#103

Published in Proc. West. Sec. Am. Soc. An. Sci., Vol 16. 1965.

FREQUENCY OF FEEDING AND UREA UTILIZATION BY RUMINANTS

R. J. Raleigh and Joe D. Wallace
Squaw Butte Experiment Station 1/
Burns, Oregon

Urea as a protein extender for ruminant feeding has been studied extensively and the literature reviewed by Belasco (1954, 1955) and Anderson et al. (1959). High levels of urea have been used successfully in finishing rations where high energy levels are fed, but often in high roughage rations for growing animals lack of readily available carbohydrates limit the use of urea (Raleigh and Wallace, 1962). If urea can be supplied in a sustained release form or fed at more frequent intervals more of the non-protein nitrogen should be converted to animal use. The purpose of this work was to determine if feeding the urea-containing portion of the ration several times a day would result in increased animal production and to determine the fate of the urea nitrogen under these different feeding regimes.

EXPERIMENTAL PROCEDURE

Thirty-two Hereford heifer calves were stratified by weight into four replications of eight each in a 2^3 factorial trial to compare 2 levels each of nitrogen and energy, and 2 types of feeding. Levels of nitrogen were 1.75 and 2.25 percent of the total rations. Levels of calculated digestible energy were 2200 and 2640 Kcal/Kg of feed and types of feeding consisted of giving the supplement containing urea once and three times daily.

The diets were composed of meadow hay and a supplement balanced to supply the protein and energy as prescribed for respective treatments. Supplements were calculated so one-half of the nitrogen of each supplement was supplied by urea and the entire mixture pelleted. Cottonseed meal and urea were the major sources of nitrogen and barley was the major energy source. Small amounts of potato starch and wheat gluten were used, where needed, to balance for exact amounts of energy and protein, respectively. Native meadow hay was coarsely chopped and fed free choice. Diet components are shown in table 1.

The calves were individually fed from October 16 to January 22 for a total of 98 days. They were tied to feed mangers from 7 AM to 3 PM daily and ranged in a common lot the rest of the time. Half of the calves received

---

1/ Jointly operated by the Oregon Agricultural Experiment Station and the Crops Research Division, Agricultural Research Service, U.S.D.A.

Technical Paper No. 1990 Oregon Agricultural Experiment Station.

Table 1. INGREDIENTS AND CHEMICAL COMPOSITION OF THE DIETS

Ingredient	Diet: Low N - Low E			Low N - High E			High N - Low E			High N - High E		
	Total	N	DE	Total	N	DE	Total	N	DE	Total	N	DE
	%	%	Kcal/Kg	%	%	Kcal/Kg	%	%	Kcal/Kg	%	%	Kcal/Kg
Hay	95.00	1.37	2046	71.15	1.02	1584	91.93	1.32	1980	68.19	0.98	1518
CSM	2.68	0.17	88	0.93	0.06	66	3.98	0.26	110	0.44	0.03	44
Barley	1.90	0.04	66	25.00	0.50	880	1.80	0.04	66	25.83	0.52	902
Starch	-----	----	----	2.50	----	110	-----	----	----	2.60	----	110
Wh. gluten	-----	----	----	-----	----	----	1.20	0.16	44	1.83	0.25	66
Urea	0.42	0.17	----	0.42	0.17	----	1.09	0.46	----	1.09	0.46	----
Total	100.00	1.75	2200	100.00	1.75	2640	100.00	2.24	2200	100.00	2.24	2640

all their supplement at 7 AM each day and the rest received one-third of their total daily supplement at 7 AM,10 AM, and 1 PM. Water was available at the feed mangers and in the lots. Salt and bonemeal were available in the lots. Calves were weighed initially and at two-week intervals during the trial. Weights were taken after an overnight restriction from feed and water.

In addition to the performance trials with weaner calves, digestibility trials were conducted with the high-nitrogen diet with each level of energy and once and 3 times a day feeding. Four wethers were used in a latin square design for this evaluation. The sheep were caged in conventional digestion crates and fed their respective diets in the same proportions as the heifers in the performance trial. Nitrogen digestibility and balance were calculated.

RESULTS AND DISCUSSION

The average daily gains for respective treatments are presented in table 2. Gains were significantly ($P < 0.05$) different between the two levels of energy with the heifers receiving the higher level gaining 0.46 and those on the lower level gaining 0.32 kilograms per day. Feeding the supplement

Table 2. AVERAGE DAILY GAIN OF ANIMALS FOR INDIVIDUAL TREATMENTS AND MAIN EFFECTS 1/

Nitrogen level %	Energy level Kcal/Kg	Average daily gain, Kg	
		1 feeding	3 feedings
1.75	2200	$.30^{ab}$	$.38^{b}$
	2640	$.42^{b}$	$.44^{b}$
2.25	2200	$.16^{a}$	$.44^{b}$
	2640	$.48^{b}$	$.50^{b}$
Average of N Levels			
	1.75%	$.36^{c}$	$.41^{c}$
	2.25%	$.32^{c}$	$.47^{c}$
Average of Energy Levels			
	2200 Kcal/Kg	$.23^{d}$	$.41^{e}$
	2640 Kcal/Kg	$.45^{e}$	$.47^{e}$
Average of Times of Feeding		$.34^{f}$	$.44^{g}$

1/ Any values with the same superscript are not significantly ($P < 0.05$) different, main effects comparisons are differences between levels with each main effect.

3 times per day caused a significant ($P < 0.05$) increase in average daily gain over the once a day feeding. Animals fed 3 times daily gained 0.44 kilograms daily while those fed once daily gained 0.34 kilograms. This difference was primarily due to response of animals receiving the low level of energy and fed once daily. The heifers receiving the high protein-low energy diet fed once a day gained 0.16 kilograms per day which was significantly less than all others. This would indicate that available energy was not adequate for proper utilization of the urea supplied in the one time daily feeding. However, calves on this same ration gained 0.44 kilograms per day when the supplement was fed 3 times each day, suggesting better use of the urea. The number of times fed did not affect performance when the high level of energy was fed with the 2.25% level of nitrogen.

Level of nitrogen had no significant effect on rate of gain. The average gains were 0.38 and 0.39 kilograms daily for the heifers receiving the 1.75 and 2.25% nitrogen levels, respectively. Energy levels apparently limited gains to the extent that any effect there may have been from additional protein was masked. However, the 1.75% nitrogen diet should have supplied adequate nitrogen to meet the growth requirement for that class of animal (N.R.C., 1958).

Feed efficiency, as would be expected, followed the same pattern as daily gains. There was no apparent difference in feed efficiency resulting from feeding either once or 3 times daily. Rate of gain was apparently the primary factor involving feed efficiency, with the better gaining animals being the most efficient since maintenance was relatively constant.

Results of the digestion and balance trial are presented in table 3. Nitrogen digestibility was significantly increased by the higher level of energy in the ration, but was not affected by the number of times fed each day. However, the sheep fed 3 times daily had significantly greater nitrogen balances than those on the same diet but fed only once daily. Nitrogen balance was not significantly affected by level of energy. The sheep used in the trial had been on a maintenance diet prior to the trial so the positive nitrogen balance was expected.

SUMMARY

Thirty-two Hereford heifer calves were used in a 2^3 factorial trial to compare the effects of feeding urea containing rations once a day or 3 times a day with two levels of nitrogen and two levels of energy. Nitrogen levels were 1.75 and 2.25% of the total ration and energy levels were calculated to be 2200 and 2640 Kcal/Kg of digestible energy.

Digestibility and balance trials were conducted with sheep on the high protein diet with each level of energy and once and three times per day feeding.

The animals on the higher level of energy gained significantly more than those on the lower level, but level of nitrogen, within the range tested, had no significant effect on animal performance.

Table 3. NITROGEN DIGESTIBILITY AND DAILY NITROGEN BALANCE OF SHEEP FED THE HIGH NITROGEN DIET WITH EACH LEVEL OF ENERGY ONCE AND THREE TIMES DAILY. 1/

Diet	Times fed/day	Nitrogen digestibility	Nitrogen balance
		%	g
High nitrogen-low energy	1	60.4[a]	3.3[c]
	3	60.8[a]	7.4[d]
High nitrogen-high energy	1	67.0[b]	4.5[c]
	3	69.2[b]	7.6[d]

1/ Any values with the same superscript are not significantly different ($P < 0.05$)

Animals fed the urea supplement three times per day gained significantly more than animals receiving all of their supplement once a day. The heifers receiving the low level of energy and fed once a day gained significantly less than all others. The number of times fed did not effect performance when the high level of energy was fed with the high level of protein.

Nitrogen digestibility was significantly greater with those fed the higher level of energy, but was not affected by the number of times fed daily. All animals were in positive nitrogen balance during the digestion trials. Feeding the urea mixture 3 times per day increased nitrogen balance over those fed once daily.

LITERATURE CITED

Anderson, G.C., G.A. McLaren, J.A. Welch, C.D. Campbell, and G.S. Smith. 1959. Comparative effect of urea, uramite, biuret, soybean protein, and creative on digestion and nitrogen metabolism in lambs. J. Animal Sci. 18:134.

Belasco, I.J. 1954. Comparison of urea and protein meals as nitrogen source for rumen microorganisms. Urea utilization and cellulose digestion. J. Animal Sci. 13:739

Belasco, I.J. 1955. The role of carbohydrates in urea utilization, Cellulose digestion, and fatty acid formation. J. Animal Sci. 14:1193.

N.R.C. 1958. Nutrient Requirements of Farm Animals, No. 4 Nutrient Requirements of Beef Cattle. National Research Council, Washington, D. C.

Raleigh, R. J. and Joe D. Wallace. 1963. Effect of urea at different nitrogen levels on digestibility and on performance of growing steers fed low quality flood meadow roughage. J. Animal Sci. 22:330.