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Director's Digest

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THE INFLUENCE OF INCREASING RUMINAL UNDEGRADABLE PROTEIN ON GROWTH RATE OF LIGHT GROWING STEERS

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This is a preliminary report from Dr. Zinn but thought it was important to include in the Manual.

PRELIMINARY ABSTRACT

One hundred-forty crossbred calves were used to evaluate the ruminal escape protein requirements of feedlot steers during an 84-d growing period (198 to 317 kg live weight). Dietary treatments were as follows: 1) basal diet; 2) basal diet plus 2% of a high bypass protein blend (HBP; 1/3 blood meal, 1/3 meat and bone meal and 1/3 feather meal); 3) basal diet plus 4% HBP; and 4) basal diet plus 6% HBP. The basal diet contained 18% alfalfa hay, 10% sudangrass hay, 61% steam flaked corn, 2.5% yellow grease, 6% molasses and 2.5% supplement. Urea was the sole source of supplemental N. HBP was substituted for corn in the basal diet. The diets were formulated to roughly contain 4.2, 5.2, 6.2 and 7.2% ruminal escape protein, respectively. There was a quadratic effect ($P<.05$) of ruminal escape protein supplementation on daily weight gain and feed conversion. The greatest response was with treatment 2 (2% HBP), which increased gain and DM conversion 13.4 and 8.4%, respectively, over that of the basal diet. There was also a quadratic effect ($P<.05$) of protein supplementation on the NE value of the diet. The addition

of 2% HBP increased the NEm and NEg of the diet 5.6 and 7.5%, respectively. The basis for the response is yet uncertain. The results of the metabolism trial should help to clarify what is happening.

EXPERIMENTAL PROCEDURE

Trial 1. One hundred seventy-five calves weighing (initial weight, 182 kg) were assembled from sale barns in Central Texas and trucked to the Imperial valley Agricultural Center September 19, 1989. Processing on arrival will include branding, ear-tagging, vaccination for infectious bovine rhinotracheitis virus, parainfluenza-3 virus, blackleg and malignant edema, injection with 1 x 10 IU vitamin A and 1.5 x 10 IU vitamin D, treatment with anthelmintic and grubicide and implanting with Synovex. Bull calves were castrated and horns, if present, will be trimmed to the base of the skull. All calves subjectively diagnosed (visually) as sick received antibiotic therapy until rectal temperature remained below 39.4 C for 24 h or until clinical symptoms disappeared. Following a 21-d adjustment period, 140 steers were selected for use in the growing trial. Steers were blocked by weight into 7 weight groups and randomly assigned, within weight groupings, to 28 pens (5 head/pen) equipped with automatic waterers and fence-line feed bunks. The steers were then allowed a 7-d adjustment period prior to beginning the growing trial on October 17, 1989. Composition of dietary treatments is shown in table 1. Diets were formulated to contain approximately 4.2, 5.2, 6.2 and 7.2% ruminal escape protein, respectively, for treatments 1 through 4. Diets were prepared at approximately weekly intervals and stored in plywood boxes located in front of each pen. Calves were fed roughly 110% of appetite twice daily. Calves were weighed and feed consumption calculated at intervals of 28 d. Live weights were reduced 4% to account for digestive tract fill. Energy retention was not measured directly in this trial, however, given the assumption that the primary determinant of energy gain was weight gain, then energy gain can be calculated by the equation (NRC, 1984): $EG = .-0557BW^{75}ADG^{1.097}$, where EG is the daily energy deposited (Mcal/d). Maintenance energy expended (EM) was calculated by the equation: $EM=.077BW^{.75}$ (Lofgreen and Garrett, 1968).

From the derived estimates for energy required for maintenance and gain, the NEm and NEg values of the diet are obtained by process of iteration to fit the relationship: NEg=.877 NE. + .41 (derived from NRC, 1984). The trial was analyzed as a randomized complete block design experiment. Pen means were used as experimental units. Treatment effects were analyzed for linear, quadratic and cubic components by means of orthogonal polynomials (Hicks, 1973).

Table 1. COMPOSITION OF EXPERIMENTAL DIETS FED TO STEERS

	Treatments			
	1	2	3	4
Ingredients[a]				
Alfalfa hay	18.00	17.65	17.31	16.98
Sudangrass hay	10.00	9.80	9.62	9.19
Steam-flaked corn	61.36	60.15	59.01	57.89
Yellow grease	2.50	2.45	2.40	2.36
Cane molasses	6.00	5.88	5.77	5.66
Meat and bone meal		.66	1.28	1.89
Blood meal		.66	1.28	1.89
Feather meal		.66	1.28	1.89
Urea	.50	.49	.48	.47
Limestone	.55	.54	.53	.52
Dicalcium phosphate	.59	.58	.57	.56
Trace mineral salt[b]	.50	.49	.48	.47
Vitamin A[c]	+	+	+	+
Nutrient composition[d]				
NE, Mcal/kg				
Maintenance	2.07	2.06	2.05	2.04
Gain	1.41	1.40	1.39	1.38
Crude protein	12.0	13.3	14.6	15.8
Ruminal escape protein	4.2	5.2	6.2	7.2
Ca	.85	.91	.97	1.03
P	.35	.39	.42	.45

[a]DM basis.

[b]Trace mineral salt contained: $CoSO_4$, .068%; $CuSO_4$, 1.04%; $FeSO_4$, 3.57%; ZnO, .75%; $MnSO_4$, 1.07%; KI, .052%; and NaCl, 93.4%.

[c]2200 IU/kg.

[d]Based on tabular values for individual feed ingredients (NRC, 1984) with exception of supplemental fat which was assigned NE_m and NE_g values of 6.03 and 4.79, respectively (Zinn, 1988). Ruminal escape protein values were based on NRC(1988) .

Table 2. INFLUENCE OF RUMINAL ESCAPE PROTEIN SUPPLEMENTATION ON FEEDLOT GROWTH PERFORMANCE AND ESTIMATED NET ENERGY VALUE OF GROWING DIETS FED TO STEERS (TRIAL 1)

Item	Treatment 1	2	3	4	SD
Weight, kg					
1-d	198	198	198	198	1
28-d[a]	234	239	237	239	4
56-d[b]	277	286	279	281	6
84-d[bc]	311	326	317	315	7
Weight gain, kg/d					
1-28-d[d]	1.27	1.48	1.39	1.45	.15
28-56-d[b]	1.52	1.67	1.51	1.52	.12
56-84-d[c]	1.22	1.42	1.34	1.21	.12
1-84-d[bc]	1.34	1.52	1.41	1.39	.09
Dry matter intake, kg/d					
1-28-d	6.46	6.30	6.25	6.26	.32
28-56-d[b]	6.74	7.26	6.82	7.01	.35
56-84-d[be]	7.24	7.78	7.26	7.24	.39
1-84-d[a]	6.81	7.11	6.78	6.84	.31
Dry matter conversion					
1-28-d[bfg]	5.11	4.27	4.53	4.35	.44
28-56-d	4.42	4.36	4.51	4.64	.30
56-84-d[e]	5.94	5.52	5.43	6.09	.55
1-84-d[c]	5.10	4.66	4.80	4.93	.25
Diet NE, Mcal/kg					
Maintenance[e]	1.82	1.93	1.90	1.87	.07
Gain[e]	1.19	1.27	1.26	1.23	.06
Observed/expected diet[h] net energy					
Maintenance[e]	.88	.94	.93	.91	.03
Gain[e]	.85	.92	.90	.89	.03

[a]Cubic effect, P<.10.
[b]Cubic effect, P<.05.
[c]Quadratic effect, P<.01.
[d]Linear effect, P<.10.
[e]Quadratic effect, P<.05.
[f]Linear effect, P<.05.
[g]Quadratic effect, P<.10.
[h]Expected diet net energy values were calculated on the basis of diet formulation and tabular values for individual feed ingredients (NRC, 1984) with exception of supplemental fat which was assigned NE_m and NE_g values of 6.03 and 4.79, respectively (Zinn, 1988b).