The Effect of Choline Chloride, Urea and Roughage Fed at Varying Levels Upon Feedlot Performance And Carcass Characteristics of Steers

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THE EFFECT OF CHOLINE CHLORIDE, UREA AND ROUGHAGE FED AT VARYING LEVELS UPON FEEDLOT PERFORMANCE AND CARCASS CHARACTERISTICS OF STEERS

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Choline has two known biological functions. It is a lipotropic (fat transporting) agent and serves as a methyl donor for the synthesis of many physiologically important compounds. Choline is required in the diet of the immature ruminant and monogastric animals. The needs of the mature or ruminating ruminant may or may not be met either through adequate levels of choline in their diet or by microbial synthesis. Because of the varying diets and the variations existing among component parts of their diets, the response of beef cattle to choline has been quite varied. If choline actually functions as a methyl donor in ruminants, it should be most effective when non-protein nitrogen makes up a portion of the diet.

The following experiment was conducted to (1) determine the effect of choline chloride upon non-protein nitrogen x roughage interrelationships; (2) compare the finishing performance of beef cattle on two levels of choline (0 and 400 mg. per pound of concentrate), two levels of roughage (10% and 20%), and three levels of urea (0, .5 and 1.0%); and (3) determine the effect of the three variables (choline, level of roughage and level of urea) upon carcass characteristics.

Methods

The feeder steers used in this trial had previously been on a wintering trial gaining at the rate of about 1.5 pounds per day. When the steers reached an average weight of about 700 pounds, they were stratified as to previous treatment and weight and randomly allotted to treatments. One roughage treatment was started two months later than the other so that starting weights would be comparable.

The experimental design was a 2 x 2 x 3 factorial consisting of 10% or 20% roughage, 0 or 400 mg. of choline per pound of concentrate and 0, .5 or 1.0% urea. The concentrate consisted of 15% beet pulp, 5% molasses, 39.5% steam rolled wheat, 39.5% steam rolled barley, .5% trace mineralized salt, .5% limestone and 50,000 International Units of Vitamin A. The urea and the choline chloride replaced equal amounts of the steam rolled barley and wheat by weight.

The hay was coarsely chopped and fed separately and should have made up 10 and 20% of the total ration. However, due to rather large amounts of hay being fed during the adjustment period, the exact amounts of 10 and 20% of the total ration were never realized (Table 1).

Table 1. Periodic Average Daily Dry Matter Intake (DM), Percent Roughage Intake (% R.) And Average Daily Gain (ADG)

Treatment	Choline	Urea		28 days	28 days	28 days	28 days	28 days	Approx. 14 days	Total Av.	Total - 1st Period Av.
20% R.	0 mg.	0%	DM (lbs.)	21.0	24.0	26.3	26.9	26.7	24.2	24.6	--
			% R	52.1	21.0	17.1	18.4	17.8	20.2	24.4	18.3
			ADG (lbs.)	2.99	3.57	3.46	3.06	3.11	2.88	3.25	3.22
	0 mg.	.5%	DM	21.2	26.7	25.5	26.9	26.7	24.2	24.6	--
			% R	52.9	28.8	14.4	18.3	17.9	20.2	24.7	18.6
			ADG	3.10	3.63	3.48	2.96	3.31	2.56	3.28	3.19
	0 mg.	1%	DM	21.4	24.0	26.2	26.8	26.5	24.1	24.6	--
			% R	52.8	21.0	17.4	20.0	17.9	20.2	24.7	18.7
			ADG	2.95	3.54	3.11	3.11	3.45	2.43	3.23	3.13
	400 mg.	0%	DM	23.2	25.6	28.6	26.3	27.6	24.7	24.9	--
			% R	53.3	21.5	15.4	17.4	16.9	20.1	24.6	17.8
			ADG	2.70	3.27	3.88	2.65	3.24	2.56	3.08	3.12
	400 mg.	.5%	DM	21.3	24.1	25.7	26.8	26.6	24.7	24.5	--
			% R	44.2	21.9	17.0	18.3	17.7	19.7	24.6	18.4
			ADG	2.73	3.47	3.79	2.73	3.33	2.93	3.19	3.25
	400 mg.	1%	DM	21.3	24.2	26.3	27.0	26.8	24.5	24.7	--
			% R	53.2	21.0	17.0	18.4	17.8	20.3	24.7	18.6
			ADG	2.68	3.56	3.59	2.56	3.31	1.87	3.09	2.98

Table 1. (Continued)

Treatment				28 days	28 days	28 days	28 days	Approx. 14 days	Total Av.	Total - 1st Period Av.
	Choline	Urea								
10% R.	0 mg.	0%	DM	21.8	22.7	27.2	24.3	23.6	24.1	--
			% R	43.0	20.0	12.1	12.1	13.2	20.9	13.9
			ADG	3.71	3.10	3.67	2.74	3.61	3.32	3.01
	0 mg.	.5%	DM	21.3	23.3	27.2	24.9	20.7	24.0	--
			% R	43.0	19.8	12.1	12.1	16.3	21.1	14.4
			ADG	4.16	3.10	3.80	3.03	1.83	3.47	3.18
	0 mg.	1%	DM	21.8	23.4	27.2	24.4	23.6	24.3	--
			% R	41.1	20.0	12.2	12.1	13.5	21.0	14.1
			ADG	3.54	2.47	3.76	2.41	3.07	3.08	2.73
	400 mg.	0%	DM	21.7	23.2	29.7	24.7	21.6	24.5	--
			% R	43.2	19.8	12.2	12.0	--	21.0	14.1
			ADG	3.71	3.24	3.65	2.63	3.19	3.36	3.08
	400 mg.	.5%	DM	21.8	23.3	28.0	24.5	24.1	24.2	--
			% R	43.2	19.8	12.2	12.1	13.9	20.8	16.0
			ADG	3.89	3.26	3.80	2.64	4.55	3.46	3.06
	400 mg.	1%	DM	23.2	24.3	28.5	25.4	24.6	25.4	--
			% R	43.9	20.8	12.7	12.3	15.8	21.7	15.0
			ADG	3.83	2.82	4.30	2.57	4.00	3.41	3.09

The steers were marketed at either a choice live grade or 1100 pounds weight. Complete carcass data were collected (carcass weight, conformation score, marbling score, ribeye area, backfat and grade) and the yield of closely trimmed boneless retail cuts from the round, loin, rib and chuck was estimated.

Results and Discussion

The use of choline alone or in combination with urea did not materially affect gains of steers on finishing rations. Although the differences among treatments were non-significant, the results of this trial tend to further confuse the literature as to the importance of choline to the ruminating animal.

Earlier work at this station indicated that perhaps choline supplementation was more effective in a low energy ration. The results of this trial are contradictory since the lower energy rations actually show a slight decrease in gains from choline supplementation whereas an equal increase in gains resulted when higher energy diets were supplemented with choline (Table 2). The statistical analysis of variations in average daily gain indicate that energy level (or roughage level) and level of urea were greater contributors to this variation than choline or choline x urea interaction.

There were no differences in feed efficiency due to choline supplementation.

The use of urea at the 0.5 percent level resulted in small increases in gains and corresponding feed efficiency improvements. The 1.0 percent level tended to retard gains somewhat but did not greatly change feed efficiency.

If the ruminating steer is actually below the choline requirement on normal rations, one might expect greater gains on rations containing non-protein nitrogen supplemented with choline. The incorporation of nitrogen with small carbon fragments to form amino acids and B complex vitamins by bacteria could certainly make use of methyl groups donated by choline. The results reported herein would indicate that since choline failed to produce an added response, perhaps available methyl groups were not limiting for such synthesis.

Table 2. Summary of Steer Performance and Carcass Characteristics Due to Varying Levels of Choline, Urea and Roughage

Treatment	Initial weights	Final weights	Average daily gain	TDN/cwt of gain	Marble score[a]	USDA grade[b]	Backfat	Trimmed cuts[c]
20% Roughage								
0 chch[d] + 0 urea	693	1125	3.25	540	13.8	16.5	.5	49.8
0 chch + 1/2% urea	676	1112	3.28	537	13.4	16.2	.5	50.0
0 chch + 1% urea	694	1121	3.23	544	13.6	16.6	.5	49.5
Average	688	1119	3.25	540	13.6	16.4	.5	49.8
400 mg. chch + 0 urea	674	1094	3.08	570	14.1	16.5	.5	50.0
400 mg. chch + 1/2% urea	683	1109	3.19	546	13.1	16.3	.5	49.9
400 mg. chch + 1% urea	684	1092	3.09	570	15.0	16.8	.5	49.5
Average	680	1098	3.12	562	14.1	16.5	.5	49.8
10% Roughage								
0 chch + 0 urea	672	1059	3.32	525	12.8	16.0	.4	50.3
0 chch + 1/2% urea	686	1085	3.47	499	12.0	15.9	.5	49.1
0 chch + 1% urea	678	1036	3.08	568	13.0	16.2	.5	49.1
Average	679	1060	3.29	531	12.6	16.0	.5	49.5
400 mg. chch + 0 urea	688	1075	3.36	560	12.5	16.0	.5	49.4
400 mg. chch + 1/2% urea	684	1085	3.46	506	12.7	16.1	.5	49.3
400 mg. chch + 1% urea	681	1074	3.41	534	12.8	16.1	.5	49.5
Average	684	1078	3.41	533	12.7	16.1	.5	49.4
Urea average 0%	682	1088	3.25	549	13.3	16.2	.5	49.9
1/2%	682	1098	3.35	522	12.8	16.1	.5	49.6
1%	684	1081	3.20	554	13.6	16.4	.5	49.4

[a] Marble score: 9 = slight, 12 = small, 15 = modest.

[b] USDA grade: 14 = good, 17 = choice.

[c] Trimmed cuts: estimated % of carcass weight in boneless, closely trimmed retail cuts from the round, loin, rib and chuck.

[d] chch = Choline Chloride.

It was interesting that the greatest increase due to choline occurred with 1.0% of urea added on the lower roughage treatment. However, by increasing the roughage only slightly the results were reversed and to nearly the same magnitude.

The carcass characteristics measured were not affected by either choline or urea supplementation.

Summary

One hundred forty-four yearling steers were used in a 2 x 2 x 3 factorially designed experiment. The treatments consisted of 0 or 400 mg. of choline per pound of concentrate, 14.6 or 18.4% roughage and 0, 0.5 or 1.0% urea. There were no significant differences due to treatments. The greatest contribution to the variations noted were due to level of roughage followed by level of urea, level of choline chloride and very little due to urea-choline interaction. The carcass characteristics measured were very comparable for all treatments.