

The Effects of Feeding Strategies on Performance and Liver Abscess Prevalence on Growing Beef × Dairy Steers

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Abstract

A 126-day backgrounding study was conducted to evaluate the effects of feeding strategy on growth performance and liver abscess (LA) prevalence in growing beef × dairy steers. A total of 529 beef × dairy crossbred steers (initial body weight [BW] = 650 ± 16.9 lb) were blocked by weight, stratified by arrival BW within block, and assigned to pen. Pens were randomly assigned to one of five treatments; 50 NEg (Mcal/100 lb) diet targeting 2 lb of gain per day (50-2 lb), a 60 NEg (Mcal/100 lb) diet targeting 2 or 3 lb of gain per day (60-2 lb and 60-3 lb, respectively), or a 64 NEg diet fed for *ad libitum* intake with or without tylosin phosphate (64-ALT and 64-ALNT, respectively; Tylovet 100, Huvepharma, Peachtree City, GA). Individual BW and LA prevalence were measured at beginning and end of the feeding period. Cattle were weighed for feed call adjustments, starting on day 14 and every seven days until day 42 when weights were recorded every 14 days. At the completion of the feeding period, final BW, average daily gain, and dry matter intake differed ($P < 0.01$). Feed:gain was greatest for the 50-2 lb treatment ($P < 0.01$) and similar among the other four treatments ($P \geq 0.20$). Prevalence of LA differed ($P = 0.05$), being least for steers fed 60-3 lb than for steers fed 64-ALNT or 64-ALT treatments. Overall, the use of limit feeding a 60 NEg diet can reduce the prevalence of LA when compared with feeding a higher energy diet *ad libitum*.

Introduction

Total cattle on feed in the United States has declined in recent years, resulting in record-high live cattle prices. As a result, the placement of beef × dairy cattle has increased in feedlots due to a consistent supply from dairy producers. Sexed semen has allowed dairy producers to breed less productive cows to beef sires to increase the value of their calves. One issue associated with beef × dairy cattle is their increased susceptibility to developing liver abscesses (LA; Grimes et al., 2024). Liver abscesses result in trim and organ loss, which represent annual economic losses of \$400 million (Broadway et al., 2024). The formation of LA has been theorized to result from the translocation of *Fusobacterium necrophorum* from the rumen to the portal vein as a result of ruminal acidosis (Nagaraja and Chengappa, 1998). Historically, cattle fed diets with a high inclusion of rapidly fermentable carbohydrates can be subjected to ruminal acidosis.

The inclusion of roughage and corn coproducts can be used to maintain ruminal pH and improve buffering capacity, lowering the risk of ruminal acidosis in high-grain diets. Tylosin phosphate is a macrolide antibiotic that has been commonly used in feedlots for the control of LA for nearly 60 years.

Beef × dairy calves are raised on ranches and start on concentrate-based diets as young as 60 days of age. Prolonged feeding of cereal grains could predispose beef × dairy cattle to greater LA prevalence compared to native beef cattle. The objectives of this study were: 1) to determine the effects of growing strategy and roughage inclusion in the diet on growth performance and LA prevalence in beef × dairy steers; and 2) to compare the effects of the inclusion of tylosin phosphate on LA prevalence in growing beef × dairy calves fed a high-concentrate diet.

Experimental Procedures

A total of 529 beef × dairy crossbred steers (initial body weight [BW] = 650 ± 16.9 lb) were purchased in Texas and transported to the Kansas State University Beef Stocker Unit on March 20, 2024, and used in a 126-day growing study. Steers were placed in pens containing 12 to 14 head and limit fed a common growing diet at 2.2% of BW (dry matter [DM] basis). On day -1, steers were individually weighed in a hydraulic chute (Silencer, Moly MFG, Lorraine, KS) and given a visual identification tag. The following day, steers were blocked by weight (heavy and light), stratified by individual BW, and assigned to pens containing 12 to 14 head. Steers were given a pen tag, and treated for internal (Safe-Guard, Merck, Rahway, NJ) and external (Clean-Up II, Elanco, Greenfield, IN) parasites. Treatments were randomly assigned to each pen with a total of eight pens/treatment. Treatments (Table 1) included a 50 NEg (Mcal/100 lb DM) diet targeting 2 lb of gain per day (50-2 lb), 60 NEg (Mcal/100 lb DM) diet targeting a 2 or 3 lb of gain per day (60-2 lb and 60-3 lb, respectively), or a 64 NEg (Mcal/100 lb DM) diet fed for *ad libitum* intake with or without tylosin phosphate (64-ALT and 64-ALNT, respectively; Tylovet, Huvepharma, Peachtree City, GA). Only the 64-ALT treatment received tylosin phosphate. Pens were identical in size (30 × 50 ft) with a packed soil floor and a concrete bunk apron (30 × 12 ft). Steers in all pens were provided *ad libitum* access to water.

On days 0 and 126, steers were shaved on the right side from the 9th to 13th rib. Isopropyl alcohol (70%) was applied and each intercostal space was viewed using a convex, portable ultrasound (Clarius C3HD3VET convex scanner, Vancouver, BC, Canada) to identify any visible LA. Prevalence of LA was calculated for each pen as the number of steers with at least one LA divided by the total number of steers. Pen weights were measured using a pen scale (Rice Lake Weighing System, Rice Lake, WI) on days 0, 14, 21, 28, 35, 42, 56, 70, 84, 98, 112, and 126. Pen weights were used to adjust feed calls for each pen being fed 50-2 lb, 60-2 lb, and 60-3 lb using a programmed gain calculator (Galyean, 2019). On day 126, cattle were individually weighed after a 12-hour fast to account for gut fill and had an ultrasound for LA, and a pen weight was collected.

Results and Discussion

At the conclusion of the 126-day feeding period, final BW and average daily gain (ADG) were lowest for 50-2 lb and 60-2 lb, intermediate for 60-3 lb, and greatest for 64-ALT and 64-ALNT ($P < 0.01$; Table 2). Overall ADG were 2.70, 2.58, 3.30, 3.80, and 3.78 for 50-2 lb, 60-2 lb, 60-3 lb, 64-ALNT, and 64-ALT, respectively. The higher-than-expected gains for the 50-2 lb, 60-2 lb, and 60-3 lb treatments could

be attributed to unclear nutrient requirements for growing beef × dairy cattle. The program gain calculator is based on historical data of native beef cattle; therefore, adjustments may be needed for beef × dairy cattle. DM intake was least for 60-2 lb ($P < 0.01$), intermediate for 50-2 lb and 60-3 lb, and greatest for 64-ALNT and 64-ALT. Differences in DM intake can be attributed to the study design. Steers fed 50-2 lb, 60-2 lb, and 60-3 lb treatments were limit fed to achieve specific rates of gain. Feed:gain was highest ($P < 0.01$) for 50-2 lb steers compared with the other treatments, and feed:gain did not differ ($P \geq 0.20$) among steers fed 60-2 lb, 60-3 lb, 64-ALNT, and 64-ALT. The use of a high-roughage diet and a low program feeding regimen can reduce the risk of metabolic upset and aid in rumen development but may come at a cost to feed efficiency. Previous data (Feitoza et al., 2025) did not suggest the inclusion of tylosin phosphate affects feedlot cattle performance. Similarly, this study observed no effect of tylosin phosphate on the performance of growing beef × dairy steers.

At the beginning of the feeding period, no steers had visible LA (Table 2). At the conclusion of the feeding period, LA prevalence was least ($P \leq 0.05$) for the 60-3 lb treatment when compared with 64-ALT and 64-ALNT. Prevalence of LA for 50-2 lb, 60-2 lb, 60-3 lb, 64-ALNT and 64-ALT treatments was 10.4%, 11.4%, 7.55%, 20.56%, and 19.95%, respectively. The use of roughages, corn co-products, and controlled intake of cereal grains can help maintain normal ruminal pH, which may aid in the prevention of acidosis and thus possibly reduce the risk of LA formation. Cattle fed 64-ALNT had a 20.56% LA prevalence. When intake was limited and roughage and corn co-product inclusion in the diet increased by 10% (60-3 lb) we observed a decrease of LA prevalence. Liver abscess prevalence was unaffected by the addition of tylosin phosphate to the diet containing 64 Mcal Neg/100 lb. Public concern has grown in recent years over feeding antibiotics to cattle, and pressure has been put on producers to reduce the length/quantity of antibiotics they use. In our experiment, LA prevalence was 20.6% and 20.0% ($P = 0.78$) when steers were fed 64-ALNT and 64-ALT, respectively, suggesting tylosin phosphate was not effective in reducing LA prevalence in beef × dairy steers during the growing period.

Implications

When compared to *ad libitum* feeding of a 64 NEg diet, limit feeding a 60 NEg diet can reduce the incidence of LA without sacrificing feed conversion in growing beef × dairy steers. However, as expected, *ad libitum* feeding of the 64 NEg diet led to greater growth rates than limit feeding of the 50 or 60 NEg diets.

Acknowledgments

The authors thank Micro Technologies and Huvepharma for their contributions to and support of this study.

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Table 1. Experimental diets

Ingredient, % dry matter	Treatment ¹				
	50-2 lb	60-2 lb	60-3 lb	64-ALNT	64-ALT
Dry-rolled corn	24.37	41.38	41.38	58.91	58.91
Sweet Bran ²	40.00	40.00	40.00	30.00	30.00
Prairie hay, chopped	30.00	13.00	13.00	7.00	7.00
Control supplement ³	5.63	5.62	5.62	4.09	---
Tylosin supplement ⁴	---	---	---	---	4.09

¹ 50-2 lb: formulated to contain 50 Mcal of net energy for gain (NEg)/cwt dry matter (DM) and fed to achieve 2 lb of gain/day; 60-2 lb: formulated to contain 60 Mcal of NEg/cwt DM and fed to achieve 2 lb of gain/day; 60-3 lb: formulated to contain 60 Mcal of NEg/cwt DM and fed to achieve 3 lb of gain/day; 64-ALNT: formulated to contain 64 Mcal of NEg/cwt DM and fed *ad libitum* without tylosin phosphate; 64-ALT: formulated to contain 64 Mcal of NEg/cwt DM and fed *ad libitum* with tylosin phosphate (Tylovet 100: Huvepharma, Peachtree City, GA).

² Cargill Corn Milling (Blair, NE).

³ Supplement pellet formulated to contain (DM basis) 11.29% crude protein, 0.63% phosphorus, 4.7% salt, 0.73% potassium, 3.41% fat, and 429.69 g/ton monensin (Rumensin; Elanco, Greenfield, IN).

⁴ Supplement pellet formulated to contain (DM basis) 10.57% crude protein, 0.62% phosphorus, 4.7% salt, 0.68% potassium, 3.41% fat, 429.69 g/ton monensin (Rumensin; Elanco, Greenfield, IN), and 193.37 g/ton tylosin phosphate (Tylovet 100: Huvepharma, Peachtree City, GA).

Table 2. Effects of growing strategy on growth performance and liver abscess prevalence of growing beef × dairy steers

Item,	Treatment ¹					SEM ²	P-value ³
	50-2 lb	60-2 lb	60-3 lb	64-ALNT	64-ALT		
Number of pens	8	8	8	8	8		
Number. of steers	106	105	106	107	105		
Body weight, lb							
Day 0	650	651	651	650	651	16.9	1.00
Day 126	990 ^a	976 ^a	1,067 ^b	1,129 ^c	1,121 ^c	17.7	< 0.01
Average daily gain, lb/day	2.70 ^a	2.58 ^a	3.30 ^b	3.80 ^c	3.74 ^c	0.052	< 0.01
Dry matter intake, lb/day	18.03 ^b	15.52 ^a	20.30 ^c	22.73 ^d	22.71 ^d	0.231	< 0.01
Gain:feed lb/lb	0.15 ^a	0.17 ^b	0.16 ^b	0.17 ^b	0.16 ^b	0.002	< 0.01
Feed:gain lb/lb	6.69 ^a	6.03 ^b	6.16 ^b	5.98 ^b	6.08 ^b	0.104	< 0.01
Liver abscess prevalence, ⁴ %							
Start of growing period	0	0	0	0	0		
End of the growing period	10.4 ^{ab}	11.4 ^{ab}	7.5 ^b	20.6 ^a	20.0 ^a	3.9	0.05

^{abcd} Within row, means with unlike superscripts differ ($P < 0.05$).

¹ 50-2 lb: formulated to contain 50 Mcal of net energy for gain (NEg)/cwt dry matter (DM) and fed to achieve 2 lb of gain/day; 60-2 lb: formulated to contain 60 Mcal of NEg/cwt DM and fed to achieve 2 lb of gain/day; 60-3 lb: formulated to contain 60 Mcal of NEg/cwt DM and fed to achieve 3 lb of gain/day; 64-ALNT: formulated to contain 64 Mcal of NEg/cwt DM and fed *ad libitum* without tylosin phosphate; 64-ALT: formulated to contain 64 Mcal of NEg/cwt DM and fed *ad libitum* with tylosin phosphate (Tylovet 100: Huvepharma, Peachtree City, GA).

² Largest standard error of the mean.

³ Treatment main effect.

⁴ Liver abscess prevalence = (steers positive for at least one liver abscess/total head count in pen) × 100.