A Comparison of Cottonseed Meal and Urea in Low Protein Winter Range Supplements for Cattle

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Story in Brief

One hundred and ninety grade Angus cows, bred for spring calving, were used to compare urea and cottonseed meal in low protein supplements, when these were fed to beef cows grazing native range forage during the winter season.

Animals fed the cottonseed meal supplement lost less weight and were in better condition at the end of the supplemental feeding period. Differences in weights and condition changes from November 1 to September 26 were small, but tended to favor cows receiving the cottonseed meal. Treatments did not affect birth weights of calves. Dams which had received the cottonseed meal during the winter season weaned calves which averaged twelve pounds heavier than those receiving urea.

Treatments did not affect blood levels of calcium, magnesium, copper, zinc or urea, but animals receiving the urea supplement had higher levels of phosphorus and ammonia. The supplements were also fed to steers, which were equipped with permanent rumen fistulae, and which permitted sampling of rumen fluid at various times after the rations were fed. Higher ruminal fluid ammonia levels were found in those fed the urea-containing supplement.

These results indicate that the level of urea was too high for this type of urea-containing ration.

Introduction

For many years ranchers have fed cottonseed and soybean meals to supply protein to cattle kept on low-protein forages during the winter season. However, the rapid increase in world population has increased the demand for oil meals in human nutrition and thereby has decreased the supply of these products for ruminant nutrition. Therefore, the need for protein substitutes in ruminant nutrition is becoming acute.

Urea can be made from the products of air, and economics would indicate a wider usage of it in ruminant rations. Research results indicate that urea has high value as a protein substitute in ruminant fatten-

ing-type rations; however, urea-containing supplements have not been well-utilized when fed to cattle consuming high levels of low-quality roughage.

The purpose of this study was to compare a urea-containing supplement to an isonitrogenous one containing cottonseed meal when both were fed to beef cows grazing native range forages during the winter season.

Experimental Procedure

Trial 1.

One hundred and ninety grade Angus cows, bred for spring calving, were divided into two equal groups on the basis of initial weight, age, and sire-test group. Each of these groups was then further subdivided into two groups and four groups were fed their assigned rations from November 5, 1966, until April 25, 1967. Two locations on the north side of the Lake Carl Blackwell Range area were utilized with both rations being fed at each location. Animals on the different treatments within a location were rotated among the pastures in an attempt to minimize the effect of pasture upon animal performance.

Each cow received three lb. per day of its assigned ration from November 5 until parturition, at which time her ration was increased to four pounds per day, the level fed until April 25. All animals were fed the supplements (Table 1) daily during the feeding period. In addition, a poor quality grass hay was fed when snow covered the forage.

Each cow was weighed at the beginning of the experiment, when supplemental feeding was discontinued, and when their calves were weaned. The calves were weighed within 24 hours after birth, when supplemental feeding was discontinued, and again when weaned. Condition scores were assigned to each cow at the initiation of the experiment, when the supplemental feeding period ended, and again when the calves were weaned. A score of one was assigned, arbitarily, to animals in the poorest condition of flesh, while those animals in better condition were assigned higher scores, up to a score of nine for those showing the highest condition in the groups.

Five animals were randomly selected from each subgroup on March 1, 1967, and blood samples were taken from each of these animals 2 hours after feeding. The plasma of each sample was analyzed for its content of calcium, phosphorus, magnesium, copper, zinc, ammonia and urea.

Table 1. Percentage Composition of Rations[1]

Treatments	Ration 1	Ration 2
Ingredients		
Ground milo	48.0	74.5
Alfalfa meal	5.0	5.0
Molasses	5.0	5.0
Wheat bran	5.0	5.0
Cottonseed meal	32.0	---
Trace minerals—salt[2]	3.0	3.0
Diammonium phosphate	1.0	1.0
Dicalcium phosphate	1.0	1.5
Vitamin A[3]	---	---
Urea	---	4.0
Sodium phosphate	---	1.0
TOTAL	100.0	100.0
Chemical Analysis		
Crude protein	20.8	21.0
Calcium	0.42	0.45
Phosphorus	1.00	1.00

[1] Feeds ground and pelleted into three-quarter inch diameter pellets.
[2] To each 100 pounds of diet was added the following mineral salts in grams: NaCl, 1296.2; $CoSO_4.7H_2O$, 0.4; $CuSO_4.H_2O$, 3.7; $FeSO_4.7H_2O$, 41.3; $MnSO_4.H_2O$, 5.6; K. I. 0.02; and $ZnSO_4.H_2O$, 13.6.
[3] Each pound of supplement contains 10,000 I.U. of vitamin A palmitate.

All cows were allowed to graze the indigenous green forage in two different locations during the subsequent spring and summer, allotment to the locations being made on the basis of winter treatment and sire group. The cows were rebred starting on May 1 and ending Aug. 1. In order to determine the possible effect of previous winter rations upon reproductive performance, the subsequent date of calving as well as the weight of the calf were obtained on all cows.

Trial 2.

Steers, equipped with permanent rumen fistulae, were used to determine the effect of the two rations, which were used in the first trial (Table 1), upon ruminal fluid ammonia levels. The trial consisted of two parts: In the first part, six steers, three per treatment, were given their assigned rations for 10 days in order that they might adjust to the supplements. Food was removed for 36 hours and they were then fed four lb. of the assigned supplement and eight lb. of poor-quality grass hay. Rumen fluid samples were taken zero, 30, 60, 90, 120, 180, 240, 300, 360, 480, 600 and 720 min. after feeding and analyzed for their ammonia contents.

In the second part, four fistulated steers, two per treatment, were used. Feeding, management, and sampling of the animals were the same as described in the first part of the trial except no fasting period preceded the feeding and sampling of the rumen fluid.

Results and Discussion

The performances of the cows in trial 1 are shown in Table 2. Animals receiving the cottonseed meal supplement lost less ($P<.005$) weight during the winter feeding period and were in better ($P<.005$) condition of flesh when the season ended.

Weight changes and condition scores during the total period from November 1, 1966, to September 1, 1967, were small; however, both measurements apparently favored the cows which received the cottonseed meal. The cows did not consume the urea-containing supplement readily and on some days they did not consume all of the supplement for several hours after feeding. In contrast those receiving ration 1 consumed the feed within a very short time after feeding.

Neither birth weight nor weaning weight of the calves was affected significantly by winter feed; however, there appeared to be a trend in favor of the calves from mothers receiving the cottonseed meal-containing supplement. Winter treatments did not affect the subsequent calving dates or birth weights.

Blood values on samples taken from five cows in each subgroup are shown in Table 3. As location had no effect ($P>.05$) on any mineral, each value in Table 3 represents the average values from 10 cows. Rations did not affect ($P>.05$) serum levels of calcium, magnesium, copper, zinc or urea. However, the animals receiving the urea-containing supplement contained higher levels ($P<.005$) of both ammonia and phosphorus. The higher phosphorus level in cows receiving the urea-containing supplement has two plausible explanations: (1) The forage in one pasture contained a higher level of phosphorus than the

Table 2. The Effect of Protein Supplements on Performance of the Cows

Item	Diet		SE[1]
	Ration 1 CSM	Ration 2 urea	
Weight change, winter[2]	—80.4	—124.3	7.1
Condition change, winter[2]	— 1.5	— 2.1	0.13
Weight change, total[3]	9.6	— 14.1	12.7
Condition change, total[3]	— 0.52	— 0.83	0.17
Birth weight of calves[4]	63.9	62.9	1.4
Weaning weight of calves[5]	469.4	457.9	7.1

[1] Standard error of treatment means.
[2] The winter feeding period was from November 5 to April 25.
[3] The total period was from November 1, 1966, to September 26, 1967.
[4] Corrected for sex by multiplying the heifer weight by 1.048.
[5] Corrected for 205 day weaning weight by formula (ADG × 205 + birth weight), and corrected for sex by multiplying the heifer weight by 1.059.

Table 3. Effect of Protein Supplements upon Blood Serum Constituents of the Cows

Item	Diet		SE[1]
	Ration 1 CSM	Ration 2 urea	
Constituents			
Number of cows	10	10	
Calcium (mg/100 ml.)	11.10	10.75	.185
Phosphorus (mg./100 ml.)	6.79	8.18	.230
Magnesium (mg./100 ml.)	2.61	2.59	.044
Copper (ppm)	0.80	0.77	.034
Zinc (ppm)	0.80	0.79	.061
Ammonia (mg./100 ml.)	1.56	2.05	.095
Urea (mg./100 ml.)	5.14	7.16	1.09

[1] Standard error of treatment means.

other three pastures and one group of cows from those fed the urea-containing diet were in this pasture when blood samples were obtained. (2) The urea-containing diet contained a higher proportion of inorganic phosphorus than the other diet.

The higher blood ammonia values in cattle fed urea were expected: Urea is readily hydrolyzed by microbial urease present in ruminal

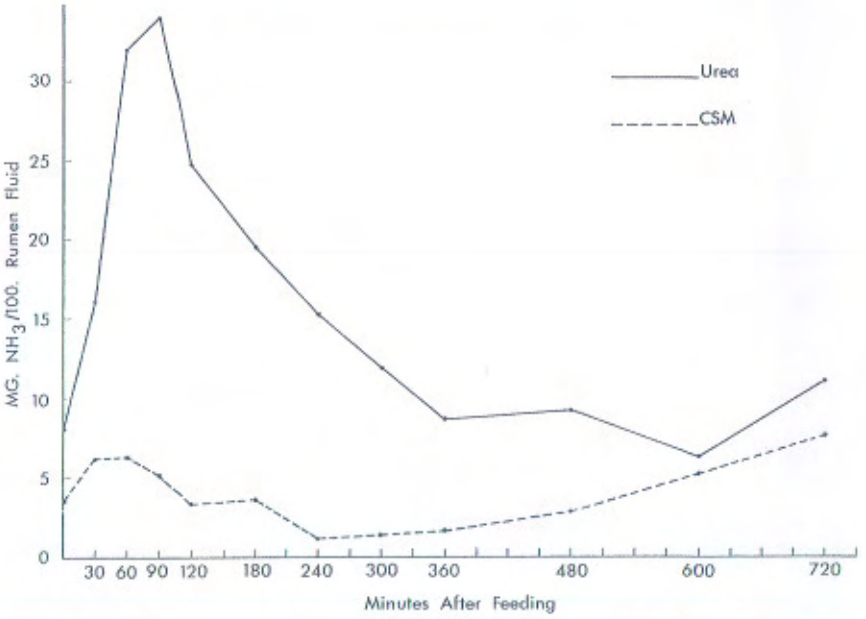

Figure 1. The effect of protein supplement on ammonia concentration in rumen fluid of steers.

fluid to ammonia and carbon dioxide. If there are sufficient carbon fragments (alpha keto acids) from carbohydrate origin present, the ammonia is incorporated into microbial protein. However, if there is not a sufficiency of the carbon fragments present, the ammonia crosses the rumen wall and goes into the blood. These results indicate combination of weathered range grass and the supplement did not provide enough carbon fragments and that much of the urea nitrogen provided in ration 2 was wasted.

Ruminal fluid ammonia values of trial 2 are shown in Table 4 and these values were greater ($P<.005$) in animals which had received the urea-containing ration. These values along with the blood ammonia values of Trial 1 indicate that protein synthesis in animals consuming the urea-containing supplement was low. For this reason greater weight loss and a poorer condition was found in these animals as compared to those fed the cottonseed meal-containing supplement.

These results support the idea that the level of urea in ration 2 was too high. Missouri workers have shown by use of artificial rumen

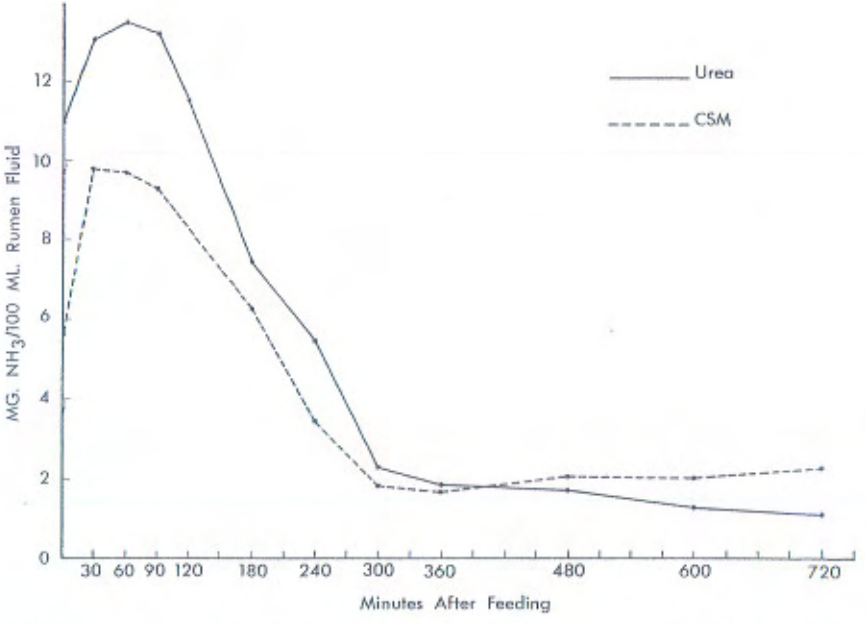

Figure 2. The effect of protein supplements on ammonia concentration in rumen fluid of steers fasted 36 hours prior to feeding and sampling.

Table 4. The Effect of Protein Supplements on Ammonia Concentrations in Rumen Fluid

	Diet		
	Ration 1	Ration 2	SE[1]
36 hour fasting (mg./100 ml.)	5.2	7.0	0.30
Non fasting (mg./100 ml.)	4.0	16.0	1.8

[1] Standard error of treatment means.

studies that a ratio of 55 parts of carbohydrate is needed for optimum protein synthesis when urea is the sole source of dietary nitrogen. As feed grade urea contains about 45 percent nitrogen, these results would indicate that a ratio of about 25 parts of NFE to one part of urea is needed for optimum urea utilization. More importantly, the NFE of weathered range forage is slowly hydrolyzed, thus it is doubtful if the NFE contained in these feeds is of much value for furnishing the carbon fragments needed for protein synthesis in the rumen. If this is true, all of the required NFE for protein synthesis must be included in the urea-containing supplement. This, of course, would place the upper level of urea in most range supplements to around two percent.

These results of the present experiments offer a possible explanation as to why Nelson and coworkers of this station never obtained good urea utilization when urea-containing supplements were fed to range cows.

The Association Between Sex and Certain Lamb Carcass Characteristics

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Story in Brief

Differences in economically important live animal and carcass characteristics were observed between sexes in lambs. Ram lambs grew faster, reached slaughter weight at an earlier age, had higher daily gains throughout life and produced more muscle and bone in a shorter period of time than wether and ewe lambs. Ewe lambs grew slower, thus re-