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Department of Animal and Range Sciences
CLAYTON LIVESTOCK RESEARCH CENTER
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Route 1 Box 109 Clayton, New Mexico 88415 505-374-2566

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Effects of Ionophore, Added Fat, and Roughage Level on Performance by Growing/Finishing Steers[1]

K. J. Malcolm-Callis, M. L. Galyean, G. C. Duff, and D. R. Garcia

Ionophores are used extensively by the cattle feeding industry to improve feed efficiency. In recent years, the response to ionophores has been noted to decrease as dietary energy density increased (roughage level decreased), and some repoorts have suggested a diminished response to ionophores in diets with added fat. The present study was designed to evaluate effects of ionophores on performance by growing/finishing beef cattle as influenced by dietary levels of roughage and added fat.

Three hundred sixty crossbred (British x Continental) beef steers were used in a 2 x 2 x 3 factorial arrangement of 12 dietary treatments. All steers were fed a 90% concentrate diet, containing Rumensin (31mg/kg) + Tylan (11mg/kg) for approximately 2 weeks before the experiment began. At the start of the trial, the steers were weighed and sorted by weight into light, medium, and heavy blocks, implanted with Synovex S, and vaccinated with a seven-way clostridial preparation. Treatment diets (Table 1) contained (dry matter basis) either 0 or 4% added fat, 6 or 12% dietary roughage, and either no ionophore (control), Bovatec (33 mg/kg) plus oxytetracycline (OTC; 8.8 mg/kg) or Rumensin (33 mg/kg) plus Tylan (8.8 mg/kg). Within a weight block, steers were stratified by body weight to 12 pens. Hence, a total of 36 pens (12 pens per weight block), with 10 steers per pen was used in the experiment. After 56 days on feed, at the time of a regularly scheduled body weight measurement, each steer was revaccinated with 5 mL of a clostridial seven-way preparation. Steers in the medium and light blocks were reimplanted with Synovex S after 84 days on feed; heavy-block steers were not reimplanted. After 28, 56, 84, and 112 days on feed, steers in the three blocks were weighed before the morning feeding; these non-shrunk weights were taken to assess performance of the cattle on a regular basis. Steers in the heavy block were shipped to a commercial slaughter facility after 112 days on feed. Medium-block steers remained on feed for an additional 21 days before shipment. An interim body weight measurement was taken on the light-block steers after 140 days on feed, after which these steers were fed an additional 14 days before shipment to a commercial slaughter facility. Carcass measurements included hot carcass weight, ribeye area, marbling score, percentage of kidney, heart, and pelvic fat, fat thickness measured between the 12th and 13th ribs, and liver abscess score.

Effects of ionophore, level of added fat, dietary roughage level, and all possible interactions were analyzed in a randomized block statistical model, with block x ionophore x fat x roughage as the residual error term. Orthogonal contrasts were used to test effects of ionophore treatments. These contrasts were 1) control vs ionophore and 2) Bovatec + OTC vs Rumensin + Tylan.

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Table 1. Ingredient composition (dry matter basis) of the 0 and 4% added fat diets with either 6 or 12% dietary roughage (R)

	0% Fat		4% Fat	
Ingredient	6% R	12% R	6% R	12%R
Sudangrass hay	2.94	5.89	2.94	5.89
Alfalfa hay	3.00	6.01	3.00	6.01
Whole corn	9.97	9.97	9.98	9.97
Steam-flaked milo	72.67	65.66	67.68	60.75
Soybean meal	2.25	3.30	3.25	4.20
Molasses	5.03	5.03	5.03	5.03
Fat (yellow grease)	-	-	4.01	4.02
Limestone	.75	.75	.75	.75
Dicalcium phosphate	.51	.51	.50	.50
Salt	.35	.35	.35	.35
Urea	1.01	1.01	1.00	1.01
Ammonium sulfate	.51	.51	.51	.51
Premix[a]	1.01	1.01	1.00	1.01

[a]Wheat middlings-based premix consisted (dry matter basis) of .665% vitamin A (30,000 USP units/g), .27% vitamin E (500,000 IU/kg), 6% trace mineral (contained on a dry matter basis: .36% cobalt carbonate, 3.27% copper sulfate, .27% calcium iodate, 19.44% ferrous sulfate, 6.94% manganous oxide, 28.17% zinc sulfate monohydrate, 29.76% magnesium oxide, 8.83% wheat middlings, and 2.95% mineral oil), and Bovatec, OTC, Rumensin, and Tylan as dictated by treatments.

Main-effect means for daily gain, dry matter intake, and feed:gain for the overall experiment are shown in Table 2. The only interaction noted among the three factors in the experiment (ionophore, added fat, and roughage level) for performance data was an ionophore x fat interaction ($P < .10$) for daily gain from days 0 to 84 of the experiment. This interaction suggested a positive effect of added fat in diets that contained either Bovatec/OTC or Rumensin/Tylan compared with the control diet during this portion of the feeding period. In contrast to these results, Clary et al. (1993) reported that 4% added tallow negated the gain and efficiency response with Rumensin/Tylan observed with a 0% tallow diet. Clary et al. (1993) noted positive effects of 4% added tallow on gain and efficiency with a Bovatec-containing diet.

Final body weight was greater ($P < .04$) for steers fed the two ionophores than for Control steers, and overall daily gain was greater ($P < .10$) for the average of the two ionophores vs Control. Dry matter intake was increased ($P < .01$) for Bovatec/OTC compared with Rumensin/Tylan, and not different ($P > .83$) for the Control diet vs the average of the two ionophore-containing diets. Feed:gain was improved ($P < .03$) for the average of the two ionophores compared with the Control diet, and improved for Rumensin/Tylan vs Bovatec/OTC ($P < .04$). Calculated NE values of the diet were increased for both ionophores compared with the Control diet. Added dietary fat increased ($P < .03$) overall daily gain, did not affect dry matter intake, and improved feed:gain ($P < .01$). Dietary roughage level did not affect daily gain ($P > .73$), whereas 12% dietary roughage increased ($P <$

.01) dry matter intake and resulted in a greater (P < .01) feed:gain ratio than 6% dietary roughage.

Hot carcass weight was greater (P < .10) for cattle fed Bovatec/OTC than for those fed Rumensin/Tylan (Table 2). Dressing percentage, ribeye area, kidney, heart, and pelvic fat, and marbling score did not differ (P > .10) among ionophore treatments. An interaction of ionophore x fat was noted for dressing percentage (P < .09), kidney, pelvic, and heart fat (P < .03), fat cover (P < .01), and yield grade (P < .06). Control steers fed 4% added fat had lower kidney, pelvic, and heart fat, fat cover, and yield grade (2.27, .34, and 2.3, respectively) than Control steers fed 0% fat, (2.34, .41, and 2.6, respectively). In contrast, 4% added fat increased the dressing percentage of steers fed Bovatec and Rumensin (62.0 and 61.2; 61.7 and 61.0, respectively) compared with steers fed 0% fat plus an ionophore, but had no effect on kidney, pelvic, and heart fat, fat cover, or yield grade. An interaction of ionophore x roughage level was noted for dressing percentage (P < .05). Bovatec steers fed 12% roughage had a lower dressing percentage (61.2) than those fed 6% roughage (62.1). Added roughage did not affect dressing percentage of steers fed Rumensin or the Control diet. Liver abscess score data were not analyzed statistically because of limited numbers of abscessed livers.

The absence of significant interactions for performance data among the three factors considered in this experiment suggests that the efficacy of an ionophore in high-concentrate diets does not depend on either added fat (up to 4% yellow grease) or dietary roughage level (up to 12%). Results with other sources of fat could differ from ours, and further research with other fat sources, especially tallow, may be warranted.

Literature Cited

Clary, E.M., R.T. Brandt, Jr., D.L. Harmon, and T. G. Nagaraja. 1993. Supplemental fat and ionophores in finishing diets: Feedlot performance and ruminal digesta kinetics in steers. J. Anim. Sci. 71:3115.

Table 2. Main effects of ionophore, added fat, and roughage level on performance and carcass characteristics of growing/finishing beef steers

	Ionophore[a]						Fat[b]			Roughage[c]			
Item	C	B	R	OSL-1[d]	OSL-2[d]	SE[d]	0%	4%	OSL[e]	6%	12%	OSL[e]	SE[e]
Initial BW, lb	738.0	739.2	739.7	.56	.87	2.04	738.6	739.4	.74	737.7	740.3	.29	1.67
Final BW, lb	1,222.9	1,245.4	1,236.3	.04	.33	6.45	1,224.7	1,245.1	.02	1,231.7	1,238.1	.40	5.25
Daily gain, lb[f]	3.68	3.81	3.76	.10	.45	.050	3.68	3.82	.03	3.73	3.76	.74	.041
Daily DMI, lb/steer[f]	20.80	21.31	20.37	.84	.01	.173	20.88	20.62	.76	20.23	21.42	.01	.141
Feed:gain[f]	5.67	5.60	5.43	.03	.04	.053	5.68	5.45	.01	5.43	5.70	.01	.043
NEm, Mcal/kg[g]	2.09	2.11	2.17	-	-	-	2.09	2.16	-	2.17	2.08	-	-
NEg, Mcal/kg[g]	1.43	1.44	1.49	-	-	-	1.42	1.48	-	1.49	1.41	-	-
Hot carcass wt., lb	755.9	767.5	758.3	.15	.10	3.74	752.1	769.0	.01	760.2	760.9	.87	3.06
Dressing, %[h]	61.8	61.6	61.4	.11	.28	.17	61.4	61.8	.06	61.7	61.5	.22	.14
Ribeye area, in^2	13.6	13.5	13.6	.73	.87	.16	13.4	13.7	.21	13.5	13.6	.86	.13
Kidney, pelvic, and heart fat[h]	.38	.39	.37	.89	.30	.013	.38	.38	.78	.38	.38	.87	.010
Marbling score	4.07	4.14	4.02	.87	.13	.054	4.07	4.08	.99	4.06	4.09	.60	.044
Yield grade[h]	2.5	2.5	2.4	.68	.24	.06	2.5	2.5	.82	2.5	2.5	.92	.05

[a] C = control (no ionophore); B = Bovatec at 33 mg/kg of diet plus oxytetracycline at 8.8 mg/kg of diet; R = Rumensin at 33 mg/kg of diet plus Tylan at 8.8 mg/kg of diet.

[b] Added fat (yellow grease) at either 0 or 4% of dietary dry matter.

[c] Roughage level at either 6 or 12% of dietary dry matter.

[d] OSL-1 = Observed significance level for the contrast of C vs the average of B and R; OSL-2 = Observed significance level for the contrast of B vs R. SE = pooled standard error of treatment means, n = 12 pens per treatment.

[e] OSL = observed significance level for fat and roughage level comparisons. SE = pooled standard error of treatment means, n = 18 pens per treatment.

[f] Days on feed varied with blocks: Heavy block = 112 days; Medium block = 133 days; Light block = 154 days.

[g] Calculated from gain and feed intake using NRC (1984) equations for large-framed steer calves.

[h] Ionophore x fat interaction (dressing, % = P < .09; kidney, pelvic, and heart fat = P < .03; fat cover = P < .01; yield grade = P < .06). Ionophore x roughage (dressing, % = P < .05).

Bobby Rankin
Department Head, Animal and Range Sciences, New Mexico State University

Department of Animal and Range Sciences
New Mexico State University
Box 30003, Department 3-I
Las Cruces, NM 88003-0003

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