South Dakota State University

Department of Animal Science | SDSU Extension

Animal Science Research and Extension Report - Bison

2026

Contents

Statistics in the South Dakota State University Animal Science Report

The purpose of research at SDSU is to provide reference information that represents the various populations of livestock production. Since the researcher cannot apply treatments to every member of a population, he/she must sample the population. The use of statistics allows the researcher and readers the opportunity to evaluate separation of random occurrences and real biological effects of a treatment. The following is a brief description of the major statistics used in these proceedings.

- **Mean:** Data for individual experimental units (cows, pens of cattle, steers, steaks) exposed to the same treatment are generally averaged and reported in the text, tables, and figures. The statistical term representing the average of a group of data points is mean.
- **Variability:** The inconsistency among the individual experimental units used to calculate a mean for the item measured is the variance. For example, if the ADG for all the steers used to calculate the mean for a treatment is 3.5 lb then the variance is zero. However, if ADG for individual steers is used to calculate the mean for a treatment range from 1.0 lb to 5.0 lb, then the variance is large. The variance may be reported as standard deviation (square root of the variance) or as standard error of the mean. The standard error is the standard deviation of the mean as if we had done repeated samplings of data to calculate multiple means for a given treatment. In most cases, treatment means and their measure of variability will be expressed as follows: 3.50 ± 0.150. This would be a mean of 3.5 followed by the standard error of the mean of 0.150. A helpful step combining both the mean and the variability from an experiment to conclude whether the treatment results in a real biological effect is to calculate a 95% confidence interval. This interval would be twice the standard error added to and subtracted from the mean. In the example above, this interval is 3.20 to 3.80 lb. If in an experiment, these intervals calculated for treatments of interest overlap, the experiment does not provide satisfactory evidence to conclude that treatments effects are different.
- ***P*-value:** Probability (*P*-value) refers to the likelihood the observed differences among treatment means are due to chance. For example, if the author reports $P \leq 0.05$ as the significance level for a test of the differences between treatments as they affect ADG, the reader may conclude there is less than a 5% chance the differences observed between the means are a random occurrence (or 95% sure that the difference was not due to random chance). Due to this small probability of chance, there must be a difference between the treatments in their effect on ADG. Authors may discuss tendencies in data when P values are between 0.06 and 0.15, because they are not confident the differences among treatment means are real treatment effects. With *P*-values of 0.06 and 0.15 the chance random sampling caused the observed differences is 1 in 16.7 and 1 in 6.7, respectively.
- **Linear & Quadratic Contrasts:** Some articles contain linear (L) and quadratic (Q) responses to treatments. These parameters are used when the research involves increasing amounts of a factor as treatments. Examples are increasing amounts of a ration ingredient (corn, by- product, or feed additive) or increasing amounts of a nutrient (protein, calcium, or vitamin E). The L and Q contrasts provide information regarding the shape of the response. Linear indicates a straight-line response and quadratic indicates a curved response. P-values for these contrasts have the same interpretation as described above.
- **Correlation (r):** Correlation indicates amount of linear relationship of two measurements. The correlation coefficient can range from -1 to 1. Values near zero indicate a weak relationship, values near 1 indicate a strong positive relationship, and a value of -1 indicates a strong negative relationship.

- **Chi square (χ^2):** A statistical test used to compare observed results with expected results. The purpose of this test is to determine if a difference between observed data and expected data is due to chance, or if it is due to a relationship between the variables being studied. This is a nonparametric test used for data that do not follow the assumption of a normal distribution. The null hypothesis is that there are no differences between the variables. A $\chi^2 \leq 0.05$ is considered statistically significant, thus, the null hypothesis should be rejected in favor of the alternative hypothesis.

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Animal Science Research Report 2026

Observing pH of grass-fed bison heifer gastrointestinal tracts *postmortem*

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Rationale and Approach

Gastrointestinal (GI) pH is a critical indicator of metabolic health and ruminal fermentation efficiency in ruminants. While well-characterized in other ruminant species, baseline postmortem GI pH values for bison (*Bison bison*) remain largely unreported. As bison management diversifies (conservation and commercial production herds), dietary differences may significantly influence GI physiology. Establishing these baseline pH values is therefore essential for developing nutritional and health benchmarks for the species. This study aimed to characterize the pH within the rumen, omasum, and abomasum of grass-fed bison. Five approximately 36-month-old bison were humanely euthanized under USDA inspection in August 2025. Carcasses were processed in a mobile abattoir unit. The entire GI tract was removed within 24 hours postmortem. The rumen, omasum, and abomasum were identified. Digesta was collected manually by introducing a gloved arm into the lumen of each compartment. Fluid was strained through cheesecloth, and a 20 mL sample was collected for analysis. Ruminal fluid was obtained from all five animals. However, due to practical constraints during field sampling, omasal and abomasal fluids were successfully collected from a subset of two animals each (2 animals per compartment). pH was measured immediately using an Orion Star A221 Portable pH Meter (Thermo Fisher Scientific, Waltham, MA, USA), which was calibrated according to manufacturer specifications prior to use. All study animals were maintained on a grass-fed diet prior to harvest.

Results and Discussion

Given the observational nature of this trial, the results are presented using descriptive statistics. Gastrointestinal contents were harvested and analyzed at an average of 87.7 minutes postmortem. The interval between death and sample collection represents a potential limitation, as protozoal activity and autolysis occurring postmortem may have affected the measured values (Lee at al. 2010 and Wilemann et al. 2008). However, the extended sampling period was designed to capture biological variability, consistent with observations reported in other ruminant species, which may help offset this limitation. Rumen content samples were successfully collected from all five heifers. The average ruminal pH across all animals and timepoints was 5.81 (Table 1). Figure 1 illustrates the pH profiles within the rumen, omasum, and abomasum for each individual animal. The observed average ruminal pH of 5.81 falls within the range reported for pasture-fed dairy cattle (pH 5.8–6.2) (Kolver and de Veth, 2002) and is consistent with values for grain-fed beef cattle (pH 5.8–6.5) (Nagaraja and Titgemeyer, 2007). This relatively low pH suggests the consumption of highly fermentable forage. However, as a forage analysis was not conducted, any direct link between dietary composition and fermentability remains speculative. The pH values recorded in the omasum and abomasum align with established physiological benchmarks for cattle. The abomasal pH (4.59) is conducive to proteolytic enzymatic activity, while the higher omasal pH (6.11) is typical for this compartment (Pérez et al., 2023). These values support normal digestive function, indicating that nutrient absorption and enzymatic processes were likely proceeding typically in these animals at the time of sampling.

Implications

The findings from this observational study underscore the need to establish baseline GI pH values for bison. Specifically, these preliminary data enable more informed investigations into how divergent diets (such as grain supplementation versus native forage) affect ruminal fermentation, nutrient absorption, and overall animal health and productivity in this species. The observed similarity between bison pH values and those reported in domestic cattle suggests that certain physiological principles of ruminant digestion are conserved. However, species-specific variations likely exist, reinforcing the necessity of direct research on bison rather than relying solely on bovine models. Ultimately, establishing species-specific benchmarks is essential for developing science-based nutritional strategies that optimize bison welfare and production outcomes across diverse management systems.

Acknowledgements

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Table 1. pH of post-mortem bison gastrointestinal compartments (Mean ± SD, *n* = 5 for rumen, *n* = 2 for omasum and abomasum).

	Gastrointestinal compartment pH (Mean ± SD)		
Sampling time (Hour)	**Rumen**	**Omasum**	**Abomasum**
0	5.85 ± 0.27	6.16 ± 0.18	4.47 ± 0.28
0.5	5.83 ± 0.24	6.10 ± 0.14	4.54 ± 0.16
1	5.80 ± 0.26	6.10 ± 0.14	4.56 ± 0.17
2	5.80 ± 0.26	6.06 ± 0.14	4.62 ± 0.21
3	5.81 ± 0.26	6.08 ± 0.16	4.60 ± 0.25
6	5.78 ± 0.27	6.12 ± 0.18	4.60 ± 0.16
12	5.79 ± 0.30	6.13 ± 0.20	4.64 ± 0.25
24	5.80 ± 0.31	6.15 ± 0.19	4.69 ± 0.18
Total period	5.81 ± 0.31	6.11 ± 0.20	4.59 ± 0.28

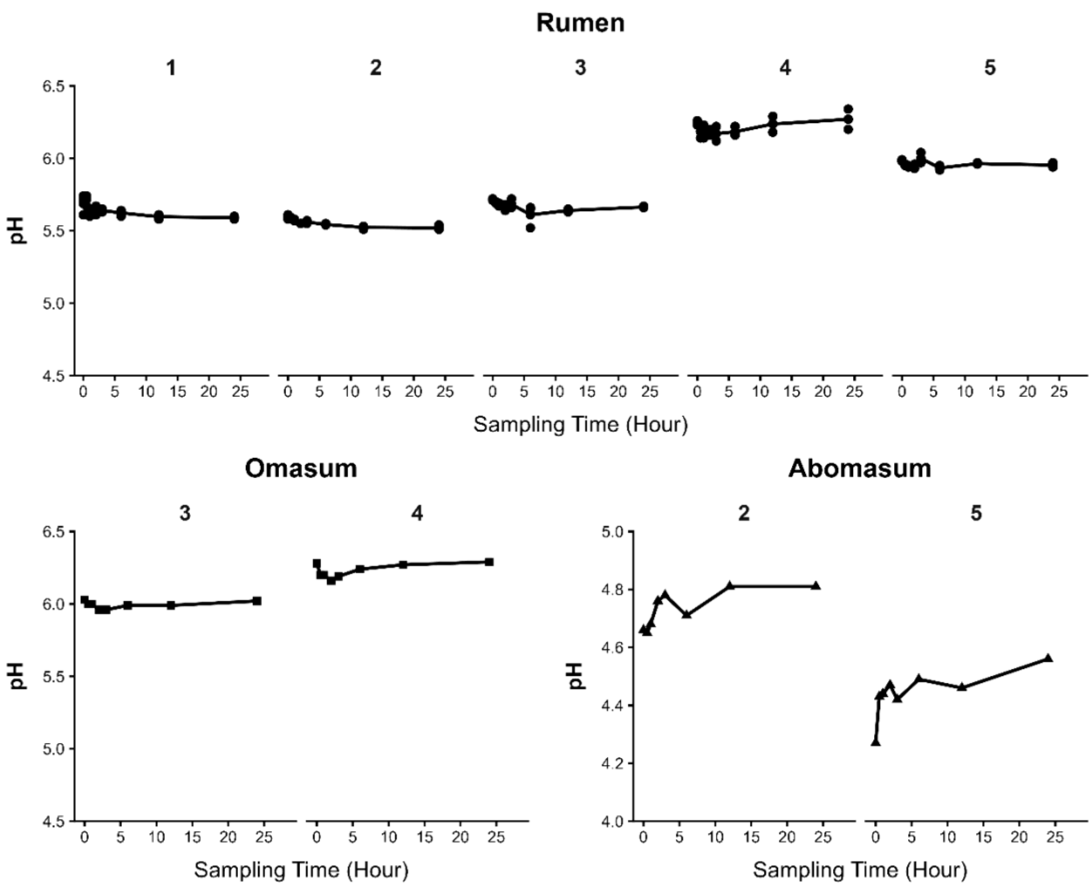

Figure 1. pH across gastrointestinal compartments in bison: rumen (*n* = 5), omasum (*n* = 2), and abomasum (*n* = 2). Number above plot indicates animal ID.

Finishing location influences the color stability of steaks from grass-finished bison bulls

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Rationale and Approach

Approximately 12,500 grass-finished bison bulls were harvested in the United States in 2025, accounting for roughly 21% of the slaughter mix. Most bison are raised and finished across the vast landscape of the Great Plains, which is composed of diverse ecosystems that vary in climate, terrain, rainfall, forage species, and micronutrient deposits. Research in other species suggests that both the environment and the composition of the diet of grass-finished animals can influence carcass characteristics, such as meat color. Meat color significantly impacts consumer acceptance at the point of sale and has become a recent concern due to its contribution to food waste, as products that do not meet consumer expectations for color are often discounted or discarded (Ramanathan et al., 2022). Therefore, the objective of this study was to determine the influence of finishing location on the color stability of steaks from grass-finished bison bulls. Bison bulls from a common management system were grass-finished in three geographically distinct locations of the Great Plains (n = 45 bulls per location): 1) Kansas (KS), 2) Nebraska (NE), or 3) Montana (MT). Striploins were collected from a subsample (n = 30 carcasses closest to the average hot carcass weight of each treatment). This group of striploins was further subsampled [n = 15 carcasses closest to the average a^* (redness) value of each treatment] for objective color analysis. One steak from each striploin was allocated to one of two packaging strategies: 1) Aerobic overwrap (OW) or 2) Anaerobic vacuum-packaging (VAC). Steaks designated for OW were on display for 11 days (display days 0 – 10) and evaluated daily with a spectrophotometer. Steaks designated for VAC were held in dark storage for 11 days, then displayed for 31 days (display days 0 – 30) and evaluated every three days with a spectrophotometer.

Results and Discussion

No treatment-by-display day interaction ($P > 0.05$) was observed for either packaging strategy. Overwrapped steaks from KS-finished bison bulls had lower ($P < 0.05$) a^*, and b^* (yellowness), while steaks from bulls finished in MT and NE had darker ($P < 0.05$) color, as indicated by lower L^* values (Table 1). However, OW steaks from KS bulls had less ($P < 0.05$) overall color change as indicated by a lower Delta E value than those from NE, while MT was intermediate, and not different ($P > 0.05$) from the other treatments. Similar to the OW color panel, VAC steaks from KS were lighter (increased L^*), less red (decreased a^*), and less yellow (decreased b^*; $P < 0.05$) than steaks from other treatments (Table 2). Although differences were observed between finishing location for most color parameters of the VAC steaks, finishing location did not influence ($P > 0.05$) Delta E, indicating less overall color change from the start to the end of the display period.

Implications

These data indicate that finishing location influences initial color as well as color stability of steaks from grass-finished bison bulls regardless of the packaging method. Future research is warranted to understand how the finishing location influences the mechanisms that drive the color stability of bison steaks and to develop strategies to maintain bison meat color, thereby reducing overall food waste associated with meat color.

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Table 1. Least square means for the effect of finishing location[1] on objective color measurements[2] of overwrap packaged striploin steaks from grass-finished bison bulls.

Variable	KS	NE	MT	SEM[3]	*P*-value
*L**	30.58[a]	27.83[c]	28.42[b]	0.183	< 0.01
*a**	20.30[b]	22.74[a]	22.21[a]	0.224	< 0.01
*b**	18.20[b]	20.19[a]	19.81[a]	0.203	< 0.01
Delta E	9.72[b]	13.58[a]	11.85[ab]	0.838	0.01

[1]Grass-finished in Kansas (KS), Nebraska (NE), or Montana (MT)
[2]*L**: 0 = Black, 100 = White; *a**: positive = red, negative = green; *b**: positive = yellow, negative = blue; Delta E: higher values indicate greater color change from the beginning to end of the display period
[3]Standard error of the mean
[a,b,c]Means in the same row lacking a common superscript differ ($P \leq 0.05$)

Table 2. Least square means for the effect of finishing location[1] on objective color measurements[2] of vacuum packaged striploin steaks from grass-finished bison bulls.

Variable	KS	NE	MT	SEM[3]	*P*-value
*L**	30.59[a]	29.65[b]	29.44[b]	0.199	0.01
*a**	12.55[b]	13.57[a]	13.52[a]	0.097	<0.01
*b**	13.26[b]	13.62[a]	13.62[a]	0.087	<0.01
Delta E	5.17	4.42	4.65	0.534	0.60

[1]Grass-finished in Kansas (KS), Nebraska (NE), or Montana (MT)
[2]*L**: 0 = Black, 100 = White; *a**: positive = red, negative = green; *b**: positive = yellow, negative = blue; Delta E: higher values indicate greater color change from the beginning to end of the display period
[3]Standard error of the mean
[a,b]Means in the same row lacking a common superscript differ ($P \leq 0.05$)

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