition Spring Conference. San Antonio, TX. April 7-9, 2021. (Approximate attendance: 250).

Podcasts:

None reported

Other:

None reported

Personnel Support:

Faculty:

Dr. Stephanie Hansen, Professor, Feedlot Nutrition, \$3,121

Extension specialists:

None

Associate scientists:

None

Post-doctoral associates:

None

Technicians:

None

Farm labor:

None

Graduate student:

Aubree Beenken, Salary, \$22,825; Tuition, \$11,754

Undergraduate student:

One student, \$1,778

Other:

None