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D.J. Bindel

R.H. Wessels

C.A. Loest

James S. Drouillard

See next page for additional authors

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Effects of ruminally protected choline and dietary fat on performance of finishing heifers

Abstract

A 120-day finishing study utilizing 318 heifers (753 lb initial body weight) examined the effects of ruminally protected choline in diets with no tallow or 2 or 4% of supplemental tallow. Heifers were fed a finishing diet based on a mix of steam-flaked and dry-rolled corn; encapsulated choline (20, 40, or 60 g/head/day, supplying 5, 10 or 15 g choline/head/day) was top-dressed to the diet or not added. Dry matter intake decreased linearly with inclusion of fat ($P < .05$) but was not affected significantly by addition of choline. Daily gains also decreased linearly ($P < .05$) with fat addition. Choline supplementation increased gain (linear, $P < .1$; quadratic, $P < .05$), with the greatest increase occurring for the first 20 g increment encapsulated choline/day. Likewise, feed efficiency improved ($P < .1$) with supplemental choline. Again, the greatest response occurred for the first 20 g/day. Kidney, pelvic, and heart fat and yield grade both increased linearly ($P < .1$) with fat supplementation. The percentage of carcasses grading USDA Choice decreased (linear, $P < .05$; quadratic, $P < .1$) when choline was added at 60 g/day. Hot carcass weight, marbling, dressing percent, and 12th rib fat thickness were not affected significantly by either fat or choline. Ruminally protected choline can improve average daily gain and feed efficiency of finishing cattle.

Keywords

Kansas Agricultural Experiment Station contribution; no. 97-309-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 804; Cattlemen's Day, 1998; Beef; Choline; Fat; Finishing; Heifers; Performance; Carcass

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Authors

D.J. Bindel, R.H. Wessels, C.A. Loest, James S. Drouillard, and Evan C. Titgemeyer

EFFECTS OF RUMINALLY PROTECTED CHOLINE AND DIETARY FAT ON PERFORMANCE OF FINISHING HEIFERS

*D. J. Bindel, J. S. Drouillard, E. C. Titgemeyer,
R. H. Wessels, and C. A. Löest*

Summary

A 120-day finishing study utilizing 318 heifers (753 lb initial body weight) examined the effects of ruminally protected choline in diets with no tallow or 2 or 4% of supplemental tallow. Heifers were fed a finishing diet based on a mix of steam-flaked and dry-rolled corn; encapsulated choline (20, 40, or 60 g/head/day, supplying 5, 10 or 15 g choline/head/day) was top-dressed to the diet or not added. Dry matter intake decreased linearly with inclusion of fat ($P < .05$) but was not affected significantly by addition of choline. Daily gains also decreased linearly ($P < .05$) with fat addition. Choline supplementation increased gain (linear, $P < .1$; quadratic, $P < .05$), with the greatest increase occurring for the first 20 g increment encapsulated choline/day. Likewise, feed efficiency improved ($P < .1$) with supplemental choline. Again, the greatest response occurred for the first 20 g/day. Kidney, pelvic, and heart fat and yield grade both increased linearly ($P < .1$) with fat supplementation. The percentage of carcasses grading USDA Choice decreased (linear, $P < .05$; quadratic, $P < .1$) when choline was added at 60 g/day. Hot carcass weight, marbling, dressing percent, and 12th rib fat thickness were not affected significantly by either fat or choline. Ruminally protected choline can improve average daily gain and feed efficiency of finishing cattle.

(Key Words: Choline, Fat, Finishing, Heifers, Performance, Carcass.)

Introduction

Fat commonly is included in feedlot diets to add texture and increase energy density. However, supplemental fat can reduce ruminal protozoal populations. Choline, a B-vitamin, is normally present in adequate amounts. However, because protozoa synthesize choline, dietary conditions that suppress protozoal populations can reduce choline supply to the animal. Choline exists mainly in phospholipids and is involved in lipid digestion and transport. It functions in cell membrane integrity and is a methyl donor, much like betaine and methionine. Because finishing cattle fed a high concentrate diet with added fat might benefit from added choline, our objective was to evaluate responses to graded levels of ruminally protected choline in diets containing 2 or 4% added tallow or not tallow.

Experimental Procedures

Three hundred eighteen yearling heifers (753 lb average initial body weight) were dispersed into 24 pens containing 11 to 15 head each. Cattle were blocked according to previous nutritional regimen (full-fed or limited growing diets) and allotted to one of 12 treatments. Two pens, one within each block, were assigned randomly to each treatment. Treatments were levels of tallow (0, 2, or 4% of diet) and graded levels of encapsulated choline (0, 20, 40, or 60 g/head/day, supply-

ing 0, 5, 10, or 15 g choline/head/day; Balchem Corp., Slate Hill, NY).

Heifers were implanted with Revalor®-H and treated for internal and external parasites upon initiation of the step-up period. The cattle were fed ad libitum on finishing diets based on a mix of steam-flaked (~26 lb/bu) and dry-rolled corn (~3,800µ particle size) and alfalfa (Table 1). Diets were formulated to contain approximately 12.5% crude protein, 0.69% calcium, 0.67% potassium, 0.30% phosphorous, 30 g/ton Rumensin®, and 10 g/ton Tylan®. Encapsulated choline was top-dressed onto the basal diet at feeding. Heifers were weighed every 30 days and fed their respective diets for 120 days. Cattle were slaughtered at a commercial packing plant, and carcass data were obtained after a 24-hour chill. Percentage of carcasses grading USDA Choice was reassessed after an additional 6- to 8-hour chill period.

Results and Discussion

Performance of cattle in this experiment was below average, likely attributable to damp, cold, and muddy conditions that prevailed throughout the final 30 days of the

study. Daily gains (unshrunk) averaged approximately 3.35 lb/day during the first 90 days of the experiment but were only .8 lb/day during the final 30 days. The average daily gains shown in Tables 2 and 3 reflect a 4% pencil shrink.

Dry matter intakes decreased linearly ($P<.05$) as supplemental fat increased. Choline had no effect on intake but increased both average daily gain (linear, $P<.1$; quadratic, $p<.05$) and feed efficiency ($P<.1$), with the greatest improvements occurring with the first 20 g/day of protected choline. With fat supplementation, kidney, pelvic, and heart fat and yield grade both increased linearly ($P<.1$). The percentage of carcasses grading USDA Choice was decreased when 60 g/day of choline was supplemented (linear, $P<.05$; quadratic, $P<.1$).

Encapsulated choline can be supplemented in feedlot diets to improve growth performance without having a negative effect on carcass characteristics. The optimum level appears to be about 20 g/head/day (5 g choline). Increases in encapsulated choline above 40 grams/head/day yielded no additional benefits.

Table 1. Compositions of Experimental Diets Fed to Heifers (% of DM)^a

Ingredient	Supplemental Fat		
	0	2%	4%
Flaked corn	40.31	38.40	37.24
Dry-rolled corn	43.75	41.67	40.42
Alfalfa hay	8.00	8.00	8.00
Molasses (cane)	3.00	3.00	3.00
Tallow		2.00	4.00
Urea	.79	.50	.50
Vitamin-mineral mix ^b	2.16	2.13	2.13
Soybean meal (47.5%)	1.99	4.30	4.30

^aEach diet was top-dressed with 20, 40, or 60 g/head/day encapsulated choline or no choline was added.

^bFormulated for diets to contain 0.69% Ca, 0.30% P, and 0.67% K, and to add 1.2 KIU/lb Vitamin A, .03 ppm Co, 6.8 ppm Cu, .43 ppm I, 1.0 ppm Fe, 41 ppm Mn, .20 ppm Se, 41 ppm Zn, 30 g/ton Rumensin, and 10 g/ton Tylan.

Table 2. Effect of Fat on Performance and Carcass Traits of Heifers

Item	Supplemental Fat			SEM
	0	2%	4%	
<u>Performance data</u>				
Initial weight, lb	751	747	760	
Final weight, lb	1091	1070	1077	
Feed intake, lb/day ^b	18.5	18.0	17.5	.24
Gain, lb/day ^{ab}	2.47	2.35	2.29	.06
Feed:Gain ^{ac}	7.46	7.63	7.63	
<u>Carcass Characteristics</u>				
Carcass weight, lb	651	646	645	5.6
KPH fat, % ^b	1.95	2.05	2.05	.03
Dressing %	62.2	62.8	62.4	.28
Backfat, inches	.37	.39	.40	.02
USDA Yield Grade ^b	1.93	2.06	2.13	.07
Marbling score	4.04	4.13	4.16	.07
USDA Choice, %	57.8	68.4	65.4	3.3

^aGain and efficiency were computed after applying a 4% pencil shrink to final weights.

^bLinear effect of fat supplementation (P<.1).

^cAnalyzed statistically as Gain:Feed but reported as Feed:Gain.

Table 3. Effect of Choline on Performance and Carcass Traits of Heifers

Item	Encapsulated Choline, g/head/day				SEM
	0	20	40	60	
<u>Performance data</u>					
Initial weight, lb	755	753	743	742	
Final weight, lb	1061	1082	1088	1086	
Feed intake, lb/day	17.8	17.9	18.2	18.0	.28
Gain, lb/day ^{abc}	2.20	2.39	2.52	2.36	.06
Feed:Gain ^{acd}	8.06	7.52	7.25	7.63	
<u>Carcass characteristics</u>					
Carcass weight, lb	641	651	645	652	6.4
KPH, %	1.99	2.02	2.06	2.01	.04
Dressing %	62.9	62.6	61.8	62.6	.32
Backfat, inches	.39	.38	.40	.36	.02
USDA Yield Grade	2.02	2.05	2.15	1.94	.08
Marbling score	4.17	4.06	4.20	4.02	.08
USDA Choice, % ^{bc}	67.2	68.2	68.0	52.0	3.8

^aGain and efficiency were computed after applying a 4% pencil shrink to final weights.

^bLinear effect of encapsulated choline (P<.1).

^cQuadratic effect of encapsulated choline (P<.1).

^dAnalyzed statistically as Gain:Feed but reported as Feed:Gain.