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PROGRESS REPORT

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Performance by finishing steers as influenced by dietary roughage and fat levels[1]

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Increasing the roughage content of beef cattle finishing diets typically results in increased dry matter intake. Added roughage presumably dilutes the energy concentration of the diet, and increased dry matter intake is a result of the animal attempting to consume to a constant energy intake. In addition, increasing the roughage level may decrease ruminal acid load and thereby affect intake. Because adding roughage to concentrate diets dilutes the energy concentration, it is difficult experimentally to differentiate the effects of energy dilution and the specific effects of roughage on dry matter intake and performance. To determine whether effects of added roughage on feed intake are independent of effects of roughage on energy dilution, we varied the roughage level of finishing diets but kept the dietary energy constant by adding fat.

One hundred eight crossbred (British x Continental) beef steers were used in the experiment. These steers had been used in a previous experiment dealing with receiving diet crude protein levels (Progress Report No. 88) and had ad libitum access to an 85% concentrate diet for approximately 6 weeks before the start of the present experiment. The steers were assigned to treatments based on their body weight at the end of the previous experiment, weighed, and placed in one of 12 feedlot pens (four pens per treatment). Treatments consisted of diets formulated to have either 7.5, 11.25, or 15% added roughage, with fat (yellow grease) added to compensate for the dilution of energy as the roughage level increased (Table 1; treatment abbreviations are 7.5R/1.5F, 11.25R/3.75F, and 15R/6F, respectively). The cattle were weighed at 28-day intervals throughout the trial. On each weigh day, feed bunks were swept, and unconsumed feed was weighed and sampled for determination of dry matter content. Diet samples were collected weekly, analyzed for dry matter content, and saved for further analyses. After 168 days on feed, all cattle were shipped to a commercial slaughter plant and carcass data were collected.

Performance data were analyzed as a completely random design with pen as the experimental unit. Individual carcass data were analyzed, but treatment effects were tested by pen within treatment variance. Orthogonal contrasts were used to test linear and quadratic responses to roughage level, recognizing that increases in fat content were confounded with increasing roughage level.

Treatment effects on performance data were remarkably consistent throughout the trial (Table 2). At each interval of the trial except days 0 to 28, daily gain was influenced quadratically by roughage level ($P < .06$), with greatest gains for the 11.25R/3.75F treatment. Similarly, dry matter intake was greatest throughout the trial for the 11.25R/3.75F treatment, intermediate for 7.5R/1.5F, and least for 15R/6F (quadratic effect, $P < .03$). Feed:gain ratio generally did not differ among the three treatments; however, from days 0 to 56 and 0 to 84, feed:gain was least for the 11.25R/3.75F treatment (quadratic effect, $P < .01$).

Table 1. Composition of the diets

	Treatment[a]		
Ingredient	7.5R/1.5F	11.25R/3.75F	15R/6F
	% of dry matter		
Sudangrass hay	2.25	7.66	10.20
Alfalfa hay	5.10	3.83	5.09
Steam-flaked corn	80.74	72.82	66.55
Soybean meal	-	2.01	2.27
Molasses	5.11	5.10	5.10
Fat	1.49	3.73	5.96
Limestone	.76	.76	.76
Dicalcium phosphate	.50	.50	.50
Salt	.36	.36	.36
Urea	.91	.76	.76
Ammonium sulfate	.50	.50	.51
Premix[b]	1.97	1.96	1.95

[a]R = percentage of roughage and F = percentage of added fat, formulated on a dry matter basis.

[b]Hominy feed-based premix supplied trace mineral mixture (.12% of diet), Rumensin (28 g/ton), Tylan (10 g/ton), Vitamin A (1,134 IU/lb of diet), and Vitamin E (6.8 IU/lb). Trace mineral composition: 4.17% Mn, 10% Zn, 5.8% Fe, .83% Cu, .17% I, .17% Co, and 16.67% Mg.

Carcass measurements (Table 2) were generally similar among cattle fed the three diets. Only hot carcass weight differed among treatments (quadratic effect, $P < .07$). Hot carcass weight was greatest for cattle fed the 11.25R/3.75F diet, intermediate for cattle fed the 7.5R/1.5F diet, and least for cattle fed the 15R/6F diet. Liver abscesses (data not shown) were minimal (total of five abscessed livers).

Based on net energy calculations, cattle in all treatment groups performed as expected, with actual gains from 100 to 105% of expected gains. These results suggest that effects of dietary roughage level on dry matter intake are not solely a result of dilution of dietary energy density. Moreover, combinations of roughage and fat should exist that will optimize energy intake by finishing beef cattle.

[1]We thank Elanco for supplying Rumensin and Tylan, Syntex Animal Health for supplying Synovex S, and Roche Vitamins and Fine Chemicals for supplying vitamin E. We also thank Dr. Ted Montgomery of the Beef Carcass Research Center at West Texas A & M University for collection of carcass data.

Table 2. Performance and carcass characteristics of finishing beef steers fed diets with varying roughage and fat levels during a 168-day feeding period

Item	Treatment[a]				Contrast[c]	
	7.5R/1.5F	11.25R/3.75F	15R/6F	SE[b]	L	Q
Body weight, lb						
Initial	706.9	699.5	692.8	2.8	.01	NS
Final	1,150.3	1,168.8	1,120.6	14.4	NS	.09
Daily gain, lb						
Days 0-28	3.48	3.59	3.39	.13	NS	NS
Days 0-56	3.09	3.50	2.99	.06	NS	.01
Days 0-84	3.05	3.22	2.80	.04	.01	.01
Days 0-112	3.02	3.19	2.83	.05	.03	.01
Days 0-140	2.77	2.93	2.67	.06	NS	.02
Days 0-168	2.64	2.79	2.54	.07	NS	.06
Daily dry matter intake, lb/steer						
Days 0-28	15.10	15.72	15.10	.17	NS	.02
Days 0-56	15.51	16.10	15.04	.12	.03	.01
Days 0-84	15.29	15.96	14.96	.12	.09	.01
Days 0-112	15.40	16.06	14.94	.18	.10	.01
Days 0-140	15.35	16.09	14.98	.23	NS	.02
Days 0-168	15.25	16.01	15.01	.27	NS	.03
Feed/gain						
Days 0-28	4.34	4.39	4.48	.13	NS	NS
Days 0-56	5.02	4.60	5.04	.11	NS	.01
Days 0-84	5.02	4.96	5.35	.04	.01	.01
Days 0-112	5.10	5.04	5.29	.09	NS	NS
Days 0-140	5.54	5.48	5.62	.09	NS	NS
Days 0-168	5.78	5.74	5.91	.11	NS	NS
Carcass measurements						
Hot carcass wt, lb	710.4	720.4	691.5	7.9	NS	.07
Dressing percentage	61.8	61.6	61.7	.28	NS	NS
Ribeye area, in^2	13.03	12.79	12.83	.22	NS	NS
Fat thickness, in	.41	.39	.39	.02	NS	NS
Kidney, pelvic, and heart fat, %	2.63	2.61	2.64	.05	NS	NS
Yield grade	2.57	2.65	2.51	.11	NS	NS
Marbling score[d]	3.98	4.17	3.92	.13	NS	NS

[a]R represents the percentage of roughage and F the percentage of added fat, formulated on a dry matter basis.

[b]Pooled standard error of treatment means, n = four pens per treatment.

[c]Orthogonal contrasts. L = linear effect of roughage level; Q = quadratic effect of roughage level. Values shown under column headings are the observed significance levels for these contrasts.

[d]3 = Slight, 4 = Small. Marbling scores > 4 = Choice grade and < 4 = Select grade.

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