Ruma Pro®

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Ruma Pro®

Introduction to Ruma Pro

Ruma Pro is an innovative product being introduced to the livestock industry as a source of slow release non-protein nitrogen (NPN) and highly digestible calcium for ruminant animals.

Ruma Pro is a stable liquid solution of highly digestible calcium bound urea, manufactured by Unipro International, Inc. through a licensing agreement with Nutri Source, Inc.

This technology provides new safety, efficiency, and labor savings to the livestock industry.

Ruma Pro®

Product Analysis

(For Ruminants Only)

Feedyard, dairy and other confinement fed animals as well as pasture grazing animals can be fed Ruma Pro as part of a complete ration or as an ingredient in a complete supplement.

CAUTION: Use only as directed.

Guaranteed Analysis:

Crude Protein, minimum	143.0%
Equivalent Crude Protein from NPN, minimum	143.0%
Nitrogen, minimum	23.0%
Crude Fat,minimum	0.0%
Crude Fiber, maximum	0.0%
Calcium, minimum	6.8%
Calcium, maximum	7.1%
Moisture, maximum	30.0%

Ingredient Statement:

Calcium Chloride, Urea ***(clear liquid solution)***

Directions for Feeding:

Add 14 pounds per ton (0.7%) Ruma Pro concentrate by weight to a complete feed ration for each one percent (1.0%) increase in crude protein desired. Completely mix ration after concentrate is added to other feed ingredients. Ration must contain sufficient carbohydrates to utilize the NPN by the type and age of animals being fed. In rations above 16% crude protein or when feeding young animals, a knowledgeable animal nutritionist should be consulted before feeding.

CAUTION:

1. Always provide an adequate supply of clean, fresh drinking water.
2. Never add Ruma Pro to drinking water.
3. Never feed Ruma Pro as a single feed ingredient.
4. Do not feed Ruma Pro to horses or other monogastric animals.
5. Use good feed management practices when starting new, very hungry, and/or starved cattle or sheep on rations or supplements containing NPN.
6. Use only as directed.

Because of the concentrated amount of NPN in this ingredient, seller warranties the analysis and limits the guarantee to percentages as stated on the label. The management and use of this product are beyond our control.

Urea and NPN

The most common NPN source used in ruminant feeding is urea.

Benefits of Urea

1. Low cost form of nitrogen (N x 6.25 = CP).
2. Efficient source of nitrogen in high energy diets.
3. Not negatively influenced by commodity or protein price fluctuations.
4. Provides ammonia, which improves rumen microbial growth efficiency.

Limitations of Urea

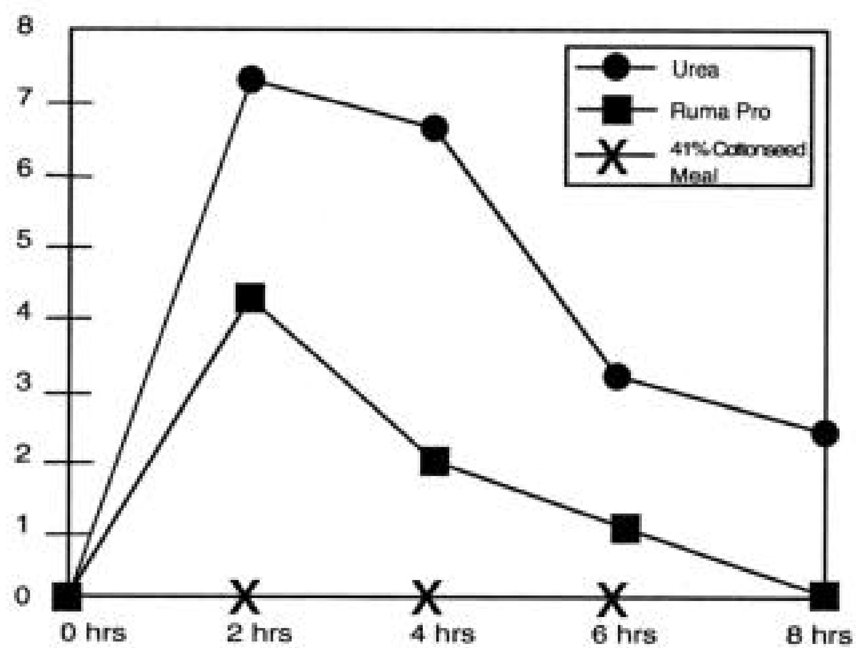
- Toxicity.
- Because of the rapid release of ammonia associated with urea, toxicity and death loss can occur.
- Due to the toxic potential, the amount of urea that can be included in feeds is limited.
- Poor utilization in low energy diets.
- Microorganisms must have energy and carbohydrates to use urea to make a protein. In low energy diets, the efficiency of urea decreases.

Ruma Pro®

Ruma Pro as a preferred source of Nitrogen

Ruma Pro is a stable liquid solution of calcium bound urea. The calcium and urea are released slowly enough to efficiently supply calcium and ammonia for an eight (8) to twelve (12) hour period after feeding. For the first time producers can have a liquid feed solution that releases NPN slowly enough to supply the rumen microflora with adequate NPN to breakdown organic matter and synthesize protein over the normal digestion period. The slow release of ammonia should eliminate the problem of urea toxicity if reasonable feeding practices are followed.

The graph below illustrates the release rate of ammonia from feed grade urea, Ruma Pro, and cottonseed meal. Data is from in vitro studies conducted at Texas Tech University of Lubbock, Texas in 1994.



In vitro digestion tests results at Texas Tech University yielded data that Ruma Pro released ammonia significantly slower than feed grade urea, and faster than 41% cottonseed meal. (See graph) (Ref. Study A- Tech Report No. T-5-342, 1994)

Ruma Pro was utilized as a protein source similar to urea and cottonseed meal as indicated by a digestibility and nitrogen retention trial conducted by Texas Tech University. (Ref. Study B – Tech Report No. T-5-342, 1994)

These studies help to substantiate the fact that Ruma Pro's slow release mode of action greatly reduces the potential for toxicity and increases microbial efficiency.

Calcium Availability

The calcium source used in Ruma Pro is more available to the animal than either calcium carbonate or dicalcium phosphate.

The following table represents the biological values for various calcium sources.

Source	Biological Value
Alfalfa Hay	74
Calcium Carbonate (Limestone)	88
Dicalcium Phosphate	116
Ruma Pro Calcium Source	128

Ref. S.L. Hansard - University of Tennessee, 1973

Higher calcium availability improves efficiency and performance while reducing the handling difficulties associated with other calcium sources.

Ruma Pro®

Ruma Pro is a patented liquid solution of highly digestible calcium bound urea.

Ruma Pro has several physical and mechanical attributes that add to its desirability as a feedstuff:

- Remains a manageable liquid solution from -70 to 285 degrees F.
- Blends readily with molasses, corn steep and all other solutions or suspensions tested to date.
- May be used in pellets, cubes, pressed blocks, poured blocks, and liquids.
- Can be stored for a long period of time because it is a very stable solution.
- Low corrosiveness and has pH of approximately 7.5.
- Ruma Pro is slightly tacky and helps bind fines in dry rations.
- It is a safe product for humans to handle.
- Has no known carcinogens.
- Has 69.6% solids to reduce excess moisture in liquid or dry feeds.
- 11.2 pounds per gallon.
- Soluble liquid calcium minimizes the problems associated with high calcium suspensions.

Guaranteed Analysis:

Crude Protein, minimum	143.0%
Equivalent Crude Protein from NPN, minimum	143.0%
Nitrogen, minimum	23.0%
Crude Fat,minimum	0.0%
Crude Fiber, maximum	0.0%
Calcium, minimum	6.8%
Calcium, maximum	7.1%
Moisture, maximum	30.0%

Texas Tech University Agricultural Sciences and Natural Resources
Technical Report No. T-5-342, 1994

IN VITRO AMMONIA RELEASE FROM UREA/CALCIUM COMPOUNDS AS COMPARED TO UREA AND COTTONSEED MEAL

J. L Cass and C. R. Richardson

SUMMARY

Two slow release urea/calcium products were evaluated for ammonia release. Four nitrogen sources (cottonseed meal, urea, 23-0-0-7 and 10-0-0-11) were mixed with corn starch or ground corn to produce in vitro substrates containing 10 and 14% crude protein. Each substrate was digested separately in 250-ml incubation flasks and sampled for ammonia determination after 2, 4, 6, 8, 16, and 24 h. Means for ammonia concentration ranged from 0 mg/dL (cottonseed meal) to 72.99 mg/dL (urea). Differences ($P < .05$) were observed among all products and within time period.

INTRODUCTION

Urea is the most commonly utilized nonprotein nitrogen (NPN) source for cattle feeding. However, urea is rapidly broken down for microbial protein synthesis in the rumen, resulting in immediate ammonia release for microbial protein synthesis, but excess ammonia is absorbed and can cause toxicity. Two of the NPN products used in this study were composed of 23-0-0-7 and 10-0-0-11 N, P, K, and Ca, respectively. The nitrogen source contained in these products was bound to calcium chloride. The purpose of this experiment was to evaluate these products, feed grade urea, and cottonseed meal in an experiment designed to determine ammonia release rate over time.

EXPERIMENTAL PROCEDURE

In vitro substrates were formulated using ground corn and corn starch. Nitrogen, not supplied by ground corn or corn starch, was supplied by one of the two urea/calcium compounds, feed grade urea, or cottonseed meal. The nitrogen sources were added at levels to achieve 10 and 14% crude protein fermentation media. One hundred grams of each medium were prepared in which each nitrogen source was weighed and then raised to 25 g with distilled water. This procedure was to insure similar mixing because of the fact that some nitrogen sources were already in a liquid form. A small stand mixer was used to mix the diets as the liquid was evenly applied by a hand spray bottle. The mixtures were digested by the procedure described by Dinus et al. (1974), and McDougal's buffer, without N, was added to all incubation flasks (Tilley and Terry, 1963). Samples taken during this procedure were analyzed for ammonia content by a colorimetric procedure (Chaney and Marbach, 1962). A Beckman DU - 50

Spectrophotometer was used in reading samples in this procedure.

RESULTS

10% Corn starch substrate medium. After 2 and 4 h of incubation In rumen fluid, the 10-0.0,11 compound had values of 1.02 and .87 mg/dL, respectively, which was the highest ammonia concentration (Table 1). The data showed no significant differences among any of the nitrogen sources at 2 and 4 h. At 6 h the 10-0-0-11 had the highest ammonia concentration at 3.26 mg/dL ($P < .05$). Differences were detected across all sources at 8 h with 10-0-0-11 having the highest ammonia concentration at 7.02 mg/dL while the lowest concentration was found for cottonseed meal at .55 mg/dL After 16 and 24 h, urea had the highest concentration of ammonia at 6.78 mg/dL and 4.59 mg/dL The 23-0-0-7 and 10-0-0-11 treatments were similar at 16 h with values of 5.42 mg/dL and 4.45 mg/dL.

Table 1. Ammonia concentrations for four substrate media

Medium and hours	Urea	23-0-0-7	10-0-0-11	CSM
10% cornstarch				
2	$.73^{a}$	$.61^{a}$	1.02^{a}	$.70^{a}$
4	$.45^{a}$	$.57^{a}$	$.87^{a}$	$.43^{a}$
6	1.66^{b}	1.51^{b}	3.26^{a}	$.82^{b}$
8	5.76^{a}	3.43^{b}	7.02^{c}	$.55^{d}$
16	6.78^{a}	5.42^{b}	4.45^{b}	$.12^{c}$
24	4.59^{a}	4.36^{a}	2.56^{b}	$.02^{c}$
14% cornstarch				
2	72.99^{a}	43.20^{b}	17.96^{c}	$.68^{d}$
4	67.14^{a}	18.34^{b}	12.35^{c}	$.79^{d}$
6	32.18^{a}	7.89^{b}	$.59^{c}$	$.14^{c}$
8	20.98^{a}	1.27^{b}	1.02^{b}	$.75^{b}$
16	27.70^{a}	12.60^{b}	8.83^{c}	$.35^{d}$
24	50.97^{a}	24.40^{b}	13.09^{c}	$.96^{d}$
10% ground corn				
2	3.90^{a}	4.70^{a}	2.10^{a}	1.35^{a}
4	4.90^{a}	4.01^{a}	4.68^{a}	2.11^{a}
6	4.83^{a}	4.04^{a}	4.96^{a}	1.75^{a}
8	3.45^{a}	3.34^{a}	4.14^{a}	4.33^{a}
16	6.69^{bc}	5.56^{c}	10.61^{ab}	13.00^{a}
24	19.97^{a}	6.39^{b}	13.93^{a}	5.61^{b}
14% ground corn				
2	4.80^{a}	4.42^{a}	4.74^{a}	$.49^{b}$
4	3.47^{a}	3.72^{a}	6.64^{b}	1.33^{c}
6	3.44^{ac}	2.19^{bc}	5.85^{a}	$.10^{b}$
8	7.39^{a}	1.55^{b}	5.05^{a}	$.12^{b}$
16	22.66^{a}	11.77^{b}	24.85^{a}	$.00^{c}$
24	44.86^{a}	16.54^{b}	11.89^{b}	1.37^{c}

$^{a, b, c, d}$ Means in a row with different superscripts differ (P < .05)

14% Corn starch substrate medium. The 2- and 4-h analyses all were different (P < .05) from one another. After 6 h, the 10-0-0-11 sample and the cottonseed meal samples did not differ from one another with values of .59 mg/dL and .14 mg/dL (P > .05). All other products were different (P< .05). Urea was different from all other sources (P < .05) at 8 h with a value of 20.98 mg/dL.. Urea remained at the highest concentration of ammonia for 16 and 24 h with values of 27.70 mg/dL and 50.97 mg/dL. The urea values were different (P < .05) from the cottonseed meal values, which were the lowest ammonia concentrations at .3 5 mg/dL and .96 mg/dL for 16- and 24-h samples.

10% Ground corn substrate medium. No differences were found until the 16-h samples. Cottonseed meal and 10-0-0-11 were similar at 16 h with values of 13.00 and 10.61 mg/dL. The data showed some differences (P < .05) between 23-0-0-7 and 10-0-0-11 as well as cottonseed meal, and cottonseed meal was different (P < .05) from urea. The 24-h samples showed that urea had the highest concentration of ammonia at 19.97 mg/dL, being not different from 10-0-0-11 at 13.93 mg/dL. Cottonseed meal had the lowest concentration at 5.61 mg/dL, with 23-0-0-7 not differing at 6.39 mg/dL.

14% Ground corn substrate medium. After 2 h of digestion, the lowest concentration of ammonia was obtained from cottonseed meal at .49 mg/dL, which was different (P < .05) from all other sources. With 4 h completed, 23-0-0-7 recorded the highest concentration of ammonia at 3.72 mg/dL, while cottonseed meal was still the lowest at 1.33 mg/dL. Urea was at a level of 3.47 mg/dL, which was similar to 23-0-0-7, while 10-00-11 and cottonseed meal were different (P < .05) from all other sources. Urea was similar to the 10-0-0-11 treatment after 6 h, with values of 3.44 mg/dL and 5.85 mg/dL. Urea also was similar to 23-0-0-7, which was at a level of 2.19 mg/dL. Cottonseed meal with a value of .103 mg/dL was different (P < .05) from urea and the 10-0-0-11. At 8 h, urea (7.39 mg/dL) and 10-0-0-11 (5.05 mg/dL) were similar while 23-0-0-7 had 1.537 mg/dL and cottonseed meal had .123 mg/dL. After 16 h, the 10-0-0-11 had the highest concentration of ammonia at 24.85 mg/dL while cottonseed meal had the lowest concentration (0 mg/dL). Urea was similar to 10-0-0-11 at a value of 22.66 mg/dL, while all other readings were different (P < .05). After 24 h, urea had the highest concentration of ammonia (44.86 mg/dL) while the 23-0-0-7 was 16.54 mg/dL and the 10-0-0-11 was 11.89 mg/dL. Cottonseed meal was different (P < .05) from all other readings at a level of 1.37 mg/dL.

CONCLUSIONS

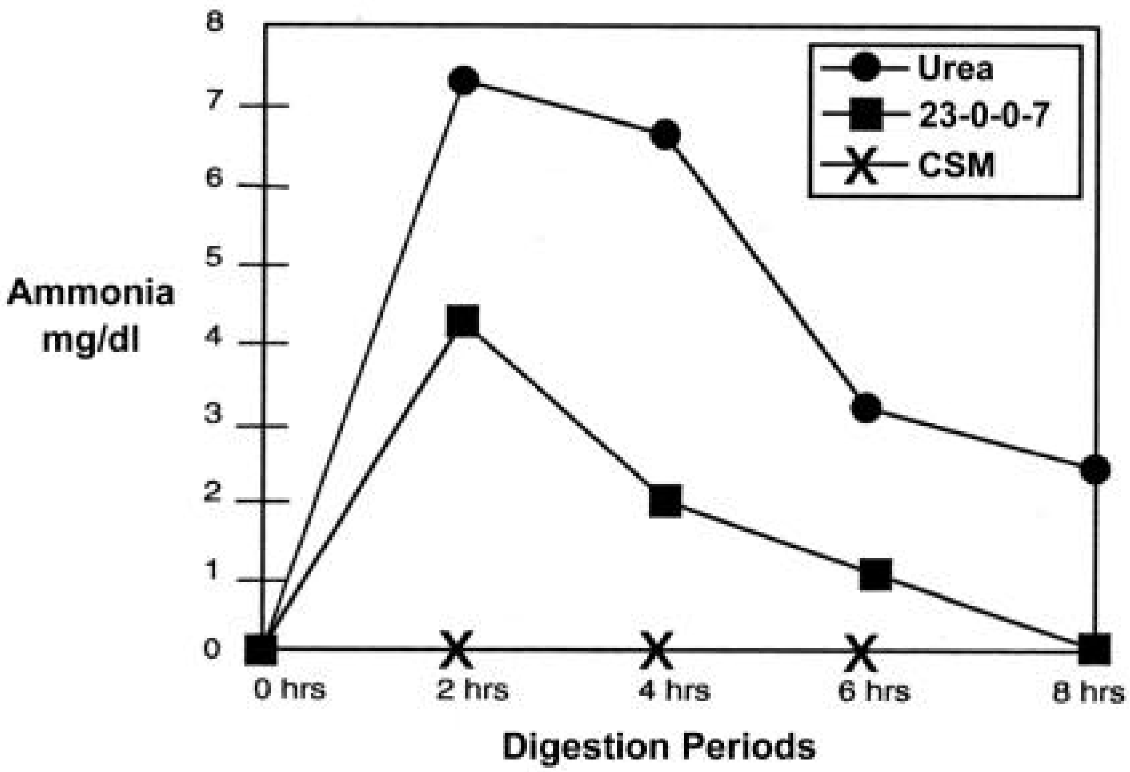
Differences were clearly visible across the four NPN sources used in this experiment. In each analysis, one or both of the urea/calcium products produced values that were comparable to the values produced by the urea treatment. The use of 23-0-0-7 and 10-0-0-11 in the formulation of ruminant diets appears to be possible as an alternative to urea.

REFERENCES

Chaney, A. L. and E. P. Marbach. 1962. Modified reagents for determination of urea and ammonia. Clin. Chem. 8:130.

Dinius, D. A., C. K. Lyon, and H. G. Walker. 1974. ***In vitro*** evaluation of protein and protein - safflower oil complexes treated with formaldehyde. J. Anim. Sci. 38:467.

<u>Corn Starch 14% Crude Protein</u>



14% PROTEIN IN CORN STARCH (IN VITRO)

Throughout this digestion trial, urea had the highest concentration of Ammonia, and cottonseed meal had the lowest; while 23-0-0-7 was a very desirable intermediate as indicated on the above graph. The 2, 4, and 6 h analysis were all different from one another. Urea was different from other sources (P< .05) at 8 h with a value of 2.0983 mg/dl, while cottonseed meal and 23-0-0-7 were not different (P <.05) with values .075 mg/dl and .102 mg/dl respectively at 8 h. The 10-0-0-11 product was omitted from the above graph because it is not being offered as a commercial product until its specific usage is determined.

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EFFECTS OF SLOW RELEASE UREA PRODUCTS ON DIGESTIBILITY, NITROGEN RETENTION, AND CALCIUM UTILIZATION BY GROWING WETHERS

J. L. Cass and C. R. Richardson

SUMMARY

A metabolism experiment with 12 crossbred wethers, averaging 59 lb, was conducted to determine the nutritional value of two urea/calcium compounds. The compounds were composed of 23-0-0-7 and 10-0-0-11 N, P, K, and Ca, respectively. These two compounds were compared to feed grade urea and cottonseed meal for DM intake, overall diet digestibilities of DM and crude protein, nitrogen utilization, and calcium utilization. Diets were ground sorghum and cottonseed hull-based with feed grade urea, 23-0-0-7, 10-0-0-11, or cottonseed meal as a protein source. The diets (Table 1) were formulated to meet NRC requirements for growing wethers and pelleted through a 7/16-in. die.

Table 1. Composition of diets

Ingredients	Urea	23-0-0-7	10-0-0-11	CSM
Ground sorghum	57.06	55.64	51.26	46.51
Chopped alfalfa	10.00	10.00	10.00	10.00
Cottonseed hulls	28.00	28.00	28.00	28.00
Molasses	1.44	1.44	1.44	1.44
Urea	1.65			
23-0-0-7 compound[a]		3.20		
10-0-0-11 compound[a]			8.00	
Cottonseed meal				12.00
Calcium carbonate	.80	.40		.75
Vitamin A	.50	.50	.50	.50
Sodium chloride	.35	.35	.35	.35
Trace mineral premix	.20	.20	.20	.20
Ammonium sulfate		.25	.25	.25

[a]N, P, K, and Ca, %.

Feed intake and nitrogen intake were lower (P < .05) for the 10-0-0-11 treatment compared to urea, 23-0-0-7, and the cottonseed meal treatments. However, digestibilities of DM and crude protein were similar (P > .05) across all treatments. Nitrogen retention and percentage of nitrogen absorbed that was retained were similar (P > .05) for wethers fed diets containing urea, 23-0-0-7, or cottonseed meal. Wethers receiving the 10-0-0-11 dietary treatment had lower (P < .05) nitrogen retention, and lower utilization of absorbed nitrogen than those on all other treatments. Percentage of nitrogen intake that was retained was lowest for the 10-0-0-11 treatment, which reflects the amount of nitrogen consumed.

PROCEDURE

All lambs were adjusted to a common urea-based diet for 28 d before random assignment to treatments by weight group. After a 14 d adjustment period for the

assigned diets, the lambs were placed on a 7 - d total collection period of urine and feces. On d 7 of the collection, blood samples were taken 4 h post feeding and stored for plasma urea nitrogen analysis. After each 7-d collection period, lambs were randomly switched as groups to an additional treatment for a 14d adjustment and followed by a 7-d collection. This pattern continued until each lamb had received every diet, resulting in four collection periods. In the collection process, feces were collected, weighed, dried in an oven, and reweighed to determine a dry weight. A representative sample was taken from the ground feces and stored for subsequent analyses. Diluted HCI (20%) was added on a daily basis to urine containers to prevent ammonia nitrogen loss. Ten percent of the total urine volume was kept from each lamb and then subsampled for subsequent analysis. Orts were collected, weighed, sampled, and analyzed to determine composition.

RESULTS

DM intake for the 10-0-0-11 treatment was lowest (P < .05) at a level of 1,055 g/d and the 23-0-0-7 treatment was the highest at 1,423 g/day (Table 2).

Table 2. ***In vivo*** digestion results

Item	Urea	23-0-0-7	10-0-0-11	CSM	SEM
DM intake g/d	1361[a]	1423[a]	1055[b]	1401[a]	51.50
DMD, %[c]	70.90[a]	68.40[a]	69.30[a]	68.40	.79
CPD, %[d]	63.00[a]	62.57[a]	63.27[a]	55.67	1.13
Nitrogen					
N intake, g/d	32.62[a]	31.73[a]	24.39[b]	32.09	1.13
Retention, g/d	12.69[a]	10.35[a]	3.79[a]	11.73	1.13
Intake retained, %	37.72[a]	33.45[a]	19.00[b]	33.22	2.67
Absorbed retained, %	51.10[a]	54.62[a]	25.10[b]	55.87	4.26
Calcium					
Digestibility, %	48.10[a]	45.84[a]	50.93[a]	47.39	2.22
Retention, g/d	5.50[a]	5.79[a]	9.35[b]	5.83	.56
PUN, mg/dL[e]	10.82[a]	10.37[a]	7.81[a]	7.32	.86

[a,b]Means in a row with different superscripts differ (P < .05).
[c]DM digestibility.
[d]Crude protein digestibility.
[e]Plasma urea nitrogen.

Because of the lower intake, the 10-0-0-11 treatment was lower (P < .05) in nitrogen intake at 24.4 g/day with urea having a value of 32.6 g/day. For DMD, no differences (P > .05) were detected across the four treatments. However, for CPD the cottonseed meal treatment was lower (P < .05) than the other three treatments. Urea had the highest percent of nitrogen intake retained at 37.7%, which was higher (P < .05) than 10-0-0-11 at 19.0 %, while 23-0-0-7 and cottonseed meal were similar to urea at 33.5 and 33.2%, respectively. The percentage of nitrogen absorbed that was retained was highest for cottonseed meal (58.9%), which was different (P < .05) from 10-0-0-11 (25.1%), while 23-0-0-7 and urea were not different from cottonseed meal at 54.6 and 51.1% respectively. No differences (P > .05) were found among the four diets for calcium digestibility, but the 10-0-0-11 treatment had a higher calcium retention (P < .05) than the three remaining treatments. Plasma urea nitrogen analysis also showed no differences (P > .05) across the four diets.

CONCLUSIONS

These data indicate that compounds that contain a mixture of urea and calcium could be utilized in ruminant diets as an NPN source. The 23-0-0-7 compound is preferred over the 10-0-0-11 compound. A cattle feeding experiment is in progress to determine the effects of 23-0-0-7 compared to feed grade urea or cottonseed meal.

EFFECTS OF SLOW AMMONIA RELEASE UREA/CALCIUM COMPOUND ON PERFORMANCE AND CARCASS CHARACTERISTICS OF FEEDLOT STEERS

J. L. Cass, C.R. Richardson, R.C. Albin, and M.F. Miller

SUMMARY

A feedlot experiment with growing/finishing crossbred steers (681 lb, n = 72) was conducted to determine the effects of a slow ammonia release urea/calcium compound compared to isonitrogenous diets containing feed grade urea or cottonseed meal. The slow ammonia release compound, as determined from previous research, contained 23% N and 7% Ca. Steers were weighted, ear tagged, dewormed, immunized against BVD, IBR, PI[3] and ***Clostridium perfringens*** types C and D, then randomly placed by weight group and breeding to three pens of eight steers per treatment. A steamed flaked grain sorghum and corn silage based diet was fed for 147 d. Carcass data were collected by experienced personnel. The slow ammonia release compound was manually added to the feed while it was being mixed and steers were fed once daily. Feeding the urea/calcium compound resulted in an 8.6% improvement ($P < .05$) in feed efficiency and a 5.9% increase ($P > .05$) in ADG as compared to cottonseed meal; and a 4.3% improvement ($P > .05$) in feed efficiency and a 2.8% decrease ($P > .05$) in ADG compared to urea. Feed intake was 3.2 and 6.9% lower when the urea/calcium was fed compared to cottonseed meal and urea, respectively. Carcass data show that the urea/calcium treatment tended to result in higher ($P = .14$) hot carcass weight as compared to cottonseed meal. Whereas, the urea/calcium treatment tended to result in improved kidney, heart and pelvic fat ($P = .14$) and yield grade ($P = .11$) compared to the urea treatment. In conclusion, these data show that the urea/calcium treatment improves feed efficiency over cottonseed meal, with a lesser improvement over urea; and tend to show a shift in carcass composition toward less fat.

INTRODUCTION

Ruminants are unique in that they can utilize nonprotein nitrogen sources to meet a portion of their crude protein needs. The host animal benefits from the microbial fermentation process that occurs in the forestomach by incorporating ammonia nitrogen and carbon structures into bacterial protein.

Urea is used extensively across the United States in diets for growing/finishing ruminants as a nonprotein nitrogen source because of its low price on a crude protein equivalent basis compared to natural protein supplements. Urea use could be increased by cattle feeders if ammonia release from urea breakdown in the forestomach could be slowed to a rate at which energy substrates became available. This problem in particular is prevalent for diets that contain substantial amounts of roughage(s), such as

growing diets, which have low urea fermentation potential. Several reports have been published on attempts to produce viable slow release urea products (2, 3, 4) with little or no industry application to date. However, Cass et al., (1)

reported that two compounds, containing either 23% nitrogen and 7% calcium or 10% nitrogen and 11% calcium, both resulted in slower ammonia release than urea in laboratory studies. This same 23% nitrogen and 7% calcium compound (23-0-0-7) was used in this experiment.

EXPERIMENTAL PROCEDURE

The steers used in this experiment were sorted from a large group of wheat pasture steers at the Texas Tech University farm at Pantex and transported to the Burnett Center research feedlot. Steers were vaccinated with Ivermectin (6.5 cc), 4 - way (2 cc), Clostridium type C & D (4 cc), ear tagged, dehorned, and initial weights were taken. The steers were divided into two pen groups (n = 37 and 38) and adjusted to a high grain diet over 26 d. After the adjustment period, all steers were weighed and implanted with Synovex S. Steers then were randomly sorted into nine pens containing eight head each by means of weight and also breed type. The steers were placed in partially slotted, concrete-floored pens for the duration of the experiment. The nine pens were in consecutive order with the automated feed bunk on the north side of the pens. All diets were formulated to meet NRC requirements and mixed automatically at the Burnett Center on a daily basis. The urea/calcium product was weighed and added into the mixer by hand for each pen allotment of feed on a daily basis. Water was blended with the urea/calcium product immediately before applying to the feed to assure adequate coverage and mixing throughout the feed. Bunks were read daily and rejected feed was removed, weighed and subtracted from the total intake values. Steers were initially weighed on trial on 3/22/94, followed by five weigh periods, which were

planned on 28-d intervals, and a final weight. After the steers were slaughtered at a commercial packing plant, and the carcasses chilled for 48 h, carcasses were ribbed and evaluated.
Composition of the basal diet, which is typical of many southwest feedlot diets, is presented in table 1. Laboratory analyses were conducted to determine the composition of the diet's DM, ash, nitrogen (CP), calcium and phosphorus (table 1). Pen was the experimental unit. Data were analyzed by ANOVA using a completely randomized

design procedure of SAS. The 23-0-0-7 treatment was compared to each of the other two treatments.

RESULTS AND DISCUSSION

The effects of urea/calcium treatment on DM intake, ADG, and feed efficiency are shown in table I. Supplementing the urea/calcium compound to meet CP needs in diets that were formulated to be equal in calcium content improved feed efficiency 8.6% ($P < .05$) and increased ADG 5.9% ($P > .05$) feed intake. These data indicate improved energetic efficiency by steers from supplementation to a rapidly rumen fermentable grain-based diet over the cottonseed meal. Both nonprotein nitrogen treatments (urea/calcium compound and urea) tended to improve feed efficiency and ADG over cottonseed meal. However, the extent of improvement was greater for feed efficiency when urea/calcium compound was supplemented, whereas, urea gave the greater gain response. Furthermore, the urea/calcium treatment resulted in a 4.3% improvement ($P > .05$) in feed efficiency over urea while reducing feed intake by 6.9% ($P < .05$).

Effects of treatment on carcass characteristics are given in table 2. No differences were found ($P > .05$) across treatments for any variable measured. However, when the urea/calcium treatment means are compared to either of the other two treatments alone, trends of differences appear. The urea/calcium treatment tended to produce higher ($P = .14$) hot carcass weight as compared to cottonseed meal. Whereas, the urea/calcium treatment was tended to improve kidney, heart and pelvic fat ($P = .14$) and yield grade ($P = .11$) compared to the urea treatment. These carcass data are supportive of the performance data and indicate that this nitrogen and calcium product is changing the growth/fattening process in a manner that tends to result in greater lean yield and a lower amount of waste fat compared to urea feeding.

IMPLICATIONS

The urea/calcium compound provides an alternative source of nitrogen and calcium for ruminants. Efficiency of gain is improved when the urea/calcium compound is formulated to provide supplemental nitrogen and calcium. Energetic efficiency is improved and carcasses tend to be leaner than when feeding urea. Feed consumption is reduced somewhat with the use of urea/calcium in place of urea or cottonseed meal

Table 1. Composition and analysis of diets

Ingredient	Cottonseed meall	Urea/ calcium	Urea
--------Composition, %--------			
Steamed flaked milo	75.02	81.25	81.96
Corn silage	11.35	11.35	11.35
Urea			1.01
23-0-0-7		2.10	
Cottonseed meal	7.98		
Molasses	3.00	3.00	3.00
$CaCO_3$	1.00	.65	1.03
NaCl	.20	.20	.20
Dical	.05	.05	.05
Rumensin	.90	.90	.90
Trace mineral premix	.25	.25	.25
Vitamin A premix	.25	.25	.25
--------Chemical analysis, %--------			
DM	73.89	73.76	73.65
CP	13.13	13.12	13.14
TDN	81.53	80.57	81.53
NEm	1.12	1.11	1.12
NEg	.59	.58	.59
Ca	.50	.63	.49
P	.40	.33	.33
--------Performance Data, %--------			
DM intake, lb	19.79[a b]	19.15[b]	20.56[a]
ADG, lb	2.90[a]	3.07[a]	3.16[a]
Feed:gain	6.83[a]	6.24[b]	6.52[ab]
Gain efficiency[c]	14.66[b]	16.02[a]	15.36[ab]

[a, b] Means in a row with different superscripts differ ($P < .05$)
[c]lb gain/100 lb intake

Table 2. Carcass data

Item	Cottonseed meal	Urea/ calcium	Urea	SEM	P Value
Hot carc. wt[a]	670	694	691	6.16	.26
Dressing percent	59.99	60.85	59.82		
Back fat Thick., in.	.52	.51	.56	.02	.48
KPHF[b], %	1.51	1.54	1.79	.07	.19
Ribeye area	11.09	11.40	11.00	.21	.77
Yield grade[c]	3.04	3.03	3.33	.07	.18
Marbling	4.00	3.95	4.07	.07	.80
Choice, %	65.00	66.70	58.00		

[a]Urea/calcium vs. cottonseed meal P = .14
[b]Urea/calcium vs. urea P = .14
[c]Urea/calcium vs. urea P = .11

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EFFECTS OF A SLOW-RELEASE UREA PRODUCT ON FEEDLOT PERFORMANCE AND CARCASS CHARACTERISTICS OF BEEF STEERS

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ABSTRACT:

Two studies evaluated the effect of a slow-release urea product (Ruma Pro) on performance and carcass characteristics of beef steers. In Exp. 1, 180 crossbred steers (Continental x British; initial BW = 400 kg) were used to evaluate a 90% concentrate diet with Ruma Pro as the supplemental CP source vs. a 90% concentrate diet (Control) with soybean meal (SBM) plus urea (1.21%; DM basis) as the supplemental CP sources. Steers were stratified by BW into three blocks (six pens per block) with nine pens (10 steers/pen) per treatment. No differences ($P > 0.10$) were noted for ADG for the overall feeding period. Although not significant ($P < 0.11$), steers fed Ruma Pro consumed 3% less feed than Control steers. For the overall feeding period, gain:feed was improved ($P < 0.01$) for steers fed Ruma Pro vs. Control. No differences ($P > 0.10$) between treatments were noted for hot carcass weight, marbling score, fat thickness, yield grade, or internal fat. Control steers had a greater ($P < 0.01$) dressing percentage and larger longissimus muscle area ($P < 0.03$) than Ruma Pro steers. In Exp. 2, 226 crossbred steers (Continental x British; initial BW = 398 kg) were used to evaluate the effects of graded levels of Ruma Pro in a 90% concentrate diet on performance and carcass characteristics. Steers were stratified by BW and assigned to five weight blocks (four pens/weight block). Treatments (five pens/treatment) included SBM and the supplemental CP source (0), or 33, 66, or 100% of the supplemental CP from Ruma Pro. No differences ($P > 0.10$) were noted among treatments for ADG or daily DMI for the overall feeding period, but gain:feed was improved was improved (linear; $P < 0.05$) with Ruma Pro level. No major differences were noted among levels of Ruma Pro.

Results suggest that a slow-release urea product might improve gain efficiency by finishing beef steers compared with soybean meal and soybean meal plus urea.

Key Words: Beef Cattle, Slow-Release Urea, Performance

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Introduction

Galyean (1996) surveyed six consulting nutritionists to quantify formulation practices regarding percentages of CP and urea in finishing diets. In the survey, percentage of CP ranged from 12.5 to 14.4% with urea levels ranging from 0.5% to 1.5% of DM. One possible advantage to higher urea levels in finishing diets might be related to buffering effects with urea as a result of hydrolysis of urea to CO2 and NH3 and the potential buffering effects via ammonia (Galyean 1996). Using a slow-release ureaproduct might further improve performance by buffering the ruminal environment over an extended period. Our objective was to evaluate a slow-release urea product (Ruma Pro) on performance and carcass characteristics of finishing beef steers.

Experimental Procedures

Exp. 1.

One hundred ninety crossbred (medium-framed British x Continental) beef steers were purchased from an order buyer in Mississippi. The order buyer maintains contracts on cattle grazing wheat pastures in the Texas Panhandle, and a majority (126 animals; average initial BW = 336 kg) of the animals were shipped from the Texas Panhandle (Follet, TX).

One load (64 steers; average BW = 332 kg) was shipped from Mississippi and had previously grazed improved pastures (fescue or fescue-ryegrass mixture; C. Keys, personal communication).

All steers were processed immediately after arrival. Processing included individual BW measurement, individual ear tag, branding, horn tipping as needed, implanting with Synovex S (Ft. Dodge Animal Health, Ft. Dodge, IA), vaccination with an IBR-PI3-BVD-BRSV (Pyramid 4; Ft. Dodge Animal Health), vaccination with a seven-way clostridial preparation (Ultrabac-7, Pfizer Animal Health, Exton, PA), treatment for control of internal and external parasites (Dectomax pour-on; Pfizer Animal Health, Exton, PA), and a 2 mL injection with vitamin A/D_3 (each milliliter contained 500,000 IU of vitamin A and 75,000 IU of vitamin D3; Agrilabs, St. Joseph, MO). From the 190 steers available for study, 180 steers were selected based on a 90% concentration diet. Steers were assigned to treatments without regards to the two different sources (Texas Panhandle vs. Mississippi). Steers were stratified by BW and assigned to one of three weight blocks (heavy, medium and light). Steers were assigned randomly within the three weight blocks to one of two treatments (nine pens with 10 steers per treatment), and pens were assigned randomly to the two treatments.

Treatments used in the study included a standard finishing diet with slow-release urea (Ruma Pro) replacing a combination of natural protein and urea in standard diet (Table 1).

To minimize any potential negative effect of switching diets on feed intake, steers were fed (approximately 15 steers per pen) Their respective treatment diets for approximately 7 d before initiation of the study. All steers were weighed (unshrunk) to obtain a sort weight on d –7 and sorted into the two treatment groups and placed in six feedlot pens for diet adaptation. After initiation of the study, each steer was individually weighed (without feed and water restriction) on d 0, 28, 56, 84, 96, 112 and 126.

Feed bunks were evaluated daily starting at 0730. On weigh days, the feed bunk from each pen was swept, and unconsumed feed was removed from bunks, weighed and analyzed for DM content. Feed ingredient samples were obtained every 2-wk for DM determination. Dry matter was determined on the bunk samples by obtaining approximately 250-g samples from the bunks. The samples were placed in aluminum pans and dried in a forced-air oven at 100^{o}C for approximately 24 h. Individual ingredient samples were dried in a similar manner to the bunk samples.

Steers were harvested when approximately 50% had reached sufficient finish to grade USDA Choice. Days on feed varied with weight block, such that heavy block steers were fed for 56 d, medium block steers for 98 d and light block steers for 126 d. Carcass data were collected by Cattlemen’s Carcass Data Service under the direction of Dr. Ted Montgomery (West Texas A&M University, Canyon). Carcass data included hot carcass weight, marbling score, fat thickness, longissimus muscle area, internal fat, yield grade and liver score.

For daily gain and carcass characteristics, data were analyzed with a model that included treatment, block, treatment x block, and pen within treatment x block. Treatment and treatment x block were analyzed with pen within treatment x block as the error term. For feed intake and feed efficiency the model included treatment, block and treatment x block. The percentage of carcasses grading Choice was analyzed using non-parametric procedures (Chi-square). All statistical analyses were computed using SAS (Version 6.12 for Windows; SAS Inst. Inc., Cary, NC).

Exp. 2.

Two hundred twenty-six crossbred beef steers (Continental x British; initial BW =398 kg) were used to evaluate the effects of graded levels of Ruma Pro on performance and carcass characteristics. Steers had previously been used on receiving and growing studies and had been adapted to a 90% concentrate diet for at least 91 d. On day 0, steers were weighed (unshrunk), implanted with Synovex-S and sorted into assigned treatment pens (five pens/treatment). Steer BW data were stratified from lightest to heaviest and assigned randomly to the four treatments. Four pens (one pen/treatment) were considered a block; hence, there were 20 pens with four treatments and five weight blocks.

Treatments included a diet with soybean meal as the CP source (0), or 33, 66 and 100% of the supplemental CP from Ruma Pro (Table 1). All other procedures were similar to Exp. 1, except that steers in Blocks 1 and 2 were implanted with Synovex-Plus, and steers in Block 3 were implanted with Synovex-S on d 56. Steers in Blocks 4 and 5 were not reimplanted and were harvested after 84 d, steers in Blocks 2 and 3 were harvested after 112 d, and steers in block 1 were harvested after 126 d. As in Exp. 1, carcass characteristics were obtained by Cattlemen's Carcass Data Service.

For daily gain and carcass characteristics, data were analyzed with a model that included treatment, block, and pen within treatment x block. Treatment means were analyzed with pen within treatment x block as the error term. For feed intake and feed efficiency the model included treatment and block. Orthogonal contrasts were used to test linear, quadratic and cubic effects of RumaPro. The percentage of carcasses grading Choice was analyzed using non-parametric procedures (Chi-square). All statistical analyses were computed using SAS.

Results and Discussion

Exp. 1. By design, no differences were noted between the conventional finishing diet and the Ruma Pro diet for initial BW (Table 2). Likewise, no differences ($P > 0.10$) were noted for final BW between the two treatments.

No differences in daily gain were noted for the overall experiment, with both treatments gaining virtually the same (Table 2).

For the overall finishing period, daily DMI tended ($P < 0.11$) to be less by Ruma Pro fed cattle vs. control cattle (3% decrease vs. the conventional finishing diet). Gain:feed ration was improved for the animals fed the Ruma Pro diet ($P < 0.01$) for the overall feeding period. To our knowledge, no studies have evaluated effects of this slow-release urea product on finishing performance by beef steers. Although not statistically significant for the overall feeding period, steers fed the Ruma Pro diet consistently ate less feed throughout the feeding period (data not shown). Ruma Pro contains 19.4% calcium chloride as an ingredient. As a result, the Ruma Pro diet contained .44% calcium chloride. Previous research (Duff et al., 1996) suggested that anionic diets containing calcium chloride (0.8% DM basis) decreased DMI during the final 14 d of the finishing period compared with a cationic diet. Hence it is possible that the results observed with Ruma Pro are a function of altering the cation/anion balance.

No major differences were noted in carcass characteristics for cattle fed Ruma Pro vs. those fed the conventional finishing diet (Table 2). There were small differences ($P < 0.10$ in dressing percentage and longissimus muscle between the two diets (Table 3), but the biological significance of these differences is questionable. No differences in the percentage of animals grading Choice were noted in the present experiment.

Exp. 2. No differences ($P > 0.10$) were noted in final BW for the experiment (Table 3). Likewise, no differences ($P > 0.10$) were noted for daily gain or daily DMI for the overall feeding period (Table 3.) The gain:feed ratio was improved (linear; $P < 0.05$) for the overall feeding period, as level of Ruma Pro increased; however, this effect was largely attributable to the 100% Ruma Pro level. Healy, et al. (1995) evaluated proportions of soybean meal:urea in 13% CP diets (steamed-flaked corn based) and reported that feed intake responded linearly as proportion soybean meal increased and daily gain and gain:feed responded quadratically to N combinations. Sindt et al. (1994) evaluated supplementing dry-rolled corn diets with urea or a combination of urea and escape protein. These authors suggested that urea supplementation alone is adequate for rapidly growing beef cattle.

Implications

Results from the present experiment suggest that Ruma Pro (a slow release urea product) can replace a combination of soybean meal and urea in a 90% concentration diet, with the result of improved gain efficiency. Moreover, there seemed to be no added benefit in gain efficiency by feeding Ruma Pro in combination with soybean meal.

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Table 1. Ingredient (DM basis) and chemical composition of diets

	Exp. 1		Exp 2. (% Ruma Pro)			
Item	Control	Ruma Pro	0%	33%	66%	100%
Sorghum sudangrass hay	9.75	9.74	10.23	10.23	10.23	10.23
Whole corn	9.73	9.73	10.01	10.00	10.00	10.01
Steam-flaked corn	65.95	68.38	59.30	62.37	65.07	67.97
Soybean meal	2.80	-	10.40	6.85	3.55	-
Molasses	5.27	5.26	4.85	4.84	4.85	4.85
Fat (yellow grease)	2.83	2.82	2.79	2.79	2.79	2.77
Limestone	0.72	0.09	1.10	0.86	0.71	0.51
Dicalcium phosphate	0.48	0.49	-	-	-	0.10
Salt	0.29	0.28	0.31	0.31	0.31	0.30
Urea	1.21	-	-	-	-	-
Ruma Pro	-	2.25	-	0.74	1.48	2.23
Premix[a]	0.97	.096	1.01	1.01	1.01	1.02

[a]Wheat middlings- (Exp. 1) or ground milo- (Exp. 2) based premix contained (dry matter basis): 90.253% wheat middlings, .665% vitamin A (30,000 USP units/g), .27% vitamin E (500,000 IU/kg), 6% trace minerals (contained on a dry matter basis: .36% cobalt carbonate, 3.27 % copper sulfate, .27% calcium iodate, 19.44% ferrous sulfate, 6.94% manganous oxide, 28.17% zinc sulfate monohydrate, 29.7% magnesium oxide, 7.9% wheat middlings, and 3.95% mineral oil), 1.687% Rumensin-80 and 1.125% Tylan 40.

Table 2. Effects of a slow-release urea product (Ruma Pro) on performance and carcass characteristics by finishing beef steers (Exp. 1)

	Treatments			
Item	Control	Ruma Pro	SE[a]	P <
Pens	9	9		
Initial BW, kg	400.1	399.1	0.94	0.46
Final BW, kg	574.1	576.0	2.87	0.67
Daily gain, kg d 0 to end	1.96	1.98	0.03	.078
Daily DMI, kg d 0 to end	12.32	11.95	0.15	0.11
Gain:feed d0 to end	0.159	0.166	0.001	0.01
Hot carcass wt, kg	352.1	351.4	1.42	0.73
Dressing %	61.3	60.9	0.18	0.10
Marbling score[b]	40.9	40.5	0.78	0.72
Longissimus muscle area, cm^2	89.8	88.4	0.37	0.03
Fat thickness, cm[c]	1.00	0.98	0.04	0.73
Yield grade	2.39	2.41	0.05	0.81
Kidney, pelvic heart fat	1.98	1.91	0.04	0.28
Choice, %	52.8	49.4	-	-

[a]Standard error of treatment means. n = nine pens per treatment.
[b]40=small; 50=modest; scores greater than 40 = Choice grade.
[c]Fat thickness measured between the 12^{th} and 13^{th} ribs.

Table 3. Effects of graded levels of a slow-release urea product (Ruma Pro) on performance and carcass characteristics of finishing beef steer (Exp. 2)

	Treatments (% Ruma Pro)					
Item	0%	33%	66%	100%	SE [a]	Contrast [b]
Pens	5	5	5	5		
Initial BW, kg	398	395	396	396	0.6	
Final BW, kg	543	542	537	546	3.17	NS
Daily gain, kg d 0 to end	1.41	1.43	1.37	1.45	0.03	NS
Daily DMI, kg d 0 to end	8.58	8.65	8.37	8.52	0.16	NS
Gain:feed d 0 to end	0.165	0.166	0.164	0.171	.002	L(0.05)
Hot carcass wt, kg	339.9	343.0	338.5	341.5	1.75	C(0.10)
Dressing %	62.7	63.3	63.1	62.6	0.26	Q(0.05)
Marbling score[c]	42.7	41.6	41.6	42.9	0.78	NS
Longissimus musclearea cm^2	82.6	84.8	81.4	83.5	1.40	C(0.10)
Fat thickness, cm[d]	1.07	1.19	1.14	1.09	0.05	NS
Yield grade	2.71	2.75	2.84	2.71	0.09	NS
Kidney, pelvic heart fat	1.99	2.03	2.08	2.05	0.04	NS
Choice, %	60.7	58.2	56.1	71.9	-	-

[a]Standard error of treatment means. n = five pens per treatment.
[b]L=Linear, Q=quadratic, C=cubic response to slow-release urea; NS=not statistically significant
[c]40=small; 50=modest; scores greater than 40 = Choice grade.
[d]Fat thickness measured between the 12thand 13thribs.

Evaluation of Ruma Pro (a calcium-urea product) on microbial yield and efficiency in continuous culture

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OBJECTIVES

To evaluate effects of RumaPro on fermentation parameters in continuous cultures operated to simulate the rumens of lactating cows (Experiment 1) and close-up dry cows (Experiment 2).

PROCEDURES

The major differences between lactating cows and close-up dry cows, in terms of rumen function, are primarily in quantity of feed intake and in rumen turnover rates. In these studies, the following conditions were used:

	Experiment 1	Experiment 2
Item	(Lactating)	(Close-up)
Liquid dilution rate, %/hr	12	10
Solids retention time, hr	22	27
Feed intake, g/d	100	60
Feeding frequency, times/day	2	2
pH	Monitored	Monitored

Diet composition for a close-up dry cow should be similar to that of a lactating cow after peak production. Because in this study the lactation ration was balanced for peak production, the close-up ration had a slightly lower nutrient content. Composition and analysis of the lactation and close-up rations are in Table 1 and 2, respectively.

Experiment 1, the lactation study, had four diets: a control in which soybean meal (SBM) and urea were the major protein sources, and three experimental diets. In the first experimental diet, RumaPro replaced the urea in the control; in the second experimental diet, RumaPro replaced the urea and 16.5% of the SBM, and in the third experimental diet, RumaPro replaced the urea plus 100% of the SBM.

Three close-up diets were used; a control, with urea and SBM, and two experimental diets in which RumaPro replaced the urea along with 35 and 94% of the SBM.

TABLE 1. Diet Composition and Analyses-Lactation Rations
(% Dry Matter Basis)

Ingredients	Control	RumaPro 1	RumaPro 2	RumaPro 3
Corn Silage	27.78	27.65	27.80	33.14
Haylage	18.52	18.43	18.54	23.15
Ground Corn	31.85	31.71	33.83	35.19
SBM 44	19.07	18.99	15.94	--------
Urea	0.37			--------
MgO	0.111	0.111	0.111	0.222
TM Salt	0.222	0.221	0.222	0.185
Limestone	0.556	0.553	0.371	--------
Dicalcium Phosphate	0.222	0.221	0.222	0.611
Sodium Bicarbonate	1.30	1.29	1.30	1.30
RumaPro	--------	0.829	1.67	6.20
Analyses				
Crude Protein	17.39	17.67	17.52	18.09
Soluble Protein, %CP	26.63	32.31	32.76	72.01
Neutral Detergent Fiber	27.89	28.51	28.25	30.54
Acid Detergent Fiber	17.90	18.71	18.84	20.44
Nonstructural Carbohydrate	37.67	38.62	41.70	37.48
Starch	34.42	36.91	39.98	35.75
Sugar	3.25	1.71	1.72	1.73
Ether Extract	2.88	2.91	2.71	2.82
Ash	6.18	6.31	6.04	6.32
Calculated NFC[1]	45.66	44.60	45.48	42.23

[1]Non Fiber Carbohydrate

The major differences in analyses between the lactation and close-up rations were that the close-up rations had less total protein and nonstructural carbohydrate, and more fiber than did the lactation rations.

Each treatment was fermented in triplicate. The results were summarized and analyzed statistically as two separate experiments. Statistical analyses were performed using SAS.

In Experiment 1 comparisons were:

Control vs the mean of all RumaPro levels
RumaPro 1 vs RumaPro 2
RumaPro1 + 2 vs RumaPro 3

In Experiment 2, comparisons were:

Control vs the mean of both Ruma Pro levels
RumaPro 1 vs Ruma Pro 2

RESULTS

Experiment 1

Digestion coefficients are shown in Table 3. Digestibilities of dry and organic matter were equal to that of the control for all treatments, with the numbers favoring RumaPro level 2 in which all the urea and 16.5% of the SBM were replaced by RumaPro.

Responses of fiber digestion, both NDF and ADF, were similar to the control for RumaPro levels 1 and 2. Fiber digestion for RumaPro level 3, however, was significantly lower than that of levels 1 and 2, and, since levels 1 and 2 were equal to the control, it can be assumed that level 3 was significantly lower than the control as well. All levels of RumaPro were equal to the control in supporting nonstructural carbohydrate (NSC) digestion. As a result of the combined fiber and NSC digestion, the total carbohydrate actually digested in g/d were greatest for RumaPro level 2, which was significantly higher than level 1.

Since there were no significant effects of the treatments on dry or organic matter digestion, it is not surprising that there were no differences in total VFA produced/day, as shown in Table 4. There were, however, changes in molar proportions of fatty acids, particularly acetic and butyric. The combined treatments had a significantly higher level of acetate than did the control, and the proportion of acetate appeared to increase with each increase in RumaPro. Butyrate responded in exactly the opposite manner, decreasing with increasing RumaPro. In the rumen, acetate and butyrate are in equilibrium. It appears that acetate is increased at the expense of butyrate, which is probably beneficial, as butyrate can be toxic in ruminants. Propionate was largely unaffected by RumaPro, but there was a trend (p=.08) for RumaPro level 3 to have higher propionate than levels 1 and 2. Acetate-propionate ratio was not significantly affected by treatments.

Average daily pH was higher for the RumaPro diets than for the control, largely due to the effects of level 3. A plot of pH over time after feeding is presented in Figure 1. At 2 hours post-feeding, level 2 maintained a higher pH (p=.02) than did the control or level 1, but no differences among the control and RumaPro levels 1 and 2 were found for the remainder of the time after feeding. RumaPro level 3 actually increased pH after feeding compared to the other treatments, and maintained a higher pH throughout the feeding period. In spite of the higher pH for level 3, fiber digestion was significantly lower for level 3 compared to levels 1 and 2 (Table 3). The higher rumen pH caused by RumaPro may well be responsible for the higher acetate found on the treatments. The reason, however, for the higher pH caused by RumaPro is not clear, but it certainly is a positive effect of the product.

Nitrogen partitioning and microbial growth are shown in Table 5. Protein digestion was unaffected by RumaPro, except at the highest level, where digestion tended (p=.13) to be higher than for levels 1 and 2. Although not statistically significant, levels 1 and 2 had numerically lower protein digestion than did the control. When RumaPro was substituted for urea only (level 1), the result was the least ammonia production for all treatments and lower microbial growth than the control. This demonstrates that the availability of RumaPro nitrogen was slower than that from urea. The addition of RumaPro nitrogen at a higher level (level 2) was sufficiently available to enhance protein digestibility, increase ammonia slightly and bring microbial protein back to the control level. Protein digestion was highest at the highest level of RumaPro, and should have provided more N for microbial growth, but this was not he case. Much of the N was lost as ammonia, which was significantly greater than on all other diets (p=.01). This resulted in the lowest by-pass of feed-N as well as the lowest microbial N production of the three treatment levels. The inefficient N use for microbial growth is clearly shown in the Feed N efficiency value of 74.9%, which is considerably lower than for all other diets. ***(continued)***

The efficiency of conversion of organic matter or carbohydrates to microbial mass also was only affected by the highest level of RumaPro. Thus, as with most responses seen, RumaPro at level 2 was superior to levels 1 and 3, and was equal to SBM in supporting microbial growth and metabolism.

TABLE 3. Digestion Coefficients for Experiment 1 – Lactation Rations

Diets					P=% Digested		
Nutrient	Control	RumaPro 1	Ruma Pro 2	Ruma Pro 3	Cont vs Trts	RumaPro 1 vs 2	RumaPro 1, 2 vs 3
Dry Matter	78.3	77.7	78.4	80.1	NS	NS	NS
Organic Matter	57.4	55.2	61.6	59.7	NS	.08	NS
Neutral Detergent Fiber	37.1	37.5	35.6	31.2	NS	NS	.01
Acid Detergent Fiber	37.2	38.1	38.4	27.9	NS	NS	.01
Nonstructural Carbohydrate	83.8	77.1	80.9	84.3	NS	NS	NS
Total Carbohydrate digested grams/d	42.2	40.8	45.1	41.3	NS	.02	NS

Figure 1. Fermentation pH
RumaPro Project - Lacation Diets

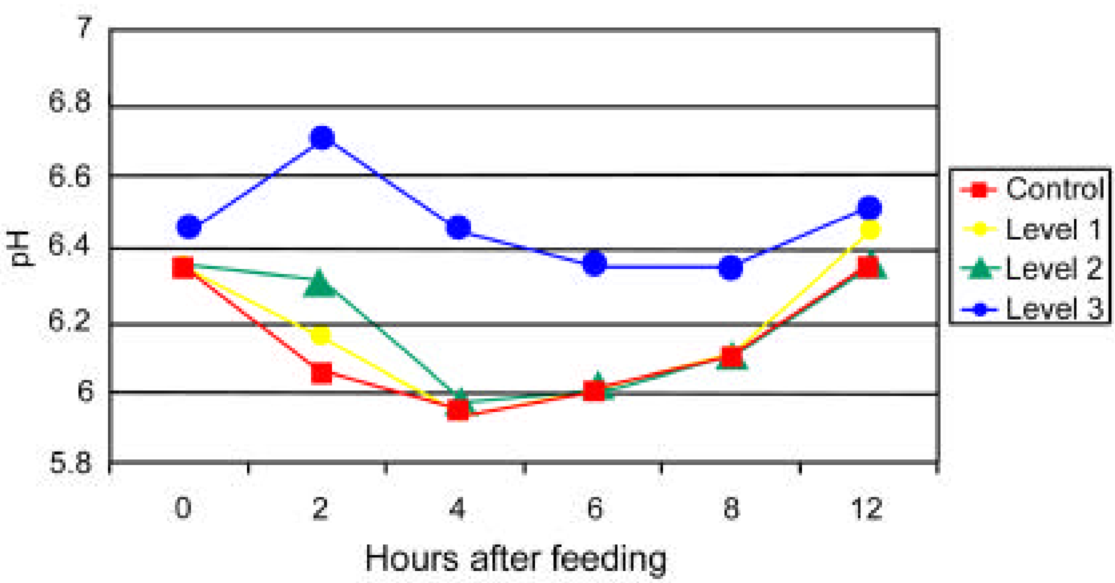

TABLE 4. Volatile Fatty Acid Production, Molar Ratios and pH for Experiment 1 – Lactation Rations

Diets						P=% Digested	
Item	Control	Ruma Pro 1	Ruma Pro 2	Ruma Pro 3	Cont vs Trts	Ruma Pro 1 vs 2	RumaPro 1, 2 vs 3
Total VFA, mm/day	352	353	362	356	NS	NS	NS
Molar Proportions, %NS.08NS	57.4	55.2	61.6	59.7	NS	.08	NS
Acetic	47.3	48.0	53.8	55.8	.04	.06	.06
Propionic	27.2	26.4	24.6	30.7	NS	NS	.08
Isobutyric	0.67	0.65	0.66	0.52	NS	NS	NS
Butyric	21.5	20.6	17.0	9.1	.01	.02	.01
Isovaleric	1.02	1.19	1.34	1.14	NS	NS	NS
Valeric	2.28	3.15	2.68	2.57	NS	NS	NS
pH, average/day	6.14	6.17	6.18	6.46	.03	ns	.01
Acetate/Propionate ratio	1.74	1.82	2.20	1.91	NS	NS	NS

TABLE 5. Nitrogen Partitioning, Microbial Growth and Microbial Efficiency for Experiment 1 – Lactation Rations

Diets						P=% Digested	
Item	Control	Ruma Pro 1	Ruma Pro 2	Ruma Pro 3	Cont vs Trts	Ruma Pro 1 vs 2	Ruma Pro 1, 2 vs 3
Nitrogen Intake, g/day	352	353	362	356	NS	NS	NS
Nitrogen Digested, %	87.2	81.2	85.3	89.0	NS	NS	.13
Non-ammonia N, g/day	2.88	2.97	2.87	2.48	02	.07	.01
Ammonia N, mg/dl	6.12	6.10	6.72	21.35	.01	NS	.01
By-pass N, g/day	0.40	0.59	0.456	0.35	NS	NS	NS
Microbial N, g/day	2.48	2.62	2.42	2.13	.10	NS	NS
<u>Efficiencies:</u>							
Mic N/kg OMD[1]	46.1	43.8	41.8	38.2	.09	NS	.12
Mic N/kg CHOD[2]	59.2	55.9	55.3	51.7	.01	NS	NS
Feed N[3]	92.3	93.3	91.4	74.9	.01	NS	.01

[1]Microbial N produced/kg organic matter digested
[2]Microbial N produced/kg carbohydrate digested
[3]Digested feed N converted to microbial N, %

EXPERIMENT 2

TABLE 2. Diet Composition and Analyses-Close-up Rations (% Dry Matter Basis)

Ingredient	Control	RumaPro 1	RumaPro 2
Corn Silage	38.61	41.97	44.35
Haylage	25.74	25.70	26.90
Ground Corn	21.45	21.41	24.35
SBM44	13.94	8.99	0.87
Urea	0.257	-	-
RumaPro	-	1.93	4.35
Analyses			
Crude Protein, % CP	31.39	41.56	72.77
Neutral Detergent Fiber	15.08	14.30	15.41
Soluble Protein	35.60	35.56	36.43
Acid Detergent Fiber	23.78	23.47	24.81
Nonstructural Carbohydrate	31.78	34.47	36.63
Starch	28.62	32.02	35.04
Sugar	3.16	2.45	1.59
Ether Extract	2.82	3.18	3.33
Ash	3.53	4.85	5.16
Calculated NFC[1];1;39.67	42.97	42.11	39.67

[1]Non Fiber Carbohydrate

Experiment 2

Digestion coefficients are shown in Table 6. As was seen in Experiment 1, no effects on dry matter or organic matter digested due to treatment were noted. Fiber digestion, however, was increased (p=.08) by both levels of RumaPro compared to the control, and the response appeared to increase with increased level of RumaPro in the diet. Although RumaPro caused a slight, but statistically significant, decrease in NSC digestion, the combined fiber and NSC digested was greater (p=.03) for the RumaPro diets than for the control diet, when determined as total carbohydrate digested in g/d.

Effects on volatile fatty acids were similar to those seen in Experiment 1, which was an increase in acetate and a decrease in butyrate, as shown in Table 7. In Experiment 2, however, the increased acetate was sufficient to cause significant increases in the acetate-propionate ratio for both treatments.

Although the average pH did not differ due to the treatments (Table 7), both treatments resulted in higher fermentation pH (p=.10) compared to the control at hours 2, 4 and 6 post-feeding (Figure 2). This is consistent with the higher fiber digestion seen with both RumaPro treatments.

Nitrogen partitioning is presented in Table 8. Nitrogen digestion was not affected by treatment. Flow of non-ammonia N, by-pass feed N and microbial N all were lower for the average of the treatments than for the control. These results were primarily caused by the responses to the highest level of RumaPro. Responses to the lower level of RumaPro appeared similar to those of the control. As seen in Experiment 1, ammonia was low for the RumaPro diet at level 1, indicating very slow release of N, probably at a rate similar to that of SBM. As a consequence of the higher carbohydrate digestion and no increase in microbial yield on the RumaPro diets, carbohydrate and organic matter efficiencies were lower than for the control. As seen in the previous experiment, the highest level of RumaPro resulted in higher ammonia losses and lower feed N efficiency compared to either the control or the lower level of RumaPro.

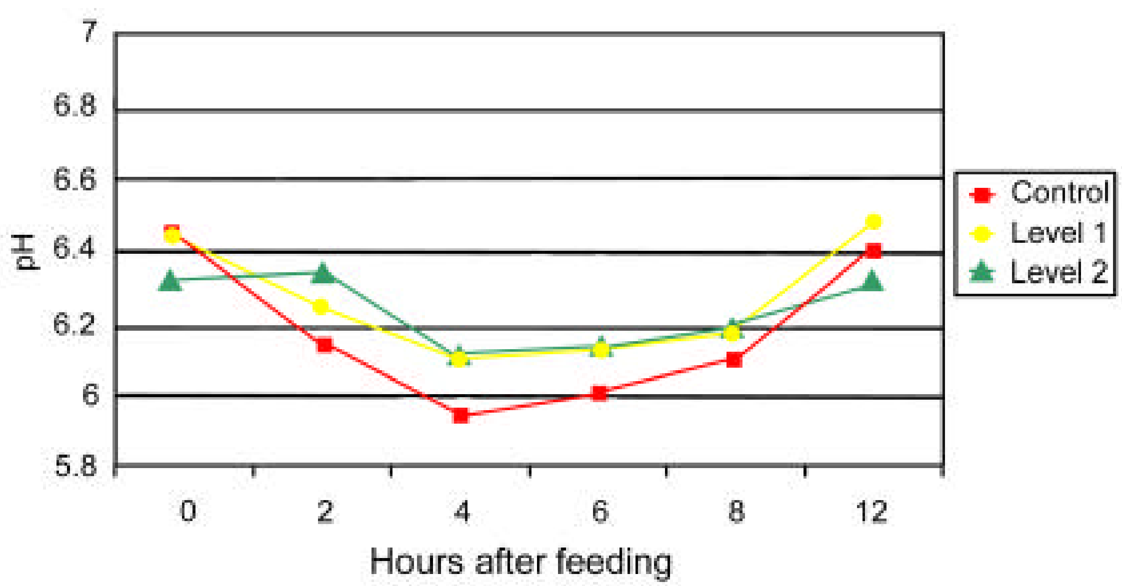

Figure 2. Fermentation pH
RumaPro Project-Close-up Diets

TABLE 6. Digestion Coefficients for Experiment 2 – Close-up Rations

Diets				P=% Digested	
Nutrient	Control	RumaPro 1	Ruma Pro 2	Cont vs Trts	RumaPro 1 vs 2
Dry Matter	77.3	73.1	76.0	NS	NS
Organic Matter	53.4	55.6	58.0	NS	NS
Neutral Detergent Fiber	27.2	33.7	37.1	.08	NS
Acid Detergent Fiber	35.3	32.4	53.6	.08	.07
Nonstructural Carbohydrate	90.9	92.0	87.4	.05	.01
Total Carbohydrate digested					
Grams/d	22.1	25.4	26.5	.03	NS

TABLE 7. Volatile Fatty Acid Production, Molar Ratios and pH for Experiment 2 – Close-up Rations

Nutrient	Diets: Control	Ruma Pro 1	Ruma Pro 2	P=%Gain: Cont vs Trts	Ruma Pro 1 vs 2
Total VFA, mm/day	238	235	229	NS	NS
Molar Proportions, %					
Acetic	55.2	60.6	61.6	.02	NS
Propionic	23.4	20.2	21.8	NS	NS
Isobutyric	0.60	0.77	0.49	NS	.01
Butyric	16.3	13.7	11.5	.01	.01
Isovaleric	1.88	2.20	2.19	NS	NS
Valeric	2.61	2.53	2.47	NS	NS
pH, average/day	6.186	6.26	6.26	NS	NS
Acetate/Propionate ratio	2.39	3.04	2.83	.10	NS

TABLE 8. Nitrogen Partitioning, Microbial Growth and Microbial Efficiency for Experiment 2 – Close-up Rations

Nutrient	Diets: Control	Ruma Pro 1	Ruma Pro 2	P=%Gain: Cont vs Trts	Ruma Pro 1 vs 2
Nitrogen Intake, g/day	2.67	2.54	2.72	-	-
Nitrogen Digested, %	72.7	66.3	70.0	NS	NS
Non-ammonia N, g/day	1.57	1.52	1.46	.07	NS
Ammonia N, mg/dl	4.81	4.23	10.02	NS	.01
By-pass N, g/day	0.47	0.55	0.52	NS	NS
Microbial N, g/day	1.11	0.97	0.94	.07	NS
Efficiencies:					
Mic N/kg OMD[1]	36.2	30.7	28.6	.13	NS
Mic N/kg CHOD[2]	49.7	37.2	34.5	.02	NS
Feed N[3]	89.1	89.1	77.2	NS	.02

[1]Microbial N produced/kg organic matter digested
[2]Microbial N produced/kg carbohydrate digested
[3]Digested feed N converted to microbial N, %

IMPLICATIONS AND CONCLUSIONS

Responses to RumaPro were similar when included in both lactation and dry cow rations. Relative to the soybean meal-urea control, results of these studies indicate important responses to RumaPro in several aspects of rumen function. Because of the apparently slow rate of N release, RumaPro is best substituted for a portion of the natural protein in the diet, in this case, soybean meal. Indications from both studies put the level of substitution between 16.5% and 35% of the SBM nitrogen. At the levels of substitution of 16.5 to 35% of SBM nitrogen, RumaPro improved total carbohydrate digestion, increased rumen pH, increased acetate proportion and decreased butyrate production; all positive responses, which have implications in terms of improved milk fat production. At these levels, the use of RumaPro nitrogen was equal to that of SBM as a source of N for microbial growth. This is shown by both microbial nitrogen production and the efficiencies of conversion of feed nitrogen to microbial nitrogen.

The increases in rumen pH may well be at least partly responsible for these responses. It was initially thought that the rumen pH was increased by extensive ammonia release. The low daily averages for ammonia cast doubt on this possibility, however. Further, in our experiences, no feed (including urea at high levels) has resulted in a pH increase after feeding as happened in both Experiment 1 and 2. It is suspected that RumaPro may have a strong buffering effect independent of ammonia.

It can be concluded, based on these studies that:

1. 1. RumaPro is a slow-release source of N.
2. 2. It may be substituted for soybean meal at 16.5 to 35% of SBM nitrogen, on an equalN basis.
3. When substituted at these levels it is equivalent, but not superior to, SBM nitrogen for supporting microbial growth.
4. RumaPro should not be used to replace all the natural protein supplement; however,the absolute upper limit to substitution was not determined in this study.

Ruma Pro®

Directions for use

(For Ruminants Only)

Feedyard, dairy and other confinement fed animals as well as pasture grazing animals can be fed Ruma Pro as part of a complete ration or as an ingredient in a complete supplement.

Guaranteed Analysis:

Crude Protein, minimum	143.0%
Equivalent Crude Protein from NPN, minimum	143.0%
Nitrogen, minimum	23.0%
Crude Fat, minimum	0.0%
Crude Fiber, maximum	0.0%
Calcium, minimum	6.8%
Calcium, maximum	7.1%
Moisture, maximum	30.0%

Ingredient Statement:

Calcium Chloride, Urea ***(Clear Liquid Solution)***

Directions for Feeding:

Add 14 pounds per ton (0.7%) Ruma Pro concentrate by weight to a complete feed ration for each one percent (1.0%) increase in crude protein desired. Completely mix ration after concentrate is added to other feed ingredients. Ration must contain sufficient carbohydrates to utilize the NPN by the type and age of animals being fed. In rations above 16% crude protein or when feeding young animals, a knowledgeable animal nutritionist should be consulted before feeding.

CAUTION:

1. Always provide an adequate supply of clean, fresh drinking water.
2. Never add Ruma Pro to drinking water.
3. Never feed Ruma Pro as a single feed ingredient.
4. Do not feed Ruma Pro to horses or other monogastric animals.

5. Use good feed management practices when starting new, very hungry, and/or starved cattle or sheep on rations or supplements containing NPN.
6. Use only as directed.

Because of the concentrated amount of NPN in this ingredient, seller warranties the analysis and limits the guarantee to percentages as stated on the label. The management and use of this product are beyond our control.

Ruma Pro®

Material Safety Data Sheet

Section I. Chemical Product and Company Information

PRODUCT NAME:	Urea Calcium Chloride 143% UPN
TRADE NAME:	RUMA PRO
SYNONYM:	Ammonium Calcium Liquid
CHEMICAL NAME:	Not applicable. A blend
CHEMICAL FAMILY:	Ammonium salt
CHEMICAL FORMULA:	Not available
MATERIAL USES:	Animal NPN supplement

MANUFACTURER
UNIPRO
5626 W. 19th Street. Suite B
Greely, CO 80634

Company's Emerg. Ph #
1-800-558-3341
Date: MSDS prepared: June 1, 2000
MSDS Serial Number: UII-101

Section II. Hazardous Ingredients

No regulated components

Section III. Hazards Identification

POTENTIAL ACUTE HEALTH EFFECTS	This product may irritate eyes and skin upon prolonged of repeated contact. Ingestion of this substances may produce irritation of the gastrointestinal tract, characterized by burning and diarrhea.
POTENTIAL CHRONIC HEALTH EFFECTS	There is no known effect from chronic exposure to this product.

Section IV. first aid Measures

EYE CONTACT	May cause skin irritation. Check for and remove any contact lenses. IMMEDIATELY flush eyes with running water for at least 15 minutes keeping eyelids open. Obtain medical attention if irritation persists.
MINOR SKIN CONTACT	May cause skin irritation. Wash contaminated skin with soap and water. Wash contaminated clothing before reusing.
INTENSIVE SKIN CONTACT	No additional remarks.
MINOR INHALATION	Repeated or prolonged inhalation of mists may lead to respiratory irritation. Loosen tight clothing around the individual's neck and waist. Allow the person to rest in a well ventilated area. Obtain medical attention if irritation persists.
SEVERE INHALATION	No additional remarks.
SLIGHT INGESTION	Have conscience person drink several glasses of water or milk. INDUCE VOMITING. Lower the head so that the vomiting will not reenter the mouth and throat. NEVER give an unconscious person anything to ingest. Obtain medical attention.
INTENSIVE INGESTION	No additional information

Ruma Pro®

Section V. Fire and Explosion Data

THE PRODUCT IS	Non-flammable.
AUTO - IGNITIONTEMPERATURE	Not applicable.
FLASH POINT	Not applicable.
FLAMMABILITY LIMITS	Not applicable.
PRODUCTS OF COMBUSTION	Material will not burn.
FIRE HAZARD IN THE PRESENCE OF VARIOUS SUBSTANCES	Not applicable.
EXPLOSION HAZARD IN THE PRESENCE OF VARIOUS SUBSTANCES	This product is non-explosive.
FIRE FIGHTING MEDIA AND INSTRUCTIONS	Non-flammable. Use extinguishing media suitable for surrounding materials.
SPECIAL REMARKS ON FIRE HAZARDS	Non combustible.
SPECIAL REMARKS ON EXPLOSION HAZARDS	No additional remark.

Section VI. Accidental Release Measures

SMALL SPILL	Absorb with an inert material and place in an appropriate waste container. Ensure disposal complies with local regulations
LARGE SPILL	Stop leak if possible to do so without risk. Dike and contain spilled material. Ensure that the spilled material does not enter sewers, wells or watercourses. Product will promote algae growth and degrade water quality and taste. Notify downstream water users. Pump up spilled material and place in suitable containers for reuse or disposal. Call for information on disposal alternatives. Insure disposal is in conformance with local regulations.

Section VII. Handling and Storage

PRECAUTIONS	After handling, always wash hands thoroughly with soap and water. Avoid contact with skin and eyes. Keep away from food, drink and animal feeds. Avoid contact with incompatible substances Keep out of the reach of children.
STORAGE	Stores well at any temperature.

Section VIII. Exposure Controls/Personal Protection

PRECAUTIONS	Use process enclosures, local exhaust ventilation, or other engineering controls to keep air borne levels below recommended exposure limits. If user operations generate mists, use ventilation to keep exposure limited.
PERSONAL PROTECTION	The selection of personal protective equipment varies, depending upon conditions of use. Where skin and eye contact may occur as result of brief periodic exposures, wear long sleeved clothing, coveralls, chemical resistant gloves, and safety glasses with side shields.
PERSONAL PROTECTION IN CASE OF LARGE RELEASE	Wear a NIOSH approved dust or mist respirator if engineering. Wear long sleeved clothing or coveralls for long term exposure.
EXPOSURE LIMITS	Has not been established.

Ruma Pro®

Section IX. Physical and Chemical Properties

PHYSICAL STATE AND APPEARANCE	Liquid. (Clear to slightly straw colored)		
MOLECULAR WEIGHT	Not available	**COLOR**	Clear to straw colored
ph	7.5	**ODOR**	Odorless
BOILING POINT	285 deg. F	**THRESHOLD**	
CRITICAL TEMPERATURE	N/A	**VOLATILITY**	None
SPECIFIC GRAVITY	1.34	**SOLUBILITY**	Easily soluble in cold or hot water
BULK DENSITY	11.2# PER GAL	**DISPERSION**	
VAPOR PRESSURE	Not available	**PROPERTIES**	Easily dispersed in any proportion of cold or hot water
VAPOR DENSITY	Not available		

Section X. Stability and Reactive Data

STABILITY	This product is stable.
INSTABILITY TEMPERATURE	Not available.
CONDITIONS OF INSTABILITY	No additional remarks.
CORROSIVITY	**Very incompatible** with **sulfuric acid** and most **poly phosphates**.
SPECIAL REMARKS ON CORROSIVITY	**Incompatible** with **copper alloys**. Corrosive to brass, ferrous metals and alloys.

Section XI. Toxicological Information

SIGNIFICANT ROUTES OF EXPOSURE	Inhalation.
TOXICITY TO ANIMALS	Use of this product is restricted to directions on the label.
SPECIAL REMARKS ON TOXICITY TO ANIMALS	More than recommended amounts could result in ammonia toxicity.
OTHER EFFECTS ON HUMANS	No additional information or remarks on this product.

Section XII. Ecological Information

ECOTOXICITY	Non-persistent and non-cumulative when applied using normal practices.
PRODUCTS OF DEGRADATION	This is a very slow release nitrogen, but will eventually change to nitrogen oxides.
TOXICITY OF THE PRODUCTS OF DEGRADATION	The products of biodegradation are not harmful under normal conditions of slow metabolic release.
SPECIAL REMARKS ON THE PRODUCTS OF DEGRADATION	Product will promote algae growth and may degrade water quality and taste. Notify downstream water users. Will disperse in water. Reclaiming material may not be viable.

Section XIII. Disposal Considerations

WASTE DISPOSAL OR RECYCLING	Pump up spilled material and place in suitable containers for reuse or disposal. Call for information on disposal alternatives.

Insure disposal is in conformance with local regulations.

Section XIV. Transportation Information

DOT	Not controlled.
SPECIAL PROVISIONS FOR TRANSPORT	Not applicable

Section XV. Other Information

OTHER SPECIAL CONSIDERATIONS	Not controlled.
FOR FURTHER SAFETY, HEALTH OR ENVIRONMENTAL INFORMATION ON THIS PRODUCT, CONTACT	UNIPRO International, Inc. 1-800-558-3341

NOTICE TO READER

The buyer assumes all risk in connection with the use of this material. The buyer assumes all responsibility to ensuring this material is used in a safe manner in compliance with applicable environmental, health and safety laws, policies and guidelines. UNIPRO International, Inc. assumes no responsibility for liability for the information supplied.

Ruma Pro®

Feedyards

Ruma Pro offers ruminant livestock producers a safe, efficient, and cost effective replacement for feed grade urea and expensive natural protein products.

Feed efficiency data from Texas Tech and New Mexico State University feeding trials indicate:

a. Ruma Pro was 8.6% better than cottonseed meal

b. Ruma Pro was 4.3% better than feed grade urea.

c. Ruma Pro was 4.2% better than soybean meal.

Preliminary carcass data from feedlot feeding trials indicate a positive trend towards several carcass characteristics. However, additional results from a large number of genotypes will have to be collected before data can be better analyzed.

Ref. Study C - Technical Report No. T-5-356, 1995. Study D - New Mexico State University, 2000. Experiment 2 research from New Mexico State University indicates that when Ruma Pro was used as the total supplemental protein source, feed efficiency was significantly increased. Ref. Study D

Range Supplements

Ruma Pro can be used in all types of range supplements.

- Pellets
- Cubes
- Poured Blocks
- Liquids

The slow release properties of Ruma Pro distinguish it from all other forms of protein and non-protein nitrogen sources, such as urea. Highly digestible calcium also makes Ruma Pro an excellent ingredient for range products.

Most range supplements are fed in low dietary energy situations. And, since urea utilization is limited by the amount of total digestible nutrients (TDN) available in the diet, the use of urea as a means to improve the protein profile in the rumen of animals in range conditions is very limited. The single most important factor influencing the amount of urea a ruminant animal can utilize is the digestible energy or total digestible nutrients (TDN) content of the ration.

Because of its unique properties Ruma Pro, when used as a protein source in ranges situations, should more nearly match the energy available in the rumen and, therefore provide a more suitable form of protein supplementation.

Ruma Pro®

Dairy

The unique handling and nutritional qualities of Ruma Pro make it an excellent source of slow release NPN and highly digestible calcium for dairy diets.

Handling Characteristics:

- Mixes well with all types of liquid supplements
- Can be added directly to TMR
- Can be added to all forms of supplement (pellets, cubes, blocks)
- Works well in a variety of diets (low moisture - high moisture)
- Ruma Pro is slightly tacky
- Aids in reducing fines

Nutritional Attributes:

- Low moisture (68.00% - 70.00% dry matter)
- Excellent source of sustained release NPN.
- Soluble liquid calcium - high bioavailability

Improved safety, efficiency, and value make Ruma Pro an effective replacement for feed grade urea and expensive natural protein products in dairy rations.

Dairy trials are currently being conducted. Results will be reported as they become available.