Methane Fermenter Product or Decoquinate for Feedlot Steers

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Story in Brief

Ninety-six steers (578 lb initially) were divided into 12 pens and fed a steam flaked corn-corn silage diet containing 0 or 6.6 percent fermentation product from a methane generation plant for 153 days. Half of the cattle received Decoquinate (0.5 mg/kg body weight) for the first 29 days of the trial. Monensin and Tylosin were included in the diet from day 30 until cattle were slaughtered. Overall, rate of gain was not altered by either methane fermenter residue or Decoquinate, but feed intake was increased by about 2.7 percent with the addition of either material. This decreased efficiency of feed use by a similar percent.

For the first 57 days of the test, cattle receiving Decoquinate consumed slightly more feed (16.1 vs 15.1) and tended to gain slightly more rapidly (3.12 vs 2.89), but by the end of the 153 day test, this advantage had disappeared. Monensin, which was fed at 26 g per ton of dry matter, may have replaced the need for a coccidiostat.

Cal-II, a product of methane fermentation of feedlot manure, replaced portions of the corn, dehydrated alfalfa, cottonseed meal, meat meal and certain minerals of the control diet to form a test diet containing 6.6 percent Cal-II. Adjusted rate of gain of cattle fed the control and Cal-II diets were similar (2.89 vs 2.87 lb per day), but feed efficiency favored the control diet (5.92 vs 6.11 lb of feed per lb of gain). This indicates that the available energy content of the Cal-II did not equal that of the mixture of feeds that it replaced. Based on feed intake and performance of steers, the added methane fermenter residue had a metabolizable energy value of 1.0 to 1.5 mcal/kg for an NE_m of 33 to 42 mcal per hundred pounds of dry matter.

Introduction

Some groups of newly arrived stressed cattle may respond to treatment with a drug to control coccidiosis (Rust et al., 1981). Decoquinate is approved as a coccidiostat for cattle. While ionophores such as monensin are effective coccidiostats (Horton and Brandt, 1981), they are frequently either not fed during the receiving period, since they suppress feed intake, or they are included in the diet at a level too low to be effective. The degree of reduction in animal performance during and after coccidial infections may be considerable.

Production of methane from feedlot waste yields a product which may be an economical ingredient for feedlot cattle. Cal-II Protein Meal™ is the trade name for the product of a methane generation plant in Oklahoma. This product contains over 15 percent protein and is high in

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calcium, potassium, phosphorus and sulfur. Routine chemical analysis suggests that it could substitute for dehydrated alfalfa in supplements for cattle. Digestibilities of protein and dry matter have been variable in many past trials which may be attributable to differences in frequency of gathering feedlot waste, method of processing and methane generation procedure (use of moderate temperatures-mesophilic versus high temperatures-thermophilic). The objective of this trial was to establish the value of this product at low levels in a feeding trial with finishing steers and the value of a coccidiostat.

Experimental Procedures

Ninety-six yearling steers (578 lb) were assembled by a cattle dealer in the Southeast U.S. and shipped to Goodwell, Oklahoma in September 1981 for feeding. Cattle were processed following normal processing procedures (OSU RP-9104) and randomly assigned to one of twelve pens. Six pens selected at random received Cal-II supplement while six pens received the control supplement. Three of each of these pens also received Decoquinate in their supplement for the first 29 days of the trial. Experimental diets are presented in Table 1. Cattle received ration 1 for 32 days, ration 2 for the next 6 days and ration 3 thereafter. Feed intake was very low for the first few days of the trial so that a high percentage of the total ration was supplement. On day 29, Decoquinate was removed from the diet. Monensin and Tylosin were added after day 29 at rates of 26 and 8.38 grams per ton of dry matter, respectively. Rations were formulated to provide similar amounts of protein, phosphorus and calcium with Cal-II displacing other feeds in the diet.

To ensure precise control of the administration of decoquinate, a fixed amount of supplement was fed each day for the first 11 days. Subsequently, diets were mixed on a percentage basis. During the first 11 days, cattle receiving the Cal-II supplement were fed 2.5 lb of supplement per day while control cattle were fed 1.77 lb. These amounts differ because the pelleted supplement carried the Cal-II.

Table 1. Ingredient composition of experimental diets.

Ration Number	1		2		3		Trial Mean	
Item	Cal-II	Cont	Cal-II	Cont	Cal-II	Cont	Cal-II	Cont
S.F. corn	46.94	50.15	62.10	64.90	79.65	81.51	73.67	75.47
Corn silage	37.00	37.00	24.00	24.00	11.00	11.00	15.71	15.97
Cal-II	9.00	-----	7.79	-----	6.00	-----	6.56	-----
Dehy. alfalfa	-----	3.83	-----	3.31	-----	3.00	-----	3.15
Cotton meal	5.66	6.51	4.89	5.62	1.19	1.54	2.07	2.57
Meat meal	-----	.50	-----	.43	-----	.40	-----	.42
Limestone	.35	.64	.30	.55	.84	1.00	.74	.92
Dical. phos.	-----	.33	-----	.28	-----	.31	-----	.31
Urea	.19	.19	.16	.16	.47	.47	.41	.41
KCL	.42	.37	.36	.32	.26	.21	.29	.24
Amon. sulf.	.17	.17	.15	.15	.17	.17	.17	.17
Salt	.25	.29	.22	.25	.28	.33	.27	.32
Misc.[a]	.02	.02	.03	.03	.05	.06	.04	.05

[a]Contains: all rations, Vitamin A; rations 1 and 2 had either Decoquinate or none; ration 3 Monensin 26 grams per ton and Tylosin 8.38 grams per ton of dry matter. Cal-II diets had no added trace mineral package.

Fecal samples were obtained from seven of the cattle on arrival for examination for internal parasites using both direct and flotation methods. The direct technique involved visually examining the feces for blood and mucus. Blood and mucus flecks were smeared onto glass slides with 1 N saline and examined at 400X for parasitic oocysts. Only samples with blood and mucus flecks were examined using the direct technique. The flotation technique was conducted by mixing one to two grams of feces with 7 ml of concentrated sugar solution and placing a glass slide on top of the mixture. The solution was allowed to maintain contact with the slide for 30 minutes after which the slide was examined for coccidia oocysts at 400X.

Cattle were weighed full at 28-day intervals and fed a total of 153 days. For slaughter, cattle were trucked 50 miles to Liberal, KS and carcass data were obtained. Final shrunk weights were calculated by dividing the hot carcass weight by .62. Live weights, with the exception of the initial weight, were gross weights although all daily gains and feed efficiencies are expressed using gross weights less 5 percent, an estimate of live weight loss due to shrinkage.

Results and Discussion

Rate of weight gain was not significantly altered by the coccidiostat or Cal-II feeding (Table 2). Effects of treatments on carcass

Table 2. Steer performance.

	Cal-II	Control	Deccox	Control
Weights				
Initial	577	579	583[a]	572
29 days	678	678	687	667
57 days	784	792	801	776
85 days	880	884	894	870
113 days	968	973	890	961
153 days	1058.44	1062.56	1068	1052
Adjusted	1016	1020	1023	1014
Daily gain				
0-57 days	2.95	3.05	3.12	2.98
58-153 days	2.71	2.67	2.64	2.74
0-153	2.80	2.81	2.82	2.79
0-153 adjusted	2.87	2.89	2.87	2.89
Daily feed				
0-57 days	15.66	15.84	16.25	15.26
58-153 days	18.80	17.97	18.53	18.25
0-153 adjusted	17.53	17.08	17.57	17.03
+ Weighback	17.93	17.41	17.89	17.41
Feed/Gain				
0-57 days	5.25	5.16	5.16	5.25
58-153 days	6.94	6.76	7.02	6.67
0-153 live	6.25	6.08	6.24[b]	6.10[c]
0-153 adjusted	6.11	5.92	6.13[b]	5.90[c]
Met. energy				
Adjusted weights	2.93[c]	3.00[b]	2.94	2.99

[a] Decoquinate.

[bc] Means in a row with different superscript differ statistically ($P<.10$).

Table 3. Carcass measurements.

	Cal-II		Deccox[1]	
	Present	Absent	Present	Absent
Carcass weight, lb	630	632	629	634
Dressing percent	59.5	59.6	59.7	59.4
Fluke incidence, %	29.2	29.2	22.9	35.4
Rib eye area				
Square inches	11.3	11.4	11.4	11.3
Sq. in./cwt	1.80	1.81	1.81	1.80
Fat thickness, in.	.44	.51	.47	.48
KHP, %	2.60	2.59	2.49[a]	2.70[b]
Cutability, %	50.1	49.7	50.0	49.8
Federal grade	12.2[d]	12.6	12.3	12.5
Marbling score	12.6[d]	13.7[c]	13.0	13.3

(1) Decoquinate.
[a][b] P<.05.
[c][d] P<.10.
[e] Closely trimmed lean cuts.
[f] Good plus=12; Choice minus=13.
[g] Slight plus=12; Small minus=13.

measurements are shown in Table 3. Marbling score and federal grade tended to be slightly lower for the steers fed Cal-II. The high incidence of flukes may have reduced overall performance although the incidence appeared equally distributed among treatments.

Per pound of weight gain, more feed (2.7 percent) was required for steers fed the Cal-II diet than for steers fed the control diet. This indicates that the Cal-II had an available energy value slightly lower than the feed ingredients which it replaced in the control diet. To calculate the energy value for Cal-II, several different methods can be used. The first involves calculating the amount of feed required per unit of weight gain with the two diets as shown in Table 4. This comparison suggests that 40 kg of Cal-II plus 3.3 kg of corn, 1.4 kg of corn silage provided an amount of energy equal to 18.7 kg of alfalfa meal plus 2.5 kg meat meal plus 2.5 kg cottonseed meal. Using the metabolizable energy (ME) value of the other feeds as listed by the NRC (1976) tables, one can calculate the ME value of Cal-II. The value by this calculation was 1.05 mcal/kg which is equal to a NE for maintenance of 33 mcal/100 lb of dry Cal-II.

Another method of estimating the value of Cal-II is based on calculating ME of both diets based on feed intake and cattle performance (Owens & Gill, 1980). The ME of replaced feeds is then deducted from the ME of the control ration (Table 5). The difference between the control and test diet remaining is due to the test ingredient, Cal-II. Since this is present at 6.56 percent of the ration, the difference is all attributable to this fraction. Using this method of calculation, the ME of Cal-II in this trial was 1.53 mcal/kg. This equates to a NE for maintenance of 42 mcal/cwt of dry Cal-II. Calculating net energy values from estimated metabolizable energy values with feeds low in ME content may be hazardous since the equations (NRC, 1976) were developed primarily with feeds with moderate or high ME content.

Table 4. Energy calculations, Model 1. Feed required per 100 kg gain (adjusted weights).

	Diet		Difference	Feed ME	Difference
	Control	Cal-II	kg	mcal/kg	in ME, mcal
Total	593	612			
Corn, SF	447.5	450.9	+3.3	3.29	+10.97
Corn silage	94.7	96.1	+1.4	2.53	+3.56
Dehy alfalfa	18.7	0	-18.7	2.24	-41.89
Cal-II	0	40.1	+40.1	x	+40.1x
Cottonseed meal	15.2	12.7	-2.5	3.29	-8.37
Meat meal	2.5	0	-2.5	2.54	- 6.30

40.1x - 42.03 = 0
x = ME of Cal-II = 1.047 mcal/kg.
NE_m = .72 kcal/g = 33 mcal/100 lb.

Table 5. Energy calculations, Model 2. ME of rations, calculated from feed intake and gain.

	Diet Difference, %	Feed ME, kcal/g	Diet ME
Corn, SF	+1.80	3.29	+.059
Corn silage	+ .26	2.53	+.007
Dehy. alfalfa	+3.15	2.24	+.071
Cotton meal	+ .50	3.29	+.016
Meat meal	+ .42	2.54	+.011
Total			.163

Control diet ME = 3.00
Control diet minus ME of above feeds = 2.833
Cal-II diet ME = 2.93
Difference due to Cal-II = 2.93 - 2.833= 0.097 mcal/kg

$$\text{ME of Cal-II} = \frac{0.097 \text{mcal}}{.0656 \text{ kg}} = 1.53 \text{ mcal/kg}$$

NE_m = .93 kcal/g = 42 mcal/100 lb.

Results from this experiment can be contrasted with literature reports of energy value of various products from methane generation with cattle waste (Table 6). Estimated ME contents have ranged from .07 to 2.58 mcal/kg dry matter and TDN values have ranged from 13 to 51 percent. Product from thermophilic fermentation usually has been higher in fiber and lower in ME than product from mesophilic fermentation. Additional variability in these estimates can be attributed to differences in preparation (screenings vs product with screenings removed, centrifuged solids re-added vs. only centrifuged solids) and to inaccuracy of the estimates due to feeding only a low percentage of product in the total diet. Although higher dietary levels appeared less useful in di-

Table 6. Chemical composition and energy availability from methane fermentation products from cattle waste.

Source of data	Type of Residue	Moisture Content	Composition of DM Protein %	Fiber %	Ash %	Trial Type	Percent Residue In Diet	Digestibility DM,%	Digestibility OM,%	Energy values ME * mcal /kg	NEm mcal /cwt	NEg mcal /cwt
Prior (1978) Thermophilic	Biomass cake	8.0	17.3	--	26.8	Digest	5 to 21	51	65	1.84		
Zinn (1979) Mesophilic	Screenings	64.3	14.2	59.3	24.0	Digest	15 & 30	30	45	1.08		
Prokop (1980) Mesophilic	Residue	14	15.5	16.8	34.9	Net	12.0			0.99	32	14
						energy	6.0			2.58	72	51
Prokop (1980) Thermophilic	Residue	14	14.3	24.1	34.0	Net	12.0			0.07	20	12
						energy	6.0			1.70	46	33
Harris (1982) Thermophilic	Residue	77.8	21.9	22.0	21.1	Digest	10.6	13		0.47		
						Digest	10.6	29		1.05		
						Net	10.6			0.69	8.2	
						energy	10.6			0.85	12.7	
This study Mesophilic	Cal-II	12.0	17.6	14.8	38.6	Growth	6.6			1.05	32.9	
						Growth	6.6			1.53	42.1	

* Metabolizable energy calculated from digestibilities or NE_m values according to NRC (1976).

ets for cattle (Prokop, 1980), accuracy of estimating energy value declines with higher levels of product in the diet. Ash dilutes the digestible organic matter considerably with some products, and low apparent digestibility of the ash was noted in two trials (Prior, 1978; Zinn 1979). Since less than 15 percent of the ash is calcium, additional minerals such as silica in plant cell walls may be present at high levels. The level of fiber might suggest that these products may be useful as a roughage substitute in high energy diets, although the dried, pelleted products would not possess the coarse, scabrous fraction of many fiber sources which stimulate saliva flow and rumination. These products appear useful as a pellet binder and filler.

The initial gain response of steers to Decoquinate diminished as the feeding trial progressed. This may have been due to anticoccidial action of monensin which was present in the ration after the first 29 days on feed. Initial examination of fecal material revealed that three of the seven samples contained mucus flecks though no coccidial oocysts were detected by either examination method. The correlation between subclinical coccidiosis and fecal egg count has been suggested to be poor. Additional investigation is needed to develop techniques to determine the degree of coccidial infection and to predict the response of stressed cattle to anticoccidial therapy.

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