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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°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 12th and 13th ribs.