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2nd place.. Kasi Schneid, *West Texas A&M University*
Effects of high dietary starch and erratic feed management on indicators of ruminal and colonic health and pathogenic bacteria prevalence and concentration in the gastrointestinal tract and liver of feedlot steers; Major Advisor: Dr. Kendall Samuelson

3rd place.. Jacob Henderson, *Iowa State University*
Effect of excess liver copper concentration on response to bovine respiratory disease challenge in dairy-beef steers; Major advisor: Dr. Stephanie Hansen

4th place.. Colten Dornbach, *Texas Tech University*
Longitudinal assessment of Salmonella enterica in feedlot beef cattle: Associations with liver abscess development and metaphylaxis; Major advisor: Dr. Kristin Hales

5th place.. Becca Grimes Francis, *South Dakota State University*
Effect of increased time spent on a high-forage receiving ration on growth performance, rumination activity, and carcass performance in Angus × Holstein steers; Major advisor: Dr. Zach Smith

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Limit Feeding a High Concentrate Diet to Newly Weaned Calves Does Not Negatively Affect Growth Performance

SOUTH DAKOTA STATE UNIVERSITY

T. Banks, J. Delver, B. B. Grimes Francis, F. L. Francis, R. Leeson, T. Maia Ribeiro, M. Nichols, G. Olinger, W. Peschel, F. Podversich, W.C. Rusche, Z.K. Smith, E.R. DeHaan

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Introduction

- Availability and cost of feed ingredients is dependent upon environmental conditions driving demand
- Cost per pound of gain varies based on:
  - Performance of cattle
  - Cost of dietary components
- Limit feeding high concentrates to cattle can be a valuable alternative when:
  - Reduced roughage availability
  - Corn grain sources are more affordable compared to roughage sources
- Limit feeding cattle has proven to be effective in growing and finishing cattle
- There is limited work investigating limit-feeding high concentrates-based diets to newly weaned calves

Objective

- Determine the effects of feeding a limit-fed concentrate-based diet compared to an ad libitum forage-based diet on growth production efficiency in newly-weaned steers calves during a 61-d receiving period.

Materials & Methods

<u>Treatments</u>
- Ad libitum forage-based diet (**ALF**)
  - Fed 46.89 Mcal/cwt diet ad libitum
- Limit-fed concentrate-based diet (**LFC**)
  - Limit-fed a 61.70 Mcal/cwt diet @ 76% of ALF

<u>Cattle Management</u>
- Fed at Ruminant Nutrition Center (RNC) in Brookings, SD
  - 60 Charolais × Angus steers [initial body weight (BW) = 500 ± 1.1 lb]
  - Allotted by initial BW into treatment pens
    - n = 5 pens/treatment w/ 6 steers/pen
- Steers were vaccinated against respiratory and clostridial species and administered a pour on insecticide to control internal and external parasites
- Feed was manufactured and delivered twice a day
- Monensin sodium was administered @ 25 g/ton

<u>Growth Performance</u>
- Steers individually weighed on d 1, 14, 34, 54, and 61
- Growth measures calculated for each interim period and for cumulative performance (d1 – d 61)
  - ALF and LFC steer fed ALF diet from d 54 to 61 to account for gastrointestinal (GI) tract fill differences
- Feed efficiency (F:G) calculated by dividing pen dry matter intake (DMI) by average daily gain (ADG)

<u>Statistical Analysis (SAS 9.4)</u>
- Randomized complete block design using GLIMMIX procedure
- Assumed an α level < 0.05
  - Treatment (LFC vs ALF) was the fixed effect
  - Block location was the random effect

Results

Table 1. Ad libitum forage-based (ALF) versus a limit-fed concentrate-based (LFC) diet fed to newly-weaned steers during a 61-d receiving period. LFC calves received ALF diet from d 55 to 61.

Item	ALF	LFC
Ryelage	36.94	8.74
Grass Hay	10.45	0.0
Dry Rolled Corn	0.0	41.26
Dried Distillers Grain w/ Solubles	8.81	20.63
Soybean Hulls	38.37	24.28
Supplement	5.43	5.09
Diet Composition		
Dry Matter, %	57.04	77.32
Crude Protein, %	14.41	15.60
Neutral Detergent Fiber, %	55.02	30.11
Acid Detergent Fiber, %	37.71	19.02
Ash, %	8.51	5.78
Ether Extract, %	3.46	4.40
Net energy of maintenance, Mcal/cwt	78.45	93.30
Net energy of gain, Mcal/cwt	46.89	61.70

[1]Newly-weaned steers fed at the RNC and offered a liquid supplement consisting of 68% DM, 34.99% CP, 28% NPN, 0.55 Mcal/lb NEm, 0.36 Mcal/lb NEg, 0.93% CF, 43.51% Ash, 11.0% Ca, 0.37% P, 1.94% K, 0.13% Mg, 2.84% Na, 0.45% S, 3.0 ppm Co, 210.69 ppm Cu, 20.0 ppm I, 409.43 ppm Mn, 3.08 ppm Se, 1,823.76 ppm Zn, 20,000 IU/lb Vitamin A, 200 IU/lb Vitamin E, and 500 g/ton Monensin Sodium.

Table 2. Growth performance responses from feeding an ad libitum forage-based (ALF) versus a limit-fed concentrate-based (LFC) diet during a 61-d receiving phase[1].

Item	ALF	LFC	SEM	*P*-Value
Steers, n	30	30	-	-
Pens, n	5	5	-	-
Initial BW, lbs	500	500	1.1	0.63
Initial to d 14				
d 14 BW, lbs	515	500	7.3	0.11
ADG, lbs	1.07	-0.03	0.456	0.08
DMI, lbs	8.28	7.91	0.247	0.20
F:G	7.58	-	-	0.07
d 15 to 34				
d 34 BW, lbs	545	546	5.5	0.95
ADG, lbs	1.55	2.30	0.097	0.01
DMI, lbs	12.43	11.49	0.361	0.06
F:G	8.00	4.95	0.661	0.01
d 35 to 54				
d 54 BW, lbs	605	606	4.9	0.86
ADG, lbs	2.98	3.00	0.145	0.85
DMI, lbs	15.49	12.93	0.110	0.01
F:G	5.18	4.31	0.247	0.02
Initial to d 54				
ADG, lbs	1.95	1.96	0.083	0.94
DMI, lbs	12.48	11.09	0.222	0.01
F:G	6.33	5.62	0.165	0.04
Initial to d 61[2]				
d 61 BW, lbs	630	634	4.4	0.45
ADG, lbs	2.14	2.19	0.066	0.49
DMI, lbs	12.92	11.33	0.241	0.01
F:G	5.99	5.15	0.179	0.01

[1] A 4% pencil shrink was applied to all body weight (BW) measures to account for gastrointestinal tract (GI) fill.
[2]All cattle fed ALF diet from d 55 to 61 to account for differences in GI fill.

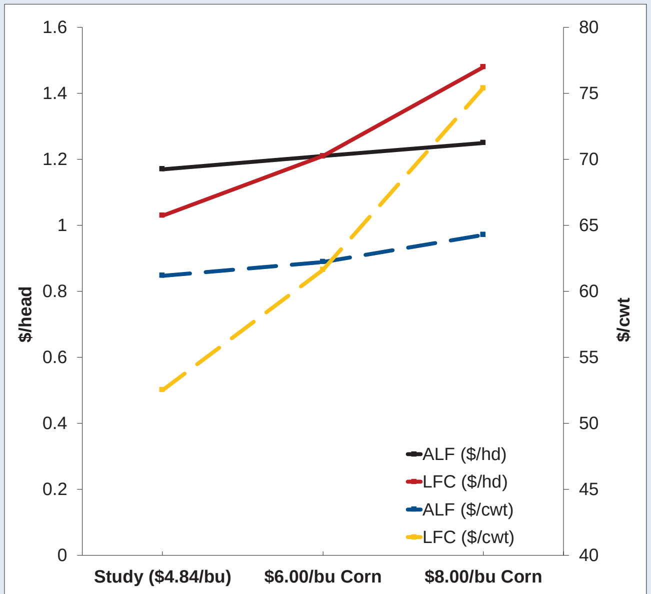

Figure 1. The cost per head ($/hd; left axis) and cost per hundred weight ($/cwt) of feeding the ad libitum forage based diet or limit fed high concentrate based diet under current study conditions, compared to when corn is priced at $6.00/bu or $8.00/bu. Current study prices were determined using USDA-AMS Market Reports for the week prior to study initiation (10/7/24). Corn and corn co-products were adjusted to reflect conditions under $6.00 or $8.00/bu.

Conclusion

- LFC and ALF steers had similar BW and ADG
- By design, LFC steers had reduced DMI by 12%
- LFC steers had improved feed efficiency by 14% compared to ALF steers
- Collectively, feeding a limit-fed concentrate based diet to newly received calves did not have negative implications on growth performance
- Based on 2024 feed prices, under the conditions of this experiment, the LFC diet is an affordable alternative to a conventional receiving diet (ALF)

Acknowledgement

- This research was funded with federal funds appropriated to South Dakota State University through the National Institute of HATCH Project Number SD00H827-44

Zinc supplementation prior to transit and transit duration effects on receiving performance of beef steers

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†Agriculture and Agri-Food Canada

USDA National Institute of Food and Agriculture
U.S. DEPARTMENT OF AGRICULTURE

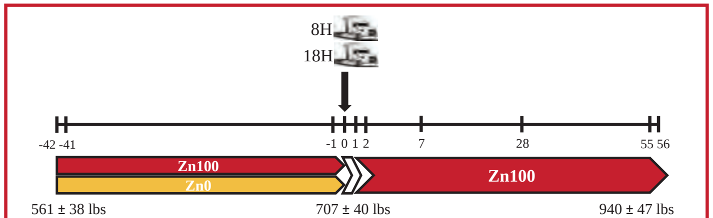
Introduction

- The segmented nature of the beef cattle industry necessitates the transportation of cattle at least once in the production cycle.
- As transit duration increases, cattle experience greater shrink due to prolonged feed and water deprivation
  - Greater shrink → poor performance and greater morbidity [1], greater incidence of lame and non-ambulatory cattle [2]
- Preconditioning in conjunction with shorter transport durations have been shown to reduce shrink, improve dry matter intake (DMI) and average daily gain (ADG) in the first month post-transport [3]
- Zinc (Zn) is involved in over 300 enzymes [4] supporting protein synthesis, transcriptional regulation, glucose metabolism, and immunity
- Zn must be constantly supplemented as it is not well stored or recycled in the body [5]
- Zn supplementation has been shown to improve DMI recovery post-transit [6]

The objective of this study was to determine the effects of Zn supplementation prior to transit and transit duration on performance of beef steers.

Materials and Methods

- 100 single source Angus-cross steers (Valentine, NE) were transported to the Iowa State University Beef Nutrition Research Unit (Ames, IA) on October 20, 2023
  - Steers were acclimated to the GrowSafe bunk system for seven days before the initiation of the trial.
- d -41: 80 steers were selected and stratified by BW into 16 pens (5 steers/pen; 4 pens/treatment)
  - Dietary treatments (**DIET**):
    - **Zn0** – no supplemental Zn (analyzed **39** mg Zn/kg DM)
      - *NRC recommendation is 30 mg Zn/kg DM*
    - **Zn100** – 100 mg supplemental Zn (**Zn as $ZnSO_4$**; analyzed at **139** mg Zn/kg DM)
  - Transit duration (**DUR**):
    - **8H** – 8-hour transit (~439 mi)
    - **18H** – 18-hour transit (~999 mi)
- Data were analyzed as a 2×2 factorial using Proc Mixed of SAS 9.4 with the fixed effects of DIET, DUR, and the interaction; steer as the experimental unit.
- Day -42/-41 body weight (BW) was used as a covariate in BW data analysis.
- A ten-day (d-11 to -1) pre-transit DMI average was used as a covariate for post-transit DMI analysis and as baseline for DMI recovery
- Significance was determined at $P \leq 0.05$ and tendencies from $0.05 < P \leq 0.10$



Literature Cited:
[1]Camp, T. H., Stevens, D. G, Stermer, R. A. and Anthony, J. P. (1981). Transit factors affecting shrink, shipping fever and subsequent performance of feeder calves. J. Anim. Sci., 52(6): 1219-24. doi: 10.2527/jas1981.5261219x.
[2]Gonzalez, L. A., Schwartzkopf-Genswein, K. S., Bryan, M., Silasi, R. and Brown, F. (2012) Relationships between transport conditions and welfare outcomes during commercial long haul transport of cattle in North America. J. Anim. Sci., 90(10): 3640-51. doi:10.2527/jas.2011-4796.
[3]Schwarzkopf-Genswein, K. S., Booth-McLean, M. E., Shah, M. A., Entz, T., Bach, S. J., Mears, G. J., Schaefer, A. L., Cook, N., Church, J., and McAllister, T. A. (2007). Effects of pre-haul management and transport duration on beef calf performance and welfare. Applied animal behaviour science. 108(1-2): 12-30. doi: 10.1016/j.applanim.2006.11.012.
[4]McCall, K. A., Huang, C., & Fierke, C. A. (2000). Function and mechanism of zinc metalloenzymes. *The Journal of nutrition, 130*(5S Suppl), 1437S–46S. https://doi.org/10.1093/jn/130.5.1437S
[5]Stewart, L. (2017). *Mineral Supplements for Beef* Cattle. Univ. of Georgia Extension. PB:895
[6]Heiderscheit, K.J. and Hansen, S. L. (2022). Effect of increasing zinc supplementation on post-transit performance, behavior, blood and muscle metabolites, and gene expression in growing beef feedlot steers. J. Anim. Sci., 100(9). Doi: 10.1093/jas/skac246.

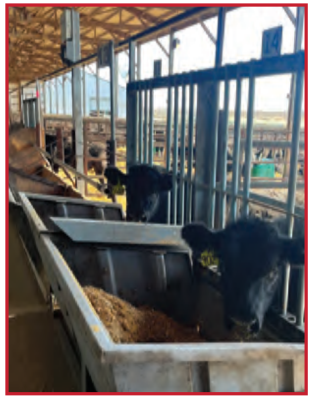
Acknowledgements:
This project was financially supported by USDA NIFA Grant #2022-08296. The authors also wish to acknowledge the efforts of the Hansen Ruminant Nutrition Lab, the Iowa State University Beef Nutrition Farm staff, and KH Trucking.

Diets

Table 1. Ingredient composition of common pre- and post-transit diets

	Pre-Transit (Zn0)	Post-Transit[1]
Ingredient, % DM basis		
Dry-rolled corn	23	23
Corn silage	40	40
DDGS	32	32
Vitamin and mineral premix[2]	3.5	3.5
Limestone	1.5	1.5
Analyzed composition[3]		
Crude protein	16.8	15.0
NDF	26.8	27.7
Ether extract	5.2	5.2
Analyzed TM, mg/kg DM[4]		
Zn	40[5]	123

[1]All steers received Zn100 diet post-transit
[2]Povided vitamins and trace minerals at 2016 NASEM recommendations unless stated otherwise and 24.5g monensin/ton TMR on DM basis
[3]Based on TMR analysis from Dairyland, Inc., Arcadia, WI
[4]Based on TMR analysis via inductively coupled plasma optical emission spectrometry (ICP Optima 7000 DV, Perkin Elmer, Waltham, MA)
[5]Pre-transit Zn100 diet analyzed at 139 mg/kg DM



Pre-Transit Performance

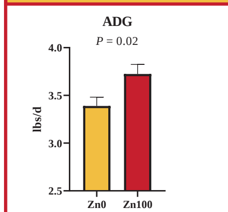


Figure 1. Effects of DIET on ADG pre-transit.

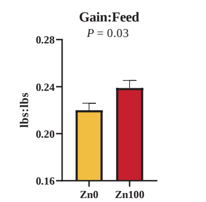


Figure 2. Effects of DIET on gain to feed pre-transit.

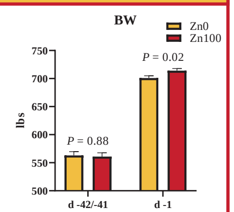


Figure 3. Effects of DIET on d -42/-41 and d -1 BW.

Post-Transit Performance

Table 2. Effects of DIET and DUR on post-transit growth performance

DIET[1]	Zn0		Zn100			*P*-value		
DUR	8H	18H	8H	18H	SEM	DIET	DUR	DIETxDUR
Shrink, %	5.1	7.3	5.2	7.3	0.21	0.84	**<0.01**	0.82
BW, lbs								
d 1	698	694	719	703	5.6	**<0.01**	0.06	0.27
d 7	737	739	730	724	5.5	*0.06*	0.76	0.44
d 28	840	837	834	827	7.6	0.28	0.54	0.85
d 55/56	926	949	948	945	7.9	0.29	0.22	0.11
d 1 to 56								
ADG, lbs/d	4.4[a]	4.3[a]	3.7[b]	4.2[a]	0.13	< 0.01	< 0.01	**0.02**
G:F, lbs/lbs	0.213	0.213	0.190	0.202	0.0061	**< 0.01**	0.32	0.28
Overall								
ADG, lbs/d	3.9	3.9	3.7	3.9	0.09	0.34	0.34	0.11
G:F, lbs/lbs	0.217	0.213	0.212	0.211	0.0057	0.30	0.87	0.99

[a-c]Least square means in a row without common superscripts differ ($P \leq 0.05$).
[1]DIET: Zn0 = 39 mg Zn/kg DM and Zn100 = supplemented 100 mg Zn/kg DM; Zn as $ZnSO_4$

Dry Matter Intake

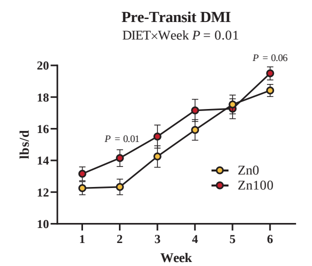


Figure 4. Effects of DIET and week on DMI pre-transit.

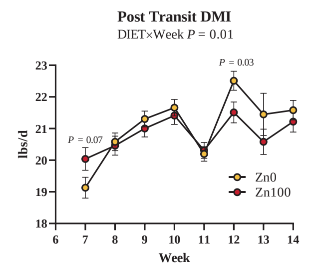


Figure 5. Effects of DIET and week on DMI post-transit.

Dry Matter Intake Recovery

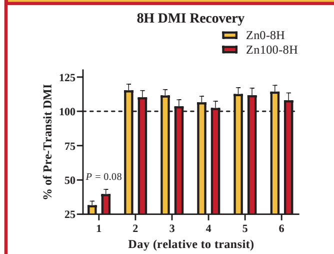


Figure 6. Effect of DIET on DMI recovery (% of pre-transit DMI) [1] for 8H

[1]Pre-transit DMI based on a 10 day average (d-11 to -2)

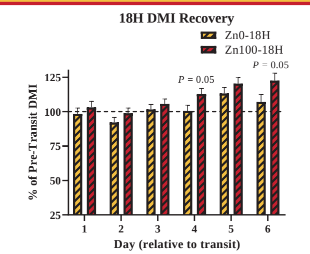


Figure 7. Effect of DIET on DMI recovery (% of pre-transit DMI) [1] for 18H

Summary and Conclusions

- Zn supplementation (100 mg Zn/kg DM) prior to transit improved performance, resulting in a 13 lbs advantage after 41 days over non-supplemented cattle (Figure 3).
- Post-transit Zn supplementation allowed previously Zn-unsupplemented cattle to overcome earlier deficits, resulting in comparable performance across treatments by the study's end (Table 2).
- Zn supplementation enhanced weekly DMI during the pre-transit period for Zn100 cattle and post-transit for Zn0 cattle (Figures 4 & 5).
- Zn supplementation improved DMI recovery across both transit duration groups, although recovery was delayed in the 18H group compared to the 8H group (Figures 6 & 7).

Zinc supplementation is a practical, effective strategy for improving performance and reducing the negative effects of transit stress in the feedlot.

Effect of Using Whole Soybeans, Roasted Soybeans, and Distillers Grains in Growing and Finishing Cattle

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NEBRASKA SOYBEAN BOARD

Introduction

The evolution of the ethanol industry to the production of more processed byproducts has resulted in lower supply of the traditional distillers grains and subsequent increases in price. Concurrently, demand for fats and oils to produce renewable diesel is increasing the availability of soybean products. Soybeans have a crude protein content of 40%, which is mostly comprised (70%) of rumen degradable protein (RDP). Roasting soybeans can increase the amount of protein that is rumen undegradable to approximately 50% or more which is subsequently available for absorption in the small intestine.

Objectives

Evaluate the use of soybean products as an alternative protein source to distillers grains in both silage-based growing diets and finishing diets.

Materials and Methods

Growing

- Randomized block design; 3 × 3 factorial plus control (CON)
- 119 crossbred heifers (initial BW 684±13lb, individually fed. Assigned randomly to treatment
- 3 protein sources: whole soybeans (WSB), roasted soybeans (RSB), distillers grains (MDGS)
- Roasted and raw beans were fed whole
- 3 inclusions: 7%, 14%, 21% diet dry matter
- Dry-rolled corn and urea control (CON)
- Ralgro (Merck Animal Health): 36mg zeranol, on day 1
- Eastern Nebraska Research, Extension and Education Center

Finishing

- Randomized block design
- 400 crossbred yearling steers (initial BW 948 ± 2 lb) assigned randomly to pen. Blocked and stratified by weight
- 5 treatment diets: WSB, RSB, soybean meal (SBM), distillers grains (WDGS), and CON
- Formulated to include same crude protein
- WSB were rolled prior to feeding
- RSB were rolled prior to roasting
- REVALOR-XS (Merck Animal Health): 200 mg trenbolone and 40 mg estradiol on day 0
- Panhandle Research, Extension and Education Center

Diets and Results

Table 1. Dietary treatment composition (DM basis) fed to growing cattle comparing whole and roasted soybeans and modified distillers grains at three inclusion levels and an urea control

	Treatment									
Type	CON	MDGS			WSB			RSB		
Inclusion	0	7%	14%	21%	7%	14%	21%	7%	14%	21%
Dry-Rolled Corn	21	14	7	0	14	7	0	14	7	0
Corn Silage	74	74	74	74	74	74	74	74	74	74
Modified Distillers Grains	-	7	14	21	-	-	-	-	-	-
Whole Soybeans	-	-	-	-	7	14	21	-	-	-
Roasted Soybeans	-	-	-	-	-	-	-	7	14	21
Supplement[1]	5	5	5	5	5	5	5	5	5	5
Urea	1.4	0.8	0.25	0	0.6	0	0	0.6	0	0
Crude Protein	12.4	12.3	12.4	13.4	12.3	12.9	15.0	12.3	12.9	15.0

[1]Diets included Rumensin (Elanco Animal Health) at 20g/ton, melengestrol acetate at 0.05 g/ton,and differing amounts of urea (as noted) due to protein supply

Fig. 1 Dry Matter Intake (DMI) by protein type and inclusion for growing cattle

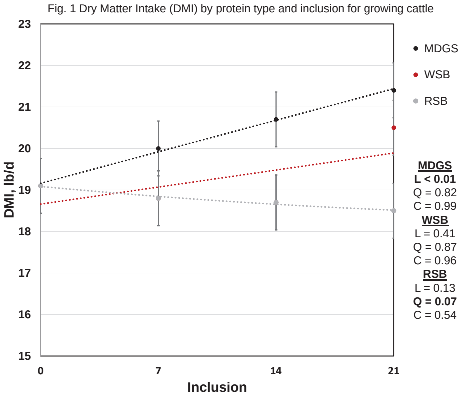

Fig. 2 Average daily gain (ADG) by protein type and inclusion for growing cattle

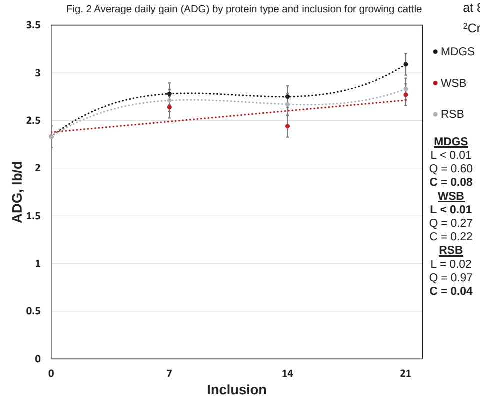

Table 2. Dietary treatment composition (DM basis) fed to finishing cattle comparing whole or roasted soybeans to soybean meal, wet distillers grains, or an urea control

	Treatment				
Ingredient	CON	WDGS	SBM	WSB	RSB
Dry-Rolled Corn	71	62	65	64	64
Corn Silage	20	20	20	20	20
Wet Distillers Grains	-	12	-	-	-
Soybean Meal	-	-	9	-	-
Whole Soybeans	-	-	-	10	-
Roasted Soybeans	-	-	-	-	10
Supplement[1]	9	6	6	6	6
Urea	1.5	1	0.5	1	1
Crude Protein[2]	13.1	14.5	14.5	14.3	14.7

[1]Diets included Rumensin (Elanco Animal Health) at 30g/ton of DM, Tylan (Elanco Animal Health) at 8.8 g/ton of DM and differing amounts of urea (as noted) due to protein supply

[2]Crude protein analyzed by Ward Laboratories

Fig. 3 Feed efficiency (G:F) by protein type and inclusion for growing cattle

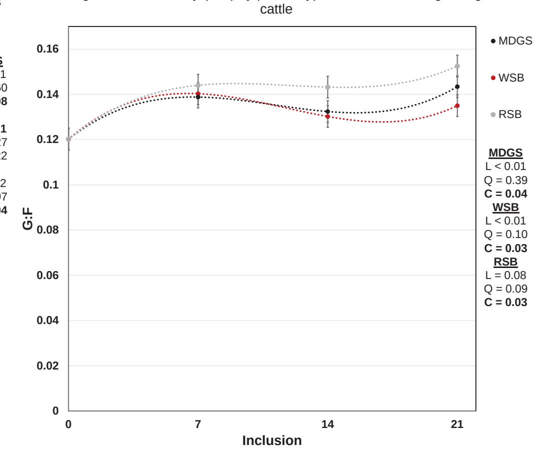

Table 3. Effect of feeding soybeans or roasted soybeans compared to soybean meal, distillers grains, or urea control on feedlot performance and carcass characteristics.

	Treatment						F-test
Item	CON	WDGS	SBM	WSB	RSB	SEM	*P*-Value
Performance							
Initial BW, lb	950	950	951	944	949	2.34	0.06
Final BW, lb[2]	1408^{c}	1473^{ab}	1469^{ab}	1462^{b}	1503^{a}	12.88	<0.01
DMI, lb/d	28.0^{a}	28.9^{a}	27.7^{ab}	26.5^{b}	28.4^{a}	0.448	<0.01
ADG, lb	3.47^{c}	3.96^{ab}	3.93^{ab}	3.92^{b}	4.20^{a}	0.095	<0.01
Gain:Feed	0.1241^{c}	0.1368^{b}	0.1418^{ab}	0.1480^{a}	0.1475^{a}	0.0027	<0.01
Feed:Gain[3]	8.058	7.310	7.052	6.757	6.780		
Carcass Characteristics							
HCW	887^{c}	928^{ab}	926^{ab}	921^{b}	947^{a}	8.15	<0.01
Marbling[4]	479^{b}	509^{ab}	495^{ab}	486^{b}	526^{a}	9.688	0.01
REA	14.1^{b}	14.3^{ab}	14.7^{ab}	14.8^{a}	14.5^{ab}	0.231	0.03
Fat	0.529^{c}	0.605^{ab}	0.568^{bc}	0.528^{c}	0.666^{a}	0.0264	<0.01
Liver Abscess, %[5]	15.2	10.0	10.4	17.7	15.5	4.296	0.56

[abc]Means within a row that lack a common superscript differ ($P \leq 0.05$)

[2]Calculated using hot carcass weight with a 63% dressing percentage adjustment

[3]Analyzed as Gain:Feed, reciprocal of Feed:Gain

[4]Marbling Score 400=Small00, 500=Modest00

[5]Liver abscess counts were analyzed in SAS as a binomial distribution, effect of diet was not significant

Conclusions

- A greater inclusion of protein as RUP increased gain in growing cattle.
- Growing cattle fed roasted soybeans were the most efficient compared to the other treatments.
- RSB contains more RUP than raw soybeans, resulting in similar outcomes to distillers grains, where they appear to contribute about the same amount of RUP (20% on DM basis)
- Soybeans may be an appropriate alternative protein to distillers grains for both growing and finishing cattle.

Influence of program feeding on growth performance and carcass characteristics of calf-fed Holstein and Angus × Holstein steers

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AgNext
COLORADO STATE UNIVERSITY
SUSTAINABLE SOLUTIONS FOR ANIMAL AGRICULTURE

Introduction

- Program feeding seeks to optimize energy intake and efficiency at a targeted rate of gain
- Utilized frequently in growing operations, but has more limited feedlot application historically
- Best practices for receiving nutrition of dairy-derived calves are not well defined
- Limited data comparing beef × dairy and straightbred dairy steers raised in identical settings

Objectives

1. Evaluate the influence of program feeding on feedlot performance and carcass characteristics
2. Evaluate the comparative growth and carcass traits of Holstein and Angus × Holstein steers

Methods

- *N* = 80 steers were received at the UC Davis Desert Research and Extension Center feedlot
  - 40 Angus × Holstein cross steers (**A×H**; 314.2 ± 8.6 lbs.)
  - 40 straightbred Holstein steers (**HOL**; 263.1 ± 7.3 lbs.)
- Allowed ab libitum access to water and sudangrass hay and rested overnight prior to initial processing
- Randomly allocated within breed to 16 pens (4 steers/pen) and assigned to one of two methods of feed allowance:
  1) Program feeding during the initial 112 d on feed followed by ad libitum access to feed (**PF**)
     - Incremental weight gain (G) and DMI estimated according to Torrentera et. al. (2017)
  2) Ad libitum access to feed throughout the entire 328 d feeding period (**ADLIB**)
- Basal diet comprised of 61.0% steam-flaked corn, 17.5% DDGS, and 12.0% roughage
  - Formulated to a NE_g of 0.69 Mcal/lbs.
- Analyzed as a 2 × 2 factorial with pen as the experimental unit
  - Fixed effects: breed, feeding method, and breed × feeding method interaction

Results

Table 1. Influence of feeding strategy on growth performance of calf-fed Holstein and Angus × Holstein steers

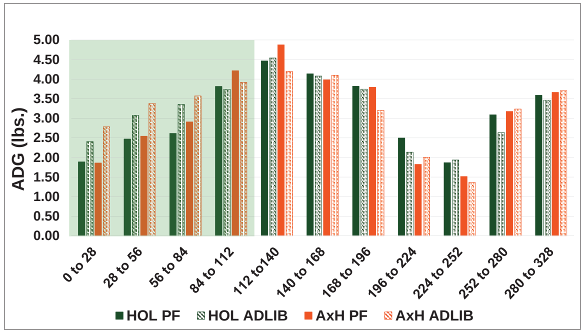
	Treatments[1]							
	Holstein		Angus × Holstein			*P* – value[3]		
	PF	ADLIB	PF	ADLIB	SEM[2]	Program	Breed	Interaction
Live weight, lbs								
Initial[4]	266	260	313	316	7.1	0.92	**< 0.01**	0.54
112 d[4]	557	606	624	686	10.8	**< 0.01**	**< 0.01**	**< 0.01**
328 d[4]	1288	1315	1337	1373	25.1	0.24	**0.05**	0.88
Average daily gain, lbs/d								
1 – 112 d	2.60	3.07	2.78	3.31	0.068	**< 0.01**	**0.01**	0.69
1 – 328 d	3.11	3.22	3.13	3.22	0.071	0.18	0.92	0.99
Dry matter intake, lbs/d								
1 – 112 d	10.30	12.61	10.43	13.19	0.194	**< 0.01**	**0.09**	0.27
1 – 328 d	16.67	17.46	16.67	17.33	0.401	**0.09**	0.88	0.85
Gain to feed ratio								
1 – 112 d	0.253	0.244	0.266	0.251	0.004	**0.01**	**0.03**	0.44
1 – 328 d	0.187	0.184	0.188	0.186	0.002	0.39	0.66	0.81
Observed/Expected NE_g								
1 – 112 d	0.87	0.81	0.99	0.92	0.016	**< 0.01**	**< 0.01**	0.53
1 – 328 d	0.98	0.96	1.03	1.03	0.014	0.53	**< 0.01**	0.62

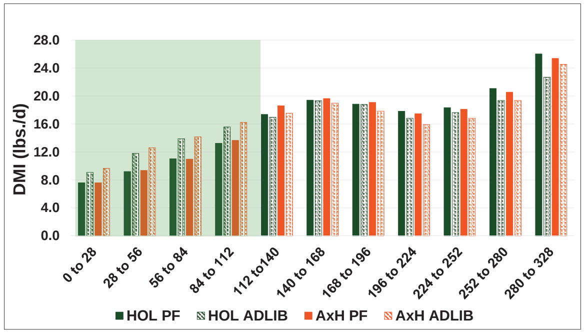
[1]Treatments: **PF**: Program fed – For the first 112 d, incremental weight gain and corresponding DMI were estimated according to Torrentera et. al. (2017); **ADLIB**: Ad libitum intake – feed was provided to allow for a daily feed residual of ~5%.
[2]Largest standard error of the mean
[3]Tested as the significance for the main effects, with interactions between main effects considered
[4]Live weight was reduced by 4% to account for fill

Table 2. Influence of feeding strategy on carcass traits of calf-fed Holstein and Angus × Holstein steers

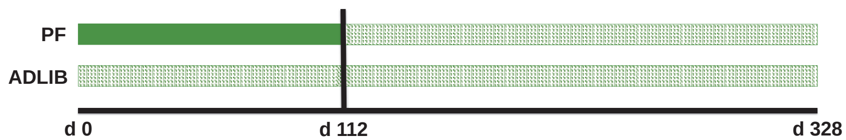
	Treatments[1]							
	Holstein		Angus × Holstein			*P* – value[3]		
	PF	ADLIB	PF	ADLIB	SEM[2]	Program	Breed	Interaction
HCW, lbs.	794	816	832	850	17.2	0.28	**0.06**	0.94
Dressing percentage	61.7	62.0	62.2	61.9	0.31	0.97	0.56	0.35
KPH[4], %	3.05	3.32	3.35	3.13	0.070	0.11	**0.05**	**0.04**
Fat thickness, in	0.20	0.22	0.36	0.36	0.028	0.80	**< 0.01**	0.64
LM area, in[2]	11.8	12.6	13.0	13.4	0.31	**0.10**	**0.01**	0.47
Marbling score[5]	4.36	4.72	5.22	5.01	0.250	0.77	**0.04**	0.27
Calculated yield grade	2.85	2.75	3.06	3.01	0.150	0.59	0.14	0.87
Liver abscess, %	5.0	11.3	0.0	0.0	4.10	0.46	**0.07**	0.46
Liver abscess scars, %	0.0	12.5	5.0	11.3	5.50	0.11	0.74	0.58

[1]Treatments: **PF**: Program fed – For the first 112 d, incremental weight gain and corresponding DMI were estimated according to Torrentera et. al. (2017); **ADLIB**: Ad libitum intake – feed was provided to allow for a daily feed residual of ~5%.
[2]Largest standard error of the mean
[3]Tested as the significance for the main effects, with interactions between main effects considered
[4]Kidney, pelvic, and heart (KPH) fat as a percentage of carcass weight
[5]Coded: minimum slight = 3.0, minimum small = 4.0, minimum modest = 5.0, minimum moderate = 6.0, and so on





Trial Timeline



Summary Results

- Program feeding during the first 112 d on feed limited daily gain and DMI, but resulted in greater feed efficiency
- During the first 112 DOF, A×H steers experienced greater ADG, tended to consume more DM daily, and were more efficient than HOL steers
- A×H steers had heavier live weights and tended to have heavier HCW compared to HOL steers
- Breed influenced energy utilization and compositional endpoint differences

Conclusion

- Early advantages in efficiency associated with programmed feeding do not persist throughout the finishing period
- However, program feeding did tend to alter total feeding period DMI
- Attention needs to be paid to performance and efficiency relative to terminal endpoint differences between breeds

Colorado State University

Effects of Pulse Feeding Monensin on Growth Performance and Carcass Characteristics in Finishing Beef Steers

SOUTH DAKOTA STATE UNIVERSITY

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Introduction

- Monensin sodium is an antibiotic ionophore that selectively inhibits gram positive bacteria
- VFA production in the rumen is altered, resulting in greater propionate production and decreased molar percentage of butyrate and acetate
- Reduction of propionate increases ruminal pH mitigating bouts of ruminal acidosis and decreases methane production.
- Since its approval in 1975, monensin has shown numerous performance benefits such as, increased FE, increased ADG, and decreased DMI.
- In early use, monensin increased F:G ratio by ~8.1%, however F:G results have been reduced to ~3.1% due to increased energy concentrations in modern diets
- Some studies suggest certain rumen microorganisms typically adapt to monensin in 4-6 weeks reducing efficacy in long term use

Objective

- Determine the effects of pulse feeding monensin on growth performance, carcass characteristics, and the prevalence of liver abscesses in feedlot cattle fed a finishing diet

Materials and Methods

Treatment
- Backgrounded Charolais × Angus steers (n = 64; initial BW ≈ 900)
- Cattle were fed at the Ruminant Nutrition Center, Brookings, SD
- Two treatment groups
  - Monensin (continuous)
  - Monensin (pulse feeding)
    - 28 d feeding period followed by 28 d withholding period

Dietary Management
- Cattle were fed twice per day and managed by a slick bunk system

Statistical analysis
- Randomized Complete Block Design
- Pen = Experimental Unit
- Proc Glimmix (SAS 9.4)
- Fixed effect of treatment
- Random effect of Block
- Significance: $P \leq 0.05$

Table 1. Dietary Composition, DM Basis

	Finishing Diet	
	D 15- 63	D 64-165
Ingredients		
DRC	57.72	19.82
MDGS	19.37	24.99
Liquid Supp.*	5.43	5.18
CRNSIL	17.48	-
HMEC	-	50.1
Nutrients**		
DM, %	59.14	63.72
CP, %	15.57	16.39
NDF, %	17.71	21.43
NEm, Mcal/cwt	92.43	91.94
NEg, Mcal/cwt	62.22	62.32

*Liquid supplement contained 30g/ton monensin when applicable to treatment group
** Nutrient values were based on tabular data from NASEM, 2016

Results

Table 2. Cumulative carcass characteristics.[1]

	Treatment[2]			
	Continuous	PF	SEM	P - value
Initial to d 165 (HCW/0.625)				
HCW/0.625, lbs.	1639	1634	37.5	0.90
ADG, lbs.	3.91	3.88	0.205	0.88
DMI, lbs.	25.16	24.59	0.974	0.59
G:F	0.156	0.158	0.0053	0.68
F:G[3]	6.41	6.33	-	-
HCW, lbs.	1024	1021	23.4	0.90
DP, %	64.68	64.84	0.160	0.37
RF, in	0.66	0.66	0.056	0.97
REA, in. sq.	14.84	14.96	0.419	0.79
Marbling	533	555	30.9	0.50
cYG	3.78	3.74	0.141	0.78
RY, %	48.44	48.54	0.285	0.74
EBF, %	33.32	33.44	0.781	0.88
AFBW, lbs.	1405	1396	16.8	0.64
Quality Grade				
Select, %	3.13	0.00	-	0.34
Low Choice, %	37.50	25.00		
Average Choice, %	37.50	50.00		
High Choice, %	18.75	17.86		
Prime, %	3.12	7.14		
Yield Grade				
1, %	0.00	0.00	-	0.59
2, %	15.63	24.14		
3, %	53.12	48.24		
4, %	25.00	17.24		
5, %	6.25	10.34		

[1] All BW measures shrunk 4% to account for digestive tract fill.
[2] Treatments include continuous feeding of monensin sodium (30 g/ton of dietary DM) and Pulse feeding monensin sodium (30 g/ton of dietary DM)
[3] Calculated as: 1/G:F

Table 3. Cumulative growth performance[1]

	Treatment[2]			
	Continuous	PF	SEM	P - value
Steers, n	32	32	-	-
Pens, n	5	5	-	-
Initial BW, lbs.	994	994	1.6	1.00
Initial to d 165				
Final BW, lbs.	1583	1579	33.6	0.91
ADG, lbs.	3.57	3.55	0.167	0.89
DMI, lbs.	25.16	24.59	0.974	0.59
G:F	0.143	0.145	0.0053	0.69
F:G[3]	6.99	6.90	-	-

[1] All BW measures shrunk 4% to account for digestive tract fill.
[2] Treatments include continuous feeding of monensin sodium (30 g/ton of dietary DM) and Pulse feeding monensin sodium (30 g/ton of dietary DM)

Table 4. Liver Health

	Treatment[1]			
	Continuous	PF	SEM	P - value
Liver Scores				
Normal, %	87.50	86.21	-	0.80
A-, %	6.25	3.45		
A, %	3.12	0.0		
A + or greater, %	3.13	10.34		

[1]Treatments include continuous feeding of monensin sodium (30 g/ton of dietary DM) and Pulse feeding monensin sodium (30 g/ton of dietary DM)

Conclusion

- Cumulative growth performance ($P \geq 0.59$) did not differ between treatment groups
- No differences in carcass characteristics or liver health were noted ($P \geq 0.34$)
- Pulse feeding monensin offered no significant advantage over continuous feeding
- Adaptation of rumen microbes may not be the cause of decline in monensin efficacy

Acknowledgements

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Energy Balance and Net Energy for Maintenance of Beef × Dairy Crossbred Steers

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INTRODUCTION

- There are approximately 3.25 to 3.5 million beef × dairy crossbreds on feed currently
- Net energy for maintenance and the efficiency of ME use is unknown in beef × dairy crossbreds
- The NE_m requirement of beef × dairy crossbred steers is hypothesized to be intermediate between beef steers and dairy steers
- Better understanding of energy partitioning and efficiency is necessary for beef × dairy crossbred steers

OBJECTIVE

Our objective was to determine the partitioning of energy in beef x dairy crossbreds fed at 2 multiples of estimated maintenance and to determine their NE_m requirement

MATERIALS AND METHODS

- Beef × dairy steers (n = 17; initial BW 1,084 ± 46 lb) sourced from a calf ranch
- Steers had Holstein dams; 8 steers had Angus sires, and 9 steers had Simmental × Angus sires
- Steers were weighed, blocked by BW, and assigned randomly to 2 multiples of maintenance:
  - **1X** Steers fed at 84 kcal/kg of $BW^{0.75}$, estimated to meet their NE_m requirement
  - **2X** Steers fed at 168 kcal/kg of $BW^{0.75}$, estimated to provide 2-times their NE_m requirement
  - Steers were used in crossover design and allowed for a 42-d level of intake adaptation between periods
    - Period A: 9 steers fed a 1X maintenance, and 8 steers fed at 2X maintenance
    - Period B: 8 steers fed a 1X maintenance, and 9 steers fed at 2X maintenance
- Steer management
  - Steers were housed in metabolism stalls for 6 d to perform total fecal and urine collections
  - During the 6-d collection period, each steer spent 24 h in an indirect respiration calorimeter headbox to estimate heat production from total gas exchange
  - After the 6-d collection period, steers were fasted for 48 h and placed in headboxes to estimate fasting heat production (FHP)
- Total fecal and urine collection
  - Steers were fitted with fecal bags and urine funnels
  - Feces and urine were weighed every 24 h to measure total excretion
  - Daily subsample was used to measure energetic loss
- Gas exchange
  - Steers remained in the headbox for 24 h and O_2 consumption and CO_2 and CH_4 production was measured
  - Heat production was estimated using the Brouwer equation
- NE_m Equation
  - Metabolizable energy intake (MEI) was regressed against retained energy (RE) using FHP, 1X, and 2X measurements
  - NE_m is the point at which RE = 0
- Statistical analyses
  - Crossover design
  - Steer was experimental unit
  - Treatment, group, and period were fixed effects
  - Steer within group was a random effect
  - Kenward Rogers degrees of freedom adjustment used



RESULTS

Energy Partitioning, % of Gross Energy (GE) Intake

Item	1X	2X	SEM	*P*-value
GE, Mcal / d	17.73	31.65	0.613	<0.01
DMI, lb	9.08	16.20	0.616	<0.01
Apparent DM digestibility, %	75.47	79.28	1.085	0.02
Fecal energy loss, % of GE intake	16.58	17.39	0.350	0.07
Digestible energy, % of GE intake	83.42	82.61	0.350	0.07
Urinary energy loss, % of GE intake	4.60	3.56	0.178	<0.01
CH_4 production, % of GE intake	4.59	3.13	0.293	<0.01
Metabolizable energy, % of GE intake	74.24	75.92	0.517	0.01
Heat production, % of GE intake	76.36	54.75	2.025	<0.01
Recovered energy, % of GE intake	-2.12	21.16	2.335	<0.01

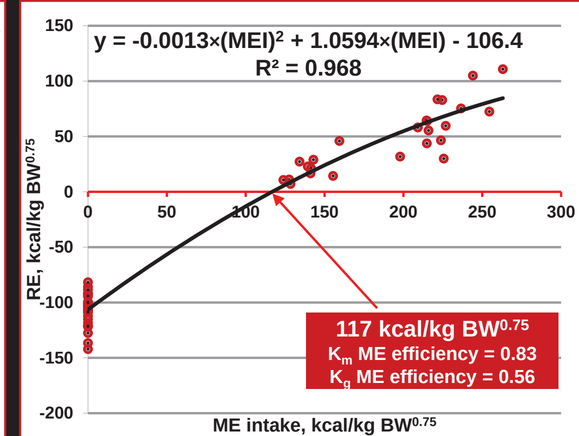
Energy Partitioning, Mcal

Item	1X	2X	SEM	*P*-value
Fecal energy, Mcal / d	2.93	5.50	0.137	<0.01
Digestible energy, Mcal / d	14.80	26.16	0.513	<0.01
Digestible energy, Mcal / lb	1.63	1.61	0.007	0.05
Urinary energy loss, Mcal / d	0.82	1.12	0.042	<0.01
CH_4 production, Mcal / d	0.81	0.97	0.077	0.06
Metabolizable energy, Mcal / d	13.17	24.07	0.496	<0.01
Metabolizable energy, Mcal / lb	1.45	1.48	0.010	<0.01
Heat production, Mcal / d	13.5	17.2	0.51	<0.01
Respiratory quotient	0.86	0.88	0.017	0.24
Recovered energy, Mcal / d	-0.33	6.82	0.539	<0.01

Diet

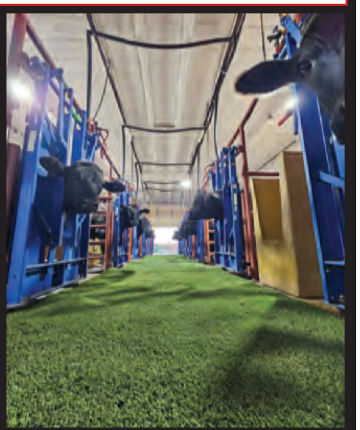
Item	Diet
Ingredient, % of DM	
Steam-flaked corn	64.71
Wet corn gluten feed	21.91
Ground alfalfa hay	9.30
Limestone	1.71
Urea	0.57
Supplement	1.80
Analyzed nutrient composition	
Diet DM, %	82.68
Crude protein, %	15.05
Neutral detergent fiber, %	17.90
Total starch, %	54.03
Crude fat, %	3.13
Ca, %	0.89
P, %	0.47
NE_m, Mcal/lb	0.98
NE_g, Mcal/lb	0.68

NE_m Equation



CONCLUSIONS

- Steers fed at 2 different multiples of maintenance differed among all energy balance measures except, DE as a % of GEI and fecal energy loss as a % of GEI
- Our estimate that beef × dairy steers had a 10% greater NE_m requirement than native beef steers was not correct
- These data suggest that NE_m for 1,100 lb beef × dairy steers is 117 kcal/kg of $BW^{0.75}$
  - Steers were outside thermoneutral zone 41% of the time during the study
  - NE_m requirement is likely greater than expected because steers were between 10 and 14 months of age during the study
  - Established that younger cattle have increased NE_m requirement because of growth
  - Blaxter (1962) estimated that growing cattle could have a NE_m requirement up to 35% greater than mature cattle
- More research is needed to determine whether this value is repeatable as metric to formulate diets for beef × dairy crossbred steers and to directly compare it with purebred beef and dairy cattle



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Impacts of Extended Days on Feed on Performance and Carcass Traits of Brahman Influenced Cattle

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Introduction

Traditionally, cattle feeders have equated the lowest feed-to-gain ratio and cost of gain with maximum profitability[1]. High carcass values, in combination with relatively low corn prices, have led many feeders to increase days on feed to maximize profitability[1 2 4]. While extended feeding periods can improve carcass weight and quality, they also impact feed efficiency, as cattle require more feed per unit of gain as they approach maturity [2 3]. Feeders must carefully balance these factors to determine the optimal harvest endpoint that maximizes both efficiency and economic returns [1]. Managing feed efficiency becomes increasingly important as cattle remain on feed longer, since diminishing returns in weight gain can lead to higher overall feed costs. Therefore, understanding how feed efficiency changes over time is critical in making data-driven decisions to optimize profitability.

Objective

The objective of this study was to create a standard curve to determine the optimal harvest endpoint for maximizing the profitability of feedlot steers.

Methods

- A total of 366 unweaned crossbred (3/8 Brahman) steers (442 lbs.) were shipped from the same ranch in Florida to a feedyard in southwest Kansas.
- The cattle were implanted upon arrival with Synovex Choice and again 90 days later with Synovex One.
- After 260 days, steers were sorted to ensure a similar average current weight (1148 ± 99 lbs.).
- Steers were assigned to one of six harvest dates: 0 day (n=60) (control; harvested 38 days after initial sort), 21 (n=61), 42 (n=62), 63 (n=61), 84 (n=61), or 105 (n=61) d.
- Vytelle bunk units were utilized to measure feed intake.
- Steers were harvested at their respective time points after control at a commercial harvest facility.
- The measured parameters included hot carcass weight (HCW), marbling score, and yield grade (YG).
- Calculated metrics included feed-to-gain ratio by dividing total dry matter intake (DMI) by the total weight gain over the period. Carcass efficiency was calculated by dividing DMI by total HCW gain divided by number of days on feed.
- The PROC MIXED procedure of SAS was used to analyze all data.
- A regression analysis was utilized to determine the slope and intercept of each parameter.

Results

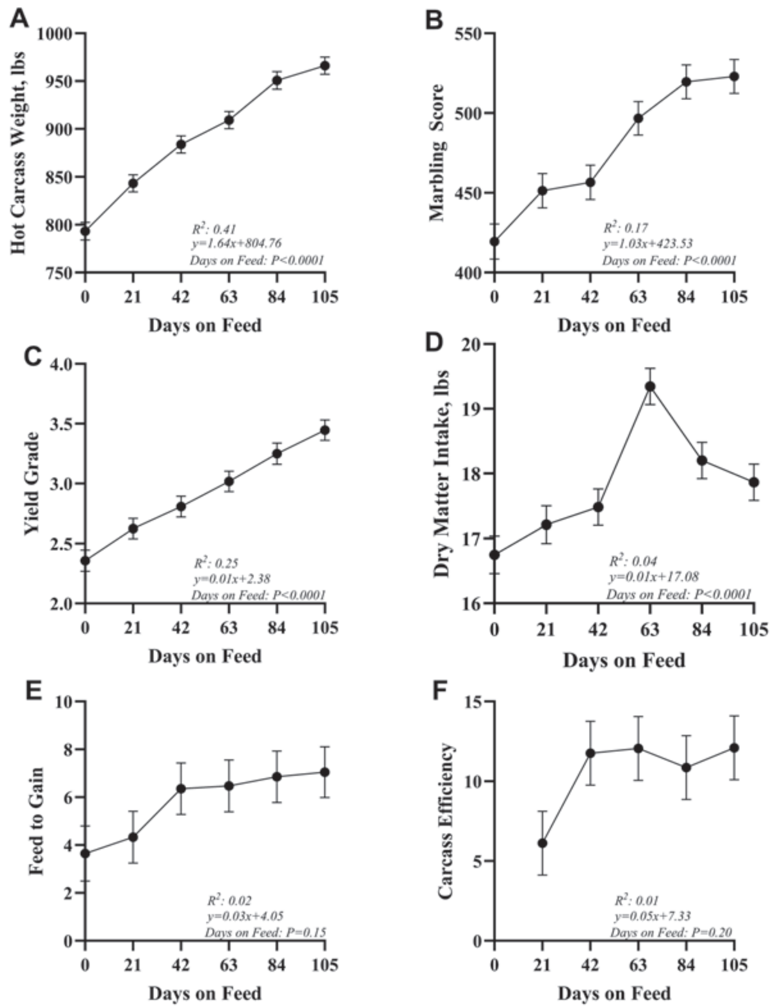

Figure 1: A total of 366 steers were stratified by weight (1148 ± 99 lbs.) into one of six harvest dates: 0 day (n=60) (control; harvested 38 days after initial sort), 21 (n=61), 42 (n=62), 63 (n=61), 84 (n=61), or 105 (n=61) d. Steers were harvested at their respective time points after control at a commercial harvest facility. The parameters that were assessed included hot carcass weight (HCW; A), marbling score (B), yield grade (C), dry matter intake (D), feed-to-gain ratio (E), and carcass efficiency (F).

Results

Conclusion

- It was determined that HCW increased by 1.64 lbs. per day across days on feed with a main effect of days on feed *(P<0.0001)* being observed.
- There was a main effect of days on feed on marbling score *(P<0.0001)*, as evidenced by a linear increase in marbling score of 1.03 per day.
- It was determined that YG increased by 0.01 per day, with a significant days on feed *(P<0.0001)* effect.
- Average DMI increased by 0.01 lbs. per day over the feeding period, and a main effect of days on feed was noted *(P<0.0001)*.
- Feed-to-gain was not impacted *(P=0.14)* by days on feed; however a slope of 0.03 was calculated.
- A general linear regression revealed that feed to carcass gain ratio increased at a rate of 0.05 per day, but no main effects *(P=0.20)* were observed.

Implications

Although carcass efficiency increased, cattle became less efficient at converting feed to carcass gain. Results indicate that while extended days on feed increase carcass weight and marbling, declining efficiency must be weighed against economic factors. The optimal harvest endpoint balances carcass value with added costs. Future research will refine economic models to predict profitability under varying market conditions.

References

1. Albright, Langemeier et al. 1993
2. Sperber, Bondurant et al. 2024
3. Terry et al., 2021
4. Lancaster et al., 2021

Acknowledgements

Authors would like to thank Armando Caballero, Casey Giffing, and Dakota Meyer for their work on this project. Additionally, help was provided by the Utah Agricultural Experiment Station in data analysis.

Predictors of First Treatment Failure and Failure to Finish for Feedyard Cattle Treated for Acute Interstitial Pneumonia

Merri E. Day[1,3], Phillip A. Lancaster[2,3], Dustin L. Pendell[1,3], Brad J. White[2,3], Robert L. Larson[2,3]

Introduction

Acute interstitial pneumonia (AIP) affects approximately 3% of cattle in U.S. feedyards. AIP is often identified in feedyard cattle closer to harvest than other respiratory illnesses and is more prevalent in heifers than steers. Coupled with late incidence, negative outcomes following AIP treatment may have severe health and economic consequences. Even if identified early in the feeding period, subsequent AIP diagnoses and treatments may affect productivity and treatment outcomes. Identification of risk factors associated with AIP treatment outcomes is essential to further the understanding of how feedyard cattle diagnosed with AIP should be managed. Clinical signs of AIP include acute dyspnea, open-mouthed breathing, and grunting. Heat stress, exposure to dust and toxins, and parasites are a few factors associated with AIP. However, the etiology of AIP remains uncertain, and there is relatively little work focused on the identification of potential risk factors associated with AIP treatment outcomes.

Objective

The objective of this analysis was to identify risk factors associated with first-AIP-treatment-failure (FTF*;* relapse of AIP requiring additional treatment, culls and mortalities following AIP treatment) and failure-to-finish (DNF; culls and mortalities following AIP treatment). Risk factors evaluated in this study include characteristics at time of arrival and treatment, timing of AIP treatment, and prior BRD treatment.

Materials & Methods

This study utilizes proprietary health data from 9 Kansas feedlots spanning from 2019 through 2023 to evaluate predictors associated with treatment outcomes of cattle treated for AIP (**Table 1**). Only cattle diagnosed with AIP ante-mortem were considered for analysis. The outcomes of interest in this study were first AIP treatment failure and did not finish. FTF was defined as retreatment for AIP or failure to finish with their cohort after receiving one AIP treatment. DNF was defined as failure to finish with their cohort, irrespective of number of AIP treatments. Mixed-effects logit models were employed to estimated the probability of FTF (PFTF) and the probability of DNF (PDNF).

Table 1: Summary statistics for nine Central U.S. high plains feedyard cattle treated for AIP from 2019 through 2023.

	Mean	Std. dev.	Min	Max
Arrival Weight (lbs.)	745	91.90	502	1000
DOF	136	34.73	1	251
First AIP Treatment Weight (lbs.)	1093	163.09	518	1895
DOF at First AIP Treatment	117	36.76	1	237
Risk Days Remaining	37	44.89	0	215
Morbidity (%) [a]	25.00	17.51	1	100
Mortality (%) [a]	3.66	3.15	0	25

Notes: [a] Mean cohort morbidity and average cohort mortality for feedyard cattle treated for AIP.

Variables used in the working dataset for analysis of risk factors associated with the PFTF and the PDNF are presented in **Table 2**. Derived variable generation was implemented to designate prior diagnosis and treatment, as well as timing of the first AIP treatment. A calf level indicator variable was generated to specify whether cattle were treated for BRD prior to receiving the first AIP treatment. Levels for DOF at first AIP treatment (*first AIP treatment date – arrival date*) and risk days remaining (*expected harvest date – first AIP treatment date*) were selected based on definition of treatment timing from previous feedyard respiratory disease studies and the distribution of data used for analysis.

Table 2: Variables used in the working dataset for analysis of risk factors associated with FTF and DNF.

Variable	Description
Feedyard ID	Indicates feedyard
Sex	Heifer or Steer
Arrival Quarter	Q1 = January, February, March; Q2 = April, May, June; Q3 = July, August, September; Q4 = October, November, December
Arrival Weight	500-599 lbs.; 600-699 lbs.; 700-799 lbs.; 800-899 lbs.; 900-1000 lbs.
First AIP Treatment Quarter	Q1 = January, February, March; Q2 = April, May, June; Q3 = July, August, September; Q4 = October, November, December
First AIP Treatment Weight	< 1000 lbs.; 1000-1250 lbs.; > 1250 lbs.
Treated for BRD First	0/1; Calf level variable indicating if animal was treated for bovine respiratory disease prior to receiving first AIP treatment; 0 = No, 1 = Yes
DOF at First AIP Treatment	< 40 days; 40-100 days; > 100 days
Risk Days Remaining	< 40 days; 40-100 days; > 100 days
First-AIP-Treatment-Failure (FTF)	0/1; Calf level variable indicating if animal finished with cohort after receiving just one AIP treatment; 0 = finished, 1 = failed
Failure-to-Finish (DNF)	0/1; Calf level variable indicating if animal died in the feedyard or was culled following any AIP treatment; 0 = finished, 1 = died or culled

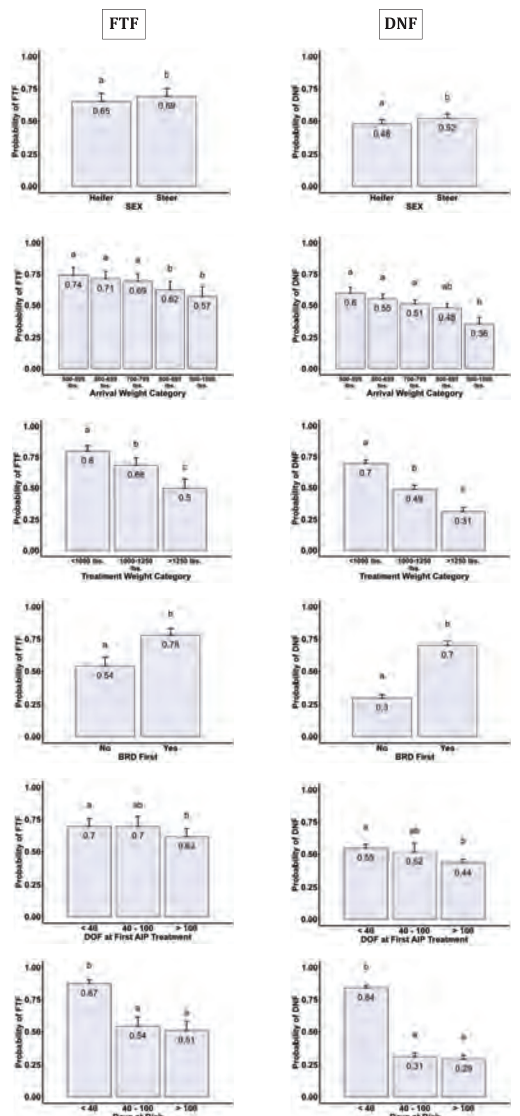

Figure 1. Probability of first AIP treatment failure (FTF) and failure to finish (DNF). Results generated from mixed-effects logistic model accounting for: (**FTF**) binomial response of FTF with random feedyard effects and fixed effects of sex, arrival weight category, first AIP treatment quarter, first AIP treatment weight category, prior BRD treatment, DOF at first AIP treatment category, and risk days remaining category; (**DNF**) binomial response of DNF with random feedyard effects and fixed effects of sex, arrival weight category, first AIP treatment weight category, prior BRD treatment, DOF at first AIP treatment category, and risk days remaining category. Different superscript letters illustrate statistical differences in probabilities ($p \le 0.05$).

Results

A description of animals treated for acute interstitial pneumonia and percent of the sample represented is provided in **Table 3**. The final multivariable model for factors associated with PFTF included fixed effects for sex, arrival weight category, quarter of first AIP treatment, first AIP treatment weight category, prior BRD treatment, DOF at first AIP treatment category, and risk days remaining category ($p \le 0.05$). The final multivariable model for factors associated with the PDNF included the same fixed effects, except for quarter of first AIP treatment ($p \le 0.05$). Arrival quarter was not statistically associated with either outcome, so it was not included in the final models. Both models also included random feedyard effects. Findings from this analysis indicated that sex, arrival weight category, first AIP treatment weight category, AIP treatment timing, and BRD treatment prior to AIP treatment were significantly associated with PFTF and PDNF for feedyard cattle treated for AIP (**Figure 1**). Most cattle are first treated for AIP with <40 days remaining at risk, regardless of arrival weight (**Figure 2**).

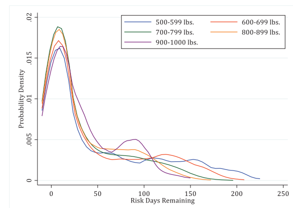

Figure 2: Distribution of risk days remaining at first AIP treatment for Central U.S. high plains feedyard cattle treated for AIP.

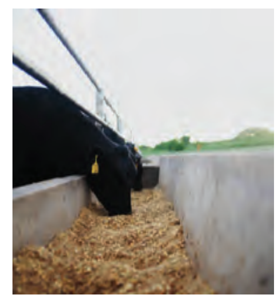

Photo courtesy of Dr. Lilli Heinen, DVM - Kansas State University, College of Veterinary Medicine

Table 3: Description of animals treated for AIP (n = 3,800) and percent of the sample represented.

Variable	Level	Number of animals	Percent
Sex	Heifer	2,634	69.32
	Steer	1,166	30.68
Arrival Quarter	1	1,420	37.37
	2	1,153	30.34
	3	530	13.95
	4	697	18.34
Arrival Weight (lbs.)	500-599	257	6.76
	600-699	887	23.34
	700-799	1,631	42.92
	800-899	857	22.56
	900-1000	168	4.42
First AIP Treatment Quarter	1	411	10.82
	2	1,504	39.58
	3	1,254	33.00
	4	631	16.60
First AIP Treatment Weight (lbs.)	< 1000	977	25.71
	1000-1250	2,193	57.71
	>1250	630	16.58
Treated for BRD First	No	2,994	78.79
	Yes	806	21.21
DOF at First AIP Treatment	< 40	111	2.92
	40-100	998	26.26
	>100	2,691	70.82
Risk Days Remaining	< 40	2,557	67.29
	40-100	760	20.00
	>100	483	12.71
First-AIP-Treatment-Failure		2,679	70.50
Failure-to-Finish		2,215	58.29

Conclusions

Results indicate that steers may be at increased risk for negative AIP treatment outcomes. Cattle placed at lighter weights have increased PFTF and PDNF compared to those placed at heavier weights. Similarly, cattle first treated for AIP at lighter weights have higher PFTF and PDNF compared to those first treated at heavier weights. Weight could be indicative of age, suggesting that younger cattle might be more susceptible to AIP than older cattle. Cattle that are first treated within 40 days of expected harvest have increased PFTF and PDNF compared to cattle treated with 40 to 100 days remaining at risk and cattle treated with more than 100 days remaining at risk. These findings imply that AIP cases identified early in the feeding period (<40 DOF) also have increased risk of negative outcomes following AIP treatment compared to those identified later in the feeding period (>100 DOF). Current findings illustrate increased PFTF and PDNF for cattle treated for BRD prior to the first AIP treatment. Although we find a significant link between prior BRD morbidity and AIP treatment outcomes, we cannot establish causality. Cattle treated for BRD may be more susceptible to AIP later on; however, this study did not investigate clinical indicators for cattle treated for both BRD and AIP.

Affiliations/Acknowledgements

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Impact of Controlled Feeding and Delayed Implanting on Growth and Carcass Traits in Finishing Steers

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Introduction

- Limit feeding is most often used in growing cattle by programming to a targeted gain or by limit feeding a high-concentrate diet
- In finishing cattle, limit feeding improves feed efficiency and simplifies bunk management, but can decrease carcass weights and quality grades or extend days on feed (Galyean et al., 1999)
- Limit feeding for a portion of the finishing period may improve feed efficiency without affecting gain and quality grade by capitalizing on compensatory gain
- Androgenic terminal implants improve ADG, F:G, and final BW but can also decrease quality grade and is wasted if cattle are limit fed during the payout period
- Delaying implant administration until the end of the feed restriction period may minimize marbling reduction while improving growth performance

Objective

Experiment 1

- Determine the effect of limit feeding yearling beef steers for 56 or 86 d before offering ad libitum feed for the remainder of the 140-d finishing period on growth performance and carcass traits

Experiment 2

- Determine the effect of limit feeding backgrounded steers and delaying implant administration for 63-d of the finishing period on growth performance and carcass traits
- Determine whether implant delay can minimize negative carcass responses in limit-fed cattle without affecting growth performance

Methods & Approach

Experiment 1

- 194 Black Angus steers (908 ± 37.0 lb) allocated into 24 pens of 8 steers per pen
- Randomly assigned to one of three treatments in a RCBD

Experiment 2

- 232 Charolais × Angus steers (1054 ± 60.4 lb) allocated into 24 open dry lot pens (8 steers/pen) and 8 partially covered concrete pens (5 steers/pen)
- Randomly assigned to one of four treatments in a 2 × 2 factorial

Processing

- Vaccinated against viral respiratory and clostridial disease, and administered an anthelmintic
- Implanted with a 200 mg TBA and 20 mg E2 implant on d 21 in Exp. 1, and on either d 1 (INI) or d 63 (DEL) in Exp. 2

Dietary Management

- Cattle were transitioned to a finishing diet over 21-d and feed was delivered daily at 0800
- Restricted groups were fed 92% of *ad libitum* group within their block and implant treatment during respective restriction periods

Statistical Analysis

- Proc MIXED procedure for growth performance. Distribution of quality and yield grades analyzed as multinomial proportions using Proc GLIMMIX

Treatments

Experiment 1

- **CNTRL**: Offered *ad libitum* feed for the entire finishing period
- **RES56**: Fed at 92% of *ad libitum* for 56 d, then *ad libitum* for 84 d
- **RES86**: Fed at 92% of *ad libitum* for 86 d, then *ad libitum* for 54 d

Experiment 2

2 × 2 factorial of diet and implant treatments

Diet Treatments

- **ADL**: *Ad libitum* feed for the entire finishing period
- **RES**: Feed restricted to 92% of *ad libitum* for 63-d then offered *ad libitum* feed for remainder of finishing period

Implant Treatments (200 mg TBA & 20 mg E2)

- **INI**: Initially implanted on d 1
- **DEL**: Delayed implant administered on d 64

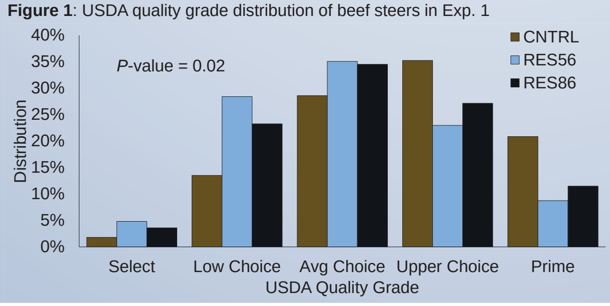
	Exp. 1	Exp. 2
Diet Ingredients, % DM		
Dry Rolled Corn	68.82	70.57
Modified Distillers Grains Plus Solubles	17.21	17.49
Sorghum Silage	9.92	7.99
Suspended Supplement	4.05	3.95
Dietary Nutrient Composition		
DM, % AF	65.4	66.6
CP, % DM	12.7	12.7
NDF, % DM	16.9	16.0
ADF, % DM	7.8	7.3
Ash, % DM	5.0	4.9
EE, % DM	3.4	3.5
NEm, Mcal/cwt	93.8	94.7
NEg, Mcal/cwt	62.7	63.5

Experiment 1

Variable[1]	CNTRL	RES56	RES86	SEM	*P*-value
Initial SBW, lb	912	907	910	-	-
DMI, lb/d	30.58[a]	29.66[b]	29.38[b]	0.148	<0.01
DMI, %SBW	1.94[a]	1.90[b]	1.86[c]	0.023	<0.01
DMI, %MBW	12.23[a]	11.92[b]	11.72[b]	0.135	<0.01
Carcass Adjusted Performance					
Final SBW, lb	1569	1561	1577	4.5	0.43
ADG, lb/d	4.70	4.67	4.77	0.030	0.46
F:G[2]	6.51[a]	6.35[ab]	6.16[b]	-	0.01
Carcass Traits					
HCW, lb	981	975	986	2.8	0.43
REA, in[2]	13.7	14.1	13.9	1.40	0.44
Rib Fat Thickness, in	0.69[a]	0.63[b]	0.62[b]	0.049	0.04
Marbling[3]	612[a]	556[b]	568[b]	14.1	0.03

[1]All body weight measurements were shrunk 4% to account for gastrointestinal fill
[2]Analyzed as G:F, the reciprocal of F:G
[3]400=Small[00]

Figure 1: USDA quality grade distribution of beef steers in Exp. 1



Experiment 2

Variable[1]	Implant: INI	Implant: DEL	Diet: ADL	Diet: RES	SEM	*P*-value: IMP	*P*-value: DIET	*P*-value: IMP × DIET
Initial SBW, lb	1013	1012	1012	1013	18.7	0.53	0.42	0.72
d 63 SBW, lb	1328	1263	1307	1284	21.2	<0.01	<0.01	0.43
Final SBW, lb	1572	1568	1573	1567	24.1	0.67	0.57	0.81
DMI, lb/d	25.43	24.76	25.42	24.77	0.499	0.02	0.03	0.55
Carcass Adjusted Performance								
Final SBW, lb	1619	1623	1620	1622	25.0	0.71	0.80	0.67
ADG, lb/d	4.30	4.33	4.31	4.31	0.097	0.66	0.97	0.66
F:G[2]	5.91	5.72	5.89	5.74	-	0.04	0.11	0.44
Carcass Traits								
HCW, lb	1012	1014	1012	1014	15.6	0.71	0.80	0.67
REA, in[2]	14.9	15.4	15.0	15.2	0.24	0.01	0.22	0.30
Rib Fat Thickness, in	0.61	0.55	0.59	0.58	0.023	0.01	0.67	0.67
Marbling Score[3]	506	514	516	504	16.3	0.59	0.43	0.32
EBF[4]	34.0	32.9	33.7	33.1	0.48	0.01	0.20	0.82
AFBW[5]	1363	1383	1374	1372	18.9	0.18	0.92	0.11
M-Scores[6]								
Rib Fat vs. Marbling	-6.92	3.93	4.07	-7.06	15.659	0.45	0.43	0.29

[1]All body weight measurements were shrunk 4% to account for gastrointestinal fill
[2]Analyzed as G:F, the reciprocal of F:G
[3]400=Small[00]
[4]Estimated empty body fat (EBF) percentage from observed carcass traits (Guiroy et al., 2001)
[5]Final shrunk body weight adjusted to 28% EBF (AFBW) according to Guiroy et al. (2001)
[6]M-score is the difference between the observed and expected marbling score from the regression of rib fat and marbling

Figure 2: USDA yield grade distribution of beef steers in Exp. 2

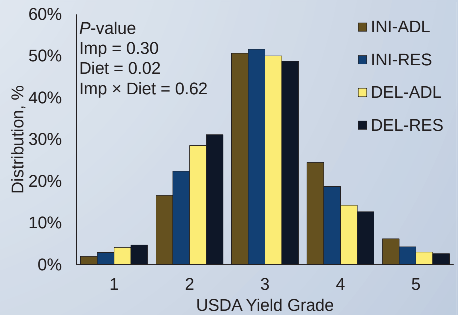
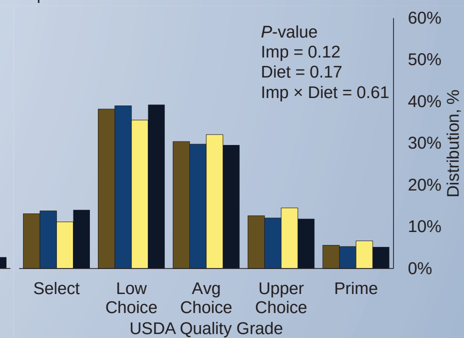


Figure 3: USDA quality grade distribution of beef steers in Exp. 2



Conclusions

Limit Feeding:

- **Decreased cumulative DMI and did not affect growth performance or HCW in both experiments**
- **Decreased marbling and quality grade distribution in experiment 1**

Delaying Implant administration:

- **Decreased DMI by 2.6%**
- **Improved feed efficiency by 3.4%**
- **Decreased rib fat thickness**
- **Increased REA**
- **Shifted USDA yield grade distribution towards more 1 and 2's**

Use of unmanned aerial vehicle technologies to assess nutrient landscape of cattle pens managed with energy-dense vs. low-energy feeding programs

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INTRODUCTION

- Uses of unmanned aerial vehicle (UAV) technologies in the feedlot industry are being developed for purposes related to inventory, animal management, and yard management
- Monitoring temperature, moisture, and bedding status directly affects cattle performance and health (Anderson et al., 2005).
- Quantifying pen conditions may allow management to aid in regulating cattle environments to decrease the effects of heat or cold stress. Additional bedding or altering rations can significantly impact performance (Mader et al. 2002).
- Use of UAV technologies to monitor and assess pen conditions may better inform and improve response times, resulting in lower health events.

HYPOTHESIS

We hypothesized cattle pen conditions can be detected using unmanned aerial vehicle (UAV) technologies

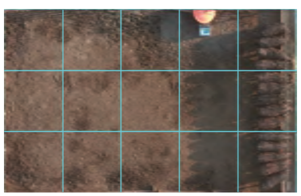
OBJECTIVES

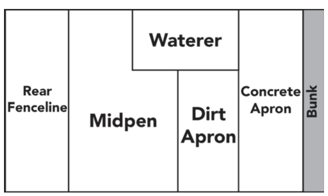
1. Characterize direct measurements to describe the landscape of cattle pens managed with energy-dense limit-fed or low-energy adlib feeding programs
2. Evaluate the association of thermal images taken using UAV technologies with the nutrient landscape of feedlot pens

MATERIALS AND METHODS

CATTLE PENS:

- Dirt floor feedlot pens (n=6) (30 ft x 50 ft) (Manhattan, KS)
  - Gridded into 15 quadrants (10 ft x 10 ft) (10 ft concrete apron)
  - Quadrants classified into regions: concrete apron, dirt adjacent to apron, area surrounding water source, mid-pen, and rear-fence line
- 14 dairy-beef crossbred steers per pen (avg. BW = 1000 lbs)





TREATMENTS:

1. Energy-dense limit-fed ration (64 NEg) (limit-fed)[a] | n = 3
2. Low-energy ad libitum ration (50 NEg) (adlib)[b] | n = 3

[a] Limit-fed ration consists of dry rolled corn (58.9%), wet corn gluten (30.0%), prairie hay (7.0%), supplement (4.1%)
[b] Adlib ration consists of wet corn gluten (40.0%), prairie hay (30.0%), dry rolled corn (24.4%), supplement (5.6%)

PEN FLOOR SAMPLES *(on 112 d. of backgrounding phase during first daily feeding):*

- Within each pen, 3 pen floor grab samples (0.55 lbs) and 3 direct temperature measurements were taken from each quadrant
  - Samples were analyzed for moisture, ash, NDF, and ADF

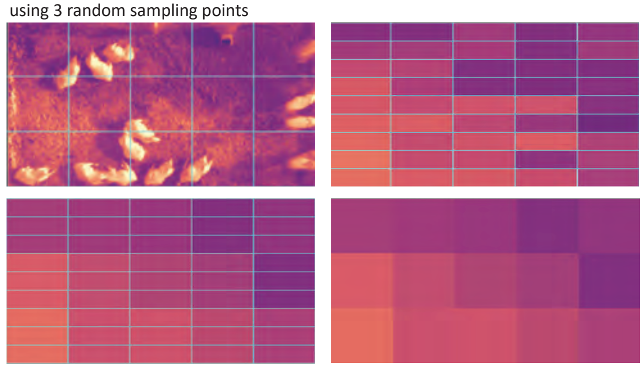
UAV IMAGING *(on 112 d. of backgrounding phase during first daily feeding):*

- UAV (DJI M300) equipped with a thermal sensor (H20T) was flown over each pen (100 ft altitude) to capture images
  - Images were processed using Pix4D and visualized using ArcGIS

MATERIALS AND METHODS

UAV IMAGE PROCESSING:

Photoshop was used to obtain average color values (luminance) for each quadrant using 3 random sampling points



*Color values from the final images were used for statistical analysis

STATISTICAL ANALYSIS:

- Data was analyzed using the linear model package in R. Pen was considered as a random factor
  - Effect of feeding program by pen region for each direct measurement variable was evaluated (moisture, ash, moisture:ash, NDF, ADF, direct temperature, luminance)
  - Variables with identified differences ($P < 0.05$) across the pen regions by feeding program were tested for association by pen region to luminance
- Lin's concordance correlation coefficient (Lin's CCC) used to determine the relationship between direct measurement variables and luminance

RESULTS

Table 1: Modeling the effect of feeding program and pen region for each direct measurement

	P-Value		
Direct Measurement	TRT	Pen Region	TRT*Pen Region
Moisture, %	0.01	<0.001	0.009
Ash, % of DM	0.06	<0.001	0.10
Moisture:Ash	0.01	<0.001	0.002
Direct Temp, ºF	0.23	<0.001	< 0.001
Luminance, cd	<0.001	<0.001	0.007
NDF, % of DM	0.01	<0.001	0.009
ADF, % of DM	0.01	<0.001	0.009

Figure 1: Landscape of differences in luminance (cd) value extracted from UAV thermal images using photoshop presented by pen region for each feeding program (energy dense limit-fed vs. low energy ad lib)

Figure 1a: Energy-Dense Limit-Fed pen luminance averages by pen region

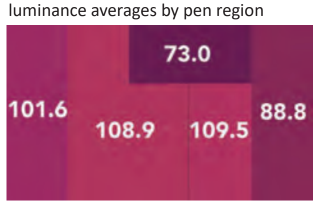
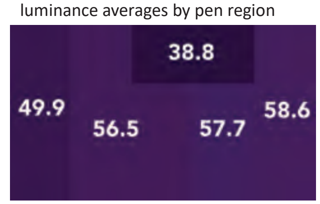


Figure 1b: Low-Energy Adlib Fed pen luminance averages by pen region



RESULTS

Figure 2: Landscape of differences in moisture (% of DM) as a direct measurement within pen region for each feeding program

Figure 2a: Energy-Dense Limit-Fed pen moisture averages

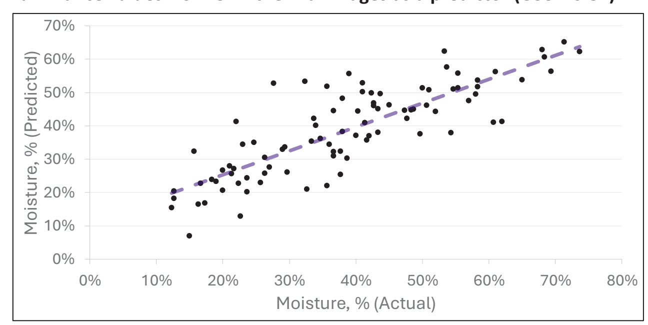
Figure 2b: Low-Energy Adlib Fed pen moisture averages

Table 2: Using luminance (cd) values extracted from UAV images to predict direct measurement variables across identified pen regions

	Luminance	Luminance*Pen Region	Actual vs. Predicted[a]
Direct Measurement	*P*-value		CCC[b]
Moisture, %	< 0.001	0.004	0.82
Ash, % of DM	< 0.001	0.04	0.36
Moisture:Ash	< 0.001	<0.001	0.59
Direct Temp, ºF	< 0.001	<0.001	0.02
NDF, % of DM	< 0.001	0.004	0.23
ADF, % of DM	< 0.001	0.004	0.18

[a] Lin's CCC with 95% confidence interval (not reported)
[b]CCC values were interpreted as: > 0.9: excellent; 0.8 - 0.9: good; 0.6 to 0.8: moderate; below 0.6: poor
*Luminance by pen region for all direct measurement variables (P<0.001)

Figure 3: Association of direct measurement values for moisture compared with predicted values for moisture by pen region using luminance values from UAV thermal images as a predictor (CCC = 0.82)



CONCLUSIONS

- Characterized landscapes of pens with different feeding programs (energy-dense limit-fed vs. low-energy adlib) showed differences in moisture, NDF, and ADF content within certain pen regions
- Characterized landscapes of cattle pens demonstrate differences in moisture, ash, NDF, and ADF across the pen floor regions, but there are varying degrees of accuracy by which they are detected by UAV thermal images
- Moisture demonstrates good accuracy and precision (CCC = 0.82) when predicted from luminance values, indicating moisture can be used to characterize pen landscape from UAV thermal images
- Direct temperature measurement differences were not detected by thermal images but hypothesized to be due to time-of-day images were collected

Longitudinal assessment of *Salmonella enterica* in feedlot beef cattle: Associations with liver abscess development and metaphylaxis

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INTRODUCTION

- Liver abscess (LA) prevalence ranges from 0 to 95.5% on a pen basis, with the overall prevalence increasing since 2012 (Grimes et al., 2024).
- Economic losses associated with LA are estimated to exceed $1 billion annually in the U.S. (Lawrence, 2024).
- Feeding of antimicrobial drugs, like tylosin phosphate, is the most common strategy to control LA.
- Little data substantiates how feedlot diet and management alter the prevalence of *Salmonella enterica* and *Fusobacterium necrophorum* in the gastrointestinal tract of finishing cattle.
  - *Salmonella* has been reported to increase the prevalence and severity of LA (McDaniel et al., 2024).
- **Our objectives were to longitudinally assess the prevalence of *Salmonella* and *Fusobacterium* in the ruminal fluid and feces of finishing beef steers with and without LA.**

- Economic losses associated with bovine respiratory disease (BRD) can exceed $2 billion annually in the U.S. (Wilson et al., 2017).
- Metaphylaxis is the primary arrival management protocol that consistently improves clinical health outcomes in high-risk cattle.
- Administration of antimicrobials can disrupt the intestinal microbiome, but a correlation between BRD incidence, antimicrobial use, and pathogen shedding has not been evaluated.
- In cattle, salmonellosis caused by *Salmonella* can be misidentified as BRD, directly or indirectly affecting feedlot cattle morbidity, mortality, and production efficiency (Guterbock, 2014).
  - The initial 14 days after feedlot arrival are critical for pathogenic bacterial transmission (Dornbach et al., 2023).
- **Our objectives were to evaluate the effects of random metaphylaxis on BRD incidence, growth performance, antimicrobial use, and *Salmonella* shedding in high-risk beef steers.**

EXPERIMENT 1

Materials and Methods

- Crossbreed steers (n = 225; 694 ± 56.9 lb) were used in a case-control design.
- *Animal Management:*
  - Steers housed in soil-surface pens from d 0 to d 21 (n = 9 to 10 steers/pen).
  - From d 22 to harvest (d 250 for block 1; d 221 for block 2), steers were housed in concrete slatted pens (n = 3 to 4 steers/pen).
- *Sample collection:*
  - Ruminal fluid and feces were collected longitudinally for *Salmonella* and *Fusobacterium*.
    - After feedlot arrival (d 5).
    - After adaptation to the finishing diet (d 35).
    - Day before harvest (End).
  - Healthy and abscessed livers were collected at a commercial abattoir.
- **Following harvest, LA prevalence was determined, and steers were allotted into 1 of 2 treatments:**
  - ***Steers without LA (n = 183).***
  - ***Steers with LA (n = 42).***
- *Statistical analyses:*
  - Steer was the experimental unit for all analyses.
  - Data were analyzed using PROC GLIMMIX (SAS 9.4) for binomial bacterial prevalence data and MIXED for continuous bacterial concentration data.
  - Fixed effects of treatment, day, and treatment × day; random effect of block × day × treatment.

Table 1: Formulated and analyzed diet composition fed to steers from d 0 to harvest.

Item	Receiving d 0 to 7	Transition 1 d 8 to 14	Transition 2 d 15 to 21	Finishing d 22 to End
Ingredient, % DM				
Steam-flaked corn	17.84	43.61	60.00	64.05
Sweet bran	56.61	33.96	20.98	24.44
Alfalfa hay	21.86	18.08	13.59	6.88
Supplement	1.96	2.41	2.38	2.08
Limestone	1.73	1.94	1.93	1.82
Urea	---	---	1.12	0.73
Nutrient analysis, % DM				
DM, %	68.5	73.5	74.2	75.5
CP, %	19.4	15.6	13.9	13.6
NDF, %	28.3	24.3	20.9	19.3
Crude fat, %	3.6	3.5	3.4	3.3
Ca, %	1.07	1.11	1.12	1.09
P, %	0.72	0.65	0.61	0.58
NEm, Mcal/cwt	89	92	94	98
NEg, Mcal/cwt	56	62	64	68

Results

Figure 1: Prevalence of *Fusobacterium necrophorum* subsp. *necrophorum* (A), *F. necrophorum* subsp. *funduliforme* (B), *F. varium* (C), and *Salmonella* (D) in the ruminal fluid of beef steers with and without LA.

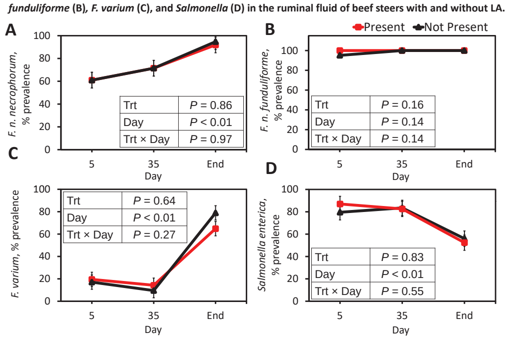


Figure 2: Prevalence of *Fusobacterium necrophorum* subsp. *necrophorum* (A), *F. necrophorum* subsp. *funduliforme* (B), *F. varium* (C), and *Salmonella* (D) in the feces of beef steers with and without LA.

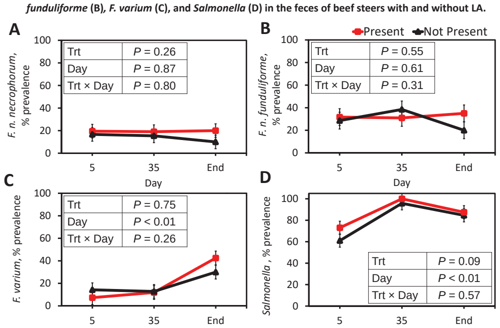


Figure 3: Relative proportion (%) of *Fusobacterium* concentrations in the ruminal fluid (A) and feces (B) of beef steers with and without LA.

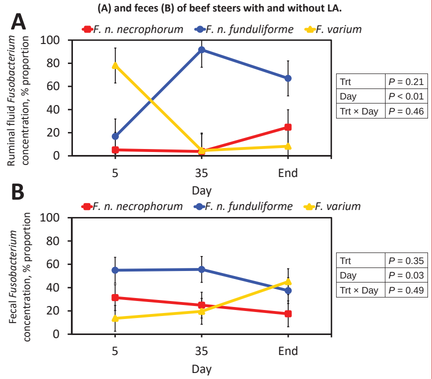


Table 2: *Salmonella enterica* concentration (log_{10} CFU/g) in the ruminal fluid and feces of beef steers with and without LA.

Item	Liver abscess Not present	Liver abscess Present	SEM	P-value Trt	P-value Day	P-value Trt × Day
n, steers	183	42				
Ruminal fluid						
Salmonella						
Day 5	3.61	3.83	0.200	0.37	<0.01	0.22
Day 35	3.41	3.39				
End	3.16	3.13				
Fecal *Salmonella*						
Day 5	3.48	3.50	0.035	0.07	<0.01	0.14
Day 35	4.62	4.47				
End	4.96	4.36				

Table 3: Absolute abundance (copies/g) and prevalence (%) of bacterial liver abscess pathogens in the liver of feedlot beef steers with and without LA.

Item	Liver abscess Not present	Liver abscess Present	SEM	P-value
Absolute abundance				
F. n. necrophorum	8.33×10^{5}	6.13×10^{7}	1.983×10^{7}	0.03
F. n. funduliforme	6.96×10^{4}	5.17×10^{4}	3.397×10^{7}	0.29
F. varium	3.16×10^{2}	2.66×10^{3}	1.273×10^{3}	0.20
Salmonella enterica, log_{10} CFU/g	3.02	3.08	0.035	0.18
Prevalence				
F. n. necrophorum	50.00	54.76	7.791	0.67
F. n. funduliforme	40.48	42.86	7.697	0.83
F. varium	4.76	7.14	3.690	0.65
Salmonella enterica	6.50	9.80	3.910	0.38

Exp. 1 Conclusions and Implication

- Transitioning beef cattle to a high-concentrate diet creates an unfavorable environment for *Salmonella* in the rumen.
  - Facilitates *Salmonella* persistence in the lower gut.
- Conversely, transition to a high-concentrate diet increased *F. necrophorum* subsp. *necrophorum* and *F. varium* prevalence in ruminal fluid.
  - Abundance and prevalence of *Fusobacterium* in feces is low.
- Relative proportions of *Fusobacterium* species change with days on feed.
- *F. necrophorum* subsp. *necrophorum* abundance greater in abscessed liver tissue.
- Overall, the concentration and prevalence of *Salmonella* and *Fusobacterium* in ruminal fluid and feces are not directly suggestive of LA development.
  - Entry into portal circulation is possible throughout the gastrointestinal tract.

ACKNOWLEDGEMENTS

Experiment 1 was supported in part by the Foundation for Food and Agriculture Research (grant #ICASALAWG-0000000061). Experiment 2 was supported by the Texas Cattle Feeders Association, and joint funding from Texas Tech University Office of the Vice President for Research and USDA-ARS Plains Area. The authors thank D. Kucera (USDA-MARC), J. Carroll, and A. Woods (USDA-ARS) for their assistance with *Salmonella* processing and hematology assays, as well as R. Rocha, E. Rocha, K. Robinson, and L. Manahan (Texas Tech University Burnett Center, Idalou, TX) for their assistance in cattle care and management.

EXPERIMENT 2

Materials and Methods

- Crossbred steers (n = 232; 470 ± 13.9 lb) were used in a generalized complete block design consisting of 4 BW blocks within each of the 2 source blocks, yielding a total of 8 pen replications/treatment.
- ***Experimental treatments:***
  - ***0M**: negative control, 5 mL sterile saline injected subcutaneously (SQ) with 1-d post-metaphylactic interval (PMI).*
  - ***33M**: SQ administration of tulathromycin (Arovyn, Merck Animal Health) at random to 33% of steers in a pen; 1.1 mL/cwt BW with 5-d PMI.*
  - ***66M**: SQ administration of tulathromycin at random to 66% of steers in a pen; 1.1 mL/cwt BW with 5-d PMI.*
  - ***100M**: positive control, SQ administration of tulathromycin to 100% of steers in a pen; 1.1 mL/cwt BW with 5-d PMI.*
- *BRD case definition:*
  - Clinical illness was determined by a treatment-blinded investigator using a 1 to 4 severity scale. Steers received therapeutic treatment if rectal temperature ≥ 103.5 °F and/or clinical illness score was ≥ 3.
- *Sample collection:*
  - Body weight and feces were collected on d 0, 14, and 35.
- *Statistical analyses:*
  - Pen was the experimental unit for all dependent variables.
  - Growth performance data were analyzed using PROC MIXED (SAS 9.4); *Salmonella* data were analyzed as a repeated measure in MIXED.
  - Health outcomes were analyzed as binomial proportions in PROC GLIMMIX (SAS 9.4).
  - Fixed effect of treatment; random effect of BW block nested within source block.

Table 4: Formulated and analyzed diet composition fed to steers from d 0 to 35.

Item	d 0 to 35
Ingredient, % DM	
Steam-flaked corn	21.35
Sweet bran	53.18
Alfalfa hay	21.77
Supplement	1.76
Limestone	1.94
Nutrient analysis, % DM	
DM, %	68.9
CP, %	18.9
NDF, %	30.8
Crude fat, %	2.6
Ca, %	1.17
P, %	0.78
NEm, Mcal/cwt	88
NEg, Mcal/cwt	56

Results

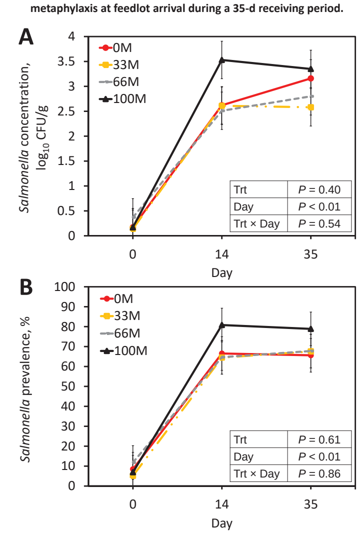
Table 5: Growth performance of high-risk beef steers administered 0, 33, 66, or 100% metaphylaxis at feedlot arrival during a 35-d receiving period.

Item	Treatment 0M	Treatment 33M	Treatment 66M	Treatment 100M	SEM	P-value
n, steers	59	59	57	59	---	---
n, pens	8	8	8	8	---	---
Body weight, lb						
Day 0	472	467	465	472	13.9	0.99
Day 14	481	489	483	494	14.1	0.89
Day 35	549	553	553	560	13.9	0.95
Average daily gain, lb/d						
Day 0 to 14	0.66^{x}	1.57^{y}	1.21^{xy}	1.61^{y}	0.267	0.07
Day 14 to 35	3.31	3.04	3.37	3.22	0.254	0.81
Day 0 to 35	2.23	2.45	2.51	2.56	0.190	0.63
Dry matter intake, lb/d						
Day 0 to 14	7.67	8.40	8.29	8.25	0.313	0.35
Day 14 to 35	13.47	13.10	13.96	14.11	0.730	0.75
Day 0 to 35	11.13	11.24	11.66	11.77	0.481	0.74
Dry matter intake, % of BW						
Day 0 to 14	1.60	1.74	1.75	1.73	0.060	0.27
Day 14 to 35	2.63	2.53	2.69	2.68	0.119	0.77
Day 0 to 35	2.18	2.20	2.30	2.28	0.079	0.64
Gain:feed						
Day 0 to 14	0.075^{x}	0.175^{y}	0.163^{xy}	0.200^{y}	0.0333	0.07
Day 14 to 35	0.250	0.225	0.238	0.225	0.0258	0.88
Day 0 to 35	0.213	0.213	0.213	0.225	0.0213	0.97

Table 6: Clinical health outcomes and antimicrobial use in high-risk beef steers administered 0, 33, 66, or 100% metaphylaxis at feedlot arrival during a 35-d receiving period.

Item	Treatment 0M	Treatment 33M	Treatment 66M	Treatment 100M	SEM	P-value
n, steers	59	59	57	59	---	---
n, pen	8	8	8	8	---	---
Metaphylaxis administered, %	0.0^{a}	31.9^{b}	69.0^{c}	100.0^{d}	1.50	<0.01
BRD1, %	49.3^{a}	27.9^{ab}	14.1^{b}	15.2^{b}	7.78	0.01
BRD2, %	5.1	3.3	3.1	3.3	2.54	0.94
BRD3, %	1.6	---	1.6	---	1.11	0.58
Mortality, %	3.1	5.1	4.2	3.3	2.74	0.95
Days to						
First treat	2.8^{y}	4.4^{y}	5.0^{xy}	9.1^{x}	1.86	0.06
Second treat	19.0	18.0	8.0	10.0	8.03	0.53
Third treat	24.0	---	21.0	---	2.32	0.34
Rectal temperature, °F						
First treat	104.9	104.8	104.8	104.3	0.43	0.65
Second treat	104.1^{a}	104.9^{a}	103.6^{ab}	100.7^{b}	1.02	0.05
Third treat	105.2	---	103.2	---	1.81	0.15
Total mg active drug	$32{,}246^{a}$	$18{,}715^{ab}$	$11{,}546^{b}$	$13{,}441^{b}$	4989.3	0.03
No. of antimicrobial injections	4.3^{a}	4.6^{ab}	6.3^{b}	8.8^{c}	0.68	<0.01
Total metaphylaxis cost, $/hd	0.00^{a}	2.36^{b}	5.00^{c}	7.41^{d}	0.139	<0.01
Total therapy cost, $/hd	10.55^{a}	6.22^{ab}	3.35^{b}	3.15^{b}	1.721	0.02
Total antimicrobial cost, $/hd	10.63	8.58	8.35	10.56	1.680	0.66

Figure 4: *Salmonella enterica* concentration (A) and prevalence (B) in feces of high-risk receiving beef steers administered 0, 33, 66, or 100% metaphylaxis at feedlot arrival during a 35-d receiving period.



Exp. 2 Conclusions and Implication

- Metaphylaxis can be administered randomly to 66% of high-risk cattle without increasing BRD morbidity, negatively affecting growth performance, or increasing *Salmonella* shedding.
- Total antimicrobial cost per steer was **$1.98** and **$2.21** less for 33M and 66M steers, respectively, compared with 100M.
- Total milligrams of active drug compound administered was least for 66M and 100M steers, while the number of antimicrobial injections per pen was greatest for 100M.
  - These conflicting interpretations demonstrate the need for standardization of methods to account for antimicrobial use in the beef industry.
- Overall, results suggest that random metaphylaxis within a pen could maintain health outcomes and growth performance in high-risk beef cattle, while decreasing antimicrobial use without increasing pathogen shedding.

Effect of increased time spent on a high-forage receiving ration on growth performance, rumination activity, and carcass performance in Angus × Holstein steers

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Introduction

- Greater utilization of beef × dairy in the fed beef industry has been observed in the past decade.
- Increased intake and longer feeding duration (300+ d) in dairy-influenced cattle has been associated with increased digestive disorders and liver abscess rates at slaughter (Amachawadi and Nagaraja, 2016).
- More information is needed regarding feedlot receiving management of beef x dairy calves

Objective

- Investigate the effects of increasing length of time spent on a high-forage receiving ration on growth performance, carcass characteristics, rumination activity, and liver abscess prevalence in Angus × Holstein steers

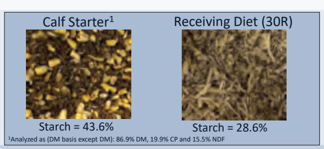
Methods

- Angus × Holstein steers (n = 144; 423 ± 37 lb)
  - 18 pens total; 6 replicate pens/trt; 8 steers/pen
- Dietary treatments:
  - Corn-silage based receiving diet was fed for either 28 (**REC28**), 56 **(REC56),** or 84 d (**REC84**).
- 3-axis accelerometer eartag was placed in all steers at initial processing.
- 100 mg TBA and 14 mg EB (Synovex-Choice) on d 97; 200 mg TBA and 28 mg EB (Synovex-ONE Feedlot) on d 189
- Lubabegron (Experior) fed at a rate of 36 mg/steer daily for the last 42 d prior to harvest
- Diet samples were obtained weekly for Penn-State Particle Separation
- All data were analyzed using SAS 9.4 with an α level of 0.05.
- Fixed effects of dietary treatment, time or the interaction of TRT x time was used when applicable to analysis.
- Rumination and extended days on feed analysis = repeated measures
- Pen was the E.U. for all analyses.

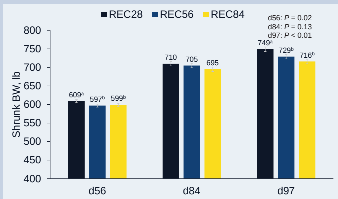
Table 1. Receiving period diet composition

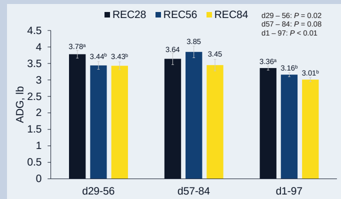
	30R	21R	12R
Item, % DM basis			
DRC	6.36	16.68	25.08
HMC	6.27	15.71	24.83
MDGS	26.42	27.02	24.29
Liquid Supp.[1,2]	6.41	6.36	6.00
Corn Silage	54.54	34.23	19.81
Calculated nutrient values			
DM, %	40.48	45.93	55.14
CP, %	17.39	17.68	17.07
NDF, %	37.84	30.55	24.29
NEm, Mcal/cwt	85.21	90.75	94.69
NEg, Mcal/cwt	55.63	60.24	63.53

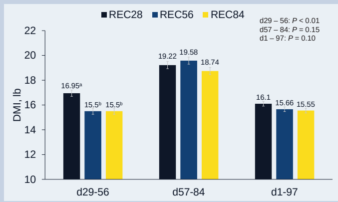
[1]Supplement provided monensin sodium at 35 g/ton.
[2]Provided vitamins at 2016 NASEM recommendation.



Results







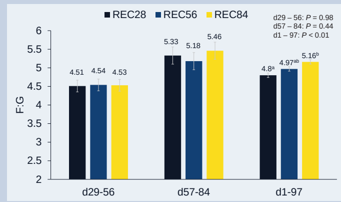


Table 2. Performance responses

	Treatment				*P*-value	
Item	**REC28**	**REC56**	**REC84**	**SEM**	**F-test**	**Linear**
Pens, n	6	6	6	-	-	-
Steers, n	47	48	48	-	-	-
Initial BW, lb[1]	423	423	423	0.75	0.98	-
d 168 BW, lb[1]	1,056	1,047	1,032	7.10	0.10	0.04
Cx Adj. FBW, lb[2]	1,501	1,487	1,465	17.7	0.38	0.18
AFBW, lb[3]	1,338	1,328	1,332	11.9	0.84	0.75
ADG, lb/d						
d 97 – 168	4.33	4.48	4.45	0.059	0.20	0.16
d 97 – end[2]	4.02	4.05	4.00	0.095	0.93	0.90
d 168 – end[2]	3.84	3.80	3.73	0.129	0.84	0.57
d 0 – end[2]	3.80	3.75	3.67	0.062	0.36	0.17
DMI, lbs						
d 97 – 168	21.16	21.64	21.72	0.242	0.18	0.09
d 97 – end	24.45	24.66	24.69	0.463	0.85	0.61
d 168 – end	26.47	26.51	26.51	0.632	1.00	0.95
d 0 – end	21.65	21.64	21.62	0.346	1.00	0.93
F:G[4]						
d 97 – 168	4.89	4.84	4.89	-	0.85	0.96
d 97 – end[2]	6.09	6.09	6.18	-	0.87	0.64
d 168 – end[2]	6.92	7.0	7.15	-	0.77	0.48
d 0 – end[2]	5.69	5.77	5.89	-	0.33	0.15

[1]All BW measures were pencil shrunk 4% to account for digestive tract fill.
[2]Adjusted final BW to a common study DP of 0.6278; Cx Adj. FBW = (HCW/0.6278).
[3]Final BW adjusted to 28% EBF (Guiroy et al. 2001).
[4]Analyzed as G:F, the reciprocal of F:G.

Table 3. Particle separation and estimated peNDF

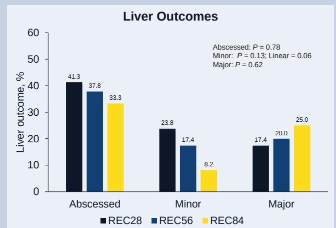
	Diets				*P*-value	
Item	**30R**	**21R**	**12R**	**SEM**	**F-test**	**Linear**
NDF, % DM	37.8	30.6	24.2	-	-	-
Sieve size, mm						
19.0	12.0^a	6.8^b	2.8^c	0.80	<0.01	<0.01
8.0	57.3^a	48.8^b	36.7^c	1.25	<0.01	<0.01
4.0	18.5^c	25.7^b	36.1^a	0.43	<0.01	<0.01
Particles < 4 mm	12.2^c	18.2^b	24.5^a	1.15	<0.01	<0.01
Particles > 4 mm	87.8^a	81.8^b	75.5^c	1.15	<0.01	<0.01
Esti. peNDF,[1] % of DM	33.2^a	25.0^b	18.3^c	0.35	<0.01	<0.01

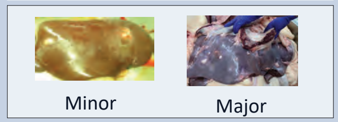
[a,b,c]Means within a row lacking a common superscript differ $P \le 0.05$.
[1]Percent peNDF was estimated by multiplying the percentage of sample > 4 mm in particle size by the percent tabular NDF of the diet.

Table 4. Carcass characteristics

	Treatment				*P*-value
Item	**REC28**	**REC56**	**REC84**	**SEM**	**F-test**
Carcasses, n	46	45	48	-	-
HCW, lb	942	934	920	11.1	0.37
DP, %	63.0	62.7	62.7	0.35	0.80
REA, in²	13.91	13.75	13.65	0.167	0.55
Rib fat, in	0.60	0.60	0.54	0.022	0.07
YG	3.49	3.52	3.33	0.087	0.19
Marbling[1]	520	525	516	15.9	0.91
EBF[2], %	31.8	31.9	31.1	0.37	0.28
Quality grade, %					
Prime	8.7	4.5	6.7	3.68	0.79
Choice or better	84.8	95.5	86.7	4.52	0.52
Select	15.2	4.5	13.3	4.61	0.52

[1]400 = Small[00].
[2]Empty body fat, % calculated from Guiroy et al. (2001)





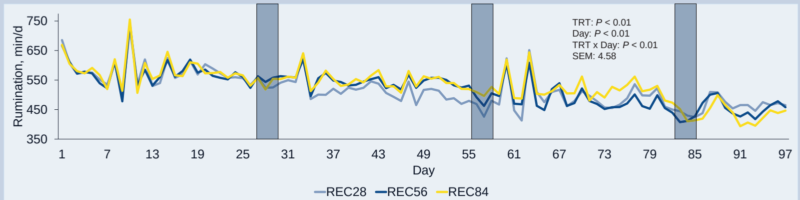


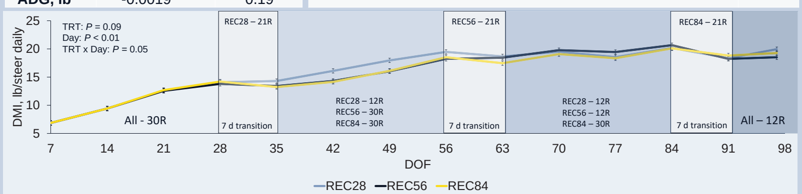
Table 5. Extended days on a high-forage receiving ration on performance.

Item	Extended days slope	*P*-value
d 1 - 97		
BW, lb	-0.5914	<0.01
DMI, lb	-0.0098	0.04
ADG, lb	-0.0062	<0.01
d 1 - End		
BW, lb	-0.5371	0.19
DMI, lb	-0.0006	0.93
ADG, lb	-0.0019	0.19

Table 6. Rumination activity and PSPS through d 91

	Treatment				*P*-value	
Item	**REC28**	**REC56**	**REC84**	**SEM**	**F-test**	**Linear**
Rumination,min/d	516.0^b	527.7^{ab}	540.8^a	6.74	0.01	0.01
DMI, lb	15.85	15.48	15.31	0.463	0.70	0.41
Rumination, min/lb						
DM	36.9	38.4	39.4	1.96	0.65	0.36
NDF	123.3^a	114.0^{ab}	105.3^b	4.41	0.02	0.01
peNDF	154.7^a	135.5^b	119.8^c	4.70	0.01	0.01

[a,b,c]Means within a row lacking a common superscript differ $P \le 0.05$.



Conclusions

Increasing time spent on a high-forage receiving diet resulted in:

Receiving period (d 1 – 97)

- Decreased DM consumed
- Lighter BW
- Less ADG
- Worsened F:G
- Increased rumination activity

Finishing period (d 97 – end)

- Numerically less BW
- No difference in DMI
- No difference in ADG
- No difference in F:G

Carcass performance

- Numerically less HCW
- Numerically smaller REA
- Tendency for leaner carcasses
- Did not alter distribution of QG
- Did not influence rates of abscessed livers

Effect of Finishing System on Growth, Efficiency, and Carcass Quality of Dairy × Beef Hybrids

Oklahoma State University
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Ally Grote, Zane Grigsby, Tom Fanning, Dusty Turner, and Paul Beck

INTRODUCTION

Due to the 2012 drought and recession in beef cow numbers in the U.S., the industry began to explore alternatives to maintain supply. From 2011 to 2016, the proportion of dairy-type carcasses increased from 9.9% to 16.3%. Dairy bull calves lost almost all value when native beef supply began to normalize. Dairies began mating a portion of their females to beef semen resulting in crosses that are currently more valuable to buyers than straight-bred dairy male calf. Dairy-beef crosses can offer better genetic merit for finishing performance and efficiency compared to straight-bred dairy steers, but the best management practices for these crossbred calves may not be at the dairy. There is also very little work investigating the post-weaning finishing system of beef-dairy crossbred calves as well as comparing side by side native beef steers to dairy-beef steers.

OBJECTIVES

This study aimed to determine the effect of calf-fed or yearling-fed finishing systems on the performance and carcass characteristics of dairy-beef crossbred steers compared to native beef steers.

MATERIALS AND METHODS

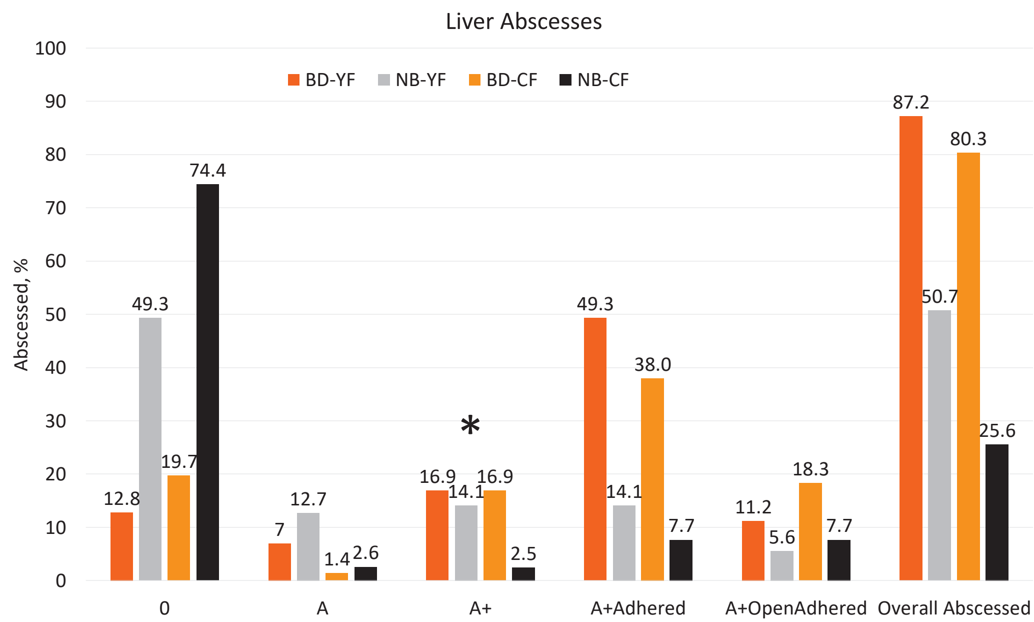
- Native beef (NB) steers were acquired from Capitol Land and Livestock (Schwertner, TX).
- Dairy-beef (DB) steers were acquired from 5-Star Dairy (Hart, TX).
- Both NB and DB steers were placed in either yearling-fed (YF) or calf-fed (CF) systems:
  - YF - transported to Marvin-Klemme Research Station (Bessie, OK) for a 144-d grazing period before finishing
  - CF - transported to Buffalo Feeders (Buffalo, OK) for finishing
- Steers were implanted with Synovex Choice (Zoetis Animal Health) at feedlot processing.
  - Steers were reimplanted with either Synovex One Feedlot (Zoetis Animal Health) or Synovex Plus (Zoetis Animal Health)

Feeding Management

- NBCF steers were fed a growing ration for 97 d, then transitioned through step-up diets for 13 d before transitioning to a finishing diet.
- DBCF steers were fed a series of step-diets for 19 d each before transitioning to a finishing diet at d 64.
- Yearling-fed steers were fed a series of step-up diets for 29 d before transitioning to a finishing diet.

RESULTS

Item	Treatments NBCF	DBCF	NBYF	DBYF	SEM	Effect *P*-value System	Breed	System x Breed
Performance								
Initial BW, lbs	791^{c}	744^{c}	590^{a}	576^{b}	9.2	<0.01	<0.01	0.01
Reimplant BW, lbs	995^{b}	920^{c}	1136^{a}	1141^{a}	14.0	<0.01	<0.01	<0.01
Slaughter BW, lbs	1463	1561	1521	1598	19.5	<0.01	<0.01	0.47
ADG, lb/day	2.93^{d}	3.26^{c}	3.65^{b}	4.22^{a}	0.079	<0.01	0.01	0.04
DMI, lbs·hd^{-1}·d^{-1}	18.5	20.2	21.2	24.0	0.43	<0.01	<0.01	0.05
DOF	296	302	200	202	2.0	<0.01	<0.01	0.16
G:F	0.127	0.143	0.159	0.176	0.0038	<0.01	<0.01	0.72
Return, $/hd	45.43^{c}	42.49^{c}	347.31^{a}	106.51^{b}	23.20	<0.01	<0.01	<0.01
Carcass Quality								
HCW, lbs	946	966	969	974	12.3	0.08	0.15	0.39
Yield Grade	3.00	3.02	2.76	2.45	0.126	<0.01	0.12	0.08
Marbling Score	484	530	473	503	14.3	0.05	<0.01	0.38
BFT, in	0.67^{a}	0.61^{b}	0.65^{ab}	0.50^{c}	0.027	<0.01	<0.01	0.03
REA, in^{2}	14.5	14.0	15.2	15.0	0.21	0.08	0.18	0.33
QG, % Choice	76.9	87.2	83.1	83.1	-	0.92	0.24	0.24
QG, % Prime	1.28	5.32	1.41	1.41	-	0.48	0.42	0.42



SUMMARY AND CONCLUSIONS

- Dairy-beef yearling steers exhibited a compensatory gain of 114% from grazing within the first 83 d of being in the feedlot.
- Yearling-fed NB steers had the greatest return per head with yearling-fed DB being intermediate.
- Calf-fed systems had the same return per head.
- The overall incidence of liver abscesses was greater in dairy-beef and yearling-fed steers.
- Breed and finishing systems impacted performance but exhibited minimal impact on carcass quality or liver abscesses.

Effect of excess liver copper concentration on response to bovine respiratory disease challenge in dairy-beef steers

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Introduction

- Beef on dairy crossbred cattle are twice as likely to succumb to bovine respiratory disease (**BRD**) as native beef cattle[1]
- Calves born and raised on commercial dairies are exposed to greater concentrations of copper (**Cu**) compared to those born on beef cow-calf operations[2]
- Excess Cu can contribute to oxidative stress and inflammation, which may lead to impaired immune function[3]
- Mice fed diets high in Cu exhibited impaired cellular and humoral immunity[4]

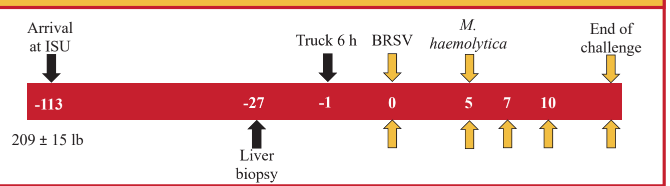
Objective: Determine the effect of excess liver Cu concentration on response to a BRD challenge in lightweight dairy-beef steers

Hypothesis: Steers with high liver Cu will exhibit heightened severity of disease compared to those with adequate liver Cu

Materials and Methods

- Sixty-four dairy-beef steers (209 ± 15 lb, ~8 wk of age) were purchased from a single grower, but multiple source dairies, and delivered to the Iowa State University Beef Nutrition Farm
- Steers blocked by weight into pens of eight head; one pen from each weight block fed pelleted diet containing 10 (**ADE**) and 20 mg (**HIGH**) Cu from Cu sulfate/kg DM fed from d -113 to d -54
- Total mixed ration fed from d -53 to d -1 (**Table 1**)
- Liver biopsies collected on d -27, and n = 13 steers per treatment were chosen for the study based on liver Cu (**Figure 1**)
- Steers trucked 6 h on d -1 and delivered to Animal Resource Station in Ames, IA
- Four steers (2 ADE, 2 HIGH) required treatment throughout the challenge and were removed from all analysis after the day they were treated.
- Starting on d 0, all steers fed 5 mg supplemental Cu/kg diet DM regardless of treatment
- Steers infected with 10^4TCID$_{50}$ bovine respiratory syncytial virus (**BRSV**) on d 0 via aerosol inoculation
- Steers intratracheally infected with 5 x 10^8 CFU *Manheimia haemolytica* on d 5
- Data were analyzed in SAS 9.4 using PROC MIXED for continuous variables and PROC GLIMMIX for categorical variables (clinical and lung scores) with day post-infection as repeated measure
- In figures 2-9, statistical differences between data points are denoted by differing superscripts

Experimental Timeline



Diet

Table 1. Composition of common total mixed ration.

Ingredient	% of diet DM
Hay	15
Corn	15
Corn Silage	15
Dried distillers grains	18.06
Sweet Bran	35
Cu premix	5
Trace mineral premix	0.0204
Limestone	1.5
Salt	0.31
Vitamin A & E premix	0.1
Rumensin 90	0.0135
Analyzed Composition	
Crude protein, %	18.4
Neutral detergent fiber, %	33.1
Ether extract, %	5.2
Sulfur, %	0.31
Molybdenum, mg/kg DM	0.97
Copper, mg/kg DM	4.8
Zinc, mg/kg DM	67.5
Iron, mg/kg DM	211

Liver Copper Status

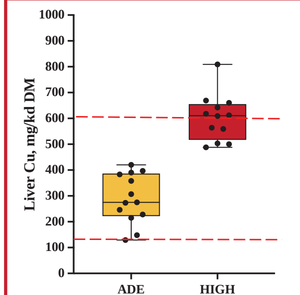


Figure 1. Liver Cu concentrations for ADE and HIGH 27 d prior to challenge. Dashed lines represent threshold for adequate liver Cu[5].

Signs of Clinical Disease

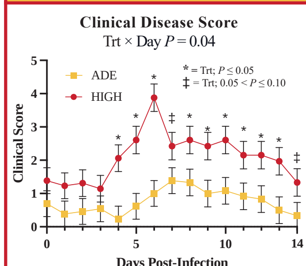


Figure 2. Effect of liver Cu × day on post-infection clinical disease scores.

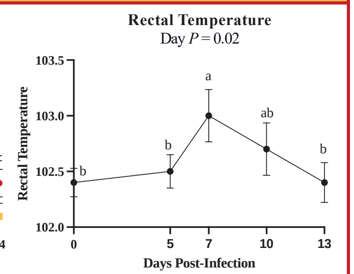


Figure 3. Effect of day post-infection on rectal temperature throughout BRD challenge.

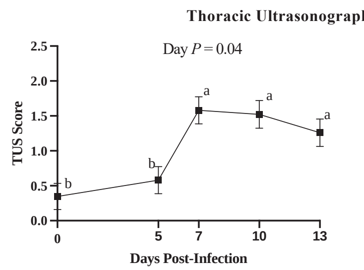


Figure 4. Effect of day post-infection on thoracic ultrasonography scores throughout BRD challenge.

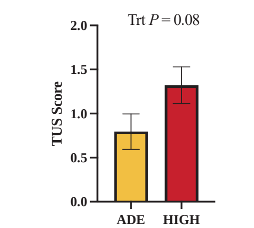


Figure 5. Effect of liver Cu treatment on thoracic ultrasonography scores.

Plasma Trace Mineral Concentrations

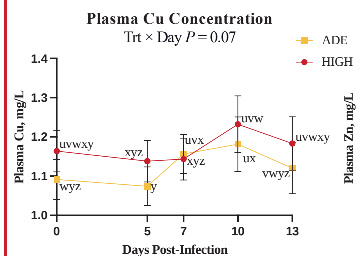


Figure 6. Effect of liver Cu × day on post-infection plasma Cu concentrations.

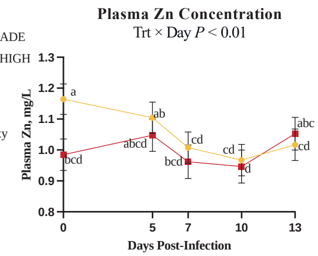


Figure 7. Effect of liver Cu × day on post-infection plasma Zn concentrations.

Inflammation

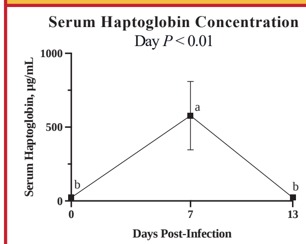


Figure 8. Effect of day post-infection on serum haptoglobin concentrations in response to disease challenge.

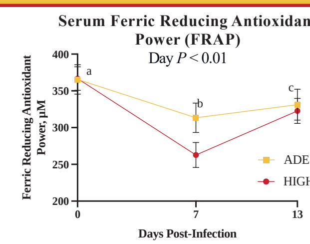


Figure 9. Effect of liver Cu × day on post-infection serum ferric reducing antioxidant power in response to disease challenge.

Summary and Conclusions

- High liver Cu in dairy-beef steers increased clinical disease presentation and lung consolidation, as well as impaired nutritional immunity responses to infection.

These findings suggest excess Cu supplementation may contribute to the poor health of dairy-beef calves entering the feedlot.

Acknowledgements

The authors appreciate Olivia Genther-Schroeder from Land O' Lakes for her assistance in sourcing calves and diet formulation as well as funding from the Iowa State Beef Checkoff.

Literature Cited:

[1]Theurer, M. E., J. Trent Fox, T. A. Portillo, N. F. Meyer, D. T. Ensley, and D. G. Renter. 2020. Comparison of gamithromycin post-treatment intervals for beef cattle naturally affected with bovine respiratory disease. Bov Pract (Stillwater). 54.

[2]Puschner, B., M. C. Thurmond, and Y.-K. Choi. 2004. Influence of Age and Production Type on Liver Copper Concentrations in Calves. Journal of Veterinary Diagnostic Investigation. 16:382–387. doi:10.1177/104063870401600503.

[3]Bremner, I. 1998. Manifestations of copper excess. Am J Clin Nutr. 67:1069S-1073S. doi:10.1093/ajcn/67.5.1069S.

[4]Pocino, M., L. Baute, and I. Malavé. 1991. Influence of the oral administration of excess copper on the immune response. Fundamental and Applied Toxicology. 16:249–256. doi:10.1016/0272-0590(91)90109-H.

[5]Kincaid, R. L. 1999. Assessment of trace mineral status of ruminants: A review. Proceedings of the American Society of Animal Science. 77:1–10.

Evaluation of ground grain sorghum vs dry-rolled corn for finishing beef steers

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Introduction

- Irrigation water in the High Plains region is supplied by the Ogallala Aquifer which is being withdrawn from faster than it can be recharged by precipitation.
- Roughly 2.57 million cattle are on feed in the semi-arid Northern High Plains as of Dec. 2024, which will likely be affected by these water scarcity conditions.
- Sorghum is a drought-tolerant crop grown in the region with great potential to adapt to reduced irrigation, but wide adoption of sorghum as a feedstuff is needed to increase sustainability of water usage.

Objective

Compare ground grain sorghum and rolled corn-based diets with respect to impact performance and carcass characteristics of finishing steers.

Materials and Methods

Study Design
- Black hided beef steers (n=300; 763.5 ± 24.5 lb initial body weight) were fed for 182 days in a randomized complete block design of 15 replicates at the KSU Southeast extension and Research Center (Mound Valley, KS).

Dietary Treatments
- Dry-rolled corn-based finishing diet
- Ground grain sorghum-based finishing diet

Measurements
- Pen weights were recorded on days 0, 28, 56, 84, 112, 140, and 168.
- Fecal samples were taken from every pen to analyze nutrient output.
- Kill order and carcass measurements were recorded after steers were transported 349 miles to Tyson Fresh Meats in Holcomb, KS.

Statistical Analyses
- Performance data were analyzed as mixed models (SAS ver 9.4) with diet, time, and diet x time interactions as fixed effects and initial weight block as a random effect. Time was a repeated measure, pen was the subject, and compound symmetry was used as the covariance structure.
- Pen was the experimental unit.
- For carcass data and energy calculations, diet was the fixed effect and weight block was a random effect.
- Incidence and severity of abscessed livers, USDA quality grade, and USDA yield grade were analyzed as multinomial distributions. Least-squares means were separated using the predicted difference function of SAS.

Composition of diet treatments (dry matter basis).

Item	Corn	Sorghum
Corn silage	12.00	12.00
Dry-rolled corn	79.37	-
Ground grain sorghum	-	79.37
Supplement[1]	8.63	8.63
Mean geometric particle size,	2,510	617
Nutrient composition, analyzed[2]		
Crude protein, %	11.6	11.5
Neutral detergent fiber, %	13.8	12.5
Starch, %	68.9	68.5

[1]Supplement contained soybean meal, urea, minerals, vitamins, and feed additives and was formulated to provide (total diet dry matter basis) 0.7% calcium, 0.7% potassium, 0.3% salt, 33 g/ton monensin, 8 g/ton tylosin, and the following added amounts of trace elements and vitamins: 1,000 IU/lb vitamin A; 7 IU/lb vitamin E; 0.1 ppm cobalt; 10 ppm copper; 0.5 ppm iodine; 40 ppm manganese; 0.2 ppm selenium, and 40 ppm zinc. Ractopamine hydrochloride was included at 25 g/ton of the diet dry matter for the final 37 days on feed.

[2] Analyzed for samples of total mixed rations.

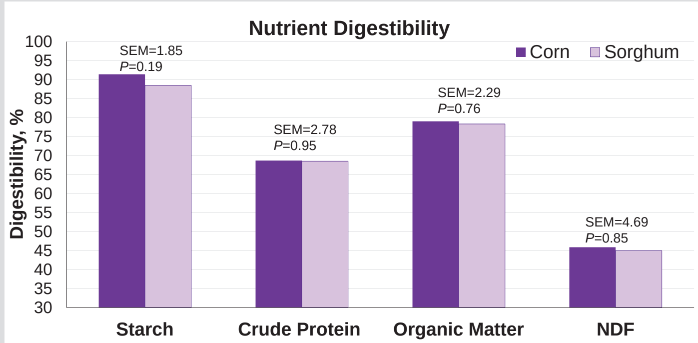
Results

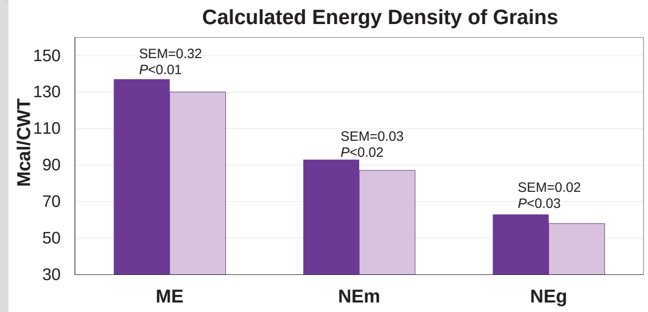
Feedlot performance and carcass characteristics

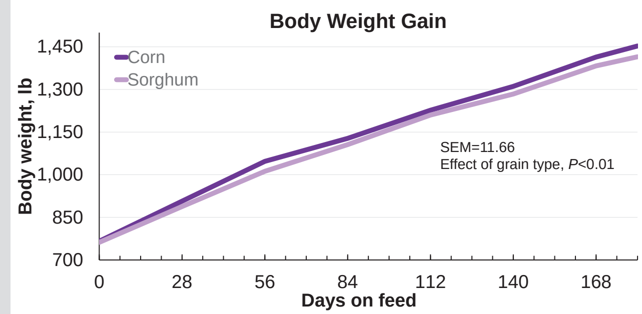
Item	Corn	Sorghum	SEM	*P*-value
Growth performance				
DMI, lb/h/d	23.9	24.7	0.36	<0.01
ADG, lb	3.84	3.70	0.067	<0.01
G:F	0.166	0.153	0.0018	<0.01
Initial BW, lb	766	762	6.3	0.578
Final BW, lb	1440	1387	11.6	<0.01
Carcass traits				
Carcass weight, lb	877.8	845.5	7.12	<0.01
Marbling score[‡]	519	468.8	6.25	<0.01
12th rib fat, in	0.56	0.53	0.02	0.188
Ribeye area, in²	13.2	12.9	0.10	<0.01
Prime, %	5.3	0.7	2.25	0.057
Premium Choice, %	47.6	29.3	5.49	<0.01
Low Choice, %	47.3	35.6	5.79	0.061
Select, %	21.3	11.5	4.19	0.034
Sub-Select, %	0.0	0.7	0.67	0.334
Yield Grade 1	1.4	0.0	0.96	0.165
Yield Grade 2	24.4	30.0	5.64	0.335
Yield Grade 3	52.8	51.0	6.94	0.867
Yield Grade 4	20.1	15.3	4.22	0.280
Yield Grade 5	1.3	0.7	1.13	0.564
Abscessed livers, %	8.7	6.0	2.62	0.314
Total carcass value, $[§]	2,492	2,379	22.11	<0.01

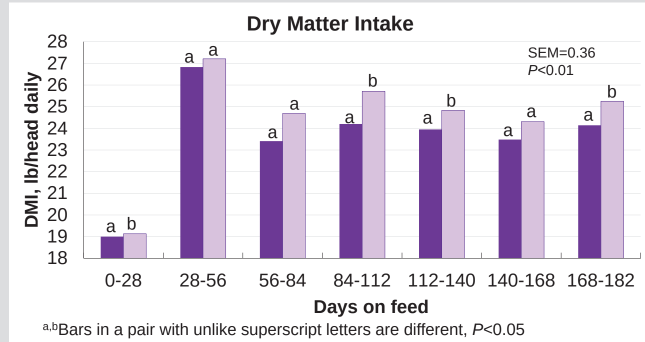
[‡]Slight amount of marbling, 300-399; Small amount of marbling, 400-499; Modest amount of marbling, 500-599; Moderate amount of marbling, 600-699

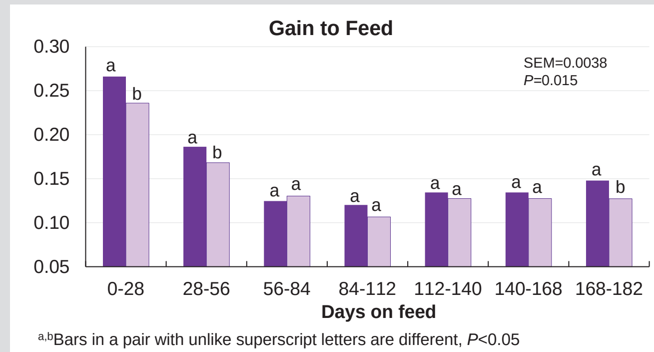
Based on average price premiums and discounts reported by USDA on Sept 13, 2024











Conclusions

- Growth performance was greater for cattle fed corn, with increased ADG and G:F compared to cattle fed sorghum.
- Cattle fed sorghum excreted 0.53 lb/day more starch in feces than cattle fed corn.
- NEg content of sorghum was determined to be 92% that of corn.
- Carcass value was $112/head greater for cattle fed the corn-based diet.
- Given ongoing decline of the Ogallala, continued utilization of locally grown grains by cattle feeders will require identification of strategies to improve feed value of drought tolerant crops like sorghum through more extensive processing and/or sorghum breeding programs.

Evaluation of palm oil as an ingredient in beef cattle diets

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Introduction

- In 2016, Samuelson et al. found that 54% of clients from surveyed nutritionists included supplemental fat in their finishing diets. That number had reduced since 2007, when it was found that nearly 70% of consulting nutritionists' clients used added fat (Vasconcelos and Galyean, 2007).
- In recent years, this number has likely significantly decreased again, due to the increased demand for fats within the biofuel industry, making fat prices reach historic highs. For this reason, alternative fat sources like palm oil, which do not qualify for biofuel credit, are being explored due to their reduced-cost.
- Kobza et al. conducted a study in 2023 which compared corn oil to whole palm, RBD olein, and RBD stearin. It was found that all diets containing added fats increased final BW, ADG and G:F compared to diets containing no oils.
- It is important to note that the palm tree variety and processing methods used lead to diverse palm oil end products. Based on previous studies, it was necessary to further explore different palm oil products.

Objective

The objective of this study was to evaluate the value of palm oil as an ingredient in cattle feed.

Materials & Methods

Experiment design: Generalized, randomized, block design
Treatment design: unstructured

- 430 crossbred calf-fed steers (initial BW 1040; sd = 49 lbs)
- Steers were stratified by BW into 3 blocks
- Light block (2 reps), Middle block (4 reps), Heavy block (2 reps)
- 40 pens, 8 pens/treatment, 10-11 steers/pen

Dietary Treatments (TRT): Corn-based diet with 5 treatments

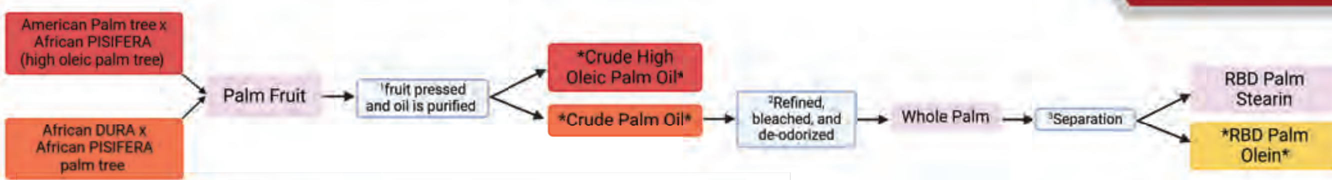
- No added fat, Tallow, Crude Palm Oil, Crude High Oleic Palm Oil, Refined, Bleached, and De-Odorized Olein Palm Oil **(Table 1)**

Steers were implanted with Rev-XS (Merck Animal Health) upon initiation of the trial.

Cattle were fed for a total of 159 days and due to a delay in obtaining the palm oils from Colombia, cattle received treatments for the last 107 days before slaughter.

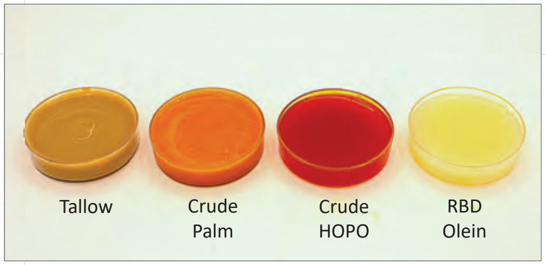
Table 1. Ingredient composition of dietary treatments.

	Treatments				
Items	**No Oil**	**Tallow**	**Crude Palm**	**Crude HOPO**	**RBD Olein**
Ingredient, % of DM					
High-moisture corn	56	52.5	52.5	52.5	52.5
Sweet Bran	18	18	18	18	18
MDGS	12	12	12	12	12
Corn Silage	7	7	7	7	7
Corn Stalks	3	3	3	3	3
Tallow	-	3.5	-	-	-
Crude Palm	-	-	3.5	-	-
Crude High Oleic Palm Oil	-	-	-	3.5	-
RBD Olein	-	-	-	-	3.5
Supplement	4	4	4	4	4



**Oils that were used in study
[1]Fruit pressed- *fruit is sterilized through the use of steam and then pressed using a double* screw press. Liquid extracted from this process is a mixture of oil, water and solids. The oil is then separated from the water and solids and then purified, removing any remaining moisture before being stored.
[2]Refined, bleached, and de-odorized- removes impurities, color pigments and odors, making oil suitable for fractionation
[3]Separation- After being refined, oil is cooled under controlled conditions to allow different components to crystallize at different temperatures. The oil is then filtered which separates the solid crystals from the liquid oil resulting in olein and stearin.

This research was funded by a grant from Fedepalma, the National Federation of Oil Palm of Colombia.

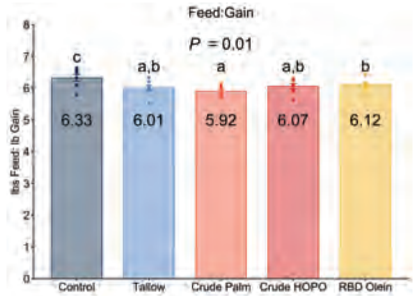


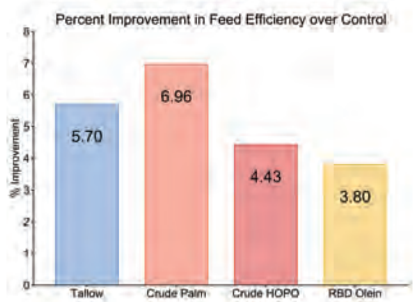
Results

Table 2. Effects of diets containing no oil, tallow, or fractions of palm oil on finishing cattle performance and carcass characteristics

	Treatments[1]						
Items	No Oil	Tallow	Crude Palm	Crude HOPO	RBD Olein	SEM[2]	*P*-Value
Allocation BW[3], lb	891	889	891	892	893	1.2	0.38
Initial BW[4], lb (oil initiation)	1041	1043	1037	1038	1038	3.8	0.76
CAdj. Final BW[5]	1539	1564	1557	1545	1542	11.3	0.50
DMI, lb/d	29.5	29.2	28.8	28.8	28.9	0.34	0.51
ADG, lb (from oil initiation)	4.67	4.87	4.87	4.75	4.73	0.09	0.39
G:F	0.158^{c}	0.167^{ab}	0.169^{a}	0.165^{ab}	0.164^{b}	0.0021	**0.01**
HCW, lb	970	985	981	974	972	7.1	0.50
Ribeye Area, in^2	15.51	15.59	15.47	15.51	15.31	0.123	0.59
12th rib fat, in	0.619	0.646	0.644	0.646	0.661	0.0147	0.38
Marbling Score[6]	589	586	596	567	600	11.37	0.30
Calculated Yield Grade	3.27	3.39	3.45	3.41	3.46	0.071	0.47

[abc]Means within a row with different superscript letters differ, *P* < 0.10, when the F test < 0.05
[1]No Oil = negative control 0.0% added fat, Tallow = positive control, 3.5% tallow; Crude Palm = 3.5% crude palm oil; Crude HOPO = 3.5% crude high oleic palm oil; RBD olein = 3.5% refined, bleached, and de-odorized, olein palm oil
[2]Standard error of the mean
[3]Body weight at initial allocation
[4]Initial body weight at beginning of palm oil inclusion
[5]Carcass adjusted final body weight
[6]Marbling score 400 = Small00, 500 = Modest00, 600 = Moderate00





Conclusions

Feeding palm oil products as a source of supplemental fat in finishing diets is comparable to feeding tallow, as all diets containing supplemental fat experienced improvements in feed efficiency. Crude palm oil had the greatest impact on G:F (*P* < 0.01); with a 6.96% improvement in feed efficiency over control, while RBD olein had the lowest percent improvement (3.80%) with crude HOPO and tallow serving as intermediates. While palm oil sources differ in their dietary energy content, producers can select the most economical option and realize an improvement in feed efficiency.

Grain Processing Methods for Enogen Corn and Impact on Feedlot Cattle Performance

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Introduction

- Enogen® corn (EC) is genetically modified to express high concentrations of thermotolerant α-amylase in the corn kernel.
- Corn processing methods (e.g., dry-rolling, steam-flaking) enhance starch digestibility, improving feed efficiency.
- Previous studies have demonstrated superiority of flaked grains over dry-rolled grains in terms of impact on starch availability and finishing cattle performance.
- Enogen corn has yielded improvements in growth performance compared to conventional corn, as a result of increases in starch digestion.

Objective

- This study investigated combinations of grain processing method and grain hybrids to identify effects on processing costs, cattle performance, carcass traits, and cost of gain.

Materials and Methods

- Crossbred beef steers (n=960; 942 ± 23.2 lb initial body weight) were used in a randomized complete block design with a 2 × 2 factorial arrangement of treatments in six replicates. The study was conducted at the KSU Beef Cattle Research Center in Manhattan, Kansas.

Factor 1: Grain type

Enogen feed corn (EC) vs. Control No.2 Yellow Corn (CC)

Factor 2: Grain processing

Dry-rolled (DR) vs. Steam-flaked (SF)

- Dry rolled grains were processed to a mean geometric particle size of 2,500 µ. Control grain was flaked to a density 28 lb/bu and Enogen was flaked to a density of 30.6 lb/bu, yielding starch availabilities of 50.5 and 56.7%, respectively.
- After days on feed, steers were transported to Tyson Fresh Meats in Holcomb, KS where kill order, carcass measurements were recorded, and livers were scored.
- Data were analyzed using the GLIMMIX procedure of the Statistical Analysis System (SAS ver. 9.4). Fixed effects included treatment (corn hybrid type processing method, and the interaction). The experimental unit was pen and block was the random effect.
- Categorical data (liver abscesses, yield grade, quality grade) were analyzed as multinomial distributions.
- Least-squares means were separated using the predicted difference function of SAS.
- To estimate grain processing costs, electrical energy, steam usage, and throughput were monitored on two separate days with 16-ton runs.
- Feed cost of gain was calculated using a base corn price of $4.25/bu (assumes 14% moisture); $42.50/ton for corn silage; $300/ton for soybean meal; and $535/ton for the supplement. Grain processing costs were added to the base grain price.
- Cost per pound of gain to a target gain of 475 lb was calculated for each treatment group.

Composition of experimental diets (dry basis)[1].

Item	% DM
Corn grain (DR or SF)	78.18
Corn silage	14.00
Soybean meal	4.00
Supplement[1]	3.82

[1] Diets were formulated to contain 14% CP; 3.5% NPN; 0.7% calcium; 0.7% potassium; 0.3% salt; 1,000 IU/lb vitamin A, 10 IU/lb vitamin E; and 33 g/ton monensin. Ractopamine hydrochloride was fed at 300 mg/head daily for the final 42 days on feed.

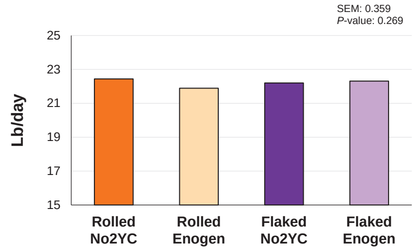
[2] Supplement contained limestone, urea, potassium chloride, salt, vitamins, trace mineral premix, and feed additives.

Effects of grain processing (dry rolling or steam flaking), corn type (No. 2 yellow corn or Enogen corn), and their interaction on feedlot performance and carcass traits of yearling feedlot steers.

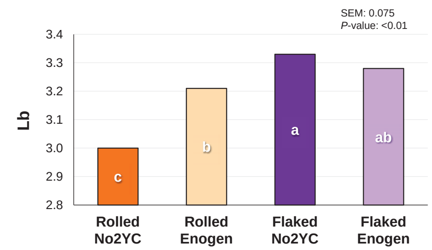
	Dry-rolled corn		Steam-flaked corn			P-value†		
Item	No2YC	Enogen corn	No2YC	Enogen corn	SEM	Processing	Grain	Interaction
Initial weight, lb	940.1	936.8	953.0	937.3	23.19	0.196	0.068	0.233
Final weight, lb	1359.8^{c}	1388.1^{b}	1421.6^{a}	1400.1^{ab}	15.35	<0.01	0.669	<0.01
Hot carcass weight, lb	849.9^{c}	867.6^{b}	888.5^{a}	875.1^{ab}	9.59	<0.01	0.602	<0.01
Marbling score‡	522	540	547	534	8.1	0.239	0.729	0.068
Ribeye area, in^2	12.7	12.9	13.1	13.0	0.11	0.023	0.864	0.249
12^{th}-rib backfat, in	0.53	0.56	0.58	0.57	0.016	0.014	0.356	0.088
Kidney, pelvic, and heart fat, %	1.87	1.89	1.88	1.89	0.012	0.837	0.379	0.719
Abscessed livers, %	14.6	13.1	14.1	14.1	2.91	0.915	0.759	0.777

†Probability values for effect of grain processing (dry-rolled or steam-flaked), effect of grain type (No2YC or Enogen corn), and the interaction between grain processing and grain type.
‡Marbling score of 200 to 299 = Trace; 300 to 399 = Slight; 400 to 499 = Small; 500 to 599 = Modest; 600 to 699 = Moderate; 700 to 799 = Slightly Abundant; 800 to 899 = Moderately Abundant.

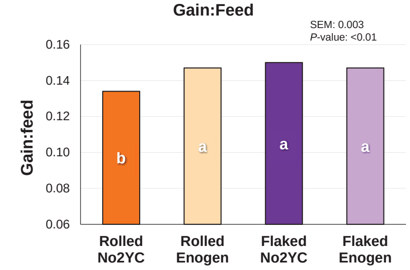
Dry Matter Intake



Average Daily Gain



Gain:Feed



Grain processing cost details

		Grain Processing Cost, $/ton grain				Flaked Enogen vs Flaked No2YC	
Utility consumption	**Unit**	**Rolled No2YC**	**Rolled Enogen**	**Flaked No2YC**	**Flaked Enogen**	**Percentage**	**Absolute**
Electricity, total	kWh/ton grain	7.43	7.40	16.97	10.07	-40.67%	-6.90
Natural gas	ft^3/ton grain	0.00	0.00	666.67	574.07	-13.79%	-92.60
Water	lb/ton grain	0.00	0.00	109.86	94.71	-13.80%	-15.16
Surfactant	lb/ton grain	0.00	0.00	0.06	0.06	---	---
Utility costs[1,2]	**Unit prices[3]**	**Rolled No2YC**	**Rolled Enogen**	**Flaked No2YC**	**Flaked Enogen**	**Percentage**	**Absolute**
Electricity total $ / kWH	$0.0764	0.57	0.57	1.30	0.77	-40.56%	-0.53
Natural Gas $ / 1000 ft^3	$4.86	0.00	0.00	3.24	2.79	-13.73%	-0.44
Water $ / lb	$0.00142	0.00	0.00	0.16	0.15	-11.11%	-0.02
Subtotal Utilities	***$/ton grain***	***0.57***	***0.57***	***4.76***	***3.77***	***-21.20%***	***-0.99***
Ongoing and maintenance costs[3]		**Rolled No2YC**	**Rolled Enogen**	**Flaked No2YC**	**Flaked Enogen**	**Percentage**	**Absolute**
Fixed costs	*$/ton grain*	---	---	1.25	1.25	0.00%	0.00
Labor	*$/ton grain*	---	---	1.00	0.64	-36.36%	-0.36
Maintenance and repair	*$/ton grain*	---	---	1.22	1.22	0.00%	0.00
Subtotal Ongoing and Maintenance	***$/ton grain***	***3.36***	***3.36***	***3.09***	***2.75***	***-10.70%***	***-0.34***
Total Processing Cost, $/ton grain		**3.93**	**3.93**	**7.85**	**6.52**	***-16.98%***	***-1.33***

[1,2] Based on published 2023 KS Industrial Utility Prices

[3]Total back-calculated from commercial processing input [Total cost - Utility costs]; category values for SFC calculated using distribution (%) of total published in Macken 2006 adjusted to 2023 USD value ($1.51 per $1.00 2006 value)

Item	Rolled No2YC	Rolled Enogen	Flaked No2YC	Flaked Enogen
Dry matter intake, lb/d	22.45	21.90	22.21	22.31
Feed cost, $/head daily including processing[1]	$2.160	$2.107	$2.176	$2.173
Average daily gain, lb	3.00	3.21	3.33	3.28
Days on feed to achieve target gain (475 lb)	158	148	143	145
Feed cost, $/head to target gain	$341.25	$311.82	$311.21	$315.02
Cost of gain, $/lb	$0.720	$0.656	$0.654	$0.662
Cost of gain vs Flaked No2YC, $/lb	$0.066	$0.002	---	$0.008

[1]Feed costs using corn grain price of $4.25/bu at 86% DM

Conclusions

- Flaking, as expected, improved performance and decreased cost of gain compared to dry rolling No 2 Yellow Corn
- Flaking costs were less for Enogen corn compared to conventional corn, largely due to increased throughput and reduced utility costs.
- Dry-rolled Enogen corn yielded performance and cost of grain comparable to that of flaked grains.

Evaluation of High-Moisture Ear Corn as a Roughage Source in Finishing Diets Fed to Beef Steers

South Dakota State University

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Introduction

- Crop and livestock systems in the Midwest capitalize on taking advantage of ample supplies of feed and high-quality feeder cattle but must deal with sometimes challenging weather conditions.
- Adverse weather during the fall can complicate corn harvest, resulting in delays and added drying expense. Harvesting high moisture ear corn (HMEC) widens harvest windows and captures starch and roughage in one feedstuff.

Objective

- Determine the roughage value and replacement net energy value of HMEC in diets fed to finishing beef steers

Materials and Methods

Treatment

- Backgrounded Charolais - cross steers (n = 192 steers; allotment BW = 990 ± 52.6 lbs)
  - Cattle were fed at the Ruminant Nutrition Center (RNC) in Brookings, SD for 146 d
  - Randomized complete block design, (n = 6 pens/treatment, 8 steers/pen; 24 pens total)
  - 4 dietary treatments, with an assumed roughage content of earlage at 20%
    1. Hay and high moisture corn; grass hay 10% DM basis inclusion **(HAY10)**
    2. Earlage; 35% DM inclusion, 6% roughage equivalent **(EAR6)**
    3. Earlage; 55% DM inclusion, 10% roughage equivalent **(EAR10)**
    4. Earlage; 75% DM inclusion, 14% roughage equivalent **(EAR14)**

Processing

- Calves were obtained from a previously conducted, unrelated growing study.
- d 28 → Implanted with Revalor-200 (Merck Animal Health; Rahway, NJ)

Dietary Management

- Feed deliveries were managed using a slick bunk management approach
- Steers were adapted to high-concentrate diets using three step-up diets over 14 days.

Statistical Analysis

- Growth performance, carcass traits, and particle size analysis of the diet were analyzed as a randomized complete block design using the GLIMMIX procedure of SAS 9.4 (SAS Inst. Inc., Cary, NC) with pen as the experimental unit, fixed effect of treatment, and block as the random effect. Orthogonal contrasts were used to evaluate the linear and quadratic effects of HMEC inclusion.
- USDA Quality and Yield Grade distributions were analyzed as multinomial distribution using the GLIMMIX procedure of SAS 9.4.
- An α of 0.05 determined significance with tendencies between 0.06 and 0.10.

Penn State Particle Separation

- Particle size distribution for weekly diet samples was determined using the Penn State Shaker Box.

Table 1. Formulated diets and nutrient composition

Ingredient, %DM	HAY10	EAR6	EAR10	EAR14
High Moisture Ear Corn	0.00	34.28	52.85	70.75
Grass Hay	10.00	0.00	0.00	0.00
High Moisture Corn	65.00	35.36	17.35	0.00
MDGS	20.00	24.46	24.99	24.53
Liquid Supplement	5.00	5.90	4.81	4.72
Composition[2], %DM				
DM, %	67.08	63.66	62.47	61.32
CP	14.24	13.87	13.55	13.23
NDF	22.24	20.31	22.70	25.10
Dietary NEm, Mcal/lb	0.96	0.96	0.93	0.90
Dietary NEg, Mcal/lb	0.65	0.65	0.63	0.61

[1]Provided 30 g/T of monensin, as well as vitamins and minerals to exceed requirements.
[2]Tabular estimates based on Preston, 2014

Results

Table 2. Cumulative growth performance responses through d 146

Item	HAY10	EAR6	EAR10	EAR14	SEM	Overall	Ear Lin.	Ear Quad.
Pens, n	6	6	6	6	-	-	-	-
Steers, n	48	48	48	48	-	-	-	-
Initial BW[1], lbs	990	989	990	989	-	-	-	-
Final BW, lbs	1505	1502	1529	1513	14.6	0.44	0.52	0.16
ADG, lb	3.54	3.51	3.68	3.59	0.90	0.31	0.32	0.08
DMI, lbs	24.43[a]	22.98[b]	24.43[a]	24.59[a]	0.369	0.01	0.01	0.02
F:G[2]	6.90[c]	6.54[a]	6.62[ab]	6.85[bc]	-	0.02	0.02	0.61
Dietary NEm, Mcal/lb	96.11[b]	99.46[a]	96.89[b]	95.89[b]	1.085	0.02	0.01	0.43
Dietary NEg, Mcal/lb	65.69[b]	68.64[b]	66.38[b]	65.50[b]	0.951	0.02	0.01	0.43
O:E dietary NEm[3]	1.06	1.08	1.07	1.08	0.012	0.43	1.00	0.37
O:E dietary NEg[3]	1.09	1.10	1.08	1.09	0.015	0.64	0.47	0.32

[1] A 4% pencil shrink was applied to all BW measures to account for gastrointestinal tract fill
[2]Analysed as G:F, the reciprocal of F:G
[3]O:E = Observed-to-expected ratio for dietary net energy for maintenance and gain
[a,b] Means within a row lacking a common superscript differ ($P \leq 0.05$)

Figure 1. Behavioral Data

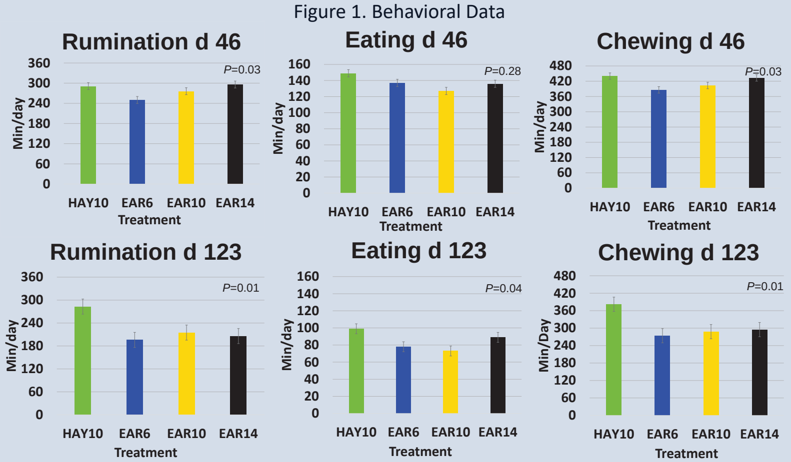


Table 3. Particle Size

Item	HAY10	EAR6	EAR10	EAR14	SEM	Overall	Ear Lin.	Ear Quad.
No. of samples	18	18	18	18	-	-	-	-
NDF, %DM[1]	22.24	20.31	22.70	25.10	-	-	-	-
Retained/screen,% Sieve screen size, in								
0.75	4.02[b]	3.60[b]	5.08[ab]	5.73[a]	0.654	<0.01	<0.01	0.49
0.31	20.32[b]	23.01[b]	25.41[a]	27.79[a]	1.234	<0.01	<0.01	0.99
0.16	24.81[b]	33.79[a]	32.91[a]	32.89[a]	1.242	<0.01	0.51	0.72
< 0.16 in	51.11[a]	39.60[b]	36.59[b]	33.56[b]	2.322	<0.01	0.01	0.99
Est. peNDF, %DM[2]	10.93[c]	12.27[b]	14.39[b]	16.67[a]	0.523	<0.01	<0.01	0.87

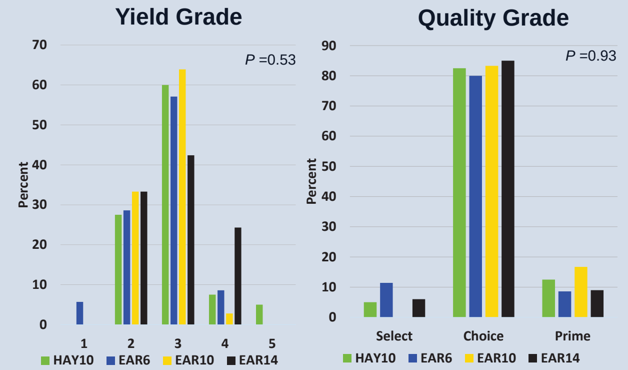
[1]Tabular estimates based on Preston, 2014
[a,b] Means within a row lacking a common superscript differ ($P \leq 0.05$)
[2] Calculated by multiplying the particles greater than 0.16 in (as a percent of the total sample) by the NDF content of the sample (Gentry et al., 2013).

Table 4. Carcass trait responses

Item	HAY10	EAR6	EAR10	EAR14	SEM	Overall	Ear Lin.	Ear Quad.
Pens, n	5	4	5	3	-	-	-	-
Steers[a], n	38	32	35	24	-	-	-	-
HCW, lbs	939	946	966	955	12.4	0.28	0.40	0.09
DP[b], %	62.4	62.8	63.2	63.0	0.72	0.81	0.69	0.50
REA, in^2	14.66	14.99	14.87	14.99	0.252	0.69	0.43	0.98
RF, in	0.60[f]	0.56[fg]	0.54[f]	0.62[f]	0.025	0.07	0.12	0.07
Marbling[c]	537	510	542	528	20.1	0.55	0.48	0.26
Calc. YG[d]	3.38	3.20	3.26	3.46	0.111	0.28	0.12	0.56
EBF[e], %	32.01[fg]	31.22[g]	31.44[fg]	32.25[f]	0.341	0.10	0.04	0.40

[a]Because of miscommunication with the slaughter plant, carcass data are missing for 47 steers
[b] DP = (HCW/final BW shrunk 4%) × 100
[c] 400 = small[00]
[d] According to the regression equation described by USDA (1997)
[e]Calculated according the equations described by Guiroy et al. (2002)
[f,g] Means within a row lacking a common superscript differ ($P \leq 0.05$)

Figure 2. Yield and Quality Grade



Conclusion

- Including HMEC to provide 10% roughage equivalent produced the greatest output (live weight and carcass weight) compared to all other treatments and was more efficient than the diet containing 10% roughage from hay.
- Dietary treatments did not affect carcass characteristics or distributions of USDA Quality or Yield Grade.
- HMEC fed to provide 6% roughage was numerically the most efficient but resulted in reduced DMI and ADG compared to the other treatments.
- Steers fed hay as their roughage source spent the most time chewing and ruminating

Acknowledgments

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BEEF Iowa Beef Industry Council

Evaluating the effects of feeding management practices and ruminal acidosis on the development of liver abscesses in beef × dairy crossbred steers

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INTRODUCTION

- Liver abscess (LA) prevalence in finishing beef steers ranges from 0 to 95.5% and is often associated with high-grain diets and management practices.
- Liver abscesses can decrease DMI, feed efficiency, and carcass value, contributing to greater than $900 million in annual economic losses in the U.S.
- In finishing beef steers, fermentable carbohydrates increase lactic and volatile fatty acid production, decreasing ruminal pH, leading to rumenitis and possible bacterial translocation.
- *Fusobacterium necrophorum* and *Trueperella pyogenes* are the primary pathogens associated with LA; however, *Salmonella enterica* has been isolated from LA but its role in LA formation is unclear.
- McDaniel et al. (2024a,b) developed a model to induce LA by inoculating steers with *F. necrophorum,* and *S. Lubbock*, resulting in LA formation in 43% and 45% of the steers, respectively.
- Steers consuming a high-forage diet have developed LA when inoculated with high doses of *F. necrophorum* and *S. Lubbock* (100 ml of 1 × 10^8 of *F. necrophorum* and 100 ml of 1 × 10^9 CFU of *S. Lubbock).*

OBJECTIVE

- Compare LA prevalence in steers subjected to acidotic cycling versus those fed a continuous high-concentrate diet.
- Evaluate the relationship between *F. necrophorum* and *S. Lubbock* inoculation on LA development in steers fed a high-concentrate finishing diet.

MATERIALS AND METHODS

Beef × dairy steers (n = 40; initial BW = 195 ± 30.6 lb) were procured and transported from a commercial calf ranch to the USDA-ARS Livestock Issues Research Unit facility near Lubbock, Texas and stratified by individual BW to 1 of 4 treatments:

- **NCON:** a high-concentrate diet representative of a standard finishing feedlot diet (STD) with no inoculation or acidotic cycles
- **PCON:** a high-starch acidotic diet (AD) in which steers were cycled 3-times between AD for 3 d and then switched to a low-starch diet (CON) for 2 d and received 3 intraruminal doses of *F. necrophorum* and *S. enterica* serovar Lubbock (1 × 10^6 and 1 × 10^6 CFU, respectively)
- **STDF:** a high-concentrate diet representative of a standard finishing feedlot diet and received 3 intraruminal doses of *F. necrophorum* (1 × 10^6 CFU)
- **STDFS**: a high-concentrate diet representative of a standard finishing feedlot diet and received 3 doses of *F. necrophorum* and *S. enterica* serovar Lubbock (1 × 10^6 and 1 × 10^6 CFU, respectively)

Animal Management

- Steers were provided fresh feed and water *ad libitum* daily.
- Ruminal fluid collected pre- and post-intraruminal inoculation for bacterial isolation.
- Complete blood count (CBC) analysis occurred every 12 d via jugular venipuncture.

Gross Pathology

- All steers were humanely euthanized on d 34 to evaluate gross pathological scores of lung, rumen, colon, ileal, and liver and liver abscesses (if present).
- Rumen, lungs, colon, and ileal scores were classified as normal or abnormal.
- Livers were classified as 0, A-, A, A+
- Samples of organ tissues were collected and analyzed for prevalence of bacteria.

Statistical Analysis

- Completely randomized design with steer as experimental unit.
- Model for gross pathology included treatment as fixed effect.
- Repeated measures were used for most live parameters and binomial proportions for prevalence.
- Model for hematology included fixed effects of treatment, time, treatment × time.
- Significance was recognized at α = 0.05

EXPERIMENTAL DIETS

Item	Control	Acidotic	Standard
Ingredient, % of dry matter (DM)			
Steam-flaked corn	-	53.8	67.9
Dry-rolled corn	20.0	-	-
Wet corn gluten feed	46.5	22.0	19.8
Ground corn	-	15.0	-
Ground alfalfa hay	30.0	5.00	8.00
Limestone	1.50	1.50	1.60
Urea	-	0.70	0.70
Vitamin and mineral supplement	2.00	2.00	2.00
Analyzed nutrient composition, % of DM			
Diet DM, %	73.0	78.0	78.1
Crude protein, %	18.4	17.5	15.1
Neutral detergent fiber, %	27.6	15.8	16.6
Acid detergent fiber, %	15.5	6.30	7.20
Ether Extract, %	2.70	3.40	3.50
Total starch, %	29.3	55.9	54.9
Ca, %	0.90	0.58	0.76
P, %	0.60	0.48	0.51
NE_m, Mcal/lb	0.85	1.06	1.03
NE_g, Mcal/lb	0.56	0.74	0.72

RESULTS

Gross Pathology

Item	NCON	PCON	STDF	STDFS	SEM	*P*-value
	Treatment					
Liver, %						
Abnormal	0.0	22.2	33.3	44.4	0.115	0.86
0	100.0	77.8	67.7	55.6	0.115	0.81
A-	0.0	11.1	0.0	11.1	0.053	1.00
A	0.0	11.1	22.2	22.2	0.096	0.92
A+	0.0	0.0	11.1	11.1	0.053	1.00
Lung, %						
Abnormal	100.0	44.4	77.8	100.0	0.078	0.58
Rumen, %						
Abnormal	100.0	88.9	100.0	100.0	0.026	1.00
Colon, %						
Abnormal	55.6	44.4	66.7	44.4	0.163	0.75
Ileum%						
Abnormal	88.9	77.8	88.9	88.9	0.113	0.88

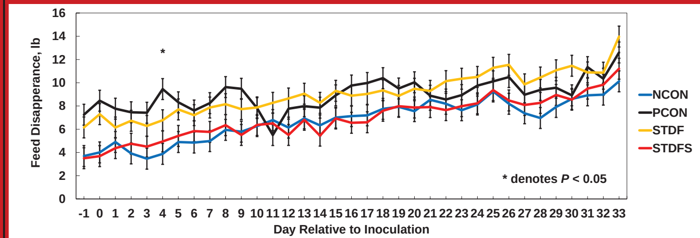
F. necrophorum and *S. enterica* from ruminal, colonic, and ileal tissues

Bacterium	NCON %, (n=9)	PCON %, (n=9)	STDF %, (n=9)	STDFS %, (n=9)
	Treatment			
F. necrophorum* subsp. *necrophorum				
Ruminal				
Healthy	22.2, (2)	88.9, (8)	88.9, (8)	77.8, (7)
Rumenitis	33.3, (3)	88.9, (8)	77.8, (7)	66.7, (6)
Colonic	22.2, (2)	22.2, (2)	11.1, (1)	11.1, (1)
Ileal	22.2, (2)	33.3, (3)	22.2, (2)	0.0, (0)
F. necrophorum* subsp. *funduliforme				
Ruminal				
Healthy	88.9, (8)	88.9, (8)	77.8, (7)	77.8, (7)
Rumenitis	100.0, (9)	100.0, (9)	77.8, (7)	88.9, (8)
Colonic	11.1, (1)	11.1, (1)	11.1, (1)	0.0, (0)
Ileal	11.1, (1)	33.3, (3)	11.1, (1)	33.3, (3)
S. enterica				
Ruminal				
Healthy	66.7, (6)	100.0, (9)	55.6, (5)	77.8, (7)
Rumenitis	44.4, (4)	66.8, (6)	77.8, (7)	77.8, (7)
Colonic	33.3, (3)	88.9, (8)	55.6, (5)	77.8, (7)
Ileal	77.8, (7)	55.6, (5)	55.6, (5)	88.9, (8)

Complete Blood Cell Counts

Item	NCON	PCON	STDF	STDFS	SEM	Trt	Day	Trt × Day
	Treatments					*P*-value		
Red blood cells, × 1,000,000/μL	10.11	10.13	10.19	9.85	0.205	0.66	<0.01	0.38
Hemoglobin, g/dL	11.49	11.32	11.47	11.03	0.226	0.46	<0.01	0.08
Hematocrit, %	34.63	33.36	33.64	32.27	0.960	0.34	<0.01	0.31
Platelets, × 1,000/μL	709.54[a]	703.65[a]	676.65[a]	546.69[b]	31.040	<0.01	<0.01	<0.01
White blood cells, × 1,000/μL	9.05[b]	11.94[a]	11.62[a,b]	9.03[b]	0.674	<0.01	<0.01	0.04
Neutrophils, × 1,000/μL	2.58[b]	4.20[a]	3.97[a]	2.84[b]	0.285	<0.01	<0.01	0.01
Lymphocytes, × 1,000/μL	4.61	5.44	5.68	4.40	0.394	0.08	<0.01	0.06
Monocytes, × 1,000/μL	1.68[b]	2.09[a]	1.90[a,b]	1.66[b]	0.119	0.05	<0.01	0.38
Eosinophils, × 1,000/μL	0.07	0.05	0.05	0.09	0.0172	0.38	<0.01	0.07
Basophils, × 1,000/μL	0.05[a,b]	0.11[a]	0.03[a,b]	0.03[b]	0.0189	0.02	<0.01	<0.01
Neutrophil:lymphocyte ratio	0.62	0.81	0.70	0.71	0.0697	0.31	<0.01	<0.01

Daily Feed Disappearance



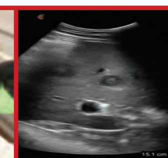
Daily feed disappearance from beef × dairy steers who were fed a high-concentrate diet (NCON), fed a low-starch control diet with 3 low-dose inoculation and cycled with high-starch acidotic diet 3 times (PCON), fed a high-concentrate diet with 3 low-dose inoculations of F. necrophorum (STDF), and fed a high-concentrate diet with 3 low-dose inoculations of *F. necrophorum* and *S. enterica*. A difference in treatment × time ($P \leq 0.01$) was observed.

F. necrophorum and *S. enterica* isolated from healthy and abscessed livers

Bacterium	NCON Healthy %, (n = 8)	NCON Abscessed %, (n = 0)	PCON Healthy %, (n = 7)	PCON Abscessed %, (n = 2)	STDF Healthy %, (n = 5)	STDF Abscessed %, (n = 4)	STDFS Healthy %, (n = 5)	STDFS Abscessed %, (n = 4)
	Treatment							
F. necrophorum* subsp. *necrophorum	25, (2)	-	0, (0)	100, (2)	0, (0)	50, (2)	0, (0)	100, (4)
S. enterica	37.5, (3)	-	42.9, (3)	0, (0)	40, (2)	75, (3)	40, (2)	50, (2)

CONCLUSION AND IMPLICATIONS

- The NCON (STD diet only) treatment group had 0% LA, whereas LA were present in all treatment groups that received intramural inoculation, confirming that pathogenic bacteria in the rumen could be more influential to LA formation than diet or management practices alone.
- Confirms that acidotic cycles are not necessary to induce LA as PCON (acidotic cycles) had 22.2% LA prevalence, whereas STDF (standard diet + *F. necrophorum*) and STDFS (STD diet + *F. necrophorum* and *S. enterica*) had 33.3% and 44.4% LA prevalence, respectively.
- Overall rumenitis prevalence (97%) confirms the need for further research into early life management and its role in LA formation.



ACKNOWLEDGEMENTS

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Impact of Constant Versus Variable Inclusions of Modified Distillers Grains Plus Solubles on Feedlot Cattle Performance and Carcass Characteristics

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Introduction

Distillers grains in feedlot diets are critically important to Nebraska and surrounding states. A recent challenge that beef producers have been facing is managing supply and inconsistent delivery of distillers grains loads. The implications of interruptions in distillers grains supply and the consequences that varying inclusions throughout the feeding period may have on cattle performance are unclear. A previous study at the University of NE evaluated the effects of varying inclusion on modified distillers grains plus solubles (MDGS) on a weekly basis with two inclusions of grass hay on finishing yearling steer performance. This study included 2 inclusions of grass hay (6% and 12%) with 3 inclusions of modified distillers grains plus solubles (0%, 25% constant, and 25% varying from 15-35%). There were no interactions observed between MDGS inclusion and hay inclusion. Additionally, varying MDGS from 15 to 35% while averaging 25% did not have an impact on performance compared to constant MDGS inclusion.

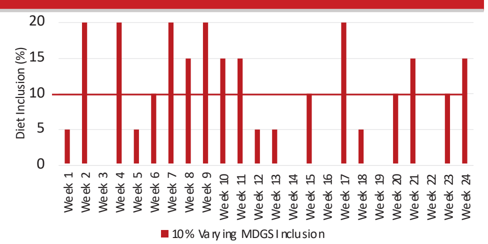
Objectives

- Determine the impact of changing inclusion of MDGS throughout the feeding period on feedlot cattle performance and carcass characteristics when MDGS inclusions are 10% or 25% of diet
- Quantify the impacts of changing inclusion for consulting nutritionists, cattle feeders, and ethanol plants to better align the supply and demand of distillers

Materials and Methods

- 2x2+1 factorial
- 400 calf-fed steers, 10 head per pen, 40 pens
- 5 treatments:
    1. 0% MDGS control
    2. 10% MDGS constant
    3. 10% MDGS varying (from 0-20%)
    4. 25% MDGS constant
    5. 25% MDGS varying (from 15-35%)
- Steers were blocked by weight into three blocks
- Each treatment replicated across 8 pens
- Varying diets inclusions changed weekly
- Control diet cattle received Empyreal (Cargill Wet Milling) on a phase-out schedule to ensure metabolizable protein was not limiting growth
- Implanted with Revalor-XS (200 mg trenbolone acetate and 40 mg estradiol; Merck Animal Health
- Cattle received Optaflexx (Elanco Animal Health) for an average of 35 days at the end of feeding period
- Fed for an average of 191 days

MDGS Weekly Randomization



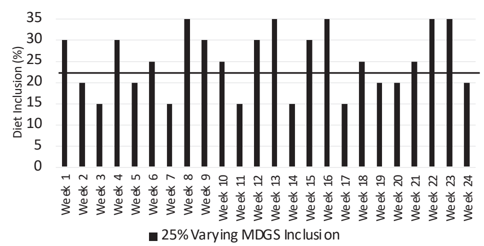


Figure 1. The randomized inclusions for the variable 10% MDGS treatment. The red bars show the amount of MDGS fed each week to the treatment that averaged 10% MDGS throughout the feeding period. This treatment could be 0, 5, 10, 15, or 20% distillers and inclusion was randomly assigned and changed weekly.

Figure 2. The randomized inclusions for the variable 25% MDGS treatment. The black bars show the 25% MDGS treatment. This treatment could be 15, 20, 25, 30, or 35% distillers each week, also randomly selected and changing weekly.

Diet Composition

Table 1. Diet composition (DM-basis) fed to steers containing 0, 10, or 25% modified distillers grains (MDGS) on a constant or variable basis.

	Treatments												
			Variable						Variable				
Ingredient	0% MDGS	10% MDGS Constant	0%	5%	10%	15%	20%	25% MDGS Constant	15%	20%	25%	30%	35%
HMC	40	35	40	37.5	35	32.5	30	27.5	32.5	30	27.5	25	22.5
DRC	40	35	40	37.5	35	32.5	30	27.5	32.5	30	27.5	25	22.5
Corn Silage	15	15	15	15	15	15	15	15	15	15	15	15	15
MDGS	-	10	-	5	10	15	20	25	15	20	25	30	35
Supplement	5	5	5	5	5	5	5	5	5	5	5	5	5
Urea	1.2	1.0	1.2	1.2	1.0	0.67	0.33	0	0.67	0.33	0	0	0

Results

Table 2. Performance and carcass characteristics of steers fed 0, 10, or 25% MDGS on a constant or variable inclusion basis.

	Treatments						*P*-value			
							Constant		Variable	
Item	0% Control	10% MDGS Constant	10% MDGS Variable	25% MDGS Constant	25% MDGS Variable	SEM	Linear	Quadratic	Linear	Quadratic
Steer Performance										
Initial BW, lb	633	634	633	632	635	0.9	0.20	0.33	0.15	0.53
Final BW, lb	1299	1315	1316	1350	1332	12.7	<0.01	0.74	0.08	0.83
DMI, lb/d	22.1	22.3	22.7	23.2	22.7	0.4	0.03	0.61	0.32	0.39
ADG, lb	3.48	3.56	3.57	3.76	3.65	0.066	<0.01	0.69	0.09	0.76
F:G	6.34	6.26	6.34	6.19	6.22	-	0.18	0.87	0.25	0.63
Carcass Characteristics										
HCW, lb	819	828	829	851	840	8.01	<0.01	0.74	0.08	0.84
12th rib fat, in	0.537	0.563	0.584	0.638	0.586	0.024	<0.01	0.62	0.18	0.34
LM area, in^2	13.5	13.7	13.7	13.8	13.8	0.134	0.09	0.77	0.23	0.47
Marbling score	531	556	566	552	545	14.4	0.37	0.37	0.61	0.11
Yield grade	3.34	3.40	3.46	3.60	3.46	0.058	<0.01	0.59	0.17	0.34
Abscessed livers, %	38	43	50	37	46	6.09	0.81	0.44	0.42	0.26

Summary

- No interactions were observed between MDGS consistency and MDGS diet inclusion for any performance or carcass characteristics
- Increasing the inclusion of MDGS from 0 to 25% of the diet and feeding it consistently linearly increased dry matter intake, average daily gain, hot carcass weight, and final body weight
- Fat thickness, ribeye area (LM area), and yield grade were also increased by increasing MDGS from 0 to 25% of the diet when inclusion was consistent each day
- No improvement in feed efficiency with increasing concentrations of MDGS was observed
- Increasing the average dietary concentration of MDGS from 0 to 25% but allowing the concentrations to vary also tended to increase average daily gain and hot carcass weight but to a lesser degree than constant inclusion
- Concluded that varying MDGS inclusions in diets due to inconsistent deliveries has minimal impact on feedlot animal performance and carcass characteristics

Effects of a formulated botanical blend on growth performance in feedlot cattle: a pooled analysis

South Dakota State University

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Introduction

- Essential oils contain secondary metabolites produced by medicinal plants to elicit protective effects and defense mechanisms for the host plant.
- **Capsicum oleoresin** can reduce inflammation and influence glucose metabolism and nutrient partitioning. Additionally, it can improve heat tolerance by increasing vasodilation.
- **Clove essential oil** exhibits anti-inflammatory properties in the gastrointestinal tract and other tissues, potentially enhancing overall health.
- **Garlic essential oil** exhibit activity against a broad spectrum of bacteria, including both Gram-positive and Gram-negative pathogens, enhance immune function and decrease methane production.

Objective

Pool data from 4 studies to determine the effects of supplementation of a formulated blend of capsicum oleoresin, clove essential oil, and garlic essential oil (CCG; Fytera® Advance - Selko® USA, Indianapolis IN) on growth performance of steers and cutting-bulls.

Methods & Approach

- Randomized complete block design experiments (n = 4 experiments) were used in the pooled analysis.
- Data was pooled by feeding phase: Receiving (2 studies) and Finishing (2 studies). One study for each phase was conducted in each location: South Dakota and Oklahoma.
- Similar arrival processing was used across experiments where 1701 steers and 341 cutting-bulls were enrolled into 64 pens (32 pens per treatment) with 6 to 80 head per pen.
- . Within each study, pens were assigned to 1 of 2 treatments:
  - **1) non-supplemented control (CON);**
  - **2) supplemented with 500 mg/steer daily of CCG.**

Statistical Analysis

- Data were analyzed using the GLIMMIX procedure of SAS 9.4
- Models were fitted with a Gaussian distribution, Kenward-Roger's denominator degrees of freedom method.
- Pen was the experimental unit
- Treatment was fixed effect
- Random intercepts for blocks within trials were included. Model-adjusted means and standard errors were obtained; means separations included a Tukey-Kramer adjustment for multiple comparisons.
- Distribution of USDA Yield and Quality grade data were analyzed as multinomial distributions using the GLIMMIX procedure of SAS 9.4. Pen served as the experimental unit, by including pen within treatment as the subject of the random error.
- Statistical significance was denoted at an $\alpha \le 0.05$ and tendencies were observed at $0.05 < \alpha \ge 0.10$.

Diets

Table 1. Nutrient content

Experiment	CP, %	NEm, Mcal/cwt	NEg, Mcal/cwt
South Dakota 1	13.8	78.9	48.5
South Dakota 2	13.5	93.4	63.0
Oklahoma 1	17.1	73.5	45.8
Oklahoma 2	12.6	100.7	65.75

Diets contained monensin (South Dakota only) or monensin and tylosin phosphate (Oklahoma only) and consisted of ingredients common to each region
Monensin - 27g/ton
Monensin - 30g/ton
Monensin; Tylosin - 31.4g/ton; 61 mg/hd/d
Monensin; Tylosin; Ractopamine – 44.g/ton; 90 mg/hd/d; 300 mg/hd/d for 39d

Results

Table 2. Description of studies

	CCG, mg/steer daily							
	0				500			
Receiving studies	Blocks	Head in	DOF	Initial BW	Blocks	Head in	DOF	Initial BW
SD1	8	64	56	602	8	64	56	603
OK1	9	235	56	524	9	221	56	526
Finishing studies								
SD2	7	47	144	898	7	47	144	898
OK2	8	605	178	840	8	601	178	839

Treatments were: CON (No supplementation of CCG); or CCG (Cattle were supplemented with 500mg of CCG daily; Fytera® Advance - Selko® USA, Indianapolis IN)

Table 3. Growth performance of receiving cattle supplemented with CCG

	CCG, mg/steer daily			
Item	0	500	SEM	*P* - Value
Studies, n	2	2	-	-
Replicates, n	17	17	-	-
Initial BW[2], lbs	561	563	1.6	0.32
Final BW[2], lbs	697	699	2.5	0.32
ADG, lbs	2.71	2.76	0.055	0.32
DMI, lbs	14.65	14.54	0.098	0.28
F:G[3]	5.46	5.32	0.094	0.16

Table 4. Growth performance of finishing cattle supplemented with CCG

	CCG, mg/steer daily			
Item	0	500	SEM	*P* - Value
Studies, n	2	2	-	-
Replicates, n	15	15	-	-
Initial BW[2], lbs	868	867	2.3	0.65
Final BW[2], lbs	1472	1481	6.5	0.20
ADG, lbs	3.86	3.93	0.033	0.07
DMI, lbs	22.69	22.58	0.096	0.28
F:G[3]	5.89	5.77	0.055	0.04

Table 5. Growth performance of receiving and finishing cattle supplemented with CCG

	CCG, mg/steer daily			
Item	0	500	SEM	*P* - Value
Studies, n	4	4	-	-
Replicates, n	32	32	-	-
Initial BW[2], lbs	705	705	28.9	0.80
Final BW[2], lbs	1060	1066	70.5	0.11
ADG, lbs	3.25	3.31	0.12	0.07
DMI, lbs	18.42	18.31	0.741	0.12
F:G[3]	5.66	5.53	0.085	0.02

[1]Treatments were: CON (No CCG); or CCG (Supplemented with 500mg of CCG daily; Fytera® Advance - Selko® USA, Indianapolis IN).
[2]A 4% pencil shrink was applied to all BW measures to account for digestive tract fill.
[3]Analyzed as G:F, the reciprocal of F:G.
*ADG (average daily gain); DMI (dry matter intake); F:G (feed for gain).

Table 6. Carcass and liver outcomes

	CCG, mg/steer daily			
Item	0	500	SEM	*P* - Value
HCW, lbs	941	945	3.1	0.19
Dressing Percentage[1], %	63.90	63.82	0.162	0.65
REA, in sq.	14.69	14.86	0.100	0.11
RF, in	0.61	0.63	0.009	0.26
Marbling	504	509	7.6	0.57
cYield Grade	3.30	3.30	0.051	0.81
EBF[2], %	31.91	32.05	0.164	0.42
Yield Grade Distribution[3], %				
YG1	5.1	5.2	-	0.83
YG2	36.4	36.8	-	
YG3	41.5	41.2	-	
YG4	15.0	14.7	-	
YG5	2.0	2.1	-	
Quality Grade Distribution[4], %				
Standard	0.1	0.1	-	0.95
Select	10.1	10.0	-	
Low Choice	37.4	37.3	-	
Upper Choice	47.9	48.0	-	
Prime	4.5	4.6	-	

[1]Calculated as : (HCW/final BW shrunk 4%) × 100
[2]Calculated from Guiroy et al. (2002)
[3]671 animals were evaluated from control and 629 dor CCG500
[4]651 animals were evaluated from control and 657 for CCG500

Conclusion

- There were no improvements of supplementing 500mg/day of CCG during the receiving period
- During the finishing period, supplementing 500mg/day of CCG improved F:G by 2% and tended to improve ADG in 1.8%
- Cumulatively, F:G was improved and ADG tended to improve when CCG was supplemented. However, Final BW and DMI were similar across treatments
- Carcass and liver outcomes were not improved by CCG supplementation
- This pooled analysis provides valuable insights and underscores the necessity for further research
- Additional studies are needed to explore optimal EO dosages, identify the most effective combinations, and evaluate their interactions with varying diets and management systems

Comparison of Synovex® reimplant programs for beef steers fed more than 200 days-on-feed

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INTRODUCTION

Growth-promoting implants increase ADG and have shown to improve feed efficiency in all classes of cattle over different production phases (Smith and Johnson, 2020). In the last 20 years lighter cattle have been placed in feedlots resulting in cattle being fed for longer than 200 days (Smith, 2019). In the first-generation noncoated TBA + E_2 implant products, the effective anabolic payout is 60 to 120 days (Mader, 1998). Synovex® One Feedlot, a coated implant containing 200 mg TBA and 28 mg estradiol benzoate, has been used in feedlot production to extend hormonal release 200+ days after implantation (Smith, 2019). Recent regulatory changes have left producers with fewer option for reimplanting. Guidance for Industry (GFI) #191 issued by the FDA, outlines the production phases in which cattle can be implanted and/or reimplanted. In 2022, Zoetis received approval for three reimplant programs where Synovex Choice® is the first implant and a Synovex Choice, Synovex Plus®, or Synovex One Feedlot implant is administered 60-120 days later. As a result, implant programs are being evaluated for cattle with longer days on feed.

OBJECTIVE

- To evaluate performance responses of on arrival compared to delayed implant strategies in feedlot steers.

MATERIALS AND METHODS

- 2299 Steers (681 ± 21.6 lb) were fed for 236 days held in 30 pens (~77 head per pen).
- This was a randomized complete block design, blocked by arrival date.
- The pens were used as an experimental unit, with treatment as a fixed effect and block as a random variable.
- Significant differences described (P < 0.10) and tendencies (P < 0.15).
- Statistical analyses were evaluated using R (RStudio Team 2024).

Three Treatment Groups:

1. Choice/Plus

Synovex Choice → Synovex Plus

Arrival — Day 120 — Day ~ 236

2. Delay/Choice/Plus

Delay → Synovex Choice → Synovex Plus

Arrival — Day 30 — Day 150 — Day ~ 236

3. Choice/Synovex One Feedlot (SOF)

Synovex Choice → Synovex One Feedlot

Arrival — Day 80 — Day ~ 236

RESULTS

Table 1. Live performance of beef steers fed an average of 236 days-on-feed administered three different implant strategies[1].

	Treatments				
	Choice/Plus	Delay/Choice/Plus	Choice/SOF	SEM	*P*-value
Head Count	767	766	766	-	-
Initial BW, lb	679	682	683	21.6	0.53
DMI, lb	20.1[y]	19.4[x]	19.9[xy]	0.29	0.07
Final BW[2], lb	1468[x]	1473[xy]	1483[y]	11.4	0.15
Deads In					
ADG	3.28	3.26	3.26	0.06	0.92
F:G	6.16	5.97	6.13	0.14	0.34
Deads Out					
ADG	3.35[x]	3.36[xy]	3.40[y]	0.05	0.11
F:G	6.10	5.89	5.99	0.12	0.19

[1]Dead and removed steers were excluded from this analysis.
[2]Weights decreased by 4% to represent a standard industry shrink.
[xy]Means in the same row that do not have a common superscript letter differ, *P* < 0.10.

Table 2. Carcass performance of beef steers fed an average of 236 days-on-feed administered three different implant strategies.

	Treatments				
	Choice/Plus	Delay/Choice/Plus	Choice/SOF	SEM	*P*-value
HCW, lb	961.5[x]	966.7[xy]	972.2[y]	7.21	0.15
DP[1], %	65.5	65.6	65.6	0.10	0.76
REA, in²	15.0[x]	15.3[y]	15.0[x]	0.17	0.04
Backfat, in	0.74[y]	0.71[x]	0.75[y]	0.03	0.03
Marbling[2]	523[x]	527[x]	538[y]	14.2	0.03
Yield grade distribution					<0.01
USDA YG 1, %	1.30[x]	1.73[y]	1.16[x]	0.53	-
USDA YG 2, %	18.48[x]	23.14[y]	16.93[x]	4.71	-
USDA YG 3, %	45.23	46.51	44.39	2.62	-
USDA YG 4, %	28.18[y]	23.44[x]	29.98[y]	4.60	-
USDA YG 5, %	6.80[y]	5.16[x]	7.53[y]	1.97	-

[1]Dressing percentage.
[2]Small[00] = 400, Modest[00] = 500
[xy]Means in the same row that do not have a common superscript letter differ, *P* < 0.10.

Table 3. Live Performance – Carcass adjusted performance of beef steers fed an average of 236 days-on-feed administered three different implant strategies.

	Treatments				
	Choice/Plus	Delay/Choice/Plus	Choice/SOF	SEM	*P*-value
Final BW[1], lb	1467[x]	1475[xy]	1483[y]	11.4	0.15
ADG, lb	3.34[x]	3.36[xy]	3.39[y]	0.05	0.12
F:G	6.04[y]	5.78[x]	5.88[xy]	0.11	0.06
In. HCW[2], lb	389	391	391	14.1	0.52
Carcass ADG, lb	2.43[x]	2.44[xy]	2.46[y]	0.03	0.12
Carcass F:G	8.30[x]	7.95[y]	8.09[xy]	0.15	0.06

[1]Pen mean hot carcass weight ÷ (mean DP for that block/100).
[2]Initial hot carcass weight = 0.2598*(Initial BW(kg)^1.1378).
[xy]Means in the same row that do not have a common superscript letter differ, *P* < 0.10.

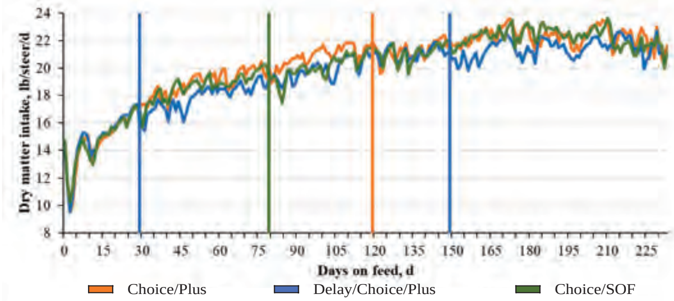
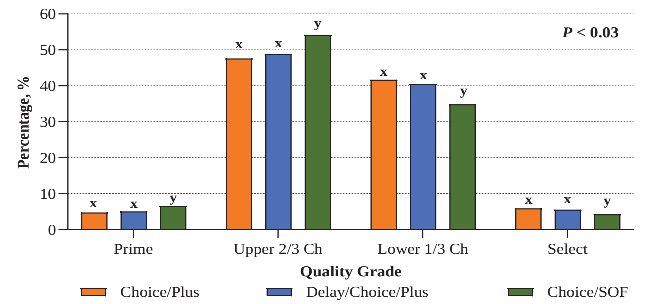


Figure 1. Descriptive Average Daily Feed Delivery (DM).



[xy]Means in the same row that do not have a common superscript letter differ, *P* < 0.10.

Figure 2. Marbling-Based – Quality Grade Distribution.

CONCLUSIONS

- Choice/Synovex One Feedlot had greater ADG, final BW, and HCW than Choice/Plus.
- Delay/Choice/Plus was intermediate and not different from either treatment for any performance variable.
- Choice/Synovex One Feedlot improved quality grade distribution and Delay/Choice/Plus improved yield grade distribution.

REFERENCES

Mader, T.L. Implants. *Vet. Clin. N. Am. Food A*. 1998, 14(2):279–290.

Smith, Z.K.; Kim, J.; Johnson, B.J. Feedlot performance and biological responses to coated and non-coated steroidal implants containing trenbolone acetate and estradiol benzoate in finishing beef steers. *J Anim Sci*. 2019, 97(11):4371-4385.

Smith, Z.K.; Johnson, B.J. Mechanisms of steroidal implants to improve beef cattle growth: a review. *Journal of Applied Animal Research*. 2020, 48(1):133-141.

Statistical process control procedures to monitor mortality and morbidity in steers and heifers supplemented with Lubabegron in real-time

SOUTH DAKOTA STATE UNIVERSITY

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Introduction

In 1931, Shewhart proposed statistical process control charts to monitor the variation in a process over time. With the variation continuously monitored, investigators can determine if variation is due to inherent or external factors and can decide if and how to respond more efficiently.

Statistical process control charts have been found to be useful in service, financial, and health care industries. The aim of this study was to determine if a continuous graphical tool could help determine if a newly adopted technology directly affects the rate of morbidity and mortality of feedlot cattle.

Objective

To evaluate the use of statistical process control procedures in real-time to monitor the mortality and morbidity of feedlot cattle supplemented Lubabegron.

Data Collection & Transformation

- Data points from the 2024 calendar year were collected from two sources:
  1. Benchmark Real-Time Database
  2. Elanco Asset Database
- Lots were accessed for mortality and morbidity .
- Observations from the Experior Data Asset were transformed to a Standard Normal Basis using observations from Benchmark Real-Time Database.
- The transformation method used the mean and variation estimates from within the same closed month and gender.

$$((x\text{-}\mu)/\sigma)$$

- This transformation method adjusted observations from the Experior Data Asset to account for the average heath maladies from cattle not receiving a beta ligand and put them on a universal scale.

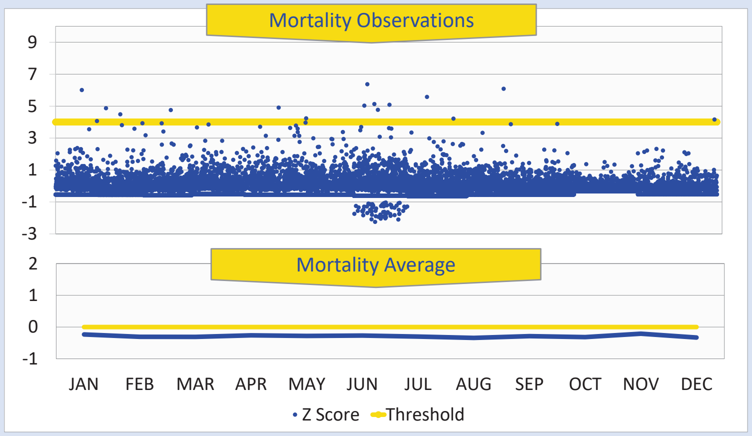
$$(\mu = 0, \sigma = 1)$$

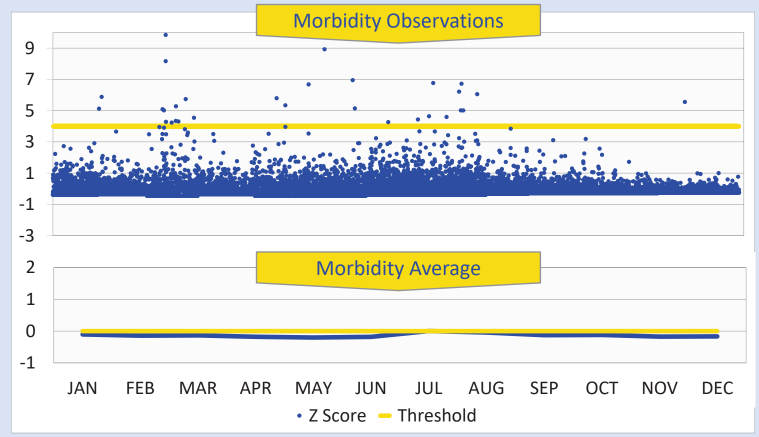
- The data transformation allows the health monitoring process to stay on the same scale regardless of season, year, gender, etc.

Using the Statistical Process Control Chart

- Statistical process control charts, also known as Shewhart charts, provide a graphic display of a process over a given period. Unlike other continuous charts, statistical process control charts put the emphasis entirely on the last data point, making it easier to detect and respond to large changes that occur quickly.
- Mean shifts of ≥4 σ were investigated to determine if the variation was due to inherent or external factors.
- In practice, statistical process control charts often have additional rules that make them more sensitive to changes, help pick up drifts from the center line, or both. However, this study did not set any additional rules due to the limited number of data points plotted thus far.

Results - Steers





- The 2024 analysis represents 27,888 lots and 4,622,350 head of cattle.
  - 19 steer lots were flagged for increased mortality rates, representing 0.087% of the monitored steer population. 74% of the flagged steer lots were ≤ 70 head.
  - 22 heifer lots were flagged for increased mortality rates, representing 0.358% of the monitored heifer population. 32% of the flagged heifer lots were ≤ 70 head.
- Many of the lots flagged for increased mortality rates were of relatively smaller head count (≤70 head), resulting in several lots being flagged due to the increased power a single calf has on the lot average.
  - 30 steer lots were flagged for increased morbidity.
  - 65 heifer lots were flagged for increased morbidity.
- Unlike the lots flagged for mortality, a majority of those flagged for morbidity had more than 70 head.

Number of lots identified for mortality and morbidity		
Measure	Steers	Heifers
Flagged for mortality, *n*	19	22
Flagged for morbidity, *n*	30	65
Total lots	21,755	6,133
Flagged for mortality, %	0.087	0.359
Flagged for morbidity, %	0.138	1.060
Percentage of large and small lots identified		
	> 70 head per lot	≤ 70 head per lot
Mortality, steers	26	74
Mortality, heifers	68	32
Morbidity, steers	87	13
Morbidity, heifers	92	8

Future Directions & Applications

- As more data points are collected, this monitoring method should eventually use a less conservative approach to help detect more subtle changes in variation and drift from the mean.
- Other continuous graphical tools such as cumulative sum charts could eventually be implemented to detect changes over a longer period.
- Graphical tools such as the one used in the current study may eventually be common practice for those trying to monitor animal health during dietary changes or after adoption of a new product.

Thank you to Elanco Animal Health for supporting this study.

Effect of Extended Days on Feed on Growth Performance, Efficiency, and Carcass Characteristics of Steers and Heifers of Different Proportions of Angus and Limousin Genetics

South Dakota State University

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Introduction

- Cattle feeders have extended days on feed (DOF) resulting in hot carcass weights (HCW) exceeding the upper bounds of existing serial slaughter datasets.
- Consequently, there is a need for new research to evaluate cattle growth, efficiency, and carcass outcomes as cattle are fed to heavier HCW (> 1000 lbs for steers)
- In addition, cattle genetics are not static and therefore there may be unrecognized differences in how cattle of different genetic types respond to management decisions.

Objectives

1. Investigate how adding DOF affects DMI, ADG, and F:G as cattle approach heavier harvest weights.
2. Determine how longer feeding periods impact carcass composition and grade distributions.
3. Assess how differences in sex and breed type affect response to extended DOF.

Materials and Methods

Genetic management

453 commercial Angus cows from two Montana ranches were artificially inseminated in 2022 to 9 sires (3 of each Limousin, Lim-Flex, and Angus). Clean up bulls were also representative of the contemporary groups. DNA was collected at birth to confirm sire ID.

Initial Processing and Management

- 216 calves that resulted from the 2022 matings were delivered to the Ruminant Nutrition Center in Brookings, SD in November 2023.
- Upon arrival, calves were vaccinated for viral respiratory pathogens (IBR, BRSV, PI3, BVD Types 1 and 2), clostridial species, and topically administered moxidectin.
- Calves were fed twice daily to achieve a gain target of 2.5 lbs/d until January 24, 2024

Experimental Design

- Calves were moved to the Cow Calf Education and Research Facility (CCERF) on January 25, 2024 and placed in 1 of 3 pens (~72 hd/pen).
- Calves were fed the same diet *ad libitum* and individual intake data was collected via Insentec System (12 nodes/pen)
- **Implant strategy:** Implanted on d – 58 with a 36 mg Zeranol implant, d 28 with 100 mg trenbolone acetate and 14 mg estradiol benzoate and reimplanted, and d 104 with a coated 200 mg trenbolone acetate and 28 mg estradiol benzoate implant.
- On d 141, cattle were re-sorted to harvest groups according to equivalent BW and equal breed representation.
- Cattle were shipped after 200, 235, and 270 days on test.

Statistical Analysis

- Proc GLIMMIX – model included fixed effects of breed, sex, and days on feed with random effect of source herd
- For estimates of change coefficients for days on feed, the same model was used except days on feed was set as a covariate.

Table 1. Diet formulation

Ingredient	% DMI Inclusion
Dry-Rolled Corn	57.8
DDGS	20.0
Corn Silage	16.0
Liquid Supplement[1]	6.2
Melengestrol Acetate[2]	--
CP, %	14.5
NEg, Mcal/cwt	63.3

[1]Provided 30 g/T of monensin, as well as vitamins and minerals to exceed requirements.
[2]Heifers received an MGA pre-mix at 1 lb/hd/d.

Results

**No interactions between DOF, breed, and sex; only main effects are shown.*

Table 2. Effect of breed, sex and DOF on growth and carcass characteristics.

Item	Sire Breed			Sex		DOF			SEM	P-Values		
	Angus	Lim-Flex	Limousin	Steer	Heifer	200	235	270		Breed	Sex	DOF
Initial wt. (lb)	691	681	686	707	666	684	689	686	34.0	0.78	<0.01	0.95
Final wt. (lb)	1474	1469	1470	1562	1381	1362	1475	1576	49.4	0.96	<0.01	<0.01
DMI (lb)	22.0	21.7	20.9	22.2	20.8	20.8	21.6	22.1	0.86	<0.01	<0.01	0<.01
ADG (lb)	3.32	3.36	3.34	3.64	3.04	3.39	3.35	3.29	0.138	0.80	<0.01	0.24
F:G	6.73	6.52	6.28	6.13	6.89	6.19	6.54	6.80	0.311	<0.01	<0.01	<0.01
HCW (lb)	938	941	948	996	890	872	946	1009	34.7	0.76	<0.01	<0.01
RF (in)	0.74	0.71	0.64	0.67	0.73	0.62	0.70	0.78	0.101	0.05	0.04	0.01
REA (in²)	14.36	15.11	15.39	15.68	14.23	14.08	14.95	15.84	0.700	<0.01	<0.01	<0.01
Marb.	583	556	506	523	572	532	552	560	44.1	<0.01	<0.01	0.26
YG	3.8	3.5	3.3	3.4	3.7	3.4	3.6	3.7	0.41	<0.01	0.08	0.09
EBF	33.71	32.89	31.62	32.31	33.17	31.42	32.80	34.00	1.60	<0.01	0.11	<0.01
AFBW	1262	1296	1353	1397	1211	1247	1306	1358	51.7	<0.01	<0.01	<0.01

Table 3. Slope estimates for the effects of DOF on growth and carcass traits

Item	Steer			Heifer		
	Slope Estimate	SEM	P-Value	Estimate	SEM	P-Value
DMI (lb)	0.026	0.0080	<0.01	0.013	0.0060	0.03
ADG (lb)	-0.0007	0.00122	0.58	-0.0019	0.00105	0.07
F:G	0.0086	0.00274	<0.01	0.0086	0.00234	<0.01
HCW (lb)	2.16	0.314	<0.01	1.78	0.243	<0.01
RF (in)	0.0017	0.00076	0.03	0.0029	0.00086	<0.01
REA (in²)	0.029	0.0061	<0.01	0.021	0.0053	<0.01
Marb.	0.803	0.3460	0.02	0.034	0.3666	0.93
USDA YG	0.003	0.0032	0.36	0.007	0.0034	0.03

Figure 1. *Comparison of DP between steers and heifers across sire breeds.*

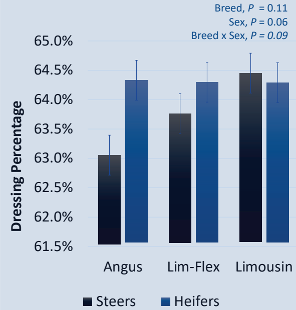


Figure 2. *Carcass QG distribution by sire breed.*

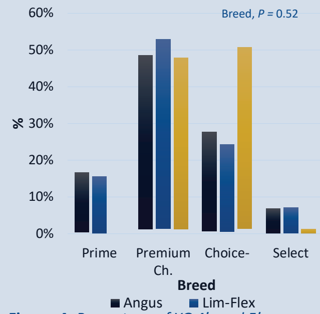


Figure 3. *Percentage HCW > 1,100 lb between steers and heifers across DOF*

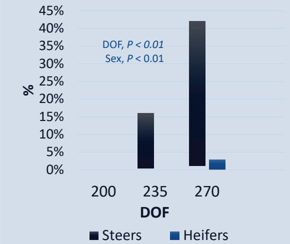
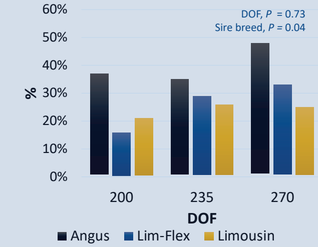


Figure 4. *Percentage of YG 4's and 5's distributed by sire breed.*



Conclusion

Impact of Days on Feed (DOF):

- DMI and F:G increased with added DOF.
- HCW increases with added DOF (2.16 and 1.78 lb/d for steers and heifers, respectively).
- Ribeye Area (REA), rib fat (RF), and Yield Grade (YG) increase with added DOF.
- Percentage HCW > 1100 lbs increased with greater DOF, particularly in steers.

Breed Differences:

- Breed did not affect ADG, final BW or HCW. Increased Limousin influence reduced DMI and improved F:G.
- Increased Limousin influence increased REA and reduced RF and YG.
- Angus influence increased marbling score. Lim-flex sired cattle had similar proportion of premium carcass grades compared to Angus.

Sex Differences:

Steers and heifers performed as expected.

- Steers had greater ADG, DMI, were heavier and had greater REA.
- Heifers had more RF, higher YG with increased marbling scores.
- Steers added marbling in response to added DOF while heifers did not. Yield grade in heifers increased with DOF but was unaffected in steers.

Acknowledgments

The authors wish to acknowledge the North American Limousin Research Foundation for funding this project, and Paul Schlobohm and Kevin Vander Wal for the daily care of cattle.

LIMOUSIN NORTH AMERICAN LIMOUSIN FOUNDATION

Effect of increasing potency of an initial steroidal implant on growth performance of newly-weaned beef steers during the dry-lot phase

South Dakota State University

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Introduction

Rationale:

- Previous research has shown dose-dependent responses of trenbolone acetate (TBA) and estradiol-17β on the growth performance of calves weighing less than 650 lb when fed high-energy diets (63 Mcal/cwt Neg).
- There is limited information on the dose-dependent response to TBA and estradiol benzoate (EB), in newly-weaned steers fed a low-energy diet during an initial 'dry-lot' phase.
- Compared to cattle high-energy diets, cattle fed lower-energy diets exhibit decreased daily gains, prompting the question:
    - **Can greater doses of TBA and EB further improve growth performance in cattle fed lower-energy diets and subjected to the stress of weaning?**

Objective: Evaluate the effects of increasing implantation doses of TBA and EB, on growth performance and feed efficiency of **newly weaned beef steers fed a low-energy diet** during the dry lot phase**.**

Materials & Methods

Background

- Newly-weaned Charolais-cross steers (n = 240; BW = 554 ± 48.3 lb)
- Randomized complete block design; 8 pens per treatment; 10 steers per pen (24 uncovered 25 ft x 25 ft concrete pens total).

Processing

- Arrival: steers were tagged, weighed, and allocated
- Following day (d 1): vaccinated for viral respiratory (Bovi-Shield Gold 5, Zoetis, Parsippany NJ), clostridial species (Ultrabac 7/Somubac, Zoetis), received pour-on moxidectin (Cydectin, Elanco), and implanted with their respective implant treatment.
- Fed for 91 days: intake managed first 14 d and *Ad libitum* access to feed allowed from d 15 to 91 (Slick-Bunk Approach).

Treatments: Implant strategy

- **1) Control**: No Implant
- **2) SYNOVEX® Primer™**: 50 mg TBA + 7 mg EB
- **3) SYNOVEX Choice®**: 100 mg TBA + 14 mg EB

TBA: Trenbolone Acetate, EB: Estradiol Benzoate
(7 mg EB = 5 mg estradiol; 14 mg EB = 10 mg estradiol)

Table 1. Diet formulation & nutrient composition[1]

	d 1 - 49	d 50 - 59	d 60 - 91
Ingredients, % DM basis[2,3]			
Liquid supplement	5.34	5.30	4.33
DDGS	8.44	21.44	13.09
Ryelage	39.42	--	--
Soybean hulls	36.84	15.08	9.71
Grass hay	9.96	7.21	--
Sorghum + Corn silage	0.00	50.97	72.87
Nutrient composition			
DM, % as fed	57.3	57.9	54.4
OM, % of DM	91.5	92.5	92.6
CP, % of DM	14.4	15.0	15.2
NDF, % of DM	55.0	46.0	44.8
ADF, % of DM	37.7	28.1	27.1
EE, % of DM	3.5	4.4	4.4
NEm, Mcal/cwt	78.3	79.7	80.5
NEg, Mcal/cwt	46.8	49.3	50.3

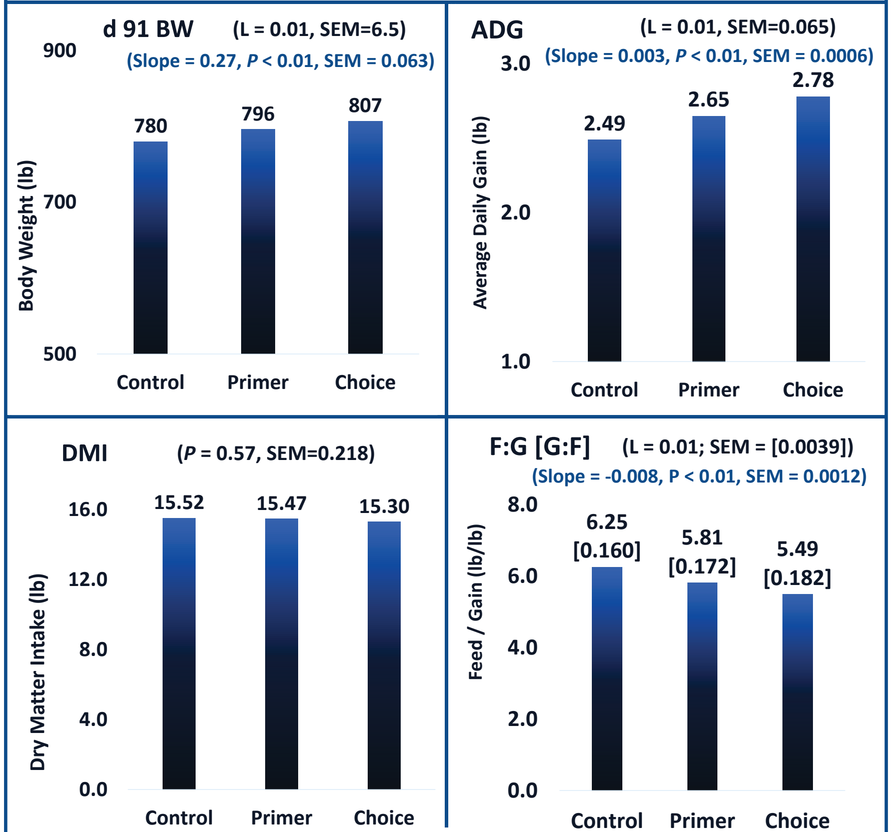
[1]Based on tabular values
[2]Monensin sodium (Rumensin-90, Elanco Animal Health) at 25 g/ton
[3]Vitamin supplementation met 2016 NASEM recommendations

Statistical Analysis: PROC GLIMMIX procedure of SAS (SAS Institute Inc., Cary, NC). Randomized complete block design, with pen as the experimental unit, treatment as a fixed effect, and block as random. Polynomial contrasts were conducted (L = linear, Q = Quadratic).

Additionally, the analysis was conducted using implant dose as a continuous variable (0, 50, and 100 mg TBA; 0, 5, and 10 mg estradiol) to obtain the dose-dependent rate of change in growth responses.

Results

Effects of increasing levels of trenbolone acetate (TBA) & estradiol benzoate (EB) from d 1-91



Control: 0 mg TBA and EB; Primer: 50mg TBA + 7 mg EB; Choice: 100 mg TBA + 14 mg EB

Conclusion

Table 2. Treatment Comparison

Item	Primer	Choice
% Improvement		
	Control vs.	
ADG	6.4%	11.7%
DMI	-0.7%	-0.58%
F:G	-7%	-12%
BW difference (lb)		
d 91 BW	16	27

- During the initial 91 days, administration of a:
    - **Primer implant** produced a 6.4% increase in ADG compared to **no implant**.
    - **Choice implant** (additional 50 mg of TBA and 7 mg of EB) resulted in a 4.9 and 11.7% increase in ADG over **Primer** and **no implant**, respectively.
- DMI was unaffected by implant strategy.
- Increased ADG with unaltered DMI resulted in improved feed conversion by 7% and 12% for Primer and Choice, respectively.

Outcomes of Unintended Consequences: Frequency of Lactation and Intact Males and Their Impact in Finished Cattle

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Introduction

Accumulation of excess fat may cause fat cells to produce estrogens (Mattson & Olsson, 2007), potentially initiating lactation without pregnancy (galactorrhea). Intact males divert more energy to muscle production and finish slower, due to endogenous testosterone (Arthaud et al., 1977).

Objectives

1) Audit finished cattle during harvest to determine frequency of intact males and lactating steers or heifers.
2) Determine carcass performance and value of intact males vs steers and of lactating animals compared to their pen mates.

Methods

- Cattle (*n* = 20,481) were audited during harvest, originating from 33 feedlots.
- All cattle were assessed for lactation.
- All steers were manually palpated to detect testicles.
- Carcass outcomes for audited lots were obtained to compare cattle identified as lactating or intact males to the remaining balance of their lots.
- Frequency data were analyzed via chi-square methods.
- Mixed models were used to determine the effect of lactation or intact testicles among cattle-type populations regarding carcass performance.
- Milk samples (*n* = 120) were taken from dairy-cross heifers (*n* = 30), native heifers (*n* = 30), dairy-cross steers (*n* = 30), and native steers (*n* = 30) and analyzed for milk composition.

Frequency Results

- 29.68% of cattle (*n* = 6,078) were identified as lactating.
- Dairy-cross heifers were lactating at the greatest (*P* < 0.01) frequency (55.81%), followed by native heifers (28.77%), dairy-cross-steers (19.66%), and native steers (14.55%).
- Of male cattle (*n* = 10,221) evaluated for testicles, 0.96% (*n* = 98) were intact males. No difference (*P* = 0.26) was detected among cattle types.
- Four cattle (3 dairy-cross; 1 native) were lactating intact males.

Results

Table 1. Carcass outcomes of intact male cattle and steers.

	n	HCW (lbs.)	REA (in^2)[1]	FAT (in)[2]	Color Score[3]	MARB Score[4]	Yield Grade	EBF (%)[5]	Price per lb. ($)	Carcass Value ($)
Males										
Intact Males	98	922.9	15.77	0.48	70.3	450	2.79	29.3	2.72	2,509.87
Steers	10,123	917.3	15.25	0.57	73.0	495	3.17	30.8	2.76	2,529.88
SEM		10.91	0.17	0.02	0.57	10.91	0.11	0.37	0.02	25.61
P-Value		0.54	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.37

[1]Ribeye Area (REA) in^2 = Ribeye area measurement taken at the 12th and 13th rib interface
[2]Fat Thickness (FAT) in = Subcutaneous measurement of backfat at the 12th rib
[3]Color Score: Normal = >60; Off Color = 60 - 56.5; Dark = < 56.5
[4]Marbling Scores: Scale ranges from 100-1000; Low Choice = 400 (Small 0)
[5]Percentage of Empty Body Fat (EBF) = 17.76107 + (4.68142 x FAT) + (0.01945 x HCW) + (0.81855 x ((QG/100) + 1)) – (0.06754 x REA). (Guiroy et al., 2001)

Table 2. Carcass outcomes of lactating and non-lactating steers and heifers.

	n	HCW (lbs.)	REA (in^2)[1]	FAT (in)[2]	Color Score[3]	MARB Score[4]	Yield Grade	EBF (%)[5]	Price per lb. ($)	Carcass Value ($)
Steers										
Lactation	1,735	930.5	15.29	0.58	73.4	505	3.25	31.2	2.76	2,555.65
Non-lactating	8,486	914.8	15.25	0.56	72.8	493	3.16	30.7	2.77	2,524.53
SEM		6.40	0.09	0.01	0.27	5.45	0.07	0.19	0.01	14.00
P-Value		< 0.01	0.39	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Heifers										
Lactation	4,343	820.4	14.75	0.62	71.1	534	3.23	31.2	2.87	2,349.47
Non-lactating	5,917	825.9	14.59	0.64	71.9	540	3.38	31.6	2.86	2,354.24
SEM		4.68	0.08	0.01	0.27	4.89	0.06	0.15	0.01	12.30
P-Value		< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.34

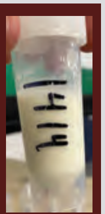
[1]Ribeye Area (REA) in^2 = Ribeye area measurement taken at the 12th and 13th rib interface
[2]Fat Thickness (FAT) in = Subcutaneous measurement of backfat at the 12th rib
[3]Color Score: Normal = >60; Off Color = 60 - 56.5; Dark = < 56.5
[4]Marbling Scores: Scale ranges from 100-1000; Low Choice = 400 (Small 0)
[5]Percentage of Empty Body Fat (EBF) = 17.76107 + (4.68142 x FAT) + (0.01945 x HCW) + (0.81855 x ((QG/100) + 1)) – (0.06754 x REA). (Guiroy et al., 2001)

Table 3. Average composition of milk samples from each population.

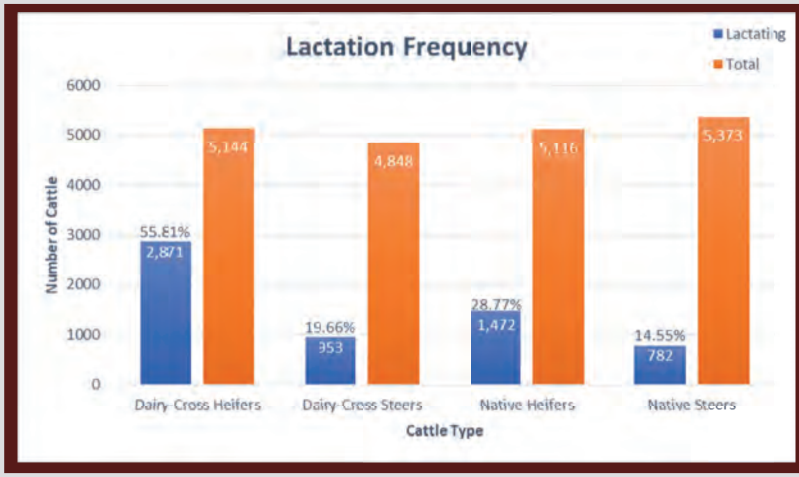
Type	n	Fat (%)	True Protein (%)	MUN (mg/dL)[2]	Lactose (%)	TS (%)[3]
Dairy-Cross Heifers	30	2.078	7.101	13.088	2.102	13.199
Dairy-Cross Steers	30	0.752	2.400	--	0.397	4.794
Native Heifers	30	1.334	6.820	14.570	1.178	10.989
Native Steers	30	0.579	2.411	--	0.472	4.893
SEM		0.26	0.58	4.86	0.23	0.80
P-Value		< 0.01	< 0.01	0.22	< 0.01	< 0.01
Contrast						
Heifer vs Steer		< 0.01	< 0.01	--	< 0.01	< 0.01
Dairy-Cross vs Native		0.08	0.82	0.95	0.07	0.18
Holstein Cows[1]		3.62 – 4.11	3.00 – 3.27	7.77 – 22.31	4.24 – 5.34	12.00 – 12.75
Jersey Cows[1]		4.62 – 4.99	3.55 – 3.75	5.61 – 17.13	3.85 – 5.34	13.65 – 15.73

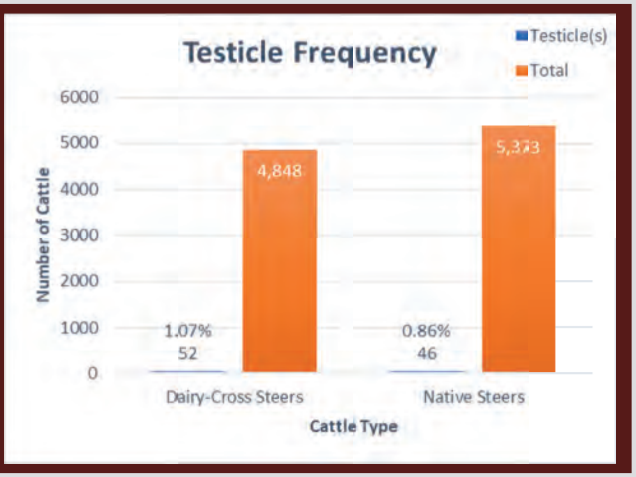
[1]Holstein and Jersey ranges = based on published articles, databases, and scientific papers.
[2]Milk Urea Nitrogen (MUN) mg/dL= Composition of the sample that has nitrogen measured in milligrams per deciliter.
[3]Total Solids (TS) = Percentage representing all solids in the sample including butterfat (fat), lactose, and other solid components.

Sample 1414	
Sex	Steer
Type	Native
Fat (%)	3.65
Tru.Prot (%)	3.55
MUN (mg/dL)	17.10
Lactose (%)	4.29
TS (%)	12.7



Sample 1119	
Sex	Heifer
Type	Dairy Cross
Fat (%)	2.27
Tru.Prot (%)	3.39
MUN (mg/dL)	9.6
Lactose (%)	5.09
TS (%)	11.71





Conclusion

- Intact males occurred at a low frequency in the sampled fed beef population, whereas lactating heifers and steers occurred at notable rates.
- Lactation unequally influenced carcass quality, yield, and value outcomes of steers and heifers.
- Data suggest that lactation impacted carcass outcomes and total carcass value.

Works Cited

- Arthaud, V. H., R. W. Mandigo, R. M. Koch, A. W. Kotula. 1977. Carcass composition and palatability attributes of bulls and steers fed different energy levels and killed at four ages. JAS. 44:53-64.
- Guiroy, P. J., D. G. Fox, L. O. Tedeschi, M. J. Baker, and M. D. Cravey. 2001. Predicting individual feed requirements of cattle fed in groups. JAS. 79:1983-1995.
- Mattsson, C., and T. Olsson. 2007. Estrogens and glucocorticoid hormones in adipose tissue metabolism. Curr. Med. Chem. 14:2918-2942.

Ruminal papillae characterization and ruminal metabolomics of beef on dairy heifers with abscessed or non-abscessed livers

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INTRODUCTION

Liver abscesses has been shown to negatively affect cattle growth performance and profitability of beef cattle. Nagajara and Chengappa, (1998) describe the pathogenesis of bovine liver abscess as more prone of development when cattle are offered high-grain based diets. Thus, inducing ruminal disfunction (acidosis) which can compromise the integrity of the primary barrier in the digestive tract. For reasons not yet unveiled, beef-on-dairy crossbred cattle (specially heifers) are facing a challenge with the prevalence of liver abscesses. The limited knowledge regarding specific nutritional requirements for such animals and the rumen epithelial development (Bittante et al. 2020) impose a barrier for mitigation strategies. Ruminal papillae morphometrics development for Angus cattle were describe by Lopez et. al. (2024) and Camron et. al. (2023). Pederzolli et. al. (2018) and Novak et. al. (2019) studies such topic for Hostein cattle, while beef-on-dairy are assumed to be intermediary. Thus, characterizing ruminal papillae morphology and cell organization becomes crucial to investigate potential interactions within the presence of liver abscesses for the crossbreeds.

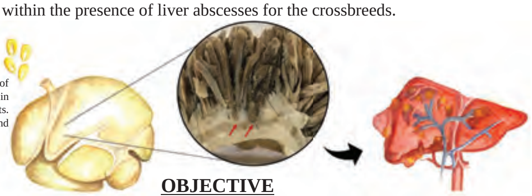

Figure 1. Representation of pathogenesis of liver abscesses in cattle offered high-grain diets. Adapted from: Nagajara and Chengappa (1998).

OBJECTIVE

To evaluate ruminal papillae morphology, histology, and ruminal volatile fatty acid (VFA) profile of feedlot (beef-on-dairy) heifers with abscessed and non-abscessed livers.

MATERIAL AND METHODS

- A randomized complete block (kill group) design was used to source heifers upon harvest, n = 94 from animals with liver abscesses, and n = 110 without liver abscesses.
- Individual fragments from the cranial sac (morphometric assessment) and ventral sac (histologic assessment) of the rumen were collected, while ruminal fluid was taken upon animal harvest and immediately frozen (dry ice).
- The GLIMMIX procedure of SAS with animal as the experimental unit, the fixed effect of liver abscess presence, size (small or large) intensity (local or diffuse), location (left, right, both), or diffusion (local or diffuse), while lot (n = 27) within harvest-group (n = 6) was used as random effect.

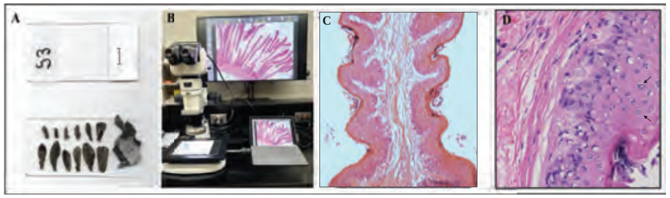

Figure 2. (A) Papillae count was performed by 3 trained individuals; 12 average-papillae fragment and fragment-base were scanned (ImageJ®); (B) Microscopic pictures for the histology assessment; (C) Representative section of bovine rumen papilla stained with Hematoxylin and Eosin (H&E); (D) 40X focus with arrows showing mitotic cells.

RESULTS

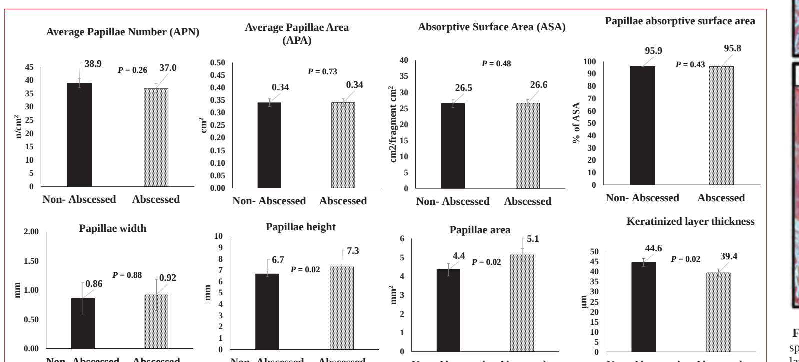

Figure 3. Morphometric characteristics of ruminal papillae tissue from animals with abscessed or non-abscessed livers.

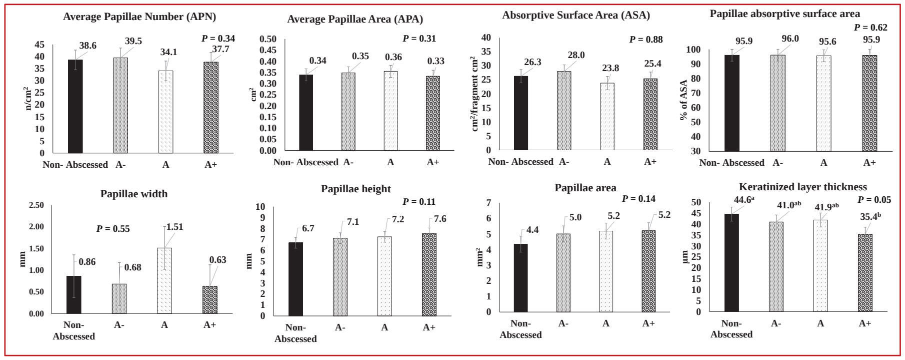

Figure 4. Morphometrics characteristics of ruminal tissue from animals with abscessed or non-abscessed livers, by abscess severity.

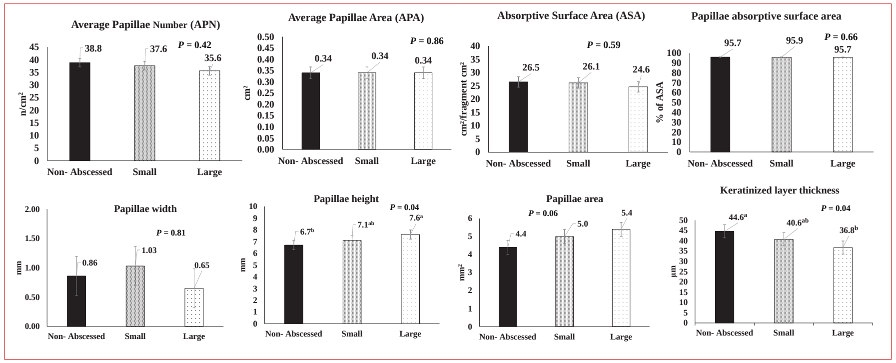

Figure 5. Morphometrics characteristics of ruminal tissue from animals with abscessed or non-abscessed livers, by abscess size.

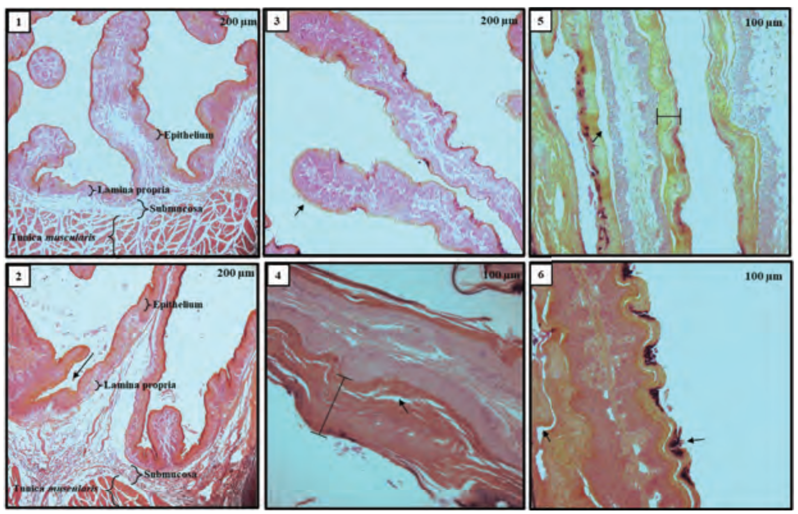

Figure 6. (1) Integrity of papillae shown in an animal with non-abscessed liver; (2) Papillae base with clefting scores with arrow pointing to extracellular spaces in an animal presenting a liver abscess A+, large, diffuse on both lobes; (3) Thinner keratinized papillae layer from an animal with liver abscess A+, large, diffuse on both lobes abscess; and (4, 5 and 6) high keratinized papillae layer with arrows showing sloughing scores from an animal with non-abscessed livers

Table 1. Ruminal VFA profile collected at harvesting time (Molar proportion)

Variables[1]	Non-Abscessed	Abscessed	*P*-value
Total (tVFA)	100.2	95.79	0.44
Acetate	53.98	54.74	0.41
Propionate	27.95	27.14	0.31
Butyrate	10.13	10.27	0.72
Valerate	2.42	2.41	0.90
Isobutyrate	1.53	1.51	0.74
Isovalerate	3.74	3.68	0.78
Caproate	0.26	0.26	0.96
C2:C3	2.03	2.16	0.19
Branched	5.27	5.19	0.75

[1] mM/100 mM of tVFA (mM).

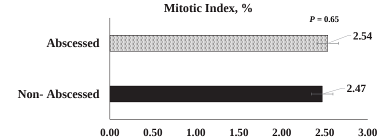

Figure 7. Mitotic Index, % (main effect of abscessed and non- abscessed livers)

Table 2. Morphometrics characterization of ruminal tissue from animals with abscess and non-abscessed liver, **by abscess diffusion**

Liver Abscess, by diffusion	None	Local	Diffuse	SEM*	*P* - value
Macroscopic variables					
Number of papillae, n	39	37	37	2.8	0.53
Mean Papillae area, cm^2	0.34	0.34	0.34	0.03	0.94
ASA**, cm/cm^2 of rumen wall	24.3	25.4	25.7	1.99	0.77
Papillae area, % of ASA	96.0	95.7	95.9	0.33	0.65
Microscopic variables					
Papillae width, mm	0.86	0.72	0.99	0.520	0.90
Papillae height, mm	6.69	7.56	7.20	0.415	0.06
Papillae area, mm^2	4.35^b	5.61^a	4.96^{ab}	0.529	0.04
Papillae keratin, µm	44.6^a	43.7^{ab}	37.9^b	3.37	0.02
Mitotic index, %	2.47	2.50	2.55	0.213	0.87

*Standard error of the mean.
**Absorptive surface area.

Table 3. Morphometrics characterization of ruminal tissue from animals with abscess and non-abscessed liver, **by abscess location**

Liver Abscess, by lobe	None	Both	Left	Right	SEM*	*P* - value
Macroscopic variables						
Number of papillae, n	39	36	44	37	4.1	0.24
Mean Papillae area, cm^2	0.34	0.35	0.35	0.34	0.037	0.98
ASA**, cm/cm^2 of rumen wall	26.3	24.8	30.5	25.7	2.87	0.25
Papillae area, % of ASA	95.9	95.7	96.7	95.8	0.17	0.17
Microscopic variables						
Papillae width, mm	0.86	1.20	0.69	0.64	0.789	0.79
Papillae height, mm	6.69	7.42	7.50	7.07	0.560	0.11
Papillae area, mm^2	4.35	5.25	5.14	4.98	0.762	0.13
Papillae keratin, µm	44.6	40.2	37.6	39.1	4.99	0.14
Mitotic index, %	2.47	2.59	2.71	2.42	0.320	0.73

*Standard error of the mean.
**Absorptive surface area.

CONCLUSION

Ruminal papillae quantitative and macroscopic assessment of morphology seemed not to be affected by the presence, severity, size or location of liver abscess, while histological microscopic measurements revealed that animals containing liver abscess (influenced by presence, size, and diffusion) had more pronounced and vulnerable ruminal papillae tissue.

ACKNOWLEDGMENT

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Effects of high dietary starch and erratic feed management on indicators of ruminal and colonic health and pathogenic bacteria prevalence and concentration in the gastrointestinal tract and liver of feedlot steers

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RESEARCH FEEDLOT

Introduction

- Rapid fermentation that leads to ruminal acidosis is commonly attributed to consumption of readily available starch and variation in DMI patterns.
- Rumen and/or hindgut acidosis may damage the epithelium of the gastrointestinal tract, decreasing barrier function and predisposing cattle to liver abscess risk.
- *Fusobacterium necrophorum* has been identified as the primary causative agent for liver abscesses, however, recent research suggests *Salmonella* may also play a role in liver abscess development.

Objective

- Investigate the effects of dietary starch concentration and feeding management regimen on gastrointestinal health and prevalence of pathogenic bacteria populations associated with liver abscessation.

Materials and Methods

- All animal procedures were approved by WTAMU IACUC
- **Randomized complete block design:**
  - ✓ On d 0, steers (n = 720; Initial BW = 897 ± 9.98 lb) were allocated into 48 pens with 15 steers per pen
    - Interaction = 12 pens/treatment; main effect = 24 pens/treatment
    - Fed REC for 7d followed by 18 d transition to dietary treatments
- **2 × 2 factorial arrangement of treatments:**
  - ✓ Dietary Treatments:
    - **CON** = Finishing diet designed to mimic recommendations of consulting feedlot nutritionists
    - **HOT** = Finishing diet with increased readily fermentable starch, low roughage, and no grain-milling byproducts
    - Diets contained no tylosin phosphate and 35 g/ton monensin
  - ✓ Management Treatments:
    - **REG** = Consistent feed delivery
    - **ERR** = Randomized variations in feed quantity and delivery time
      - 85% followed by 115% of 4-d average DMI once weekly
      - Feed delivery delay of 1, 2, 3, or 4 h twice weekly
- **Rumen Scoring:**
  - ✓ The rumen of each animal was evacuated, rinsed, and scored from 0 to 6 based on the presence of papillae damage, scars, and lesions
- **Tissue Collection:**
  - ✓ 3 steers per pen (n = 144) were selected for tissue sample collection

  From this subset:
  - ✓ Rumen, colon, and liver abscess samples were collected at harvest and shipped overnight to Kansas State University
  - ✓ Additional rumen and colon samples were collected and stored in 10% neutral buffered formalin until further processing for morphological and histological measurements
- **Statistical Analysis**:
  - ✓ Continuous data = MIXED procedure
  - ✓ Categorical data = GLIMMIX
  - ✓ Model = diet, management, and diet × management
  - ✓ Random = Block

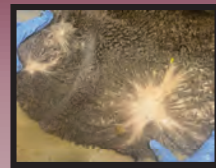
Treatment	Liver Abscess, %
Diet	
CON	33.4
HOT	55.1
Mgmt	
REG	42.4
ERR	46.1

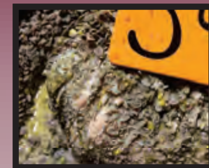
Ingredient and nutrient composition

Item	Dietary Treatment CON	HOT
Ingredient, % of DM		
Corn grain, flaked	58.25	80.85
Sweet Bran	22.45	0.00
Soybean meal	0.00	6.85
Corn stalks	10.00	3.00
Corn oil	1.25	1.25
Molasses blend	4.00	4.00
Growing supplement	-	-
Finishing supplement	4.05	4.05
Nutrient analysis, DM basis		
DM, %	74.43	78.12
CP, %	13.37	13.23
NDF, %	19.19	9.35
Total starch, %	49.1	64.4
NEm, Mcal/lb	0.96	1.00
NEg, Mcal/lb	0.66	0.70

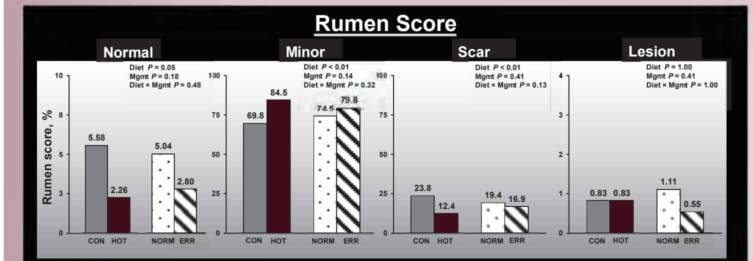
Results


Papillae Clumping


Rumen Scar

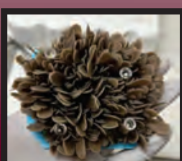

Rumen Lesion

Normal	Minor	Scars		Lesions		Minor
0	1	2	3	4	5	6
No scars or lesions	Minor spots of papillae consolidation	One healed ulceration	Multiple healed ulcerations	One active lesion	Multiple active lesions	Other abnormality

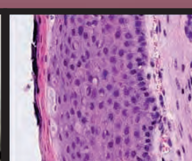


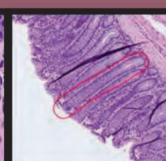
Morphology

Item	Diet CON	HOT	Feeding Management REG	ERR	SEM	*P*-value Diet	Mgmt	Diet × Mgmt
Papillae Morphology								
Count	44.5	43.9	46.7	41.7	5.72	0.88	0.22	0.21
Length, cm	0.959	0.907	0.940	0.925	0.04	0.17	0.68	0.63
Width, cm	0.276	0.268	0.267	0.278	0.008	0.37	0.19	0.11
Surface area, cm²	0.475	0.452	0.459	0.468	0.025	0.31	0.70	0.19
Perimeter, cm	2.30	2.19	2.26	2.23	0.084	0.14	0.77	0.62
Papillae Histology, µm								
Stratum corneum	13.75	15.47	13.88	15.34	0.62	0.05	0.09	0.39
Stratum granulosum	13.05	14.53	13.48	14.10	0.35	<0.01	0.19	0.87
Statum spinosum/ stratum basale	90.3	105.6	94.8	101.0	2.69	<0.01	0.12	0.71
Colon Morphology, µm								
Crypt length	423	401	404	420	10.87	0.03	0.11	0.26
Crypt width	50.1	52.6	51.8	51.0	2.03	0.22	0.69	0.50


Rumen Sample


Plated Papillae


Rumen Epithelial Strata


Colonic Crypt

Culture-based prevalence of bacterial pathogens in liver abscesses, ruminal epithelial, and colonic epithelial tissues

Item	No. of Samples	No. of positive Samples	Diet CON	HOT	Feeding Management REG	ERR	P-value Diet	Mgmt	Diet × Mgmt
Liver Abscess, %									
F. subsp. *necrophorum*	133	104	77.8	78.4	77.7	78.5	0.94	0.92	0.92
F. subsp. *funduliforme*	133	78	41.7	64.8	50.0	56.1	0.03	0.60	0.28
Salmonella enterica	133	93	70.9	75.7	70.4	76.1	0.68	0.69	0.10
Trueperella pyogenes	133	6	(1/6)	(5/6)	(3/6)	(3/6)	-	-	-
Rumen, %									
F. subsp. *necrophorum*	176	40	11.9	23.6	11.6	24.1	0.09	0.07	0.35
F. subsp. *funduliforme*	176	137	79.4	81.8	78.7	82.4	0.71	0.57	0.60
Salmonella enterica	176	75	25.7	39.7	33.8	30.8	0.11	0.72	0.25
Trueperella pyogenes	176	70	24.0	47.3	37.8	31.8	<0.01	0.48	0.64
Colon, %									
F. subsp. *necrophorum*	160	7	(2/7)	(5/7)	(5/7)	(2/7)	-	-	-
F. subsp. *funduliforme*	160	42	12.1	22.5	15.0	18.5	0.14	0.61	0.77
Salmonella enterica	160	72	45.4	44.1	47.9	41.6	0.88	0.48	0.07
Trueperella pyogenes	160	12	(2/12)	(10/12)	(6/12)	(6/12)	-	-	-

Concentration of bacterial pathogens in liver abscesses, ruminal epithelial, and colonic epithelial tissues before enrichment using qPCR

Item	Diet CON	HOT	Feeding Management REG	ERR	SEM	P-value Diet	Mgmt	Diet × Mgmt
Liver Abscess, CFU/g								
F. subsp. *necrophorum*	4.0×10^7	3.5×10^7	4.8×10^7	2.7×10^7	1.7×10^7	0.71	0.15	0.59
F. subsp. *funduliforme*	1.9×10^7	3.7×10^7	3.3×10^7	2.3×10^7	1.2×10^7	0.15	0.38	0.93
Rumen, CFU/g								
F. subsp. *necrophorum*	5.3×10^4	1.8×10^5	1.1×10^5	1.1×10^5	4.5×10^4	<0.01	1.00	0.66
F. subsp. *funduliforme*	3.6×10^5	8.4×10^5	4.2×10^5	7.7×10^5	2.4×10^5	0.04	0.14	0.50
Colon, CFU/g								
F. subsp. *necrophorum*	3.9×10^3	1.3×10^4	5.9×10^3	1.1×10^4	9.3×10^3	0.31	0.58	0.14
F. subsp. *funduliforme*	2.0×10^4	6.3×10^3	8.1×10^2	2.6×10^4	1.0×10^3	0.15	0.01	0.12

Conclusion

- No interactions for ruminal or colonic health or pathogenic bacteria outcomes suggests dietary starch concentration does not influence susceptibility to feed management challenges.
- Increased readily fermentable starch with decreased roughage inclusion exposes finishing steers to ruminal and colonic damage and increased concentrations of *F. necrophorum* in ruminal epithelial tissues.
- Prevalence and concentrations of *F. necrophorum* in colonic epithelial tissues suggest that colon is also a source of pathogens of liver abscesses.

Effect of accelerated diet transition on health, performance, carcass traits, and economics in feedlot heifers

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INTRODUCTION

- Accelerating diet transition in feedlot cattle to reach their finishing diet earlier may improve efficiency and performance; however, ruminal acidosis and increased liver abscessation could be consequential.
- *Megasphaera elsdenii*, the lactate-utilizing bacteria in the product Lactipro can be used to mitigate some of the risk associated with accelerating ration transition but timing of administration could impact efficacy.

OBJECTIVE

The study objective was to determine the effects of an accelerated diet transition protocol without bunk hay and efficacy of Lactipro administered at initial processing only or at initial processing and reimplantation (d 90) on health, performance, carcass traits, and economic outcome of heifers finished in a commercial feedlot.

MATERIALS AND METHODS

Randomized complete block design

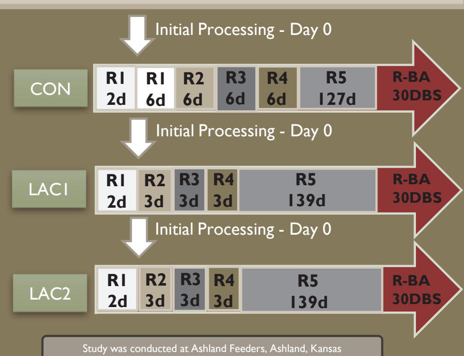
- Pen was the experimental unit for all variables
- A total of 2,047 heifers (initial BW=717 lb) were randomly allocated to 30 pens receiving 1 of 3 treatments (n=10) across 10 arrival blocks

Experimental treatments:

1. CON - standard ration transition strategy including hay offered until d 3, with 6 days on each of 4 step-up rations prior to the final finishing ration

2. LAC1 - 20 ml oral dose of Lactipro at initial processing, 3 days on each ration, and no bunk hay

3. LAC2 - 20 ml oral dose of Lactipro at initial processing and 20 ml at terminal reimplant, 3 days on each ration, and no bunk hay



Statistical Analysis

- PROC MIXED in SAS v9.4
- Single df contrast (CON vs. LAC)
- Block was random effect, α = 0.10
- Economics: partial budget analysis, mixed linear model, Kenward-Roger degree of freedom adjustment, and restricted maximum likelihood estimation in STATA, with treatment as fixed effect and block as random effect

Table 1. Ingredient and nutrient composition.

	Diets					
Item	**R1**	**R2**	**R3**	**R4**	**R5**	**R-BA**
Ingredient, % DM						
Corn grain, flaked	22.5	36.5	48.5	61.0	72.0	72.0
WDG	29.5	25.0	20.5	16.0	13.0	13.0
Mixed Hay	44.0	34.0	25.0	16.0	7.0	7.0
Starter Liquid	3.0	3.0	0.0	0.0	0.0	0.0
Finisher Liquid	0.0	0.0	4.0	4.5	5.0	5.0
Fat	0.0	0.5	1.0	1.5	2.0	2.0
Supplement	1.0	1.0	1.0	1.0	1.0	1.0
Nutrient Composition						
Dry Matter, %	64.9	65.5	66.0	68.4	71.8	72.2
CP, % of DM	18.5	15.0	19.0	16.8	14.8	14.7
NDF, % of DM	43.1	39.1	32.1	21.2	15.6	15.4
Crude Fat, %	3.5	3.9	6.0	5.8	6.3	6.6
Total Starch, %	14.5	22.3	27.2	43.8	54.3	54.2
TDN, %	61.4	65.3	72.3	83.8	89.8	90.0
NEm, Mcal/lb DM	0.62	0.68	0.78	0.93	1.02	1.02
NEg, Mcal/lb DM	0.35	0.41	0.50	0.63	0.70	0.70

RESULTS

Table 2. Performance parameters of accelerated transition vs control.

	Treatment				*P*-value	
Item	**CON**	**LAC1**	**LAC2**	**SEM**	**Treatment**	**Contrast**
Initial BW, lb	717.8	715.1	718.6	9.4	0.42	0.69
D 90 BW, lb	1088.4	1084.7	1084.9	15.7	0.85	0.57
Final BW, lb	1331.7	1327.2	1328.0	9.8	0.62	0.34
DOF Total	181.0	181.0	181.0	-	-	-
Bunk Hay DMI Overall, lb	3.1^a	0.0^b	0.0^b	0.09	<0.01	<0.01
Ration DMI Overall, lb	19.5^a	18.8^b	19.0^b	0.33	0.04	0.01
Combined DMI Overall, lb	19.6^a	18.8^b	19.0^b	0.33	0.03	0.01
ADG Overall, lb	3.4	3.4	3.4	0.13	0.62	0.42
F:G Overall, lb	6.3	6.1	6.3	0.18	0.46	0.40
Ration DMI d 0 to 90, lb	19.9^a	18.4^b	18.7^b	0.36	0.02	0.01
Combined DMI d 0 to 90, lb	19.4^a	18.4^b	18.7^b	0.36	0.01	<0.01
ADG d 0 to 90, lb	3.9	3.8	3.8	0.16	0.84	0.70
F:G d 0 to 90, lb	5.4	5.1	5.3	0.20	0.12	0.08
Ration DMI d 90 to final, lb	19.8	19.3	19.2	0.41	0.13	0.05
ADG d 90 to final, lb	2.9	2.9	2.9	0.21	1.00	0.95
F:G d 90 to final, lb	8.2	8.0	8.1	0.47	0.87	0.70

Table 3. Health parameters of accelerated transition vs control.

	Treatment				*P*-value	
Item	**CON**	**LAC1**	**LAC2**	**SEM**	**Treatment**	**Contrast**
BRD Morbidity, %	16.6	15.9	13.2	2.2	0.25	0.53
Secondary BRD, %	2.7	1.9	3.1	0.88	0.43	0.81
Tertiary BRD, %	0.90	0.58	0.72	0.40	0.82	0.57
BRD Relapse, %	17.8	14.7	18.7	5.7	0.85	0.86
Digestive Morbidity, %	0.14	2.0	0.59	0.97	0.40	0.36
All Cause Mortality, %	2.3	2.6	3.0	0.84	0.80	0.56
Respiratory Mortality, %	1.8	2.2	2.4	0.69	0.78	0.51
Digestive Mortality, %	0.30	0.15	0.30	0.23	0.87	0.81
Removed, %	4.2	4.4	4.4	1.1	0.98	0.84

Table 4. Carcass parameters of accelerated transition vs control.

	Treatment				*P*-value	
Item	**CON**	**LAC1**	**LAC2**	**SEM**	**Treatment**	**Contrast**
HCW, lb	828.1	829.0	824.1	7.6	0.43	0.65
Dressed Yield, %	64.8	65.1	64.6	0.22	0.25	0.70
Marbling Score	493^a	495^a	507^b	13.1	0.10	0.20
Ribeye area, in^2	13.6^a	13.6^a	13.4^b	0.15	0.05	0.28
Back Fat, in	0.72	0.73	0.73	0.04	0.87	0.61
Calculated YG	3.66	3.72	3.78	0.10	0.16	0.10
YG1, %	0.46^a	1.20^b	0.44^a	0.29	0.09	0.27
YG2, %	8.9	7.8	6.3	1.9	0.17	0.13
YG3, %	35.0	33.2	33.1	3.5	0.78	0.49
YG4, %	38.2	37.1	38.8	3.3	0.90	0.93
YG5, %	17.5	20.7	21.1	3.1	0.37	0.16
Prime, %	5.4	5.5	6.9	1.5	0.38	0.43
Choice, %	72.4	73.8	74.5	3.6	0.61	0.36
Select, %	20.4	20.0	17.2	3.8	0.29	0.34
Standard, %	1.8	0.79	1.4	0.62	0.34	0.22
Edible Livers, %	61.8	67.4	62.3	6.1	0.34	0.40
A+ Adhesion Livers, %	12.3^a	8.3^b	10.4^{ab}	1.4	0.05	0.03
A and A- Livers, %	12.5	14.7	11.8	4.7	0.62	0.80
A+ Livers, %	14.2	10.8	13.8	2.0	0.39	0.41

Table 5. Economic parameters of accelerated transition vs control.

	Treatment				
Item	**CON**	**LAC1**	**LAC2**	**SED**	***P*-value**
Purchase cost, $/heifer	Referent	-11.4	-6.6	10.7	0.58
Veterinary and medicine cost, $/heifer	Referent	0.53	0.35	0.49	0.56
Feed and yardage cost, $/heifer*	Referent^a	-21.3^b	-18.3^b	8.6	0.05
Feed delivery cost, $/heifer	Referent^a	-2.1^b	-2.0^b	0.34	<0.01
Cost of gain, $/per cwt**	Referent	-4.8	-1.1	4.0	0.48
Total cost, $/heifer	Referent^a	-31.3^b	-20.5^a	12.6	0.07
Total revenue, $/heifer	Referent	-12.1	-26.6	22.5	0.51
Net return, $/heifer	Referent	19.1	-6.1	26.5	0.62

*includes feed cost, yardage cost, and interest expense

**includes feed cost, feed delivery cost, yardage cost, and interest expense

CONCLUSION

Accelerating the diet transition in feedlot heifers resulted in reduced DMI, percentage of A+ liver abscesses, and operational costs.

EFFECTS OF DIFFERENT RECEIVING PERIOD REGIMENS ON GROWTH PERFORMANCE, HEALTH, AND RUMEN BUFFERING CHARACTERISTICS OF LIGHTWEIGHT FEEDER STEERS

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Introduction

- The receiving period plays a crucial role in preparing calves for the remainder of the feeding period as diet, management, and treatment protocols have major implications on animal health and performance
- Lightweight cattle are typically at greater risk for bovine respiratory disease (BRD), have low dry matter intake, and require greater days on feed (DOF) to reach their marketing endpoint
- These cattle may also require a longer receiving period to offset challenges from stress and BRD
- More recently, a complete starter diet (RAMP, Cargill Corn Milling) has provided an alternative receiving strategy that reduces labor and commodity management associated with feeding a traditional receiving diet with high roughage concentrations
- More information is needed to understand the importance of traditional roughage sources in receiving diets containing high amounts of grain milling co-products and identify optimal diet management strategies when these diets are fed for extended periods of time
- Novel commercially available blended products for use in receiving diets could provide flexibility in management of lightweight and/or high-risk cattle based on the needs of the feedlot

Objective

- The objectives of this study were to determine the effects of using different receiving regimens on growth performance, health, rumination, and ruminal pH of lightweight feeder steers

Materials and Methods

All procedures approved by WTAMU IACUC
- Generalized complete block design:
  - 6 truck-load blocks of auction derived bulls (n = 295) and steers (n = 196); Initial BW = 514.9 ± 18.0 lb
  - 12 pen replicates per treatment, 10 or 9 animals per pen
- Day -1
  - Individual BW recorded on a certified scale
  - Administered identification tags, clostridial vaccine, MLV respiratory vaccine, anthelmintic, antimicrobial metaphylaxis, and a growth-promoting implant
  - Provided coastal Bermudagrass hay at 0.5% BW (DM basis)
  - Stratified by BW, sex, and ranch tag and randomly assigned to treatment pens within block
- Day 0
  - Bulls castrated via banding and received oral meloxicam
  - Sorted into treatment pens
  - Subset (n = 2 per pen) were assigned to receive:
    - Indwelling ruminal pH bolus
    - Rumination ear-tag

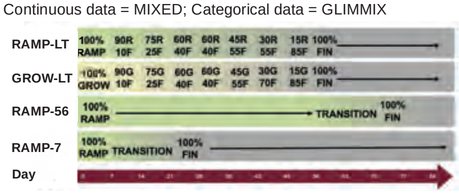
Table 1. Ingredient and nutrient composition

Item	RAMP	GROW	FIN
	Treatments		
Ingredient, % of DM			
RAMP	100.00	-	-
Corn grain, flaked	-	23.35	61.70
Sweet Bran	-	-	24.00
Cargill Test Product	-	50.00	
Blended Distillers	-	13.20	-
Corn Stalks	-	11.45	7.15
Corn Oil	-	-	1.50
Molasses Blend	-	-	2.00
Supplement	-	-	3.65
Nutrient Analysis (DM basis)			
Dry Matter, %	63.17	70.35	76.08
CP, % of DM	23.11	20.48	14.36
ADF, % of DM	17.37	17.64	8.63
Fat, % of DM	3.23	3.29	4.47
Starch, % of DM	7.06	24.64	48.42
NEm, Mcal/lb DM	0.82	0.82	1.01
NEg, Mcal/lb DM	0.54	0.53	0.70

- **Dietary Treatments (Table 1):**
  - **RAMP-7**: 7 d RAMP followed by 18 d transition to FIN
  - **RAMP-56**: 56 d RAMP followed by 18 d transition to FIN
  - **RAMP-LT**: 7 d RAMP followed by long transition (49 d) to FIN
  - **GROW-LT**-:7 d GROW followed by long transition (49 d) to FIN
- **Statistical Analysis:**
  - Continuous data = MIXED; Categorical data = GLIMMIX

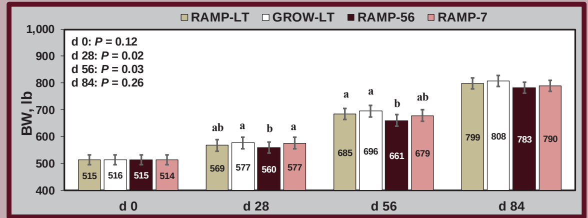
Table 2. Grow Product Composition

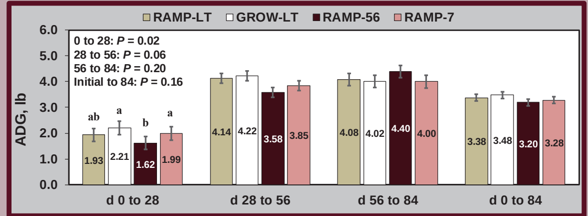
Item	
Nutrient Analysis (DM basis)	
Dry Matter, %	73.93
CP, % of DM	18.96
ADF, % of DM	12.47
Fat, % of DM	3.81
Starch, % of DM	33.53
NEm, Mcal/lb DM	0.93
NEg, Mcal/lb DM	0.63

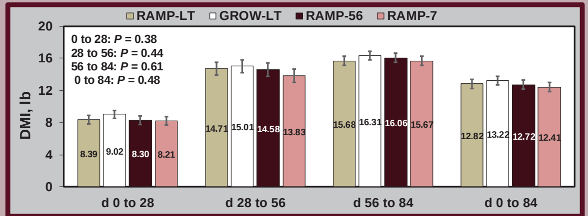


Sweet Bran Grower Product

Results







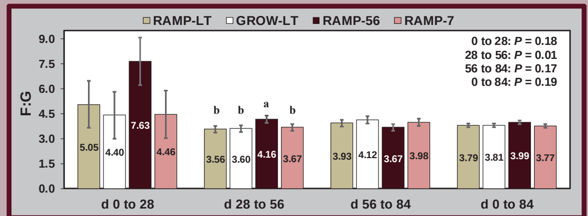
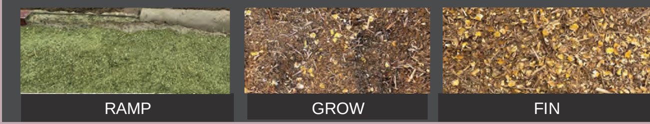


Table 3. Treatments, mortalities, and removals

Item	RAMP-LT	GROW-LT	RAMP-56	RAMP-7	*P*-Value
BRD1, %	73.89	73.06	76.48	72.50	0.91
BRD2, %	42.13	34.72	43.06	37.22	0.57
BRD3, %	22.69	19.63	23.80	18.80	0.71
Other treatment, %	0.00	0.83	1.67	2.50	0.32
Mortality, %	3.33	5.83	2.50	4.26	0.52
Removals, %	6.76	12.04	10.46	6.85	0.53

Table 4. Particle size distribution and estimated peNDF

Item	RAMP	GROW	FIN	SEM	*P*-Value
	Diets				
NDF, % of DM	38.27[a]	32.47[b]	21.28[c]	1.08	< 0.01
Sieve size, mm					
19.0	0.23[c]	2.51[a]	1.65[b]	0.22	< 0.01
8.0	11.00[c]	23.41[b]	38.03[a]	0.97	< 0.01
4.0	30.28[a]	25.65[b]	23.26[c]	0.65	< 0.01
Pan	58.50[a]	48.43[b]	37.06[c]	1.02	< 0.01
Particles > 4 mm	41.50[c]	51.57[b]	62.94[a]	1.03	< 0.01
peNDF, % of DM	15.86[b]	16.78[a]	12.49[c]	0.46	< 0.01



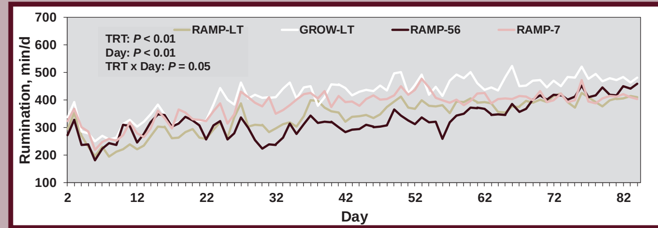
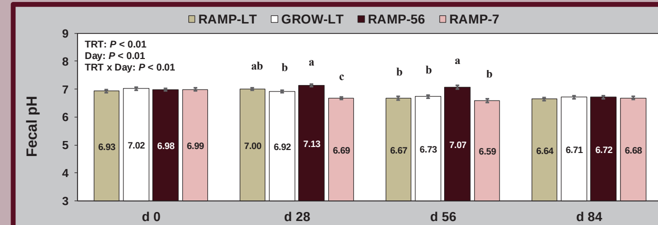


Table 5. Ruminal pH

Item	RAMP-LT	GROW-LT	RAMP-56	RAMP-7	*SEM*	TRT	Day	TRT × Day
						P-Value		
Daily pH	6.05	6.16	6.08	6.05	0.06	0.52	< 0.01	0.64
Minimum pH	5.33	5.40	5.49	5.35	0.04	0.17	< 0.01	0.17
AUC 5.6	60.39	38.30	41.61	69.44	6.35	0.50	< 0.01	0.12



Conclusion

- Cattle fed RAMP-56 had reduced growth performance for the first 56 d on feed; BW and growth performance did not differ among the 4 dietary treatments by 84 d
- The peNDF was greatest for GROW, intermediate for RAMP, and least for FIN, however, rumination was greatest when at least a portion of the diet included corn stalks
- Use of novel starter diets and transition regimens with branded feed products warrant further investigation as a replacement for traditional receiving strategies

Evaluating the seasonality effect of vitamin D status in commercial feedlot steers and heifers

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INTRODUCTION

- Cattle synthesize vitamin D from exposure to sunlight. However, vitamin D status can be influenced by season, gender, hide pigmentation, and production stage.
- Serum 25-hydroxyvitamin D_3 (25(OH)D_3) concentrations are reliable indicators of vitamin D status in cattle (Poindexter et al., 2019).
- Serum 25(OH)D_3 concentrations of 30 ng/mL have been proposed as a lower threshold for sufficiency, whereas lower thresholds for supporting immune response in dairy cows have been estimated to be ≥ 100 ng/mL (Nelson and Merriman, 2012).
- Vitamin D supplementation is highly variable in cattle finishing diets.
- The table below shows data presented in a feedlot nutritionist survey published by Samuelson et al. (2016) on the variability in vitamin D inclusion in receiving and finishing diets.

	No. of Responses	Mean	Min.	Max.	Mode
Vitamin D, IU/ lb					
Receiving diet	19	123	0.0	400	0.0
Finishing diet	18	65	0.0	200	0.0

NRC (2016) recommends 125 IU/lb of supplemented vitamin D for receiving and finishing beef cattle.

MATERIALS AND METHODS

Experimental Design

- 603 crossbred feedlot cattle were enrolled in a year-long survey to evaluate the seasonal variation in serum 25(OH)D_3 concentration
- All cattle were housed in outdoor pens without shades

- **Dietary Treatments:**
  - **CON** = common finishing diet with steam-flaked and high-moisture corn
  - **HyD** = common finishing diet with steam-flaked and high-moisture corn + 1.0 mg/day calcidiol
    - Both diets contained 125 IU/ lb of vitamin D_3
    - Treatments were applied for a minimum of 60 d prior to blood collection.
- **Blood Sampling:**
  - Whole blood samples were taken at terminal reimplant (approx. 70 d before harvest) at 4 different time points from 2 randomly selected pens (~150-200 h/pen) per treatment for steers and heifers

No. of Samples	Spring	Summer	Fall	Winter
CON	**75**	**79**	**69**	**120**
Steers	35	39	40	80
Heifers	40	40	29	40
HyD	**75**	**75**	**70**	**40**
Steers	35	40	40	0
Heifers	40	35	30	40

- Whole blood was set aside to clot before being centrifuged at 1,500 G for 12 minutes. Serum was removed and placed into 2 ml cryovials and stored in a freezer (-18 °C) until it was analyzed. TMAS analytical laboratory (dsm-firmenich, Belvidere, NJ) analyzed the serum samples for 25(OH)D_3 concentration using HPLC coupled with tandem MS

Statistical Analysis

- Data were analyzed using the MIXED procedures of SAS. Animal was considered the experimental unit. The model included treatment, gender, season, and hide pigmentation as fixed effects and pen as a random effect

ACKNOWLEDGMENTS

Appreciation is expressed to dsm-firmenich and Foote Cattle Company for their support on this survey

OBJECTIVES

1. Determine the serum 25(OH)D_3 concentration of feedlot cattle at four time points throughout the year (spring, summer, fall, and winter) in commercial steers and heifers located in western Kansas.
2. Evaluate serum 25(OH)D_3 concentrations of steers and heifers supplemented with 1 mg/d calcidiol (HyD®, dsm-firmenich, Plainsboro, NJ) in addition to 125 IU/lb of vitamin D_3.

RESULTS

Figure 1. Effect of season on serum 25(OH)D_3

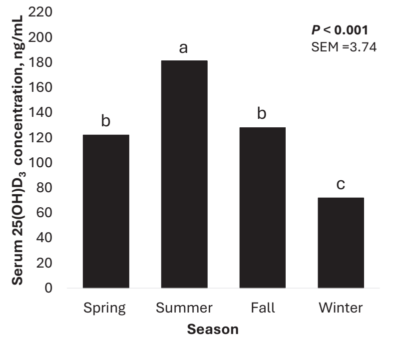


Figure 2. Effect of treatment on serum 25(OH)D_3

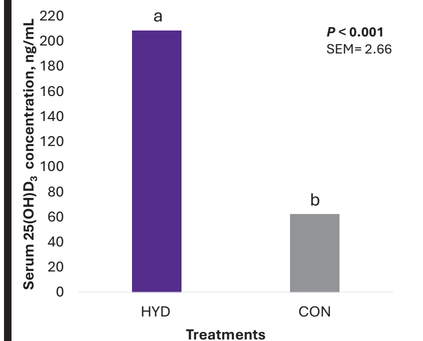
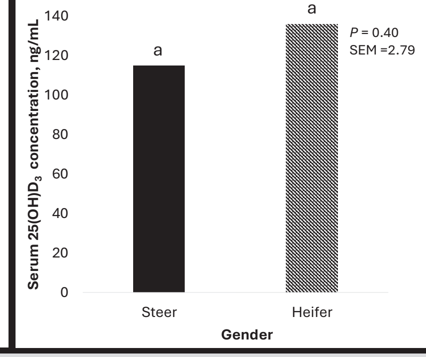


Figure 3. Effect of gender on serum 25(OH)D_3



Figures 1-3. The effects of season (spring, summer, fall, and winter), treatment (HyD and CON), and gender (steer or heifer) on serum 25(OH)D_3 concentration.

Figure 4. Effect of vitamin D_3 and calcidiol supplementation compared to average day length exposure prior to blood collection.

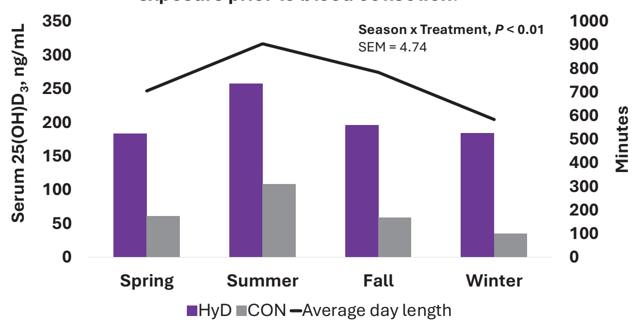


Figure 4. Cattle were on treatment for at least 60 d prior to blood collection to be eligible for survey time points. The average sun exposure 60 d prior to blood collection shows a similar trend between day length and CON cattle serum 25(OH)D3 concentration. These data suggest that vitamin D status is influenced by day length.

Figure 5. Effect of gender by treatment on 25(OH)D_3 serum concentrations across season

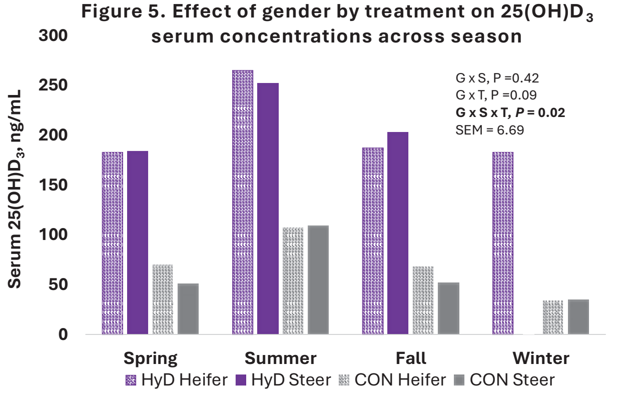


Figure 5. Serum 25(OH)D3 concentration across treatment and gender by season. (Winter HyD Steers were not collected). G = Gender, S = Season, and T = Treatment

Table 1. Effect of hide pigmentation on serum 25(OH)D_3 concentration.

	Hide Pigmentation [1]				
Item,	Black	Red	White	SEM[2]	*P*-value[3]
No. of Cattle[4]	491	74	38		
Serum 25(OH)D_3,[5] ng/mL	124[b]	137[a]	119[ab]	7.618	<0.001

[1]Hide pigmentation category was assigned by hair color and nose pigment
[2]Largest standard error of the mean.
[3]Treatment main effect.
[4]Since most cattle fed in the US are black-hided and cattle were sampled at random when entering the chute, cattle hide pigmentation is not evenly distributed for statistical analysis.
[5]Represents average values across all sample time points.
[a, b]Within row, means not bearing a common superscript letter differ (P < 0.05).

CONCLUSION AND IMPLICATIONS

- Vitamin D status in feedlot cattle varies throughout the year.
- Supplementation of HyD in finishing diets is an efficient way to increase circulating serum 25(OH)D_3 concentration.
- Hide pigmentation may influence cattle's ability to synthesize Vitamin D from sun exposure.
- Dietary vitamin D supplementation may need to be adjusted throughout the year to maintain adequate circulating vitamin D concentrations, but more research is needed to determine the ideal vitamin D status required for optimum health and performance of feedlot cattle.

Utilization of Fiber Recovered From Dairy Manure as a Roughage Source in Finishing Beef Cattle Diets

Colton Weir, Zach Duncan, Cole Ellis, Macie Weigand, Bill Hollenbeck, Sean Montgomery, Evan Titgemeyer, and Dale Blasi

Introduction

- Roughages are an essential aspect of finishing diets because of their role in maintaining ruminal health
- Roughage costs are largely driven by supply and prices typically increase during periods of drought
- Lignium Energy has developed a process to recover fiber from dairy cattle manure
- Lignium fiber (**LIGF**) could serve as a more consistent alternative to traditional roughage sources in finishing beef cattle diets
- No experiments feeding LIGF have been conducted

Objectives

- Evaluate effects of feeding LIGF on intake, apparent diet digestibility, and ruminal fermentation characteristics in finishing beef heifers

Materials and Methods

- Seven ruminally cannulated crossbred heifers (initial BW = 1145 ± 188 lb) were arranged in a replicated 4 × 4 Latin square consisting of 4 consecutive 15-d periods
- Each period included 10 d of diet adaptation, 4 d of fecal collection, and 1 d of ruminal digesta collection
- Heifers were randomly assigned to 1 of 4 experimental diets that contained 8.0% warm-season grass hay (**HAY**; DM basis), 8.0% wheat straw (**WSTRAW**), 8.0% Lignium fiber (**LIG**), or 4% warm-season grass hay + 4% Lignium fiber (**HAY+LIG**)
- Heifers were fed once daily for ad libitum intake at 1000 h
- Prior to the start of the experiment, warm-season grass hay and wheat straw were ground through a 3-inch screen using a commercial grinder
- On d 10 to 14, particle size distribution of each roughage was evaluated using the Penn State Particle Separator
- On d 4 to 14, 10 g chromium oxide was administered intra-ruminally using a gel bolus
- On d 11 to 14, fecal samples were collected at 8-h intervals beginning at feeding. Collection times advanced 2 h each day so that each 2-h period over 24 h was represented
- On d 15, ruminal digesta samples were collected prior to feeding and again 2, 4, 6, 8, 12, 18, and 24 h post feeding
- pH of strained ruminal fluid was measured, and samples were retained for analysis of ruminal volatile fatty acid and ammonia concentrations
- Data were analyzed using the MIXED procedure in SAS (SAS 9.4, SAS Inst. Inc, Cary, NC)

Roughage Composition

Nutrient composition, % DM	Grass hay[1]	Wheat straw	LIGF[2]
Dry matter	90.1	88.8	91.5
Organic matter	91.5	91.2	98.0
Crude protein	6.4	3.3	4.5
Neutral detergent fiber	59.3	71.6	86.4
Acid detergent fiber	37.9	52.3	68.4
Calcium	0.17	0.28	0.53
Phosphorus	0.02	0.04	0.05

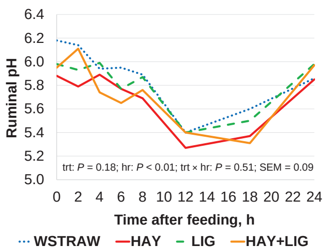
[1] Warm-season grass hay
[2] Lignium fiber (Lignium Energy; Santiago, Chile)

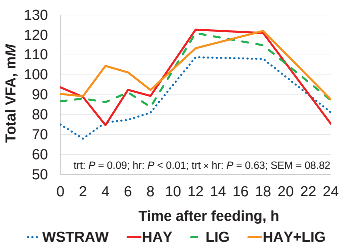
Experimental Diets

Ingredient,	Diet HAY	LIG	HAY+LIG	WSTRAW
Dry-rolled corn	46.7	46.7	46.7	46.7
Supplement[1]	5.3	5.3	5.3	5.3
Sweet Bran[2]	40.0	40.0	40.0	40.0
Warm-season grass hay	8.0	-	4.0	-
Wheat straw	-	-	-	8.0
Lignium fiber	-	8.0	4.0	-
Nutrient composition				
Dry matter	77.3	77.4	77.4	77.2
Organic matter	94.6	95.2	94.9	94.6
Crude protein	14.4	14.2	14.3	14.1
Neutral detergent fiber	19.6	21.7	20.6	20.6
Acid detergent fiber	8.2	10.6	9.4	9.4
Calcium	0.76	0.77	0.76	0.75
Phosphorus	0.58	0.57	0.57	0.57

[1] Supplement pellet formulated to contain (DM basis) 400 g/ton monensin (Rumensin; Elanco, Greenfield, IN)
[2] Cargill Corn Milling (Blair, NE)

Ruminal Fermentation Characteristics





Item,	Diet HAY	LIG	HAY+LIG	WSTRAW	SEM[1]	*P*-value[2]
Ruminal[3]						
Ammonia, m*M*	4.71	5.01	5.01	5.29	0.795	0.77
pH	5.69	5.89	5.73	5.87	0.087	0.18
Ruminal VFA,[3] m*M*						
Acetate	32.55	32.82	34.71	33.28	1.63	0.72
Propionate	43.69^{y}	43.06^{yz}	45.86^{y}	33.22^{z}	5.54	0.10
Butyrate	13.92	13.99	14.54	13.51	0.86	0.85
Valerate	2.78	2.76	2.94	2.23	0.37	0.13
Isobutyrate	0.44	0.50	0.44	0.47	0.03	0.33
Isovalerate	1.41	1.77	1.59	1.76	0.25	0.24
A:P, mol/mol	0.82^{b}	0.86^{b}	0.89^{ab}	1.08^{a}	0.01	0.05
Total VFA	94.8^{yz}	94.9^{yz}	100.1^{y}	84.5^{z}	6.38	0.09
LPR,[4] %/h	12.9	12.1	11.9	12.5	0.93	0.54
Liquid volume,[5] gal	9.3	9.9	9.1	10.6	1.63	0.76

[1] Largest standard error of the mean (SEM)
[2] Treatment main effect
[3] Average of values collected at 0, 2, 4, 6, 8, 12, 18, and 24 h post-feeding
[4] Liquid passage rate; calculated from samples collected at 2, 4, 6, 8, 12, and 18 h after feeding
[5] Ruminal liquid volume
[a, b] Within rows, means with uncommon superscripts differ ($P \leq 0.05$)
[y, z] Within rows, means with uncommon superscripts tend to differ ($P \leq 0.10$)

Particle Size Distribution

	Roughage Grass hay	Wheat straw	LIGF
Number of samples	20	20	20
Sieve screen size, mm	% retained		
19.0	36.5 ± 2.4	41.3 ± 4.6	0.4 ± 0.1
8.0	23.9 ± 3.8	26.9 ± 3.8	1.1 ± 0.4
4.0	16.0 ± 1.4	15.4 ± 1.8	4.3 ± 0.9
< 4.0	23.2 ± 2.9	16.0 ± 3.9	93.9 ± 1.4
Physically Effective NDF			
Particles greater than 4 mm	76.4 ± 3.7	83.5 ± 4.0	5.7 ± 1.3
Estimated peNDF, % DM	45.3. ± 2.3	59.8 ± 5.0	5.0 ± 1.5


Warm-season grass hay


Wheat straw


Lignium fiber

Feed Intake and Apparent Digestibility

Item,	Diet HAY	LIG	HAY+LIG	WSTRAW	SEM[1]	*P*-value[2]
No. of observations	7	7	7	7		
Intake, lb/d						
Dry matter	23.7	21.4	22.4	22.6	1.63	0.23
Organic matter	22.4	20.4	21.3	21.4	1.55	0.27
NDF	4.65	4.66	4.62	4.67	0.34	0.99
ADF	1.98^{z}	2.27^{y}	2.11^{yz}	2.11^{yz}	0.16	0.09
Apparent digestibility, %						
Dry matter	70.7	71.7	72.0	68.8	1.62	0.52
Organic matter	73.8	74.2	75.0	71.7	1.51	0.47
NDF	59.3	54.9	63.5	61.8	2.70	0.17
ADF	44.1^{y}	29.4^{z}	41.5^{yz}	36.6^{yz}	4.12	0.10

[1] Largest standard error of the mean (SEM)
[2] Treatment main effect
[y, z] Within rows, means with uncommon superscripts tend to differ ($P \leq 0.10$)

Conclusions

- Approximately 94% of Lignium fiber particles were less than 4 mm
- Intake and apparent digestibility of dry matter, organic matter, and neutral detergent fiber did not differ among treatments
- Acid detergent fiber intake tended to be greater and digestibility lesser for heifers fed LIG compared with heifers fed HAY
- Ruminal pH, ammonia concentrations, and liquid passage rate did not differ among the roughage sources

Implications and Applications

- Fiber recovered from dairy cattle manure can be utilized as an alternative roughage source in a finishing beef cattle diet based on dry-rolled corn and 40% wet-corn gluten feed (DM basis)
- Further research is warranted before using Lignium fiber as a replacement for traditional roughage sources (i.e., larger particle size) in diets containing more heavily processed grains or low amounts of co-products