DEPARTMENT OF
ANIMAL AND FOOD SCIENCES

P-1064

2022 Annual Summary

April 4, 2022

TO: Livestock Producers, Researchers, Educators, and other Stakeholders
of the OSU Department of Animal and Food Sciences

RE: 2021 Annual Research Summary of the Department of Animal and Food Sciences

We are proud to present a summary of research accomplishments from this past year. Whether basic or applied, the mission of our research program in the Department of Animal and Food Sciences is to solve problems and capitalize on opportunities in animal agriculture, companion animals, and the food industry.
This report summarizes a wide array of research activities conducted at our livestock units and in our laboratories by faculty, staff, and students. We hope to build on the Department's rich history of excellence in research to better serve animal agriculture and help provide all citizens abundant affordable and safe food supply.
We hope you find this research report useful and informative.

Sincerely,

Paul Beck and David Lalman

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Impact of nitrite-embedded packaging and enhancement on dark-cutting raw and cooked beef color

M. Denzer, G. G. Mafi, D. L. VanOverbeke, and R. Ramanathan

Justification and Actions

Dark-cutting beef has a higher pH postmortem due to increased stress caused by many factors, including transportation, weather and handling. A greater than normal pH (> pH 6) provides a darker appearance upon blooming and a pink cooked internal color of fresh beef. These attributes are negatively perceived by consumers due to the association of a bright cherry red color and freshness. Therefore, dark-cutting beef reduces carcass value. Novel nitrite-embedded packaging (NEP) has been shown to improve the redness of dark-cutting beef. However, the understanding of retail color stability, cooked color and palatability of enhanced dark-cutting steaks stored in NEP and the effects repackaging in polyvinyl chloride (PVC) overwrap on retail color are limited. Therefore, the objectives of this study were to (1) determine the effects of NEP and enhancement on the dark-cutting beef color, (2) investigate the impact of repackaging in polyvinyl chloride on the redness of dark-cutting beef and (3) evaluate the effect of enhancement and packaging on cooked color and palatability. Dark-cutting beef strip loins (n = 8; pH = 6.39) and USDA Choice beef strip loins (n = 6; pH = 5.56) were selected at a commercial packing plant. Dark-cutting loins were divided into two sections and randomly selected as non-enhanced dark-cutting (DC) and enhanced dark-cutting (DCE) treatments with 110% pump of the green weight. After enhancement, a final concentration of 0.5% glucono delta-lactone and 0.1% rosemary was measured in the loins. Steaks (0.75 in) were removed from non-enhanced normal pH, DC and DCE loins with steaks randomly assigned to three, six or nine days in dark storage. Normal pH and DC steaks were vacuum packaged while DCE steaks were packed in NEP. All steaks were stored in dark storage until three, six or nine days then repackaged in PVC and displayed for six days. During dark storage, the instrumental color was evaluated every 24 hours, and upon repackaging, instrumental and visual color (n = 6) was evaluated every 12 hours. For objective three, steaks for cooked color were placed in dark storage for 72 hours after packaging the DCE steak in NEP and the DC and normal pH steaks in vacuum packaging. A trained sensory panel (n= 6) evaluated sensory steaks for beef palatability.

Results

The DCE steaks had an increase ($P < 0.05$) in redness in 24 hours of dark storage. Upon repackaging DCE steaks, the DCE steaks had a darker red appearance, increased surface discoloration and decreased a* values. The cooked DCE steaks had lower ($P > 0.05$) internal redness than cooked DC steaks. A similar decrease in redness was observed by panelists evaluating the internal cooked color of DCE steaks. However, the external cooked color of DCE was determined to have pinker ($P < 0.05$) appearance than normal pH and DC steaks. The trained sensory panel determined there was no difference in tenderness and juiciness between the normal pH and DCE steaks. In conclusion, DCE steaks packaged in NEP improved surface redness during retail display. However, repackaging DCE steaks in PVC decreased color stability and redness of steaks within 12 hours of the display. The enhancement decreased internal redness upon cooking, and panelists did not notice major tenderness differences. The current research suggests that adopting appropriate packing and enhancement technology has the potential to increase the value of dark-cutting beef.

Table 1. Least squares means for a* (dark storage time x enhancement x hour of retail display) of steaks for displayed 144 hours (Normal pH, n=6; DC/DCE, n=8)

			Display Hour		
	Storage Time	Enhancement	0	12	24
a* values	3 d	Normal-pH	$28.04^{ab,wx}$	$31.69^{b,w}$	$31.12^{ab,z}$
SEM=1.14		DC[1]	$22.69^{a,v}$	$23.67^{a,v}$	$24.62^{a,xy}$
		DCE[2]	$27.84^{b,wx}$	$21.12^{a,v}$	$19.97^{a,vw}$
	6 d	Normal-pH	$27.34^{ab,wx}$	$30.49^{b,w}$	$30.29^{b,z}$
		DC	$23.89^{a,vw}$	$23.57^{a,v}$	$23.93^{a,wx}$
		DCE	$28.77^{b,x}$	$20.02^{a,v}$	$18.40^{a,v}$
	9 d	Normal-pH	$25.46^{a,vwx}$	$29.45^{a,w}$	$29.00^{a,yz}$
		DC	$23.66^{a,vw}$	$23.82^{a,v}$	$24.12^{a,wx}$
		DCE	$27.48^{b,wx}$	$20.26^{a,v}$	$21.06^{a,vwx}$

[ab]Least squares means within a row with different letters are significantly different (P < 0.05).
[v-z]Least squares means within a column with different letters are significantly different (P < 0.05).
[1]Non-enhanced dark-cutting (DC)
[2]Enhanced dark-cutting (DCE)

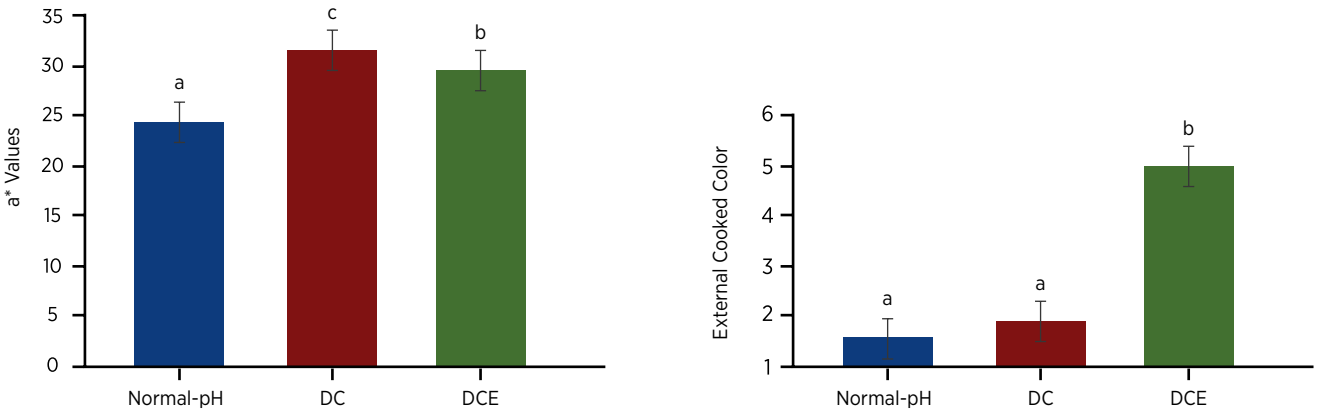

Figure 1. Effects of treatment1 on a* (A, redness) and external cooked color (B, 1 = brown, 7 = pinkish-red) of steaks. Least squares means with different letters (a-c) are significantly different (P < 0.05). SEM (A) = 0.84; SEM (B) = 0.10

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Changes in protein profiles influences muscle-pH and color of atypical dark-cutting and normal-pH beef

F. Kiyimba, S.D. Hartson, J. Rogers, G. G. Mafi and R. Ramanathan

Justification and Actions

The color of meat is an important deciding factor in consumers' assessment of meat quality. To meat buyers, the bright cherry-red color of meat indicates freshness and wholesomeness. However, atypical dark-cutting beef represents dark colored meat with a muscle pH between 5.6 and 5.8. Although previous studies have indicated that the ultimate pH of atypical dark-cutting beef is greater than normal, the mechanistic basis for the occurrence is not clear. Therefore, the objective of this study was to identify proteins related to the development of atypical dark-cutting beef. Longissimus thoracic (LT) muscles from 12 different animals (6 atypical dark-cutters and 6 normal-pH beef) were analyzed by comparing differences in protein levels using mass spectrometry-based analysis.

Findings

Mass spectrometry analysis identified 66 proteins with significant differences in protein levels ($P < 0.05$) between dark-cutting and normal, bright red beef. Of these, 22 proteins showed increased levels while 14 proteins showed reduced levels in atypical dark-cutting beef compared with normal-pH beef. When the changes in protein levels in atypical dark-cutting beef were compared with normal-pH beef using principal component analysis (PCA plot), clear separation between the atypical dark-cutting and normal-pH beef samples was observed, suggesting that the samples within each group show distinguishable clusters with different protein profiles. Further, functional classification analysis revealed that proteins that showed increased levels in atypical dark-cutting beef are involved in energy synthesis, muscle contraction and stress response processes. However, proteins that showed reduced levels in atypical dark-cutting beef compared with normal-pH beef are involved in glycogen breakdown processes. Taken together, these results show that decreased levels of glycogen breakdown enzymes are associated with differences in muscle pH and color of atypical dark-cutting and normal-pH beef. These results should improve our ability to identify mechanisms leading to dark cutting beef and enable intervention before it occurs.

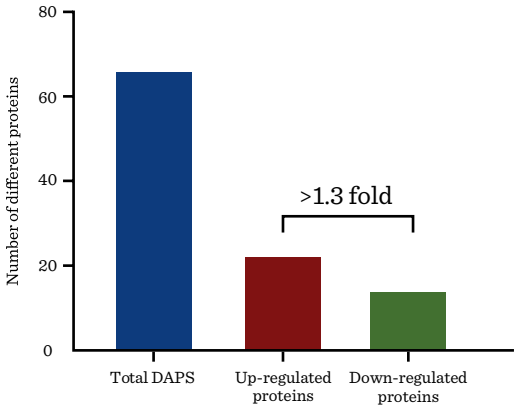

Figure 1: Total protein level of differentially abundant proteins in atypical dark-cutting beef compared with normal-pH beef. The number of proteins with increased levels (red) and proteins with decreased levels (green) in atypical dark-cutting beef relative to normal-pH beef with >1.3 fold are indicated. DAPs (blue) represents the total number of differentially abundant proteins in atypical dark-cutting compared with normal-pH beef.

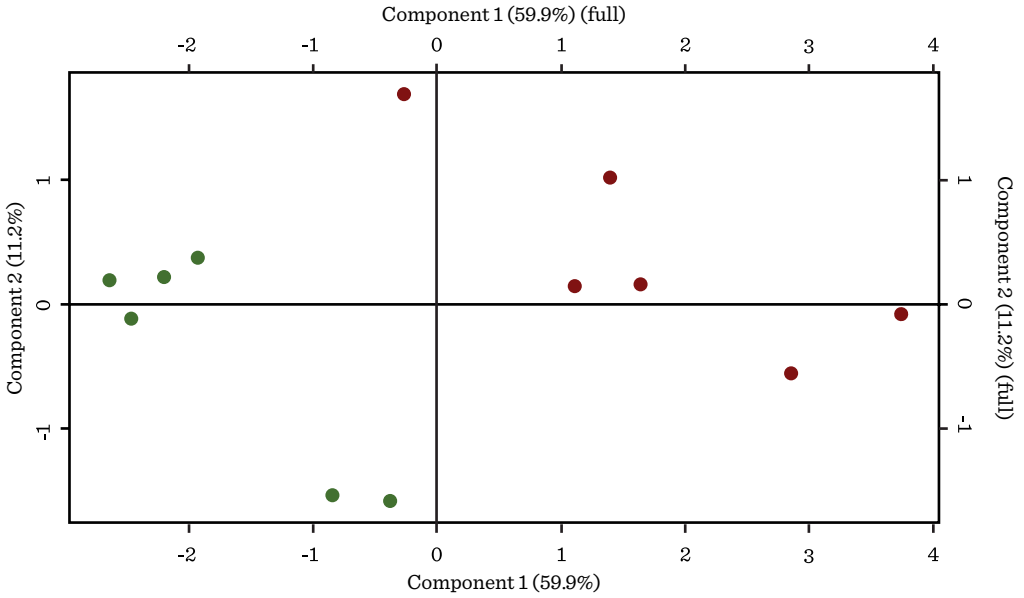

Figure 2: Principal component analysis (PCA) plot of quantified proteins differentially abundant in atypical dark-cutting beef compared with normal-pH beef.

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Effects of natural antioxidants in ground beef packaged in multiple packaging types

Laura Yoder, Tori Roser, Ranjith Ramanathan and Gretchen Mafi

Justifications and Actions

Consumers relate the color of meat to freshness and base their purchasing decisions on color more frequently than any other quality trait. When purchasing beef, studies show that consumers want to see a bright cherry red color, deeming other color deviations as unacceptable. Ground beef is the most commonly purchased beef product in the U.S., and consumers prefer to purchase their ground beef in traditional foam trays with polyvinyl-chloride overwrap (PVC). However, meat in PVC has a limited shelf life, so the use of a master package (MP) or modified atmosphere packaging (MAP) is often used to extend shelf-life during transportation and storage. In a MP, fresh beef or pork products are first packaged in traditional PVC and placed into a large bag then flushed with gas, such as carbon monoxide (CO), nitrogen (N_2) or carbon dioxide (CO_2) to create an anaerobic condition. Various factors contribute to the discoloration of meat; thus, the objective of this project was to determine the effects of adding rosemary and green tea to ground beef patties for their antioxidant properties. Additionally, packaging types were also evaluated with the goal of extending shelf life. USDA Low Choice chuck rolls were purchased and ground together. Rosemary, green tea and a combination of rosemary + green tea were added to ground beef and formed into patties. Patties were packaged into PVC, MAP or MP. Both MAP and MP were flushed with the same gas blend of 0.4% CO, 69.6% N_2 and 30% CO_2. Patties in PVC and MAP were placed directly into coffin style display cases kept at 39°F for six days with constant fluorescent lighting. Master packages were placed in dark storage for six days then removed from dark storage and opened, and PVC trays inside the MP were placed into display cases for another six days. Instrumental color and trained panelists were utilized to determine color changes throughout the display period. Lipid oxidation, which causes off flavors and odors, contributes to the occurrence of discoloration and is the primary reason for antioxidant utilization. Lipid oxidation was measured on days 0, 3 and 6 for patties in PVC and MAP and on days 6, 9 and 12 for patties in MP. A trained taste panel was utilized to detect flavor differences in patties when cooked to 165°F by using a three-point scale.

Findings

The trained taste panel did not report any fatty or rancid flavor differences ($P > 0.05$) in cooked patties with the added antioxidants. However, panelists detected differences ($P < 0.05$) between antioxidant treatments when evaluating for the green-hay flavor attribute, as shown in Table 2. Panelists strongly detected the green-hay flavor in patties with rosemary and rosemary + green tea antioxidants. However, when panelists sampled patties with green tea or regular ground beef patties, they could not detect the green-hay flavor. All patties in PVC had greater amounts of lipid oxidation than those in MAP. Patties in PVC with green tea or rosemary + green tea had less lipid oxidation than control or rosemary patties in PVC. From day 6 to day 12, patties in MP with added green tea were the only patties to not increase in lipid oxidation amount.

Patties packaged in MAP were analyzed and shown to be lighter and redder in color, and color panelists distinguished they had less discoloration compared to patties in PVC. This confirms that MAP can provide a more desirable color with the elimination of oxygen and addition of carbon monoxide to extend the shelf life of meat products. Patties packaged in PVC with rosemary and rosemary + green tea antioxidants had less discoloration than the control patties in PVC at the end of the study (Table 1). When patties in MP were evaluated by trained color panelists, the panelists identified that on day 6, there were no differences in color, but by day 12, patties with green tea were brighter than those with rosemary + green tea.

Table 1. Least squares means of display color and surface discoloration values[1] (treatment[2] × day interaction) of ground beef patties[3] in master packages[4] in simulated retail display for seven days after dark storage.

		Display d		
Parameter	Treatment[3]	6	9	12
Display Color				
	Control	2.21[c]	4.37b,u	6.39a,uv
SE = 0.29	Rosemary	2.01[c]	5.12b,u	6.35a,uv
	Green Tea	1.91[c]	3.86b,v	6.09a,v
	Rosemary + Green Tea	1.99[c]	3.88b,v	6.71a,u
Surface Discoloration	Control	1.01[c]	3.03b,u	4.92a,uv
SE = 0.28	Rosemary	1.01[c]	3.17b,u	4.92a,uv
	Green Tea	1.00[c]	2.02b,uv	4.78a,v
	Rosemary + Green Tea	1.06[c]	2.17[b,uv]	5.28[a,u]

Surface discoloration was evaluated on a 7-point scale: 1 = no discoloration, 0% Metmyoglobin; 2 = minimal discoloration, 1-10%; 3 = slight discoloration, 11-20%; 4 = small discoloration, 21-40%; 5 = modest discoloration, 41-60%; 6 = moderate discoloration, 61-80%; 7 = extensive discoloration, 81100%

[1]A lower display color score indicates a brighter color (1 = very light red, 7 = dark red); a lower surface discoloration indicates less discoloration and Metmyoglobin formation (1 = no discoloration, 0% Metmyoglobin, and 7 = extensive discoloration, 81-100%)

[2]Treatments included: control, rosemary (2500 ppm), green tea (300 ppm), and rosemary (2500 ppm) + green tea (300 ppm) [3.] 48 samples were analyzed

[4]Master packages (0.4% carbon monoxide, 69.6% nitrogen and 30% carbon dioxide) [a-c] Within a row, least squares means without a common superscript differ (P < 0.05)

[u,v] Within a column of the same parameter, least squares means without a common superscript differ (P < 0.05)

Table 2. Least squares means of sensory analysis traits of ground beef patties with four treatments[1]

SE = 0.09	Attribute Green-Hay	P – value < 0.0001	Treatment	
			Control	1.02[c]
			Rosemary	1.86[a]
			Green Tea	1.00[c]
			Rosemary + Green Tea	1.50[b]
	Fatty	0.64		
	Rancid	0.32		

[1] Treatments include: control, rosemary 2500 ppm, green tea 300 ppm, and rosemary 2500 + green tea 300 ppm

[a-c] Least squares means values differ without a common subscript (P < 0.05)

Three patties were prepared, coded with a random three-digit number and randomly served to panelists each session, with three sessions total.

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Effects of dried distillers grains cube supplementation for steers grazing introduced pastures on animal performance and forage production

Jordan M. Adams[1], Rodney Farris[1], Scott Clawson[1], Earl Ward[1], Paul Beck[1] and Dusty Turner[2]
[1] Oklahoma State University, [2] MasterHand Milling

Justification and Actions

During the summer grazing season, steers grazing introduced forages are oftentimes provided protein and energy to improve animal performance. Dried distillers grains cubes (MasterHand Milling in Lexington, Nebraska) (DDGS), a by-product of ethanol production, has become a commonly utilized supplement for growing cattle due to the high energy and protein content with minimal starch. We hypothesized that DDGS supplementation for steers could improve animal performance and replace the need for N fertilizer on introduced pastures. Therefore, our objective was to evaluate the effects of supplementing DDGS and growth promoting implants for steers (n=149; BW = 524 ± 61.1 lb) grazing mixed tall fescue (Festuca arundinacea)/ bermudagrass (Cynodon dactylon) pastures (n=9 pastures, 18 ± 7.0 acres) in eastern Oklahoma from April 14 to Sept. 17 (n=155 days) on steer performance and forage production. Supplemental treatments (n=3 pastures/treatment) included 1) Fertilized control (FC), no supplementation on fertilized pastures (50 lb N/ acre); 2) Fertilized supplement (FS), supplemented DDGS at 2.7 lb/day prorated for 3-days/week feeding on fertilized pastures; and 3) supplement (S), supplemented DDGS at 0.75% BW/day prorated for 5-days/week feeding on unfertilized pastures. Steers were previously implanted during receiving with 40 mg trenbolone acetate and 8 mg estradiol (REV-G; Revalor G, Merck Animal Health). On July 7, steers in each pasture were randomly assigned to one of three re-implant treatments: 1) no re-implant; 2) REV-G; or 3) 200 mg progesterone and 20 mg estradiol (SYN-S; Synovex S, Zoetis Animal Health).

Findings

Steers in FS and S gained 0.51 and 0.58 lb/day more ($P < 0.01$), respectively, than FC throughout the trial. Final BW was 78 and 86 lbs greater ($P < 0.01$) for FS and S steers, respectively, compared to FC. Re-implanting had no effect on ADG ($P = 0.57$) or BW ($P = 0.34$). Supplemental efficiency was only affected by treatment in the late summer ($P = 0.05$), with FS gaining 0.08 lb more per pound of supplement fed than S. Fertilizing pastures in FS and FC did not affect forage biomass ($P = 0.39$), but CP was increased ($P = 0.01$) and detergent fibers tended to decrease ($P = 0.06$) relative to S in the early summer (April, May, June and July) but not during the late summer (August and September). Additional years of study are required to determine if a treatment effect for early summer and total season supplemental efficiency is consistent over time. Although more data is necessary, DDGS supplementation may be an effective strategy to replace N fertilizer while maintaining or improving steer performance while grazing introduced pastures.).

Table 1. Effect of supplemental DDGS supplementation on animal performance[1]

	Treatment[2]				
	Fertilized Control	Fertilized Supplement	Supplement	SEM	P-value
BW, lbs					
Initial (4/10 and 4/14)	525	525	521	4.4	0.78
July 7	735[a]	780[b]	767[ab]	13.1	0.07
Final (9/16 and 9/17)	821[a]	899[b]	907[b]	11.1	< 0.01
ADG, lb/d					
Early Summer	2.50[a]	3.03[b]	2.92[ab]	0.141	0.03
Late Summer	1.21[a]	1.65[b]	1.96[b]	0.095	< 0.01
Total Season	1.90[a]	2.41[b]	2.48[b]	0.060	< 0.01
Supplemental Efficiency[3]					
Early Summer	-	0.18	0.06	0.064	0.25
Late Summer	-	0.16[b]	0.08[a]	0.020	0.05
Total Season	-	0.17	0.07	0.036	0.12

[1]DDGS, dried distillers grains cube (MasterHand Milling, Lexington, Nebraska).

[2] Fertilized control, no supplement on fertilized pastures; fertilized supplement, DDGS supplemented 6.4 lbs/day prorated for 3-days/week feeding on fertilized pastures; supplement, DDGS supplemented 0.75% BW/day prorated for 5-days/week feeding.

[3] Calculated as pounds of added gain per pounds of supplement (as-fed basis).

[a-b]Least squares means followed by different superscripts within rows differ (P <0.05).

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Profitability of supplementing dried distillers grains cubes to improve animal performance and replace N fertilizer for steers grazing introduced pastures

Jordan M. Adams[1], Rodney Farris[1], Scott Clawson[1], Earl Ward[1], Paul Beck[1] and Dusty Turner[2]
[1]Oklahoma State University, MasterHand Milling[2]

Justification and Actions

During the summer grazing season, steers grazing introduced pastures are oftentimes provided protein and energy to improve animal performance. Dried distillers grains cubes (DDGS) (MasterHand Milling in Lexington, Nebraska), a by-product of ethanol production, has become a commonly utilized supplement for growing cattle due to the high energy and protein content with minimal starch. However, it is important to determine if the additional supplementation is economically beneficial. We hypothesized that DDGS supplementation for grazing cattle could eliminate the need for N fertilizer without negative impacts on forage production and animal performance. This summary represents results from the first year of a two-year study with the objective to evaluate the profitability of supplementing DDGS to improve animal performance and replacing the use of N fertilizer (50 lb N/acre from urea). Steers (n=149; BW = 524 ± 61.1 lb) grazed mixed tall fescue (Festuca arundinacea)/bermudagrass (Cynodon dactylon) pastures (n=9 pastures, 18 ± 7.0 ac) from April 14 to Sept. 17 (n=155 d). Supplemental treatments were (n=3 pastures/treatment) included 1) fertilized control (FC), no supplementation on fertilized pastures; 2) fertilized supplement (FS), supplemented DDGS at 2.7 lb/day prorated for 3-days/week feeding on fertilized pastures; and 3) supplement (S), supplemented DDGS at 0.75% BW/day prorated for 5-days/week feeding on unfertilized pastures. The assumptions used in this analysis were based on actual costs of inputs for pasture management and the DDGS offered, as well as the five-year average Oklahoma auction market prices for 500-pound steers in April and 850-pound steers in October.

Findings

Detailed cattle performance data are provided in the previous research report, "Effects of dried distillers grains cube supplementation for steers grazing introduced pastures on animal performance and forage production." Total cost per acre was greater for S ($P < 0.01$), was least ($P < 0.01$) for FC and intermediate for FS ($P < 0.01$). It cost 15 cents and 19 cents/lb gain more ($P < 0.01$) for steers in FS and S, respectively, than for FC. Gross return per acre tended to be greatest for S ($P = 0.06$), but net return per acre was $51.26 and $62.11 less for FS and S ($P < 0.01$), respectively, than FC. Although FS and S allowed for improvement of animal performance, our results imply that FC was the most profitable due to the cost of supplementation and low supplemental efficiency of FS and S. Further study is required as these relationships are expected to change under differing grazing conditions and input cost scenarios.

Table 1. Effect of supplemental DDGS supplementation on economics of the stocker cattle enterprise using enterprise budget analysis.

	Treatment[2]				
	Fertilized Control	Fertilized Supplement	Supplement	SEM	P-value
Cost					
$/ac	121.94[a]	202.57[b]	221.30[c]	5.405	< 0.01
$/lb gain	0.38[a]	0.54[b]	0.58[b]	0.016	< 0.01
Gross Return, $/ac	149.61[a]	178.98[ab]	186.86[b]	9.372	0.06
Net Return, $/ac	27.66[b]	-23.59[a]	-34.44[a]	7.766	< 0.01

[1]DDGS, dried distillers grains cube.
[2]Fertilized control, no supplement on fertilized pastures; fertilized supplement, DDGS supplemented 6.4 lb/day prorated for 3-days/week feeding on fertilized pastures; supplement, DDGS supplemented 0.75% BW/day prorated for 5-days/week feeding.
[a-c]Least squares means followed by different superscripts within rows differ (P <0.05).

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Evaluating supplementation programs for growing calves grazing Bermudagrass pastures

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[1]Oklahoma State University Department of Animal and Food Sciences, [2]University of Arkansas Department of Animal Science and [3]MasterHand Milling in Lexington, Nebraska

Introduction

Supplemental feeding is often warranted for growing calves grazing warm-season grass pastures during the summer. Dried distillers grains (DDGS) has many benefits for its use in supplements. For example, it has little starch, high energy and high bypass protein content. However, loose DDGS have not been used extensively in a pasture setting due to the potential loss of product from wind or mixture into the soil. Recently, an extruded DDGS cube has increased the flexibility of feeding DDGS in extensive pasture operations (MasterHand Milling in Lexington Nebraska). Operational time constraints limit a producer's ability to manage supplement delivery, so a self-fed supplement offers advantages in limiting the time required for delivery of supplements to pastures. Thus, we aimed to determine gain response to self-fed (SF) or hand-fed (HF) summer supplementation programs at the University of Arkansas Livestock and Forestry Research Station on twenty 2-acre common Bermudagrass pastures stocked with five growing calves (two steers and three heifers) per pasture (initial BW ± SD = 554 ± 53.9 lbs). This research was a 2 × 2 + 1 factorial arrangement of treatments, including control (CON) – free choice mineral only; a DDGS hand-fed supplement 2.5 lbs/day DDGS cube supplement offered all summer (AS) or only late summer (LS); SF tub supplement (PVM Cattle Tub and Positive Feed Ltd. in Sealy, Texas) either AS or LS. This cooked molasses-based, tub-type supplement contained a minimum of 28% protein with 25% from non-protein nitrogen sources and at least 5% fat. Supplement costs (U.S. dollars) were $0.3718/lb for SF and $0.1675/lb for HF supplements.

Findings

Consumption of SFAS was 2.0 lbs/day in the early summer, which did not (P = 0.22) differ from the hand-feeding rate of 2.5 lbs/day, while late summer intakes of SFLS (4.7 lbs/day) were greater (P ≤ 0.02) than HF (2.5 lbs/day) and SFAS (2.4 lbs/day). Bodyweight of calves in July did not differ (P = 0.98) among treatments, because the early summer supplementation treatment had no effect (P = 0.51) on calf performance. Bodyweight at the end of the grazing season was greater (P ≤ 0.02) for HF treatments than the control, while SF treatment bodyweight was not different (P ≥ 0.41) than controls. The reason for the difference in bodyweight at the end of the grazing season are due to late season performance differences among treatments. During the late summer, HF increased ADG compared with both controls and SF (P ≤ 0.01), while ADG of SF did not differ from controls (P ≥ 0.13). Added gain per pound of supplement in the early summer did not differ (P = 0.33) between HF and SF supplements at -0.024 for SFAS and 0.09 for HFAS, neither of which differed from zero (P ≥ 0.28). Late summer added gain per pound of supplement was greater for HF (P < 0.01) than SF, averaging 0.32 and 0.36 for HFLS and HFAS, while SF supplement averaged 0.05 and -0.007 for SFLS and SFAS. Early season added gains for HF supplement cost $1.86/lb of added gain. Cost of added gains in the late summer were 52 cents and 46 cents for HFLS and HFAS and in excess of $7.98/lb of added gain for SF. This research indicates that providing an extruded DDGS supplement in the late summer is a cost-effective way to increase gains of growing calves grazing Bermudagrass. Providing SF supplements did not improve performance of steers grazing Bermudagrass and does not appear to be a cost-effective supplementation program.

Table 1. Supplementation programs affect performance and efficiency of stocker calves on Bermudagrass pastures.

	Treatment[1]						
Item	Control	HFAS	HFLS	SFAS	SFLS	SE	P-Value
Bodyweight							
May	560	557	563	562	557	560	560
July	645	654	651	657	650	645	645
August	702[a]	753[b]	747[b]	706[a]	717[a]	702[a]	702[a]
Daily Gain, lb							
Early Summer	1.88	2.14	1.95	1.89	2.06	1.88	1.88
Late Summer	1.26[a]	2.20[b]	2.15[b]	1.32[a]	1.48[a]	1.26[a]	1.26[a]
Overall	1.57[a]	2.17[c]	2.04[c]	1.61[ab]	1.77[b]	1.57[a]	1.57[a]
Gain:Supplement							
Early Summer	-	0.09	-	-0.02	-	0.07	0.33
Late Summer	-	0.36[b]	0.32[b]	-0.01[a]	0.05[a]	0.04	<0.01

[abc]Least squares means with differing superscripts differ (P < 0.05).

[1]HFAS - Hand-fed all summer; HFLS - Hand-fed late summer; SFAS - Self-fed all summer; and SFLS - Self-fed late summer

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Relationship between diet type, gas emissions and feed intake in angus cows

Amanda Holder, Megan Gross, Alexi Moehlenpah, and David Lalman

Justification and Actions

Since direct measurement of intake in grazing cattle is not possible, methods to indirectly determine or estimate intake are needed. One method of indirect measurement is evaluation of greenhouse gas emissions. The GreenFeed Emission Monitoring System (GEM; C-Lock Inc., Rapid City, SD) collects multiple short-term breath measures and estimates emissions of carbon dioxide (CO2) and methane (CH4) and consumption of oxygen (O2) from cattle in a dry lot or pasture. The GEM collects gas emissions data by baiting cattle with a small amount of pelleted feed and then collecting air samples inside the head box while the animal consumes the feed. The strength of correlation between gas emissions data and intake is dependent on diet quality and feeding patterns. The objective of this study was to examine the effects of diet type on greenhouse gas emissions and dry matter intake (DMI). We used 42 mature, gestating registered Angus cows with a wide range in DMI EPD (-1.36 to 2.29). All cows had previously been genotyped using the AngusGS selection platform. Cows were randomly assigned to begin the study consuming 1 of 2 different diet types; grass hay only (H) or 35% hay blended with 64% concentrate feeds (DM basis) in a mixed ration (C). Thus, two diet sequences were established; HC = hay only followed by the mixed ration and CH = mixed ration followed by hay. The cows were adapted to the diet and the SmartFeed individual intake units for 14 days followed by a minimum of 45 days of intake data collection for each period. Cows were exposed to the GreenFeed Emission Monitoring (GEM) system for no less than 9 days during each period. Only cows with a minimum of 20 total > 3-minute visits to the GEM were included in the data set.

Findings

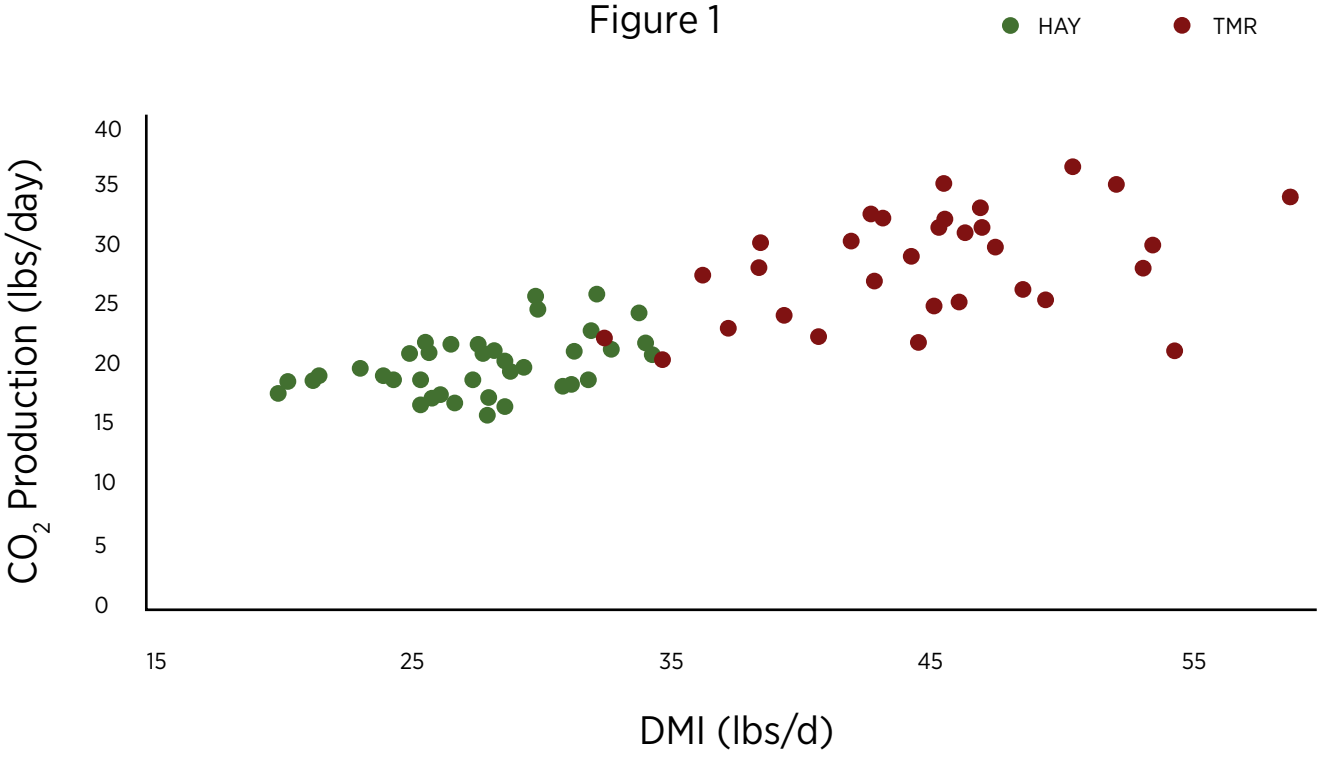
Across diet sequences H intake and C intake were significantly correlated ($r = 0.43$, $P < 0.01$). When evaluated within sequence, the correlation was 0.41($P < 0.05$) and 0.49 ($P < 0.05$) for HC and CH, respectively. Within the HC sequence, neither DMI EPD ($r = 0.23$, $P = 0.34$) nor AngusGS score ($r = 0.08$, $P = 0.59$) were correlated with measured hay DMI. However, within the CH sequence, there was a positive correlation between DMI EPD ($r = 0.58$, $P < 0.01$) and AngusGS DMI score ($r = 0.59$, $P < 0.01$) with hay DMI. Cow weight gain while consuming hay was not correlated with cow weight gain while consuming the concentrate-based diet ($r = -0.24$, $P = 0.13$) regardless of the diet sequence. There was a significant, positive correlation between hay DMI and daily CO2 production as well as daily CH4 production (Table 1) when cows first consumed hay. Similarly, when cows first consumed hay, there was a positive correlation between CO2 and mixed diet DMI (Table 1). Within the CH sequence there was a significant, positive correlation between mixed diet DMI and daily CH4 production as well as mixed diet DMI and daily CO2 production (Table 1). However, within the CH sequence, gas emissions were not correlated with hay intake (Table 1). Daily greenhouse gas emissions increased with increasing feed intake and were lower when cows consumed hay compared to emissions during the period cows consumed the mixed diet (Figure 1). The relationship of cow feed intake to genetic tools designed to predict feed intake varies with current and previous diet type. Similarly, the relationship of cow feed intake to greenhouse gas emissions varies with current and previous diet type. Cow weight gain while consuming forage was not related to cow weight gain while consuming a concentrate-based diet.

Table 1. Correlations between gas emissions and DMI during each period by diet sequence

	HC Diet Sequence		CH Diet Sequence	
Item	HAY DMI, kg/d	TMR DMI, kg/d	HAY DMI, kg/d	TMR DMI, kg/d
CO_2, g/d	0.76***	0.62*	0.11	0.69**
CH_4, g/d	0.74***	0.47	0.17	0.81***
O_2, g/d	0.64**	0.56*	0.13	0.56*

*** P<0.0001, **P<0.01, *P<0.05

Figure 1



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Dried distillers grains cube as a supplement for steers grazing mixed grass prairie in northwest Oklahoma

Zane Grigsby[1], Paul Beck[1], Stacey Gunter[2] and Dusty Turner[3]
[1]Oklahoma State University; [2]USDA-ARS Southern Plains Range Research Center; [3]MasterHand Milling

Justification and Actions

Weight gain of stocker cattle can be limited by protein availability as forage quality declines during late summer. The Oklahoma SuperGold program was designed to deliver 2.5 pounds of a mid-protein (25% crude protein) feed, providing supplemental protein, energy, minerals and an ionophore. Increased costs of production and land are driving producers to intensify production due to significant economic pressures to maximize production per acre. This practice can lead to over grazing and deteriorating range conditions. Replacing a portion of the daily forage needs with supplemental concentrate feed could offset nutrient deficiencies, allow for increased stocking density and avoid overgrazing.

We are researching the effects of an extruded distillers cube (MasterHand Milling in Lexington, Nebraska) supplemented to growing steers grazing mixed grass prairie in western Oklahoma. This research was conducted at the USDA-Agricultural Research Service's Southern Plains Experimental Range [SPER] near Fort Supply, Oklahoma, in Harper County. Our hypothesis is that stocking rates can be increased by replacing a fraction of the daily forage intake with supplemental DDGS cubes while avoiding negative impacts on animal performance and native range condition. Three treatments were initiated at Fort Supply. Treatments at SPER were: 1) negative control, no supplement; 2) positive control, supplemented with DDGS cubes 2 lbs/steer fed on alternate days (4.7 lbs/feeding) during late summer only; and 3) high supplement, 1/3 increase in stocking rate, 0.75% BW supplemental DDGS cubes throughout the grazing season (April to September or whatever).

Findings

The weather conditions during the two-year experiment were quite different with above average rainfall in the first year (2019) and below average rainfall in the second (2020). Surprisingly, the performance responses to supplementation were similar between the two years. Even though stocking rates were increased by one third, the high supplement treatment increased ($P < 0.01$) gains in the early summer by 0.6 (year 1) to 0.8 (year 2) pounds per day, resulting in calves in high supplement treatments to be heavier in mid-summer. During the late summer, steers in the positive control treatment gained 0.73 to 1.1 pounds more per day ($P < 0.01$) than negative controls. In the first year, high supplement steers gained 1.1 pounds more than negative controls and 0.37 more than positive controls during the late summer. In the second year, possibly due to drier conditions limiting forage supply with the higher stocking rates, high supplement steers gained 0.45 lbs/day less than positive controls but 0.65 more than negative controls. Positive controls only required 2.3 to 2.7 pounds of feed per pound of added gain. In both years, high supplement increased gain per acre by 110 to 150% over negative controls requiring 3.8 pounds of feed per pound of added gain per acre.

Table 1. Effect of supplemental DDGS cubes for steers grazing mixed grass native prairie at the USDA-ARS Southern Plains Experimental Range near Fort Supply, Oklahoma, during 2019 (year 1) and 2020 (year 2).

	Negative Control	Positive Control	High Supplement	SE	P-Value
Year 1					
Bodyweight, lbs					
May 17	500	494	494	8.9	0.85
July 18	589a	583a	621b	8.2	0.03
September 27	667a	710b	771c	9.4	< 0.01
Average daily gain, lb/day					
Early summer	1.45a	1.46a	2.08b	0.075	< 0.01
Late summer	1.18a	1.91b	2.28c	0.108	< 0.01
Total season	1.27a	1.64b	2.12c	0.061	< 0.01
BW gain/acre, lbs	31.6a	40.9b	79.3c	1.88	< 0.01
Animal Unit days/acre	24.9	24.9	37.4	-	< 0.01
Supplemental efficiency[ab]	-	2.7	3.8	-	-
Year 2					
Bodyweight, lbs					
May 7	646	646	649	10.4	0.96
July 16	774a	772a	831b	12.0	< 0.01
September 22	898a	969b	991b	13.4	< 0.01
Average daily gain, lb/day					
Early summer	1.87ab	1.84a	2.63	0.081	< 0.01
Late summer	1.83a	2.93c	2.48b	0.111	< 0.01
Total season	1.85a	2.38b	2.52b	0.063	< 0.01
BW gain/acre, lbs	45.5a	58.0b	95.5c	2.36	< 0.01
Animal Unit days/acre	20.1a	20.8a	32.8b	0.136	< 0.01
Supplemental efficiency[ab]	-	2.3	3.8	-	-

[a] Pounds of feed per pound of added gain during the late season only for positive control vs negative control.
[b] Pounds of feed per pound of added gain per acre for the entire season for high supplement vs negative control.

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Using a dried distillers grain cube as a supplement for steers grazing mixed grass prairie in western Oklahoma

Zane Grigsby[1], Paul Beck[1], Marty New[1], Charlie Worthington[1] and Dusty Turner[2]
[1] Oklahoma State University; [2] MasterHand Milling

Justification and Actions

Dried distillers grains have been a widely used supplement for cattle in various feeding operations. Little to no starch, high energy and high bypass protein content are a few of the main advantages in using DDGS in a stocker cattle operation. However, loose DDGS have not been used extensively in a pasture setting due to the potential loss of product from wind or in the dirt and soil. We are researching the effects of an extruded distillers cube (MasterHand Milling, Lexington, Nebraska) supplemented to growing steers grazing mixed grass prairie in western Oklahoma. This research was conducted at the Marvin Klemme Range Research Station near Bessie, Oklahoma, in Washita County to test the theory that stocking rates can be increased by replacing a fraction of the daily forage intake with supplementation while avoiding negative impacts on animal performance and native range condition.

In the summer of 2020, the second year of a grazing trial was conducted at the Marvin Klemme Range Research Station. This trial was to test the effects of supplementation with an extruded 100% DDGS cube. For this experiment, 140 crossbred steers were separated into two supplementation treatments randomly allotted to six pastures (n = 3 pastures/treatment):

1) positive control supplemented at a daily rate of 2.5 lbs/steer prorated for feeding three days per week (5.8 lbs/steer each feeding) during the last half of the grazing season from July through September with a stocking rate of 6 acres/steer.

2) High supplement, supplemented at 0.75% of BW throughout the grazing season (from May through September) with a 33% increase in stocking rate (4 acres/steer).

Findings

The results of this experiment are presented in Table 1. Early-season gains were 41.06 ± 8.93 lbs greater ($P \leq 0.01$) for high supplement than positive control with ADG of 1.67 ± 0.10 and 2.33 ± 0.10 for positive control and high supplement, respectively. Late season bodyweight gains for high supplement were 46.01 ± 28.36 lbs greater ($P \geq 0.18$) than positive control. Final BW was 42 ± 12.67 lbs greater ($P \leq 0.03$) for high supplement than positive control. Late season ADG for both high supplement and positive control did not differ ($P \geq 0.98$) at 2.19 ± 0.099 and 2.19 ± 0.097 for positive control and high supplement, respectively. Overall ADG of high supplement steers that were supplemented the entire grazing season was 0.32 ± 0.07 lbs greater ($P \leq 0.01$) than positive control. The overall BW gain per acre was 31.4 ± 1.8 lbs greater ($P < 0.01$) for high supplement than positive control. Carrying capacity of these midgrass prairie rangelands was increased by 53% from 17 AUD/acre to 26.1 AUD/acre with the high supplement supplementation, while total body weight gain per acre was increased by 74% due to the increased stocking rate combined with the increased ADG of the high supplement. Even though this was a considerably drier year, these results are similar to those previously reported for the first year in 2019. These data suggest that supplementation with a 100% DDGS cube is a viable supplement to increase performance of stocker steers grazing native range in western Oklahoma and allow for an increase in stocking rates without negative effects on individual animal performance.

Table 1. Effects of supplemental DDGS for steers grazing native range at Marvin Klemme Range Research Station near Bessie, Oklahoma.

Item	Positive Control	High Supplement	SE	P-Value
BW, lbs				
Initial (May 19)	563	564	4.8	0.96
Mid summer (July 21)	667	708	6.8	0.02
Final (Sept 28)	817	859	8.8	0.03
ADG, lbs				
Early Summer (64 days)	1.67	2.33	0.101	0.01
Late Summer (68 days)	2.19	2.19	0.067	0.98
Overall (132 days)	1.92	2.34	0.048	0.01
AUD/acre	17.0	26.1	0.12	< 0.01
BW gain/acre, lbs	42.5	74.0	1.25	< 0.01

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Using whole cottonseed to replace dried distillers grains and prairie hay in finishing rations balanced for physically effective neutral detergent fiber

Kasi Schneid, Andrew Foote, Paul Beck and Blake Wilson

Justification and Actions

Dried distiller grains (DDGS) are a readily available and competitively priced byproduct of ethanol production in the Midwest and Great Plains and have been used extensively in finishing cattle diets in recent years. Cotton is a popular commodity in the southern U.S., and cotton byproducts are consistently available in the southern U. S. and have the potential to be an effective source of protein, fat and roughage within cattle finishing rations. The objective of this experiment was to determine if replacing hay and DDGS with whole cottonseed impacts the performance and carcass characteristics of feedlot cattle in diets. At the Willard Sparks Beef Research Center in Stillwater, Oklahoma, crossbred heifers (n=103) and steers (n=104) were allocated to 12 pens in a randomized complete block design (six pens per treatment; three pens of heifers and three pens of steers) with sex and weight serving as blocking factors. Pens were randomly allocated to one of two experimental diets. Treatments consisted of the control diet (CON) of prairie hay, dry distiller's grains plus solubles, dry-rolled corn and liquid supplement and the whole cottonseed diet (CTN) of whole cottonseed, dry-rolled corn and molasses. Both diets contained a dry vitamin and mineral supplement and urea at the same inclusion rate. All cattle received a common receiving ration for four days after arrival, consisting of wet corn-gluten feed (sweet bran), prairie hay, dry-rolled corn and a dry vitamin and mineral supplement, followed by a 28-day transition period using a step-up ration approach based on the final experimental diet (CON or CTN) with seven days per step. Body weights (BW) were collected every 14 days until day 56. After day 56, BW were collected every 28 days. Due to varying weights across blocks, cattle were shipped to harvest in three different harvest groups. Thirty-one days prior to shipping to harvest, ractopamine hydrochloride (Optiflexx 45, Elanco Animal Health in Greenfield, Illinois) was added to the diet.

Findings

On day 56, when cattle were on experimental finishing diets for 18 days, there was a tendency for cattle on the CTN treatment to be heavier ($P = 0.06$). By day 140, cattle in CTN treatment were 37 lbs. heavier ($P = 0.03$) than CON. Final BW also tended ($P = 0.10$) to be greater for CTN than CON (CTN = 1,398 lbs.; CON = 1,352 lbs). The average daily gain was greater for CTN cattle for both periods prior to feeding the ractopamine HCl ($P = 0.02$) but was not different during the beta agonist feeding period ($P = 0.24$). However, overall ADG was increased for cattle receiving the CTN diet ($P = 0.03$). Dry matter intake was not different between treatments, across any intervals ($P \geq 0.29$), however, it should be noted that the CON treatment had slightly numerically greater intake. Gain to feed ratio was not different until day 140 ($P \geq 0.57$) but tended to be greater for CTN during the ractopamine HCl feeding period ($P = 0.10$) and was greater for CTN during the overall finishing period ($P = 0.05$). Both treatments had similar dressing percentages ($P = 0.88$), but CTN treatment had greater hot carcass weight ($P = 0.02$), fat thickness ($P = 0.05$) and final calculated U.S. Department of Agriculture yield grades ($P = 0.001$). There was no difference in ribeye area or marbling score ($P \geq 0.67$). This research shows that whole cottonseed can safely replace both roughage and byproduct protein sources in finishing diets, resulting in increased performance.

Table 1. Influence of using whole cottonseed to replace dried distillers grains and prairie hay in finishing rations balanced for physically effective neutral detergent fiber on growth performance, feed intake, feed efficiency and carcass characteristics of feedlot heifer and steers.

	Treatment[1]			
Item	CON	CTN	SEM[2]	P-value
BW[3], lbs				
d 0	731	747	33.1	0.32
d 56	943	976	36.5	0.06
d 140	1172	1209	37.5	0.03
Beta-agonist[4]	1255	1285	23.2	0.10
Final[5]	1352	1398	32.8	0.10
ADG[6], lbs				
d 0 to 56	3.77	4.12	0.115	0.02
d 57 to 140	3.96	4.28	0.086	0.02
Beta-agonist to final	3.05	3.43	0.414	0.24
d 0 to Final	3.08	3.36	0.106	0.03
DMI[7], lbs/d				
d 0 to 56	23.8	22.5	0.83	0.29
d 57 to 140	23.2	22.5	1.13	0.59
Beta-agonist to final	24.4	24.1	0.87	0.68
d 0 to Final	23.7	23.0	0.79	0.49
G:F[8]				
d 0 to 56	0.154	0.158	0.0045	0.57
d 57 to 140	0.166	0.165	0.0053	0.72
Beta-agonist to final	0.125	0.143	0.0164	0.10
d 0 to Final	0.130	0.148	0.0063	0.05
Carcass				
Hot carcass weight, lbs	880	917	26.8	0.02
Rib eye area, cm	91.6	90.7	2.28	0.67
Fat thickness[9], cm	1.77	1.91	0.108	0.05
Dressing percentage	64.6	64.6	0.49	0.88
Calculated Yield Grade	3.51	3.83	0.218	0.001
Marbling score[10]	480	477	20.1	0.84

[1]Treatments included (DM basis): CON = 7.73% hay, 15% dry distillers grains plus solubles, 65.52% rolled corn, 6% liquid supplement or CTN = 15% whole cottonseed, 73.25% dry rolled corn, 6% molasses. Both diets contained 5% dry supplement and 0.75% urea

[2]n = 6 pens per treatment; 3pens of heifers and 3 pens of steers per treatment. [3]Body weight (BW) was adjusted using a calculated 4% pencil shrink.

[4]Cattle were harvested in three groups: day 177 (n = 2 pens per treatment; 2 heifer pens and 2 steer pens), day 206 (n = 2 pens per treatment; 2 heifer pens and 2 steer pens) and day 227 (n = 2 pens per treatment; 2 heifer pens and 2 steer pens). Beta agonist BW was obtained the day the pens started ractopamine hydrochloride (Optiflexx 45, Elanco Animal Health in Greenfield, Illinois; 31 days prior to harvest

[5]Final BW were taken the day of shipping for harvest. [6]Pen average daily gain (ADG) was calculated from individual shrunk BW gain in kg, divided by days on feed for each period.

[7]Pen dry matter intake (DMI) was calculated from pen as fed intake for by period multiplied by the treatment diet DM percentage. [8]Gain to feed ratio (G:F) was calculated by dividing pen ADG by pen daily DMI for each period

[9]Fat measurement taken between the 12th and 13th ribs. [10] Small[00] = 400; Modest[00] = 500; Moderate[00] = 600

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Effects of virtual fencing on cortisol concentrations and behavior of beef cattle

Jancy Jeffus[1], Ryan Reuter[1], Kevin Wagner[1], Laura Goodman[1] and Todd Parker[2]
Oklahoma State University[1] and VENCE[2].

Justifications and actions

Virtual fencing is a new alternative to conventional fencing in the livestock industry. However, due to the novelty of virtual fencing, it has not been extensively used in a rotational grazing format and its effects on livestock are unknown. This research was conducted at the Oklahoma State University Bluestem Research Range near Stillwater, Oklahoma, in order to evaluate the effects of virtual fencing on stress and behavior in grazing beef cattle. Two experiments were conducted in the fall of 2020 in partnership with VENCE (www.vence.io). In both experiments, cattle were contained by either physical, two-strand electric fencing or by use of a proprietary, GPS-based virtual fencing collar, with no physical interior fencing. In both studies, hair from the tail switch was collected at the end of the experiment and analyzed for cortisol concentration to measure the accumulated stress experienced by the cattle. Additionally, a subset of cattle was fitted with pedometers to measure behaviorial responses. In the initial pilot experiment, 55 heifers (BW= 693 ± 66.0 lbs) were grazed for 28 days in either one physically fenced pasture (PF, n=24) or one virtually fenced pasture (VF, n=31). In the second experiment, 59 mature cows and heifers (BW=1,064 ± 184.8 lbs) were grazed for 56 days in one of two physically fenced (PF, n=15 and 15 animals) or one of two virtually-fenced pastures (VF, n=15 and 14 animals; 4 pastures in total). In the second experiment, blood samples were also collected and NEFA (non-esterified fatty acids, an indicator of nutritional status) and lactate (also an indicator of nutritional status) were quantified in plasma.

Findings

Only descriptive statistics were summarized for the pilot experiment, which indicated that hair cortisol concentrations were within published ranges for both fence types (0.39 ± 0.32 and 0.37 ± 0.15 pg/mg for physically or virtually fenced animals, respectively), showing that cortisol concentrations did not vary between fence type. Virtually fenced cattle appeared to move more in the first few days of adaptation to virtual fence. In the second experiment, no effect of fence type was found for behavior (number of steps, standing time, lying bouts or motion index). Further, no difference was observed in cortisol, lactate nor NEFA concentrations due to fence type. None of this data suggests that virtual fencing is different from physical fencing in the effects on cattle stress and behavior, indicating further research and development of virtual fencing technology is warranted.

Table 1. Effects of virtual fencing on cortisol concentrations and behavior of beef cattle: Pilot

	VF	PF	SE	P-value
Cortisol, pg/mg	0.37	0.39	0.3	0.79
Final, d28	533	526	5.4	0.44
Step Count/d	4656	4440	13.5	<0.01
Lying Bouts/d	13.8	11.3	3.75	0.77
Standing Time, min.	741	744	1.05	0.59
Motion Index	19848	18494	64.9	<0.01

Table 2. Effects of virtual fencing on cortisol concentrations and behavior of beef cattle

	VF	PF	SE	P-value
Cortisol, pg/mg				
Initial, d0	0.52	0.29	0.07	0.16
Final, d56	0.09	0.17	0.04	0.34
Lactate, mg/dL				
Initial, d0	36.1	37.6	4.9	0.85
Final, d56	42.3	40.9	7.8	0.91
NEFA, meq/L				
Initial, d0	452.8	346.4	16.8	0.04
Final, d56	367.1	428.4	84	0.65
Step Count/d	2659.3	3240.7	192.8	0.16
Lying Bouts/d	7.5	7.9	0.38	0.49
Standing Time, min.	785.2	782.9	10.2	0.88
Motion Index	10673.3	13027.7	851.2	0.19

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Vaccination strategies for preconditioning beef calves

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Justification and Actions

Cattle producers have adopted multiple timing strategies and viral components when administering vaccines to pre- and post-weaned calves. The Oklahoma Beef Management and Marketing Survey indicated that 66% of the beef cow herds have no defined calving season. This may increase the use of killed-virus (KV) vaccines, which are often used without the booster vaccination required by the label directions. The use of KV vaccines at branding is thought to be used to avoid potential negative effects associated with modified-live viral (MLV) vaccines on bred cows. However, this practice may provide limited protection against bovine respiratory disease (BRD) for the calf. The Oklahoma Quality Beef Network (OQBN) is a health management and value-added marketing program. For certification in the OQBN, three vaccination protocols are available, each requiring the use of MLV vaccine products. The study's objective was to examine the effects of vaccine type and timing on animal performance and immune response pre- and post-weaning of protocol strategies utilized most by OQBN participants. Research was conducted at the Range Cow Research Center, South Range Unit located near Stillwater, Oklahoma. A total of 151 Angus, Angus x Hereford, or Angus x Charolais calves were randomly assigned to one of three health protocols stratified by breed of sire, sex and date of birth. Vaccination treatments were 1) KV/MLV – multivalent KV BRD vaccine administered on day 0 (3 to 4 months of age) and revaccination with a 5-way MLV vaccine at weaning on day 127; 2) MLV/MLV – 5-way MLV vaccine on day 0 (3 to 4 months of age) and at weaning on day 127; or 3) WEAN – 5-way MLV vaccine at weaning on day 127 and 2-weeks post-weaning on day 140. Treatments 2 (MLV/MLV) and 3 (WEAN) correspond with the OQBN vaccination protocols 1 and 3, respectively. Virus specific antibody titer data was determined using serum-neutralization from serum collected on day 0, 127, 140, 154, 168 and 182. Serum collected on day 0 was used as a baseline measure. Antibody titers, body weight and average daily gain variables were evaluated following vaccination.

Results

Results indicated there was no treatment effect on body weight. Bovine viral diarrhea virus displayed significance for treatment x date interaction. The MLV/MLV treatment group provided the greatest response from day 0 (3 to 4 months of age) to day127 (weaning) than the other two treatments. There was no difference between the KV/MLV and the WEAN treatment groups from day 0 to day 127. By day 168, the KV/MLV treatment group had a greater immune response than the MLV/MLV and WEAN groups. Providing a KV at branding had minimal effect on BVD titers but responded well to MLV vaccine after weaning by day 168. The WEAN treatment group generated the lowest BVD titers overall, but by day 182, all vaccine treatments provided adequate protection to BVDV. Bovine respiratory syncytial virus (BRSV) titers were also examined but had a substantial decrease in titer levels (< 2) following baseline measurements.

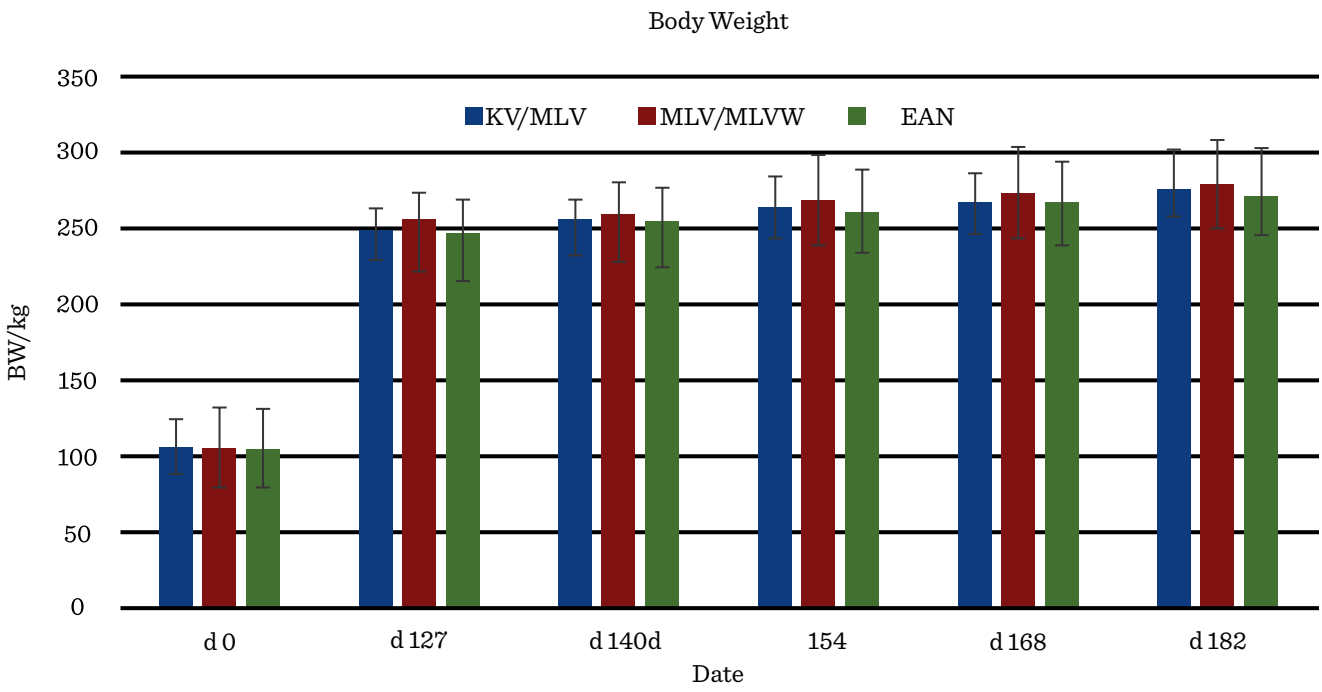

Figure 1. Mean body weight x date for each treatment group.

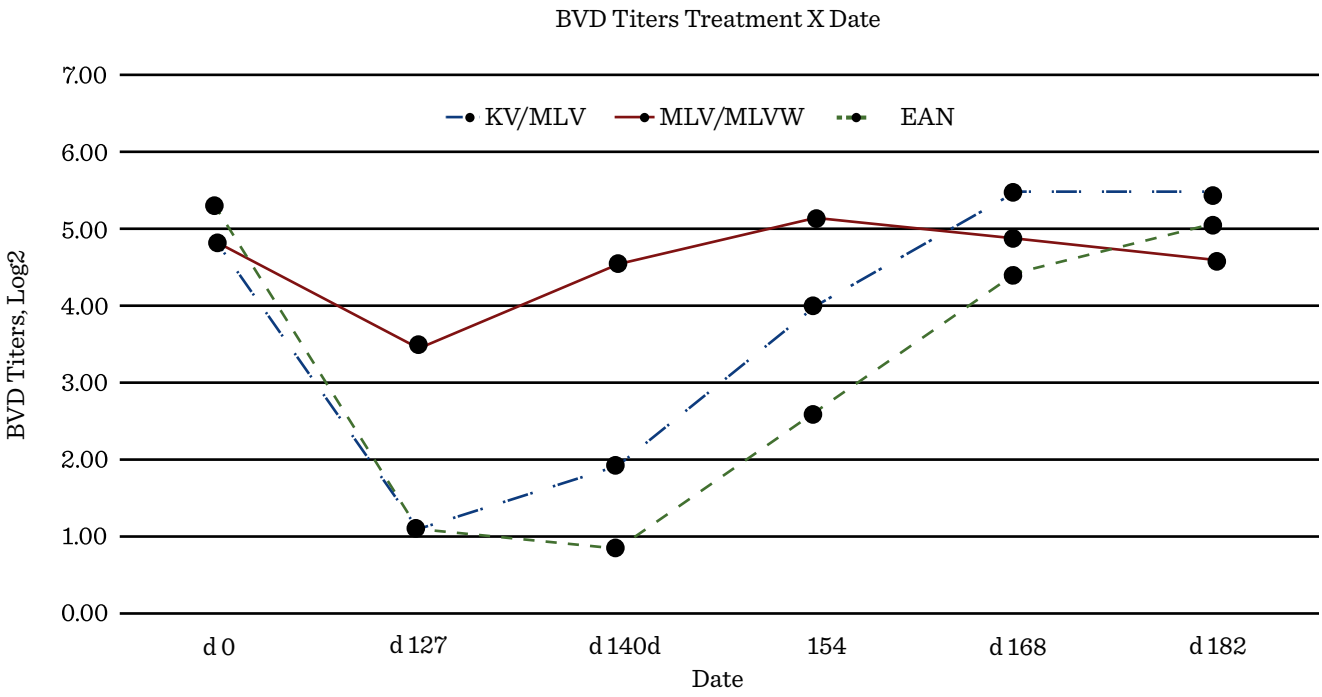

Figure 2. Mean BVD antibody titers for treatment x date interaction in calves vaccinated with either an inactivated or modified-live viral BRD vaccine. Vaccines administered for KV/MLV at day 0 and 127, for MLV/MLV at day 0 and 127 and for WEAN at day 127 and 140.

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Relationship of retained energy in lactating beef cows to maintenance energy requirement and dry period voluntary feed intake

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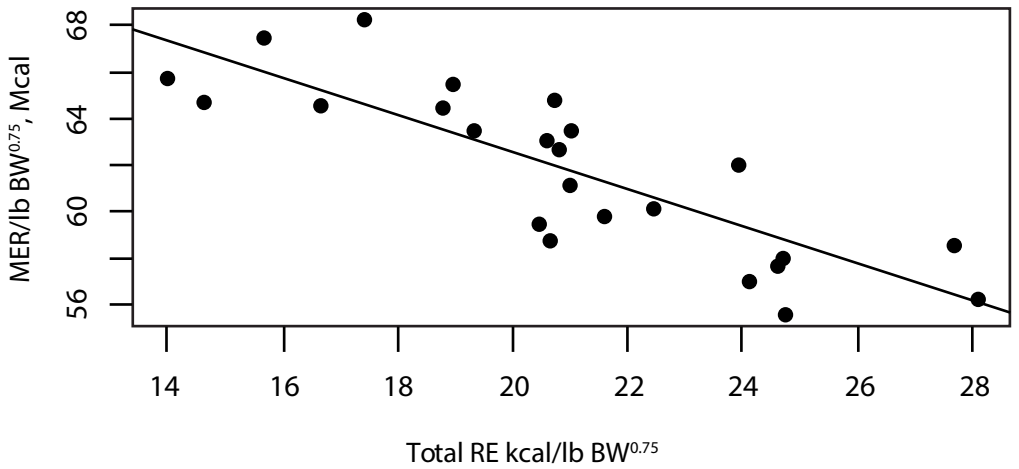
Justification and Actions

Over the last 30 years, much progress has been made in the beef industry with increasing growth rate and carcass weight. However, little research has been conducted to determine the influence of continued aggressive selection for production traits on the cost to maintain a beef cow. In studies conducted 30 to 40 years ago, breeds that had greater genetic capacity for growth and milk and mature weight also tended to have greater maintenance energy requirements. Few studies are available investigating the influence of production potential within a breed. The objective of this experiment was to determine the relationship between recovered energy (cow weight gain and milk production) in Angus cows to maintenance energy requirements and to dry period voluntary intake of grass hay. This research was conducted at the Range Cow Research Center near Stillwater, Oklahoma. Twenty-four mature fall-calving Angus cows were used in two consecutive experiments. In the first experiment, cow-calf pairs were individually fed for an 82-day period. Feed intake was adjusted every other week to ensure minimal weight and body condition change by the end of the experimental period. Recovered energy was calculated as the total of maternal tissue energy change (weight gain or loss) plus milk recovered energy (milk yield plus milk composition). From this information, maintenance energy requirements were calculated for each cow. After calves were weaned, a voluntary feed intake study was conducted to determine the influence of total recovered energy during lactation and lactation maintenance energy requirement on voluntary intake of a low-quality grass hay diet.

Results

Metabolizeable energy required for maintenance declined for each unit increase in net energy recovered (Figure 1; $P < 0.0001$, $R2 = 0.82$). There was no relationship between the amount of daily milk energy produced to post-weaning voluntary forage dry matter intake. However, increasing weight loss during lactation was associated with greater post-weaning feed intake ($P = 0.02$; $R2 = 0.21$). In contrast to previous work, these results suggest that cows within a breed that are better able to maintain their body condition and produce more milk energy at the same time have lower maintenance energy requirement.



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