Table 3. Nitrogen retention by steers receiving urea at various intervals

Item	Urea administration interval				
	No Urea	Rapid	Moderate	Continuous	SE[a]
Nitrogen intake, g/day[b]	23.2	60.4	60.2	60.4	.80
Nitrogen excretion, g/day					
Fecal[c]	20.7	24.0	23.7	24.2	.86
Urinary[b]	9.8	25.1	24.3	23.9	1.86
Nitrogen retention, g/day[b]	−7.1	11.4	12.2	12.4	1.58

[a]Standard error of the mean.
[b]Mean of urea treatments differs statistically from no urea ($P<.01$).
[c]Mean of urea treatments differs statistically from no urea ($P<.05$).

proved performance of range cows fed the slow release compound discussed elsewhere in this report.

Range Studies With A New Slow Release Urea Compound

O. Forero, F. N. Owens, P. Leme and K. S. Lusby

Story in Brief

A new slow release urea compound (SRU) which had previously been shown to attenuate ruminal ammonia release and reduce the potential for urea toxicity was evaluated in range supplements in two wintering trials. Seventy-eight pregnant Hereford cows were fed 2 lb/head/day of supplements with 15 or 40 percent all natural protein, 40 percent protein supplements with SRU furnishing 62.5 percent of the protein equivalent (one SRU supplement was pelleted, one was fed in meal form) and a 40 percent protein supplement in which urea furnished 62.5 percent of the protein equivalent. Weight changes for the 60-day trial were 9.9, 66.3, 59.0, 57.9 and 13.8 lb for the 15 and 40 percent all natural, 40 percent SRU (pellet and meal) and urea respectively. In a second wintering study, 85 lactating Hereford cows were individually fed five supplements consisting of 2.7 lb/head/day of 15 and 40 percent all natural protein, 40 percent protein (SRU meal form), 40 percent protein (urea) and a

20 percent protein supplement with urea but fed at twice the rate as the 40 percent supplements. Supplements were fed six times each week with all cows grazing a common pasture. Cow weight changes for the 92-day period were: −198.4, −78.6, −151.1, −172.1 and −172.0 for 15 and 40 percent all natural, 40 percent SRU, 40 percent urea and 20 percent urea supplements, respectively. Calf gains followed the same trend as cow weight changes with calves of SRU cows gaining significantly more than calves of urea or 15 percent natural protein fed cows. Calf gains for these groups were 78.3, 101.2, 88.1, 74.5 and 73.4, respectively. Improved palatibility of urea in the SRU form was evident with the individually fed cows. No SRU or natural protein supplements were refused while cows fed urea supplements consumed only about 61 percent of their supplement. Rebreeding performance was poorest for 15 percent natural fed cows and highest for 40 percent natural with urea and SRU cows intermediate. Samples of rumen fluid showed that SRU produced a ruminal ammonia level at one hour after feeding similar to that of soybean meal. Ammonia peaks of the urea supplements were 2 to 2.5 fold that of SRU at 1 hr.

Introduction

Urea has probably been as extensively researched as any other known feedstuff. Even so, a satisfactory urea compound for feeding to ruminants consuming high roughage diets is still unknown. One problem with urea is the rapid hydrolysis of urea to ammonia in the rumen producing excess ammonia shortly after feeding with toxicity being a well known consequence of a overfeeding error involving urea supplements. A new commercially prepared slow release urea compound (SRU), developed by NIPAK Corporation was shown in laboratory and metabolism studies to produce a slow, sustained release of ammonia in the rumen. Further SRU was shown to be much safer than urea in a toxicity study with steers.

The objective of these trials was to evaluate winter performance of pregnant and lactating Hereford cows when fed SRU, urea and natural protein supplements.

Materials and Methods

Range cow trials

Seventy-eight mature pregnant and 85 mature lactating Hereford cows were used in two winter trials on native tallgrass range in Central Oklahoma. Little bluestem (*Andropogon scoparius*), big bluestem (*Andropogon gerardi*), Indian grass (*Sorgastrum nutans*) and switch grass (*Panicum virgatum*) were the principal forage species.

Pregnant cows were randomized by weight and group-fed five supplemental protein treatments, (1) 15 percent natural protein (negative control), pelleted, (2) 40 percent natural protein (positive control), pelleted, (3) 40

percent crude protein, 62.5 percent of the crude protein equivalent from SRU, pelleted, (4) same as 3 except fed in meal form and (5) 40 percent crude protein, 62.5 percent of the crude protein equivalent from prilled urea. Supplement compositions are shown in Table 1. Supplements were fed in bunks at the rate of 2 lb/head/day prorated for feeding 6 days per week. Cows were rotated bi-weekly among five pastures of approximately 120 acres each. The wintering period extended 60 days from November 15 to January 14.

Lactating cows were randomized by weight and individually fed five supplements in covered stalls. All individually fed cows were grazed in a single pasture and gathered at 8 am, 6 days per week for supplement feeding. Supplemental treatments and pounds of supplement per head per day were (1) 15 percent natural protein (negative control), 2.7 lb, (2) 40 percent natural protein (positive control), 2.7 lb, (3) 40 percent crude protein, 62.5 percent of the crude protein equivalent from SRU, 2.7 lb (4) 40 percent crude protein, 62.5 percent of the crude protein equivalent from urea, 2.7 lb and (5) 20 percent crude protein, 62 percent of the crude protein equivalent from urea fed at twice the rate of supplement 4 so that both 4 and 5 were isonitrogenous but 5 contained twice the energy of 4.

Individually fed cows were visually scored for degree of fatness at the beginning and end of the experimental period (November 15 - February 15). A scale of 1-10 was used with 1 equal to very thin to 10 being very fat.

All cows were weighed after overnight shrink away from feed and water. Calves of the individually fed cows were weighed at the end of the trial period following 6 hr separation from their dams. Samples of ruminal fluid from individually fed cows were drawn for ammonia analysis at 1 and 4 hr after supplement feeding in mid-January.

Individually fed cows were artifically inseminated for a 30-day period (January 2 - February 1) and exposed to a bull for a further 15 days (February 2 - February 17). Estrus was detected using chin-ball markers with sterile teaser bulls during the artifical insemination period and with breeding bulls during the subsequent period. Pregnancy was determined by rectal palpation approximately 60 days after termination of the breeding season.

Results and Discussion

In range studies with pregnant cows SRU was fed in either meal or pelleted supplements to evaluate the effects of pelleting damage to the coating on performance of cows. The trial was terminated in mid-January due to drought conditions which made equal forage availability across pastures impossible after late January.

No feed refusals were noted for any of the supplements during the trial (Table 2). Cows fed the 40 percent protein soybean meal supplement gained more ($P<.05$) weight than cows fed 15 percent protein supplement. Weight gains of cows fed SRU in meal or pellet form performed identically, suggesting

Table 1. Ration compositions

Ingredient	40% natural protein	15% natural protein	40% crude protein (SRU)	40% crude protein (prilled urea)	20% crude protein (prilled urea)
Corn, rolled		53.80	43.30	43.60	69.50
Alfalfa hay, ground	5.00	15.00	15.00	15.00	7.50
Cottonseed hulls	5.00	10.00			11.00
Soybean meal	85.25	16.90	19.10	19.40	
Cane molasses			6.00	7.00	4.00
Salt, trace mineralized					
Limestone					
Dicalcium phosphate	.50	.89	1.00	1.00	1.00
NaH_2PO_4	2.20	2.70	2.70	2.70	1.35
Na/SO_4	2.10	.75	2.35	2.35	1.17
Trace mineral premix	.05	.05	.05	.05	.05
Urea				8.90	4.50
Slow release urea			10.50		
Vitamin A (30,000 IU/gm) 7-05-143	.12	.12	.12	.12	.12

Table 2. Weight changes, pregnant cows, group fed

Protein source	Soybean meal		SRU		Urea
Protein level, %	15	40	40	40	40
Form of supp	pellet	pellet	pellet	meal	pellet
No. of cows	15	16	16	15	16
Supp intake, lb	2	2	2	2	2
Cow wt change, lb (60 days)	9.9[b]	66.3[a]	59.0[a]	57.9[a]	13.8[b]

[a, b]Means on a line with the same superscript letter do not differ ($P<.05$).

that coating damage during pelleting did not affect cow performance. Both SRU groups gained slightly less than the 40 percent soybean meal fed group, indicating that SRU was well utilized by the pregnant cows. Gains of cows fed the uncoated prilled urea supplement were lower ($P<.05$) than for cows fed SRU or the positive control. The poor performance observed for prilled urea is consistent with previous work at this station (Rush and Totusek, 1975; Rush *et al.*, 1976; and Rush and Totusek, 1976).

Improved palatibility of urea in the coated form was evident with the individually fed lactating cows. No feed refusals of soybean meal protein or SRU supplements were noted, whereas cows fed uncoated prilled urea consumed about .15 lb urea per day regardless of the urea (or energy) level of the supplement. Refusal of the uncoated urea supplements made comparison of urea supplements to SRU and natural protein supplements difficult since nitrogen intake was lower with the uncoated urea treatments than for the other

groups. Yet results are indicative of expected animal performance from such supplements. Poor palability of urea has been widely reported.

Lactating cows fed the 40 percent protein soybean meal supplement lost less ($P<.05$) weight during the 92-day feeding period than the 15 percent protein supplement or the urea supplements (Table 3). Feeding slow release urea resulted in less weight loss ($P<.05$) than the 15 percent protein supplement, but weight loss of cows fed SRU or urea was still excessive. Cows fed the 40 percent protein soybean meal supplement also lost less condition ($P<.05$) during the 92-day period than all other treatments. Cows fed SRU tended to lose less condition ($P<.10$) than urea-fed cows, in agreement with weight loss patterns. These results suggest that while SRU may be adequate to meet the ruminal ammonia deficiency of dry pregnant cows, total protein supply remains inadequate for lactation. Satter *et al.* (1977) concluded high producing dairy cows should not be fed non-protein nitrogen during early lactation since their protein requirement greatly exceeds the potential microbial protein synthesis. Results from this study suggest a similar situation for lactating beef cows grazing low-quality low-protein forage. The fact that cows fed the 20 percent crude protein supplement lost almost the same amount of weight as cows fed the 40 percent crude protein supplement with uncoated urea rejects the hypothesis that additional energy improves urea utilization as measured by weight change under range conditions.

Of the 17 cows fed the 40 percent protein soybean meal supplement, all exhibited estrus and 16 were determined pregnant 60 days after termination of breeding. Of the cows fed 15 percent protein only 9 showed estrus and only 7 became pregnant during the same period. Among the urea treatments, higher pregnancy rates ($P<.05$) and frequencies of estrus were seen for cows fed the 40 percent crude protein supplement with uncoated urea. The higher estrus incidence and pregnancy rate for urea-fed cows is difficult to explain in view of the high and similar heavy weight losses seen with all three urea treatments. The number of days to first estrus during the breeding period was similar among all five treatments.

Calf gains were higher ($P<.05$) for calves of cows fed SRU than those of dams fed urea or the negative control, but less ($P<.05$) than gain of calves from the positive control group. This suggests that SRU may have been more effective in maintaining milk production than uncoated urea.

One hour after supplement feeding, rumen ammonia levels of cows fed SRU were slightly (non-significant) higher than for cows fed the 40 percent protein supplement containing soybean meal. Rumen ammonia levels of urea-fed cows were about 2 to 2½ times greater than for SRU-fed cows at one hour post feeding. At four hours post feeding, SRU produced rumen ammonia levels almost identical to those of the 40 percent protein soybean meal supplement but higher ($P<.05$) than for the 15 percent protein supplement. Urea supplement tended to produce higher levels of rumen ammonia than SRU at 4

Table 3. Cow and calf performance, individually fed cows

Protein source	Soybean meal		SRU		Urea
Protein level, %	15	40	40	40	20
Supp intake lb/day	2.7	2.7	2.7	1.6	3.4
Cow wt, initial, lb	946	946	942	944	935
Total wt loss, lb (92 days)	-192.4^{c}	-78.6^{a}	-151.1^{b}	-172.1^{b}	-172.0^{b}
Total calf gain, lb	78.3^{c}	101.2^{a}	88.1^{b}	74.5^{c}	73.4^{c}
Cow condition change[1]	−3.5	−1.6	−3.0	−3.3	−3.4
Cows showing estrus	9^{c}	17^{a}	12^{bc}	15^{ab}	10^{bc}
Cows pregnant[2]	7^{b}	16^{a}	8^{b}	13^{ab}	9^{b}
Rumen ammmonia, Mg %, 1 hr post feeding	4.8^{a}	6.2^{ab}	10.4^{b}	25.0^{d}	18.3^{c}
Mg %, 4 hr post feeding	2.7^{a}	7.2^{b}	7.3^{b}	10.3^{b}	9.2^{b}

a, b, c, d Means on a line with the same superscript letter do not differ ($P<.05$).
[1]Scale: 1 = very thin-10 = very fat.
[2]Determined by rectal palpation 60 days after breeding season.

hr post feeding also, showing that SRU did indeed slow the hydrolysis of urea in the rumen.

These results, along with previous studies with SRU (Lusby *et al.*, 1977) show that SRU does reduce the rate of urea hydrolysis, reduce toxicity and improve palatibility of urea in feeds. However the mechanism for improved animal performance seen in these two trials is not completely understood. Results of simulated slow release by Mizwicki *et al.*, (elsewhere in this publication) suggest that slow ammonia release does not improve dry matter intake or digestibility of this type roughage. If this were the case with the range trials as well, the improved performance seen with SRU may have been the result of greater and more uniform nitrogen intake or possibly alleviation of subclinical ammonia toxicity from the high ruminal ammonia peaks seen with urea. Further work is continuing.

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Feather Meal As A Protein Source For Range Cows

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Story in Brief

Hydrolyzed feather meal (HFM), a treated by-product of the poultry industry was compared to soybean meal as a protein source for 64 dry, pregnant beef cows grazing dormant, native range in winter. Feather meal furnished approximately one-half the protein in supplements containing 15 or 40 percent crude protein. The trial was conducted for 85 days from November 15, 1976 to February 8, 1977. Cows were group-fed in bunks and rotated among pastures at 2-week intervals. Weight gains were similar for HFM and soybean meal supplements although HFM fed cows tended to gain more than soybean meal fed cows at the 15 percent protein level and less than soybean meal fed cows at the 40 percent protein level. Some palatability problems were encountered at the highest HFM level with 2 of 16 cows in that group refusing to eat supplement. Gain differences between 40 percent and 15 percent protein levels were highly significant, indicating that protein was limiting in this study. Weight gains between HFM and soybean meal supplemented groups were similar although HFM produced a glossier hair coat than soybean meal.

Introduction

The high cost of the traditional plant proteins for cattle supplements has stimulated much research into alternative protein sources. Unfortunately years of research with NPN and other substitutes have not produced satisfactory results.