CATTLEMEN'S DAY 2025

BEEF CATTLE RESEARCH

SUMMARY PUBLICATION

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KANSAS STATE UNIVERSITY AGRICULTURAL EXPERIMENT STATION AND COOPERATIVE EXTENSION SERVICE

CATTLEMEN'S DAY 2025

BEEF CATTLE RESEARCH

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Meat Science

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Assessment of Nutrient Content of Kansas Grasslands Enrolled in the Conservation Reserve Program

Allen Schwartz

Objective: The objective of this collaborative field study was to evaluate the quality of standing Conservation Reserve Program (CRP) forages throughout the year and compare samples collected from different regions across the state.

Study Description: Monthly forage samples (n = 206) were collected from 19 counties in Kansas by Extension personnel. Regions were assigned east or west based on the sample's location. The samples were analyzed based on percent crude protein, acid detergent fiber, neutral detergent fiber, total digestible nutrients, calcium, phosphorus, potassium, and magnesium (dry matter basis) with precipitation being a random variable. Regions were analyzed based on the nutrient quality for each month.

Results: Crude protein did not differ between regions within a sampling month. Acid detergent fiber was different for the month of July ($P \leq 0.05$) and December ($P \leq 0.05$) for the two regions. Neutral detergent fiber was treated with amylase to remove any starch interference with the sample and did not differ between months or regions. Total digestible nutrients were different for February ($P \leq 0.05$), March ($P \leq 0.05$), and July ($P \leq 0.05$) for the two regions. Calcium was different for the month of December ($P \leq 0.05$), and phosphorus was different for May ($P \leq 0.05$). Potassium was different for the months of May ($P \leq 0.05$) and October ($P \leq 0.05$). Magnesium was different for samples collected in February ($P \leq 0.05$), August ($P \leq 0.05$), September ($P \leq 0.05$), October ($P \leq 0.05$) and December ($P \leq 0.05$). This is an ongoing study in which additional data will be added to account for year-to-year variation in forage quality.

The Bottom Line: Understanding the nutrient quality of CRP lands that are released for haying or grazing is critical for making informed supplementation and feeding decisions with producers. These data will contribute and add to the existing body of research on the nutrient content of forages for grazing.

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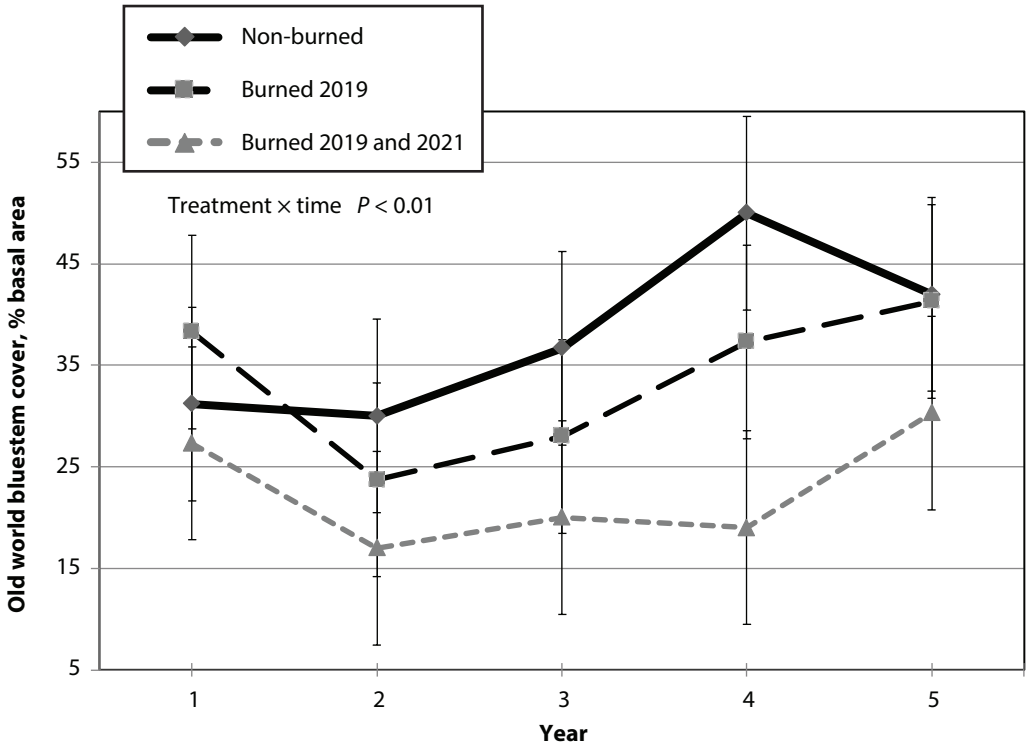
Effects of Late-Summer Prescribed Fire on Botanical Composition, Soil Cover, and Forage Production in Caucasian Bluestem-Infested Rangeland in the Kansas Smoky Hills: Final Report

Helen Giefer

Objective: Our objective was to examine the effects of late-summer prescribed fire on the frequency and basal cover of Caucasian bluestem (*Bothriochloa bladhii*), soil cover, botanical composition, and forage production in the Kansas Smoky Hills.

Study description: Eighteen one-acre plots located in a Caucasian bluestem-infested pasture in Ellsworth County, Kansas, were randomly assigned to one of three treatments: no burn (control), one burn (August 14, 2019), and two burns (August 14, 2019, and August 11, 2021). Pre-treatment data were collected in 2019 (year one); measurements of soil cover, botanical composition, forage production, and Caucasian bluestem frequency and basal cover were taken each year thereafter.

Effects of late summer prescribed fire on percent Caucasian bluestem cover



The Bottom Line: These data suggest that regular application of late-summer prescribed fire may reduce Caucasian bluestem basal cover while having no negative consequences on native species and improving overall grass-species richness.

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Impact of Limit Feeding Finishing Beef Steers on Enteric Methane Production and Animal Performance

Carlee Salisbury

Objective: The objective of this experiment was to determine the impact of limit feeding on enteric methane (CH_4) production and subsequent animal performance.

Study Description: Angus-cross steers (n = 48, body weight [BW] = 985 ± 9.7 lb) were blocked by BW and assigned to one of three treatment groups for a 134-day finishing experiment. Treatments consisted of a 1) control (CON) where steers were fed *ad libitum*; 2) treatment 1 (TRT1) where steers were fed 96 % of *ad libitum*; and 3) treatment 2 (TRT2) where steers were fed 92 % of *ad libitum*. Once weekly, TRT1 and TRT2 were adjusted based on the CON steers average intakes from the previous week. The BW was measured monthly and dry matter intake (DMI; lb/day) was measured using an Insentec Roughage Intake Control System (Insentec, Marknesse, The Netherlands). Enteric methane and carbon dioxide (CO_2) production was determined utilizing two GreenFeed emission measurement systems (AHCS; C-Lock Inc., Rapid City, SD).

Impact of limit feeding on animal performance and enteric methane emissions

	Treatment[1]				*P*-value	
Item	CON	TRT1	TRT2	SEM[2]	Linear	Quadratic
Average daily gain, lb/day	3.13	2.74	2.77	0.08	0.12	0.31
Dry matter intake, lb/day	23.9	21.9	21.5	0.56	<0.01	0.21
Gain:feed	0.13	0.12	0.12	0.005	0.70	0.43
Enteric methane (g/day)	137	114	123	5.6	0.07	0.02
Methane yield[3]	5.7	5.2	5.7	0.2	0.87	0.06
Emission intensity[4]	45.2	43.4	46.34	3.0	0.79	0.52

[1]CON = *ad libitum* intake; TRT1 = 96% *ad libitum* intake; and TRT2 = 92% *ad libitum* intake.
[2]Standard error of the mean.
[3]Methane yield = g enteric CH_4/lb of dry matter consumed.
[4]Emission intensity = g enteric CH_4/lb of gain.

The Bottom Line: Limit feeding of finishing beef steers at 96% *ad libitum* resulted in a 17% reduction in enteric CH_4 emissions. However, final BW tended to be lower at finishing for limit-fed steers. For the reduction in emissions to be economically advantageous, economic incentives for producers would be needed to offset this less desirable endpoint.

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Post-Weaning Feed Intake and Performance of Bulls Developed in an Automated Feed Intake Management System

Brandon Fraser

Objective: Our objectives were to compare expected and observed dry matter intake (DMI) and average daily gain (ADG) of beef bull calves fed in an automated feed intake system using modeled nutrient requirement equations.

Study Description: Feed intake and performance data from purebred Angus, Hereford, and Simmental bull calves across three calf crops (birth years 2021 [n = 40], 2022 [n = 37], and 2023 [n = 41]) were utilized for this analysis. Projected DMI and ADG were calculated for each group of bulls by year on an individual basis using the Growing Bull module of the Excel-based Beef Ration and Nutrition Decision Software (BRaNDS) formulation program. These predicted figures were compared to the Insentec intake data and analyzed via SAS.

Results: In the combined data from 2021 to 2023, a moderate positive correlation (r = 0.61, $P < 0.01$) was observed between actual and predicted DMI, demonstrating that BRaNDS reasonably predicted DMI across the three years. Additionally, the actual ADG remained consistently higher than the predicted values. These findings suggest that while BRaNDS provides a good prediction of DMI, it underestimates actual gains in bull growth, and substantial individual variation in intake remains present.

Actual and predicted bull performance means

	2021-2023		
Item	Actual	SD[1]	Pred.
Initial BW,[2] lb	793	114	---
Ending BW,[2] lb	1,056	137	---
DMI,[2] lb/day	20.2	3.9	20.7
ADG,[2] lb	3.63	0.79	2.26
F:G[2]	5.76	1.28	---

[1] Standard deviation.
[2] BW = body weight; DMI = dry matter intake; ADG = average daily gain; F:G = feed to gain ratio.

Correlation coefficients for actual and predicted intake and gain of bulls

	2021-2023			
Item	Actual	Pred.	r	*P*-value
DMI,[1] lb/day	20.2	20.7	0.61	< 0.01
ADG,[1] lb	3.63	2.26	0.65	< 0.01

[1]DMI = dry matter intake; ADG = average daily gain.

The Bottom Line: While significant individual variation in intake exists, the BRaNDS program more accurately predicts DMI than ADG for growing bulls. The model consistently underestimated actual ADG, highlighting the need for refinement in predicting growth outcomes, even though its predictions for intake aligned reasonably well with observed values.

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BEEF CATTLE RESEARCH

Effects of an Acclimation Protocol During the Handling Events of the 7-day CO-synch + CIDR Protocol on Temperament and Reproductive Performance of *Bos taurus* Commercial Beef Heifers

Sydney Tastad

Objective: The objective of this study was to assess the effects of acclimation during the handling events of an estrus synchronization (ES) protocol on temperament and conception rates of commercial beef heifers to timed artificial insemination (TAI).

Study Description: Heifers were stratified by reproductive tract score (RTS) and chute score (CS) into the treatment (TRT) or control (CTRL) groups and pastured together. Before each ES event, TRT heifers were sorted, acclimated by sending them through the chute, and commingled with the CTRL heifers. Exit velocity and CS were recorded for all heifers to measure temperament during all ES events. Pregnancy status was determined 40 days post-artificial insemination by rectal ultrasonography.

Average chute score, exit velocity, estrus detection patch score, and percent of heifers pregnant to the protocol by treatment group

	Average chute score		Average exit velocity, m/second)		Average estrus detection patch score		TAI conception rate, %	
Heifer group	**CTRL**	**TRT**	**CTRL**	**TRT**	**CTRL**	**TRT**	**CTRL**	**TRT**
Day -10	2.3	2.3	2.0	1.9				
Day 0	2.3	2.1	2.1	2.0				
Day 7	2.1[b]	1.7[a]	1.7	1.6				
Day 10 (TAI)	2.2[b]	1.8[a]	1.6	1.6	2.1	2.3		
Day 40							52.7	56.8
P-value	TRT = 0.0003 Day < .0001 TRT*Day = 0.0011		TRT = 0.3848 Day < .0001 TRT*Day = 0.8934		TRT = 0.1906 Location < .0001 TRT*Location = 0.4629		TRT = 0.3563 Location = 0.5405 TRT*Location = 0.9801	

[ab] Means within rows with unlike superscripts differ ($P < 0.05$).

The Bottom Line: Acclimating heifers to the facility during the handling events of the 7-day CO-synch + CIDR estrus synchronization protocol effectively decreased heifer excitability by the time of artificial insemination (Day 10). This study did not support greater reproductive performance of heifers that were acclimated.

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Effects of *Bacillus subtilis* PB6 (CLOSTAT 500) Incorporation into a Commercial Mineral Supplement on Growth Performance and Health of Beef Stocker Calves Grazing in the Kansas Flint Hills

Zachary Duncan

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Objective: The objective of this experiment was to determine if incorporating *Bacillus subtilis* PB6 (CLOSTAT; Kemin Industries, Inc.) into a commercial mineral supplement would improve the growth performance and health of beef stocker calves grazing in the Kansas Flint Hills.

Study Description: During the summer of 2024, 495 crossbred beef steers were randomly assigned to one of 18 pastures. Pastures were randomly assigned to receive one of two mineral supplements: a commercial mineral supplement (Control) or a commercial mineral supplement that contained 0.5 g/head/d CLOSTAT 500 (CLOSTAT; Kemin Industries, Inc., Des Moines, IA). Steers were grazed for 90 days from May to August, and mineral supplements were delivered twice weekly to provide 4 oz/head/day. Individual body weights were measured at the beginning and end of the grazing period.

Effects of *Bacillus subtilis* PB6 (CLOSTAT 500) incorporation into a commercial mineral supplement on growth performance of beef stocker calves grazing in the Kansas Flint Hills

	Treatment[1]			
Item	Control	CLOSTAT	SEM[2]	*P*-value[3]
Number of pastures	9	9		
Number of head[4]	246	244		
Initial body weight, lb	476.0	479.0	1.88	0.29
Final body weight, lb	658.8	657.8	5.30	0.90
Average daily gain, lb/day	2.03	1.99	0.053	0.57
Mineral consumption, oz/head/day	3.38	3.33	0.050	0.54

[1] Commercial mineral supplement (Control) or commercial mineral supplement + 0.5 g/head/day *Bacillus subtilis* PB6 (CLOSTAT 500, Kemin Industries, Inc., Des Moines, IA) provided at 4 oz/head/day.
[2] Largest standard error of the mean.
[3] Treatment main effect.
[4] Four steers were removed from the study due to lameness; CLOSTAT: 3; Control: 1. One steer from Control died. All data are presented with dead and lame steers removed.

The Bottom Line: Feeding a commercial mineral supplement that contained *Bacillus subtilis* PB6 (CLOSTAT 500) did not improve growth performance, pinkeye prevalence, or health of crossbred beef steers grazing in the Kansas Flint Hills.

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Effects of Omega-3 Fatty Acid Supplementation on Growth and Development of Bull Calves

Brandon Fraser

Objective: The objective was to evaluate the supplementation of omega-3-based fatty acids to developing, post-weaned beef bull calves on growth and reproductive development.

Study Description: This study was conducted over a 64-day period involving purebred Angus, Hereford, and Simmental bull calves (n = 42) born in spring 2023. The bulls were randomly assigned to three groups that included a control that did not receive the omega-3 supplement (n = 14) and calves that received 0.5 lb (n = 14) or 1.0 lb (n = 18) of the omega-3 supplement. The bulls were fed according to a ration formulated using the Growing Bull module of the Excel-based Beef Ration and Nutrition Decision Software (BRaNDS) formulation program.

Results: No differences ($P = 0.98$) in initial body weight (BW) were observed among the treatment groups. Final BW for the 1.0 lb supplement group showed a trend toward higher values compared to the control; however, this was not significant ($P = 0.77$). Omega-3 supplementation increased ($P = 0.04$) average daily gain (ADG) in the 1.0 lb group with ADG values of 4.25 lb/day compared to 3.60 lb/day in the control group. The dry matter intake was consistent across groups ($P = 0.64$), indicating no effect of omega-3 supplementation on feed intake. However, the probability of passing the breeding soundness exam (BSE) was lower ($P = 0.0097$) in the 1.0 lb group, suggesting a negative impact on reproductive soundness.

Effects of omega-3 supplementation on growth and development of bulls

Item	0 lb	0.5 lb	1.0 lb	SE[1]	*P*-value
Initial age	292	292	291	6.25	0.99
Initial BW,[2] lb	773	774	767	42.18	0.98
End BW,[2] lb	1,003	1,024	1,035	55.04	0.77
DMI,[2] lb/day	20.6	21.4	21.9	2.14	0.64
ADG,[2] lb	3.60[a]	3.89[a]	4.25[b]	0.307	0.04
F:G[2]	5.89	5.65	5.51	0.3295	0.72
SC,[2] in	13.7	13.6	13.8	1.14	0.67
BSE,[2] % Pass	85.46[a]	67.76[ab]	22.89[b]	0.183	0.03

[1] Standard deviation.
[2] BW = body weight; DMI = dry matter intake; ADG = average daily gain; F:G = feed to gain ratio; SC = Scrotal circumference; BSE = Breeding soundness exam.
[a-b] Within rows, means with unlike superscripts differ ($P \leq 0.05$).

The Bottom Line: Omega-3 supplementation at 1.0 lb/day improved weight gain but had negative effects on reproductive soundness, lowering BSE pass rates.

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Evaluation of Calcidol (25(OH)D_3) or Combination of Calcidol and Beta-Carotene on Feed Intake, Growth Performance, and Health in High-Risk, Newly Received Beef Heifers

Macie Weigand

Objective: The objective of this study was to evaluate the effects on feed intake, growth performance, and health when calcidol [25(OH)D_3] or a combination of calcidol and beta-carotene was supplemented in high-risk, newly received growing beef heifers.

Study Description: A total of 480 crossbred high-risk heifers (body weight (BW) = 500 ± 35 lb) were fed one of four dietary treatments for a 56-day receiving period. All cattle received a 60 net energy for gain diet limit-fed at 2.2% of BW (dry matter basis). Treatments included: 1) 3,000 IU/head/day added vitamin D_3 (Control), 2) 0.5 mg/head/day calcidol; (HyD, DSM Nutritional Products, Plainsboro, NJ; HyD Low); 3) 1.0 mg/head/day calcidol (HyD High); and 4) 1.0 mg/head/day calcidol and 100 mg of beta-carotene (Victus Transition; DSM Nutritional Products, Plainsboro, NJ; HyD + BC).

Results: Final BW, average daily gain, gain:feed, and dry matter intake did not differ (P ³ 0.36) among treatments. Heifers fed HyD High had greater (P < 0.01) serum 25(OH)D_3 concentrations than heifers fed HyD Low at days 14, 28, and 56. At days 14, 28, and 56, all heifers supplemented with HyD (HyD Low, HyD High, HyD + BC) had greater (P < 0.01) serum 25(OH)D_3 concentrations compared with heifers fed Control. The overall prevalence of respiratory morbidity and mortality was 54.6% and 1.45%, respectively. No treatment differences (P ³ 0.16) were detected for first, second, or third respiratory morbidity or mortality. Overall, supplementation with calcidol or combination of calcidol and beta-carotene did not affect feed intake, growth performance, or health of high-risk, newly received heifers.

The Bottom Line: Calcidol supplementation is the most efficient way to elevate circulating serum 25 hydroxyvitamin D_3. However, this study showed no significant differences between treatments in feed intake, growth performance, or health in high-risk, newly receiving beef cattle.

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Nutrikinetic Evaluation and Modeling of 25-Hydroxyvitamin D_3 in Beef Cattle

Macie Weigand

Objective: These two studies evaluated serum 25-hydroxyvitamin D_3 [25(OH) D_3] status in beef cattle when animals received supplemental calcidol through different administrations. Cattle in experiment one were fed diets with supplemental calcidol (HyD, DSM Nutritional Products, Plainsboro, NJ) as a top dress. Cattle in experiment two received a single dose of calcidol solution (HyD, DSM Nutritional Products, Plainsboro, NJ) through the rumen cannula to evaluate nutrikinetics of calcidol to be used in predictive modeling simulations for use as an oral drench.

Study Description: A total of 96 high-risk receiving heifer calves were used in this two-part study to evaluate calcidol as a top-dress feed. One of four treatments was applied to each pen, and heifers were randomly allocated by body weight (BW) to eight pens total. The dietary treatments consisted of: 1) no vitamin D_3 or calcidol supplementation (CON); 2) 3,000 IU/head/day added vitamin D_3 (D3); 3) 0.5 mg/head/day calcidol; HyD (HyD Low); and 4) 1.0 mg/head/day calcidol (HyD High). The second part of the study evaluated a single pulse dose of calciol administered to cannulated heifers as 3 or 5 mg per 600 lb of BW for evaluation of nutrikinetics and modeling potential with the goal of using HyD solution as an oral drench for cattle.

Results: In experiment one, serum 25(OH)D_3 concentrations in heifers on arrival averaged 12 ± 3.1 ng/mL and were considered suboptimum. Heifer calves fed HyD Low or HyD High had increased serum 25(OH)D_3 levels ($P < 0.001$) from day 14 to 60 compared with heifer calves fed CON or D3 dietary treatments.

In experiment two, the maximum concentration from calcidol pulse dose was reached in 48 hours. The half-life ($t_{1/2}$) of calcidol was determined to be an average of 7.1 days. Calcidol pulse dose remained circulating in the serum for approximately 33 days. Modeling simulations were used to predict circulating 25(OH)D_3 concentrations in various scenarios but should be confirmed *in vivo* in animals before implementation.

The Bottom Line: Calcidol supplementation is the most effective and efficient way to improve circulating 25(OH)D_3 in the serum of beef cattle.

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Individual Sweet Bran Components in High-Forage Rations Fed to Holstein Steers Contribute to Changes in Nutrient Digestibility

Ludmila de Souza Monteiro

Objective: The ruminal and total tract digestibility of high-forage diets containing individual components of Sweet Bran (corn germ meal, corn bran, and corn steep liquor) fed to Holstein steers were evaluated.

Study Description: Sweet Bran (Cargill Corn Milling, Blair, NE) is a wet corn gluten feed product that consists of a proprietary blend of corn bran, corn germ meal, and corn steep liquor. This study was conducted to evaluate the effect of the individual components of Sweet Bran on digestion. Twelve cannulated Holstein steers were housed at the Kansas State University Feed Intake Facility with continuous access diets presented in automated feed bunks and were divided into four groups with different diets: 1) Control (no Sweet Bran components); and diets containing 2) corn germ meal (germ); 3) corn bran (bran); or 4) corn steep liquor (steep). The study had four periods, each lasting 23 days. The first 18 days were for diet adaptation, and ruminal, duodenal, and fecal samples were collected from days 19 to 23.

Apparent digestibility of nutrients in the rumen and in the total tract

	Treatments[1]				
Item	Control	Germ	Bran	Steep	SEM[2]
Dry matter intake, lb/day	19.4[b]	24.6[a]	24.8[a]	26.4[a]	1.5
Ruminal digestibility, %					
Dry matter	83.2	84.4	84.3	86.4	1.1
Protein	73.6[b]	72.0[b]	75.1[b]	80.1[a]	1.5
Neutral detergent fiber	81.1[b]	86.9[a]	87.4[a]	82.8[b]	1.4
Starch	95.4	94.7	93.9	94.9	0.7
Total tract digestibility, %					
Dry matter	89.6[c]	90.9[b]	90.0[bc]	93.2[a]	0.6
Protein	87.7[c]	88.3[bc]	89.3[b]	93.0[a]	0.6
Neutral detergent fiber	84.3[c]	88.7[a]	87.5[ab]	87.0[b]	0.7
Starch	99.4[b]	99.4[b]	99.3[b]	99.7[a]	0.1

[1]Germ = corn solvent-extracted germ meal; Bran = corn bran; Steep = corn steep liquor.
[2]Standard error of the mean.
[a,b,c]Values with common superscript letters within a row are not statistically different ($P > 0.05$).

The Bottom Line: Corn steep liquor contributed to greater digestibility percentages, while corn germ meal and corn bran treatments were similar with respect to digestibility of most nutrients.

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greatOplus (Extruded Blend of Flaxseed and *Nannochloropsis oculata* Biomass) Improves Finishing Cattle Performance and Carcass Characteristics

Firman Nasiu

Objective: This study investigated feeding *greatOplus* (GOP), an extruded mixture of flaxseed and *Nannochloropsis oculata* microalgae biomass (NBO3 Technologies LLC; Manhattan, KS) on feedlot cattle performance and carcass characteristics.

Study Description: Yearling steers (n = 700; 825 lb ± 18.07 lb initial body weight (BW)) were blocked by initial BW and assigned randomly, within block, to 28 feedlot pens containing 25 animals/pen. Cattle were vaccinated against viral and clostridial pathogens and treated for internal and external parasites (Bovishield Gold 5, Ultrabac 7 Somubac, and Dectomax injectable; Zoetis Animal Health), and implanted with a combination implant (Component TE-200; Elanco USA). The control diet (CON) consisted of 58.3% steam-flaked corn, 20% wet corn gluten feed, 2.56% soybean meal, and 4.17% vitamin/mineral/feed additive premix. For the *greatOplus* (GOP; an extruded blend of flaxseed and *Nannochloropsis oculata* microalgae) diet, a portion of the corn and all the soybean meal were replaced with 10% GOP (dry basis) to create isonitrogenous diets. Cattle were fed once daily, *ad libitum*. After 175 days on feed, animals were weighed and transported to a commercial abattoir for harvest. Animal performance measurements included average daily gain (ADG), dry matter intake (DMI), and gain:feed (G:F). Hot carcass weight (HCW) and incidence of abscessed livers were assessed on the day of harvest, and marbling score, 12th rib fat thickness, longissimus muscle area, and U.S. Department of Agriculture (USDA) yield and quality grades were determined following 48 hours of refrigeration

Results: Cattle fed *GOP* had greater DMI and ADG ($P < 0.05$) compared to cattle fed CON, but G:F was not affected by treatment ($P > 0.10$). Cattle fed GOP had greater HCW compared to those fed CON (932.11 versus 902.79 lb; $P < 0.01$) and tended to produce more Prime and Choice carcasses (87.4 versus 83.0%; $P = 0.11$) with greater 12th rib backfat (0.61 versus 0.59 in; $P < 0.02$) and greater yield grades (2.91 versus 2.75; $P < 0.01$). Marbling score (488 versus 491), longissimus muscle area (14.6 versus 14.5 in^2) and liver abscess incidence (12 versus 16% for CON and GOP, respectively) were unaffected by treatment ($P > 0.10$). Carcass values were calculated using base prices, premiums, and discounts published by the USDA, and were greater for cattle fed GOP compared to cattle fed the CON diet ($2,122 versus $2,059; $P < 0.01$).

The Bottom Line: Including *greatOPlus* at 10% of the diet dry matter improved cattle performance, largely as the result of its impact on DMI and ADG.

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Effects on Stocker Steer Performance While Consuming Essential Oil or Ionophore Minerals

Tatiana Jones

Objective: To determine if essential oils produce the same performance for stocker steers as consuming an ionophore.

Study Description: Steers (n = 281 head; 641 ± 10.3 lb) were assigned to one of two mineral treatments and grazed on tallgrass native range on eight pastures. Treatments consisted of the "positive" control of ionophore (lasalocid at 3.6 lb/ton) and essential oil (garlic oil at 3 lb/ton and essential oil blend at 6 lb/ton) in free-choice mineral. Steers were weighed at the beginning and end of the 92-day grazing period. Pasture biomass production and mineral intake were monitored weekly.

Effects of mineral types on growth performance, average daily gain, average daily mineral intake, and pasture biomass

Item	Ionophore[1]	Essential oil[2]	SEM[3]	*P*-value
Initial weight, lb	629	653	10	0.16
Final weight, lb	833	856	9	0.12
Total gain, lb	204	203	8.8	0.92
Average daily gain, lb/day	2.15	2.13	0.09	0.92
Pasture biomass, lb dry matter/acre	1180	1229	79	0.67
Average mineral intake, oz/head/day	5.18	5.63	0.54	0.58

[1]Ionophore mineral (Bovatec 91 included at 18 lb/ton to provide 3.6 lb/ton lasalocid; Zoetis, Kalamazoo, MI).
[2]Essential oil mineral (3 lb/ton garlic oil and 6 lb/ton Solace; Wildcat Feeds LLC, Topeka, KS).
[3]Standard error of means.

The Bottom Line: Growth performance produced by essential oils in mineral and ionophores are similar when fed to growing stocker steers grazing tallgrass native range.

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CATTLEMEN'S DAY 2025

BEEF CATTLE RESEARCH

The Effects of Aging Time on Eating Quality of *Semimembranosus* Steaks

Samuel Stickley

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Objective: The objective of this study was to evaluate consumer palatability, instrumental tenderness, and objective color of *semimembranosus* steaks aged 14 to 70 days.

Study Description: Beef *semimembranosus* subprimals were aged for 14, 28, 35, 42, 49, 56, 63, and 70 days, then cut into 1-in steaks. Color readings were taken before and after cooking. Steaks were cooked to 160°F then analyzed by consumers for overall liking, flavor, juiciness, and tenderness liking and acceptability. Color readings were used to calculate the percentage of oxymyoglobin (OMb), deoxymyoglobin (DMb), metmyoglobin (MMb), chroma, and hue angle. Warner-Bratzler Shear Force (WBSF) tests were conducted.

Consumer panel palatability ratings for *semimembranosus* steaks across aging treatments

Aging period	Overall liking	Flavor liking	Juiciness liking	Tenderness liking
14	4.7^{c}	4.7	4.6	3.7^{c}
28	6.0^{ab}	5.7	5.9	5.2^{ab}
35	5.3^{bc}	4.8	4.9	4.5^{bc}
42	5.2^{bc}	4.9	5.2	4.8^{bc}
49	5.7^{abc}	5.3	5.2	5.0^{abc}
56	6.4^{a}	5.9	6.5	6.2^{a}
63	5.7^{abc}	5.4	5.7	5.5^{ab}
70	6.1^{ab}	5.8	5.6	5.7^{ab}
SEM[1]	0.39	0.37	0.44	0.50
P-value	0.04	0.07	0.06	0.02

^{abc}Means within the same column without a common superscript differ ($P < 0.05$).
[1]Standard error of the mean (largest) of the least square means.

Results: Consumer sensory results showed 28, 56, and 70 day steaks rated higher ($P < 0.05$) for tenderness and overall liking scores compared to 14 day steaks. There was also a higher ($P < 0.05$) percentage of 70 day steaks rated as acceptable for tenderness compared to 14 day steaks. There were no other sensory differences ($P > 0.05$) found for flavor liking and juiciness liking. Moreover, WBSF values for 14 and 35 day steaks were higher ($P < 0.05$) than all other treatments. Conversely, 49, 56, and 63 day steaks had higher ($P < 0.05$) raw L^* (lightness) values than 14 and 28 day steaks. Furthermore, 14, 28, 35, and 49 day steaks resulted in higher a^* (redness) values ($P < 0.05$) compared to the 70 day treatment. Also, 70 day steaks had a higher ($P < 0.05$) percentage of MMb than the 28 day treatment, as well as a higher ($P < 0.05$) OMb percentage than both 49 and 56 day steaks.

The Bottom Line: This research indicates extended aging improves tenderness and overall liking while not decreasing flavor for consumers, which supports using extended aging periods for historically tough muscles.

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The Effects of Aging Time on the Eating Quality of *Biceps Femoris* Steaks

Mason Prester

Objective: This study evaluated the sensory, instrumental color, and tenderness characteristics of *biceps femoris* steaks aged from 14 to 70 days.

Study Description: Beef sirloin top butt sub-primal cuts (n = 80) were collected from a commercial processing facility and aged at 35.6°F and 39.2°F throughout the duration of their aging periods. After aging, the *biceps femoris* and *gluteus medius* muscles were separated, and 1-in thick steaks were fabricated, packaged, frozen at -4°F, and stored for subsequent analysis. The steaks underwent instrumental evaluations for raw and cooked color traits, tenderness, and consumer sensory preferences.

Results: There were no differences ($P > 0.05$) in the percentage of samples rated acceptable for flavor, juiciness, tenderness, or overall. Moreover, there were no differences ($P > 0.05$) in flavor, juiciness, tenderness, or overall liking among the different aging periods. Furthermore, no differences ($P > 0.05$) were observed in the percentage of cook loss, Warner Bratzler Shear Force, or cooked color readings among aging treatments. However, raw steaks aged 14 and 28 days had higher ($P < 0.05$) a^* (redness) and b^* (yellowness) values than steaks aged 42, 49, or 70 days.

Least-squares means (n = 10/aging treatment) for the percentage of consumers who rated each palatability trait as acceptable (yes/no) for *biceps femoris* steaks

Aging period (days)	Overall acceptability	Flavor acceptability	Juiciness acceptability	Tenderness acceptability
14	93.8	94.2	96.1	89.5
28	95.2	95.1	89.1	95.2
35	92.6	89.9	92.7	91.6
42	95.6	93.6	98.8	91.1
49	92.5	87.5	89.7	86.0
56	95.1	96.8	96.3	95.4
63	91.0	90.6	92.5	91.0
70	93.3	84.2	94.4	92.2
SEM[1]	3.8	5.2	4.7	5.0
P-value	0.98	0.36	0.36	0.71

[1]Standard error of the mean (largest) of the least square means.

The Bottom Line: Despite minor differences in raw color, the aging period had minimal impact on overall eating quality, indicating that within the studied range, the aging process has only a minimal effect on the quality traits of *biceps femoris* steaks.

BEEF CATTLE RESEARCH

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BEEF CATTLE RESEARCH

The Effects of Aging Time on the Eating Quality of *Gluteus Medius* Steaks

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Objective: The objective of this study was to determine the palatability characteristics and color traits of *gluteus medius* steaks aged 14, 28, 35, 42, 49, 56, 63, and 70 days.

Study Description: Beef top sirloin butt subprimals were assigned to one of eight aging periods. Once aged, the *gluteus medius* was fabricated into 1-in. steaks. Steaks were used for consumer panels, Warner-Bratzler Shear Force (WBSF), or raw/cooked color evaluation. Color data were collected on raw steaks. Steaks were cooked to 160°F and internal color data measured. Samples were cooled for 24 hours before WBSF determination. Steaks were cooked to 160°F for consumer ratings on overall juiciness, tenderness, and flavor liking.

Results: Consumers found no difference ($P > 0.05$) among aging treatments for juiciness, tenderness, flavor, or overall liking. Although there were no differences ($P > 0.05$) in the percentage of samples rated acceptable for juiciness, tenderness, flavor, or overall liking, all treatments had, at minimum, 83% of samples rated overall acceptable by the consumers. Additionally, there were no differences ($P > 0.05$) in cooking loss, cooked L^* (lightness), a^* (redness), b^* (yellowness), deoxymyoglobin (DMb), oxymyoglobin (OMb), metmyoglobin (MMb), chroma, or hue angle among all treatments. Steaks that were aged for 14 days had a higher ($P < 0.05$) WBSF value than all other treatments. Steaks aged for 63 and 70 days were more tender ($P < 0.05$) than samples aged for 42 days or less. Although there were differences found in raw color, there were few evident trends. Steaks that were aged for 14, 49, and 56 days were redder ($P < 0.05$) than those aged for 63 and 70 days. Steaks aged for 14 days were darker ($P < 0.05$) than steaks aged for 49 days or more. Although there were no differences ($P > 0.05$) in raw calculated MMb, there were differences ($P < 0.05$) in DMb, with values being higher in steaks aged 14, 35, 49, and 56 days than at 63 and 70 days. Furthermore, OMb was higher ($P < 0.05$) at 63 days than at 14, 35, 42, and 56 days.

The Bottom Line: These results indicate that extending the aging time of *gluteus medius* steaks has limited impact on the palatability and color characteristics of the steaks.

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BEEF CATTLE RESEARCH

The Effects of Aging Period and Freezing Sequence on Consumer Palatability Ratings, Tenderness, and Color Stability of *Longissimus Dorsi, Semitendinosus,* and *Biceps Femoris* Steaks

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Objective: The objective of this study was to examine the effect of freezing and aging sequence on palatability, overall tenderness, and objective color readings of three different beef muscles and two aging periods.

Study Description: The *longissimus dorsi* (LD), *semitendinosus* (ST), and *biceps femoris* (BF) were fabricated into 1-in steaks and assigned to one of the following treatment combinations: age (21 days) then freeze, freeze then age (21 days), age (28 days) then freeze, or freeze then age (28 days). Consumers evaluated samples for flavor, juiciness, tenderness, overall liking, and acceptability for each sensory trait. Samples designated for Warner-Bratzler shear force (WBSF) were allowed 20 minutes to bloom for raw color evaluation and then cooked for analysis.

Results: The freezing treatment or aging period did not impact ($P > 0.05$) consumer sensory rating of tenderness, flavor, or overall liking. The consumers rated the LD as the juiciest ($P < 0.05$) compared to the ST and BF. As expected, the LD resulted in the highest ($P < 0.05$) tenderness rating for the consumer. The LD had the lowest ($P < 0.05$) WBSF values, indicating it was the most tender. Within flavor, the consumers rated the LD as the most flavorful ($P < 0.05$) followed by the ST, and then the BF. For raw and cooked color, the L^* (lightness) values differed ($P < 0.05$) between all main effects, including freezing treatments (Age Freeze > Freeze Age), aging periods (21 days > 28 days), and muscle (ST > LD > BF). These results showed freezing and then aging or aging and then freezing does not affect palatability or shear force values. This indicates that reversing the freezing order is not an effective way to improve the tenderness of historically tough muscles.

The Bottom Line: The results indicate reversing the typical age and freezing order does not improve tenderness and therefore is not a valid way to improve palatability of historically tough muscles.

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Determination of Consumer Purchase Thresholds for Discoloration of Beef Strip Steaks in Retail Display

Stephanie Witberler

Objective: The objectives of this study were to determine the consumer purchase threshold for discoloration of beef steaks in a simulated retail display and to determine the best objective measurement to predict consumer purchase intent.

Study Description: Steaks from 0% to 100% discoloration were evaluated by trained panelists and consumer panelists in a simulated retail display. Trained panelists scored percent discoloration, redness, and fat color, while consumer panelists were asked to rate the sample appearance and then asked if they would purchase the sample at full price and at a discounted rate. L^* (lightness), a^* (redness), b^* (yellowness), and spectral data were collected and hue angle, chroma, and percent deoxymyoglobin, metmyoglobin, and oxymyoglobin were calculated.

Results: The a^* values were a good objective predictor of purchase intent ($R^2 = 0.64$ full-priced and $R^2 = 0.56$ for discounted; $P < 0.05$). At full price, a^* values of 25.3, 29.9, 34.4, and 37.6 corresponded to a 50%, 75%, 90%, and 95% likelihood to purchase, whereas if the product was discounted, a^* values of 20.3, 25.8, 31.3, and 35.0 corresponded to those same thresholds. Trained sensory panel redness scores were also a good predictor of consumer purchase intent with $R^2 = 0.64$ full-priced and $R^2 = 0.59$ discounted ($P < 0.05$). At full price, trained redness scores of 68.0 and 86.3 corresponded to a 50% and 75% likelihood to purchase, whereas if the product was discounted, trained redness scores of 46.8, 68.8, and 90.8 corresponded to 50%, 75%, and 90% thresholds.

The Bottom Line: The a^* value and trained panel redness score are good indicators of consumer purchase intent, showing that consumers highly value redness when choosing steaks.

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BEEF CATTLE RESEARCH

The Impact of Degree of Doneness, Muscle Source, and Bloom Time on Cooked Color and Cooked Color Stability

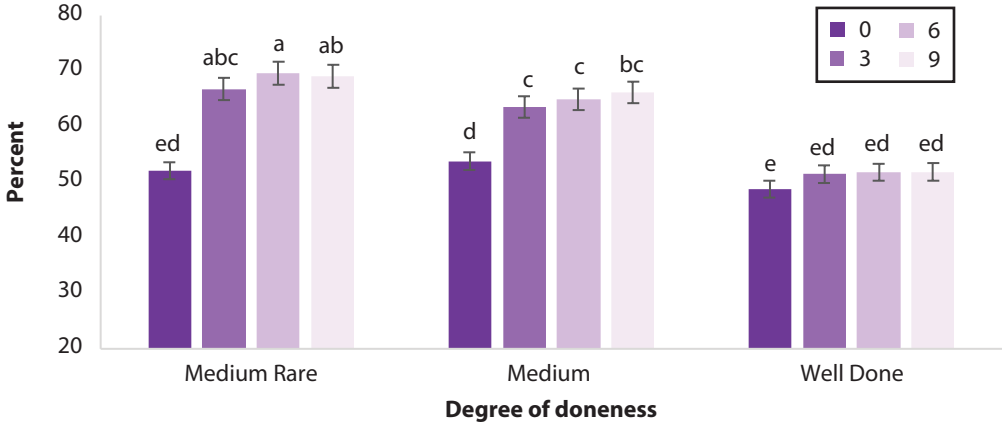
Greta Huber

Objective: This study examined the differences in color stability between three different muscles cooked to varying degrees of doneness by taking color readings at four different time points.

Study Description: *longissimus lumborum* (LL), *psoas major* (PM), and *semitendinosus* (ST) were cooked to medium rare (MR), medium (MED), or well done (WD) degree of doneness (DOD). Color was measured at 0, 3, 6, and 9 minutes to observe color stability changes.

Results: There was an interaction ($P < 0.05$) between DOD and muscle for L^* (lightness) readings. The ST had the highest L^* reading within the MR and MED DOD followed by the LL; however, there were no differences between muscles ($P > 0.05$) within the WD DOD. The 0-minute readings had a lower ($P < 0.05$) L^* reading in comparison to 9 minutes, while not being different ($P > 0.05$) from 3 or 6 minutes. Similar to the L^* readings, there was an interaction ($P < 0.05$) between DOD and muscle for a^* readings. Within the MED DOD, the ST had the highest ($P < 0.05$) a^* reading followed by the LL, while the LL had the highest ($P < 0.05$) a^* reading within the MR and WD DOD. There was an interaction ($P < 0.05$) between DOD and muscle and DOD and time for the oxymyoglobin (OMb) percentage. Within the MR samples, the LL and ST muscles resulted in similar ($P > 0.05$) OMb percentage. The MR DOD had the highest ($P < 0.05$) OMb percentage for 3, 6, and 9 minutes while the 0-minute readings for MR and MED were similar ($P > 0.05$) and higher ($P < 0.05$) than all-time points for the WD DOD.

Degree of doneness and time interaction on oxymyoglobin percentage



[abcde] Means within the same column without a common superscript differ ($P < 0.05$).

The Bottom Line: Muscle influences cooked color and its stability, so if there are significant differences among muscles, it might be necessary to provide consumers with specific cooking instructions for each muscle.

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BEEF CATTLE RESEARCH

Influence of Degree of Doneness on the Alpha-Gal Content of Striploins and its Relationship with Red Meat Allergy

Sara Hene

Objective: Alpha-Gal Syndrome (AGS) is an acquired sensitivity to galactose-alpha-1, 3-galactose (α-Gal) after exposure to a bite from the Lone Star Tick (*Amblyomma americanum*). Affected individuals can experience a range of symptoms from mild itching to potentially fatal anaphylaxis after consuming products containing mammalian tissues that contain α-Gal. Little research has been done to examine the α-Gal content of different products; thus, the objective of this study was to establish the α-Gal content of striploin steaks cooked to varying degrees of doneness to evaluate if heat treatment reduces the α-Gal content of red meat.

Study Description: Ten beef striploins were collected from a Midwest beef processing plant and transported under refrigeration to the Kansas State University Meat Laboratory (n = 10). Striploins were cut into four steaks each and either left raw or cooked to medium rare (MR; 130°F), medium (MED; 140°F), or well done (WD; 160°F). Whole muscle proteins were extracted, and proteins were separated by gel electrophoresis, transferred to a polyvinylidene difluoride membrane, and tested by immunoblot against a primary anti-α-Gal antibody. Each gel contained a reference sample of α-Gal conjugated human serum albumin with known α-Gal content.

Results: Striploins that were cooked to WD had the greatest α-Gal concentration among all cooking treatments, followed by steaks cooked to MR and MED, while steaks that were left raw had the lowest α-Gal concentration ($P < 0.01$).

The Bottom Line: Our results are consistent with other studies, which indicated that cooking seems to concentrate α-Gal glycans to a higher degree than that of the raw striploins. Further research is needed to evaluate the efficacy of other interventions to improve the care and management of AGS patients.

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Determining the Spoilage Threshold for Ground Beef Using Multiple Objective Measures

Lauren Frink

Objective: The objective of this study was to determine the point at which ground beef reaches spoilage as determined by consumers.

Study Description: Retail ground beef packages were procured from a ground beef facility and randomly assigned to a storage duration (0 – 14 days) for simulated retail display. Packages were stored in mother bags at 36 to 40°F in the absence of light until placed in the retail case under fluorescent lights on the designated display date. Samples were displayed in three coffin-style cases at 36 – 40°F for eight different display periods (0, 2, 4, 6, 8, 10, 12, and 14 days). Consumer sensory panelists evaluated eight samples for visual appearance, odor, and touch. For each measure, consumers were asked if they would purchase the sample and if they considered the sample spoiled. Trained sensory panelists evaluated the same samples on the same day of display and were asked to evaluate redness, percent discoloration, odor, and touch characteristics.

Results: Consumers were less *($P < 0.05$)* likely to purchase and more ($P < 0.05$) likely to rate samples spoiled once samples reached 8 days of display for visual appearance, touch, and odor. Consumer evaluation of the visual appearance score of the samples showed the strongest relationship to spoilage, having a high R^2 of 0.89 ($P < 0.05$). Threshold values of 50%, 75%, 90%, and 95% were identified for consumer purchase intent likelihood using multiple objective measures. With an R^2 of 0.86 ($P < 0.05$), trained panel redness scores of 60.15, 73.9, 87.6, and 96.95 corresponded to 50%, 75%, 90%, and 95% likelihood of a consumer purchasing the product. The likelihood of consumers classifying a sample as spoiled ($R^2 = 0.76$) 5%, 10%, 25%, and 50% of the time corresponded with a trained sensory panel redness score of 74.8, 64.1, 48.4, and 32.7, respectively. Overall, consumers' opinion toward the product's appearance plays the biggest role in their purchase intent and assessment of spoilage as opposed to touch and odor.

The Bottom Line: Though many changes were identified throughout the retail display period, the change in color from a bright, cherry-red to brown was shown to be the most important factor considered by consumers when they identified whether or not samples were spoiled; therefore, maintaining beef in a bright, cherry-red state is crucial to maximizing value.

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BEEF CATTLE RESEARCH

Determining the Spoilage Threshold for Ground Beef Using Microbial, Color, and Oxidation Measures

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Objective: The objective of this study was to determine the point at which ground beef becomes spoiled relative to microbiological, lipid oxidation, and color measurements.

Study Description: One lb ground beef packages from a case-ready facility were stored at 36 to 40°F in the absence of light until displayed in coffin-style cases under fluorescent lighting. The packages were assigned to one of eight display periods (0, 2, 4, 6, 8, 10, 12, and 14 days). Samples were evaluated by consumers for visual appearance, touch, and odor liking, as well as evaluated for discoloration, redness, off-odor presence, and characteristic beef texture by trained sensory panelists. Additionally, objective measurements of aerobic plate counts (APC), *Enterobacteriaceae* plate counts (EB), and *Escherichia coli* (*E. coli*) coliform plate counts (ECC) for microbiology were obtained along with thiobarbituric acid reactive substances (TBARS) for lipid oxidation and L^* (lightness), a^* (redness), and b^* (yellowness) values for color.

Results: Logistic regression models were generated to identify purchase intent thresholds and consumer spoilage classification based on the objective measures. Consumer appearance liking showed the strongest predictor values relative to the microbiological assays, explaining 81% of the variation when predicting consumer purchase intent. Logistic models for APC ($R^2 = 0.59$; $P < 0.05$) identified values of 7.3, 6.7, 6.1, and 5.8 log colony forming units (CFU)/g representing 50, 75, 90, and 95% likelihood a consumer would purchase the product. Additionally, APC values ($R^2 = 0.46$; $P < 0.05$) of 5.3, 5.9, 6.8, and 7.7 log CFU/g relating to 5, 10, 25, and 50% likelihood a consumer would consider a product spoiled. The EB and ECC models also showed the strongest relationships corresponded to appearance liking, but were not as relevant as the APC predictors. Overall, all objective measurements in relation to consumer appearance liking explained the most ($P < 0.05$) variance within the model.

The Bottom Line: Though changes in objective measures occurred throughout 14 days of display, the strongest determining factor when predicting consumer purchase intent and spoilage was the consumer appearance liking scores.

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BEEF CATTLE RESEARCH

Quality and Sensory Attributes of Tumbled or Marinated Beef Jerky

Ashton McGinn

Objective: The objective of this research was to evaluate the quality and sensory characteristics of vacuum-packaged shelf-stable beef jerky produced using tumbling or marination.

Study Description: This study used 12 USDA Select beef inside top rounds (*semimembranosus*) that were stored in a non-barrier shrink bag held at 36°F for 10 to 14 days before processing. On each processing day, whole rounds were trimmed, pH was measured, and the weights were obtained before and after trimming. Trimmed rounds were cut in half, and each half was allocated to a tumbled or marinated treatment. Before the processing treatments were applied, each beef round half was sliced using a slicer (Treif Puma Slicer, Shelton, CT) into 3 mm slices and then weighed. Pieces from each half were collected for determination of structural analysis, sarcomere length (SL), and myofiber diameter (MD) using transmission electron microscopy (TEM) and light microscopy (LM) and for proximate analysis. After tumbling or marinating, percent pickup was measured following a 5-minute rest period, and a sample from each half of tumbled or marinated rounds was held to measure sodium chloride content (SCC), structural analysis, SL, and MD. After thermal processing, samples from each treatment were vacuum-packaged and sampled initially on day 0 and after 3 and 6 months at 68°F. Cook yield was determined after thermal processing. On day 0, the pH, moisture, and protein content, water activity (a_w), instrumental color, shear force (SF), sensory evaluation, SCC, structural analysis, SL, and MD were measured. After 3 and 6 months of storage, the instrumental color, sensory evaluation, a_w, SF, SCC, moisture, structural analysis, SL, and MD were measured.

Least square means (LSmeans) of physical and chemical characteristics of vacuum-packaged beef jerky produced using tumbling or marination during storage at 68°F for up to six months

Storage time	*L** [1]	*a** [2]	Shear force, lbf	Water activity	Tenderness [3]	Texture [4]	Flavor [5]	Sodium chloride, %
Day 0	26.47[a]	3.30[b]	79.9	0.74	33.00[a]	63.45[b]	39.05[a]	3.695[a]
3 Months	25.17[a]	3.61[b]	76.0	0.75	32.10[ab]	67.30[b]	34.53[b]	3.519[a]
6 Months	23.70[b]	4.24[a]	77.6	0.76	27.33[b]	73.16[a]	34.07[b]	2.906[b]
P-value	0.0004	0.0073	0.3744	0.3196	0.0485	0.0057	0.0032	<.0001
SEM [6]	0.7243	0.2614	5.2	0.01	2.1067	2.5063	1.2207	0.0143

[ab]Means within a column without a common superscript differ ($P < 0.05$).
[1]L^* = 0 = black, 100 = white.
[2]a^* = - 60 = green, 60 = red.
[3]Tenderness: 0 = extremely tough/chewy, 50 = neither tough/chewy nor tender/non chewy, 100 = extremely tender/non chewy.
[4]Texture: 0 = extremely soft, 50 = neither soft nor brittle/hard, 100 = extremely brittle/hard.
[5]Flavor: 0 = extremely bland, 100 = extremely intense.
[6]Standard error of the least square means.

The Bottom Line: Tumbling produced a jerky product that was more tender, less brittle, and more flavorful during 6 months of storage compared to marination as a processing method.

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BEEF CATTLE RESEARCH

SUMMARY PUBLICATION

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