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Supplemental Value of Feed Grade Biuret and Urea-Molasses for Cows on Dry Winter Grass

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SUPPLEMENTAL VALUE OF FEED GRADE BIURET AND UREA-MOLASSES FOR COWS ON DRY WINTER GRASS[1,2]

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SUMMARY

Four trials were conducted to evaluate the supplemental value of feed grade biuret (in dry supplements) and urea (in liquid urea-molasses mixtures) when compared to natural protein and urea in dry supplements for beef cows grazing low quality dry winter range grass. Urea or feed grade biuret provided 50% of the nitrogen in 30% CP dry supplements and urea provided 50% of the nitrogen in 30% CP dry supplements and urea provided 94% of the nitrogen in 30% CP liquid supplements. Dry supplements were self-fed with salt added to limit intake.

Winter weight loss of cows fed dry urea-containing supplements was less than that of cows fed dry biuret-containing supplements, an average of 42 *vs* 57 kg in three trials.

Winter weight loss of cows fed 30% natural protein supplements was less than that of cows fed isonitrogenous urea-molasses liquid supplements when the cows subsisted entirely on dry winter range grass, an average of 70 *vs* 92 kg in two trials. Winter weight losses of cows fed natural protein and liquid supplements were similar when prairie hay was provided in addition to winter range grass.

Spring and summer gains were greatest for cows that lost the most weight during the wintering period and fall weights of cows were not significantly different. Birth weights and weaning weights of calves were not significantly affected by treatment.

Winter weight loss of cows in these trials indicated that neither biuret in a dry supplement nor urea in a liquid supplement provided an advantageous alternative to urea in dry supplements for cows wintered on low quality dry winter range grass.

(Key Words: Biuret, Urea, Liquid Supplement, Wintering Cows.)

INTRODUCTION

Low quality forages are used extensively for wintering beef cattle and supplementation with protein is usually needed for satisfactory performance. Nelson and Waller (1962) summarized 16 experiments involving beef cattle wintered on low quality native range grass in Oklahoma and found that urea-containing supplements were of lower value than supplements containing cottonseed meal for maintenance of winter weight. Most research indicates that urea utilization is poor when used to supplement cattle grazing low quality forage. Since the poor utilization is caused in part by rapid hydrolysis of urea, much attention has been directed toward the use of biuret which is hydrolyzed at a slower rate (Berry *et al.*, 1956; Hatfield *et al.*, 1959; Clanton, 1970; Raleigh and Turner, 1968; Oltjen *et al.*, 1973).

Readily available carbohydrates improve the utilization of urea and in many areas of the world liquid molasses is an economical carbohydrate source and serves as a good carrier for urea. Urea-molasses blends offer the advantage of self-feeding which may reduce labor and also provide for a slow and intermittent intake.

Gains of cattle subsisting on low quality forages have been improved with urea-molasses, but usually not with molasses alone, indicating that protein is the first limiting nutrient (Beames, 1959).

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The purpose of these trials was to compare supplements containing all natural protein with dry supplements containing relatively high levels of urea and biuret and liquid supplement high in urea for cows grazing low quality forage.

EXPERIMENTAL PROCEDURE

The trials were conducted in Central Oklahoma on dry native range grass during winter. The predominant forage is of the tall-grass type with climax species consisting of little bluestem (Andropogon scorparius), big bluestem (Andropogon gerardi), Indian grass (Sorghastrum natans) and switch grass (Panicum virgatum).

Angus and Hereford cows were randomly allotted, after stratification by breed, to treatment groups in each trial. The majority of calves were born during February, March and April. Cow treatment groups were rotated among pastures at approximately 28-day intervals in each trial to minimize differences due to pastures. At the end of each trial condition of cows was estimated by scoring each cow on a scale of 1 to 9, with 1 being the thinnest and 9 the fattest. Birth weights of heifer calves were adjusted to a bull equivalent by multiplying heifer weights by 1.048. Bull calves were castrated at an average age of 3 months. Weaning weights of calves were adjusted to a 205-day steer equivalent basis by multiplying age adjusted weights of heifers by 1.05.

Trial 1. The objective of this trial was to compare a liquid supplement containing urea and molasses with a dry supplement containing natural protein. Forty-two 5-year-old pregnant-lactating Angus and Hereford cows were used in a wintering trial of 140 days. A 25% natural protein supplement was hand-fed to one treatment group at the rate of 1.35 kg per cow daily and the second treatment group was allowed to consume a 30% CP liquid urea-molasses supplement *ad libitum* from a lick tank.

The major ingredients in the dry supplement were milo (sorghum, milo, grain, grnd (4) 4-05-643) and cottonseed meal (cotton, seed w some hulls, solv-extd. grnd mn 41 prot mx 41 fbr mn .5 fat (5) 5-01-621) with 5% alfalfa (alfalfa, aerial part, dehygrnd mn 17% protein (1) 1-00-023) and 5% liquid molasses (sugarcane, molasses, mn 48 invert sugar mn 79.5 degrees brix (4) 4-04-696). Both supplements were formulated to contain 1.25% phosphorus and 22,000 IU of vitamin A per kilogram. The protein equivalent from urea in the liquid supplement was 28.1 percent. In addition to the protein supplements good quality prairie hay (native plants, Midwest, hay, s-c, mid-blm (1) 1-07-956) was fed at the rate of 4.5 kg per cow daily beginning at the start of calving, approximately February 1, which was 84 days before the end of the trial. All cows calved before the end of the trial.

Trial 2. The objective of this trial was to compare dry supplements containing urea or biuret with a dry supplement containing natural protein. Thirty-one 4- and 5-year-old non-lactating Angus and Hereford cows were used in a 139-day wintering trial. Three supplemental protein treatments were compared: natural protein, feed grade biuret and urea. The supplements were formulated to contain 30% CP with NPN sources contributing 50% of the nitrogen. The major feed ingredients in the supplements were wheat (wheat, grain, (4) 4-05-211) and soybean meal (soybean, seeds, solv-extd, grnd (5) 5-04-604). The supplements were formulated to contain 5% dehydrated alfalfa, 5% molasses, 1.5% phosphorus, .5% calcium, .5% sulfur and 22,000 IU of vitamin A per kilogram. Supplements were self-fed with consumption regulated by the inclusion of salt. Hay was fed only when snow covered the grass. Cows were open at the beginning of the trial and were pasture exposed to bulls for 45 days during the trial.

Trial 3. The objective of this trial was to compare dry supplements containing urea or biuret and a liquid supplement containing urea and molasses with a dry supplement containing natural protein. The same supplements fed in trial 2 were used in trial 3. In addition, a fourth treatment group received a commercial 30% CP liquid supplement (28.1% CP equivalent from urea) *ad libitum* from a lick tank. Experimental cows in this 139-day trial were 38 6-year-old pregnant-lactating Hereford and Angus cows. Twenty-seven cows calved during the latter part of the trial. Because the number of cows which had not calved by the end of the trial was not equal among treatments and since calving involves considerable weight loss, the final weight of the cows that had not calved was adjusted to a calved basis. This was done by using a regression equation derived from data obtained in trials wherein cows were accurately weighed prior to and after calving and calves were weighed at birth (Ewing *et al.*, 1966, and *unpublished data*). The following equation was

TABLE 1. INGREDIENT MAKEUP OF DRY SUPPLEMENTS (PERCENT), TRIAL 4

Ingredient	International reference no.	Supplement, % CP			
		1 Natural 15	2 Natural 30	3 Urea[a] 30	4 Biuret[a] 30
Sorghum, milo, grain grnd (4)	4-05-643	72.8	34.0	63.1	61.4
Soybeen, seeds, solv extd, grnd (5)	5-04-604	17.4	56.8	19.4	19.9
Alfalfa, aerial part, dehygrnd mn 17% protein (1)	1-00-023	5.0	5.0	5.0	5.0
Urea (45% nitrogen)		...	...	5.31	...
Feed grade biuret[b]		...	...	...	6.46
Calcium phosphate, dibasic, commercial (6)	6-01-080	1.28	.90	1.27	1.27
Sodium phosphate, monobasic, $NaH_2PO_4 \cdot H_2O$cp	6-04-287	3.52	3.30	3.58	3.59
Sodium sulfate, $Na_2SO_4 \cdot IOH_2O$cp (6)[c]	6-04-292			2.35	2.35
Vitamin A[d]		+	+	+	+

[a]To furnish one-half of total crude protein.

[b]Approximate chemical composition (dry matter basis): biuret 60%; urea 15%; cynanuric acid and triuret 21%; total nitrogen 37%.

[c]Formulated to supply nitrogen:sulfur ratio of 14:1.

[d]Added to supply 22,000 IU per kilogram.

TABLE 2. PERFORMANCE OF COWS AND CALVES, TRIAL 1

Item	Supplement, % CP Natural 25	Liquid 30	Probability[a]
No. cows	22	20	
Supplement consumed, kg	1.36	1.91	
Weight per cow			
Initial, kg	426	434	
Winter loss, kg	65 ± 4.1[c]	64 ± 4.3	.84
Winter loss, %	15.3 ± .70	14.7 ± .73	.51
Summer gain, kg[b]	77 ± 3.6	73 ± 3.8	.52
Adj. weaning wt, kg	229 ± 4.9	226 ± 5.2	.74

[a]Probability that differences in means are due to chance.

[b]Gain from end of wintering trial to weaning date of calf.

[c]Standard error of mean.

used to adjust the final winter weights of the cows which had not calved:

$$\text{Adjusted final weight} = \text{actual final weight} - [(\text{calf birth weight} \times 1.9697) - 19.0]$$

Aluminum sulfate at a rate of .5 to 1.0% was used to limit intake of the liquid supplement which was provided in tanks equipped with self-feeding wheels. Hay was fed only on a few days when snow covered the grass.

Trial 4. The objective of this trial was to compare dry supplements containing urea or biuret and a liquid supplement containing urea and molasses with both negative and positive control supplements. Six supplements were fed, four dry and two liquid (table 1). Two dry all-natural protein supplements containing 15 and 30% CP served as negative and positive controls, respectively. Two dry supplements containing 15 and 30% CP included urea or feed grade biuret to provide 50% of the nitrogen. Supplements were formulated to contain the same level of calcium and phosphorus as in trial 3 and to have a nitrogen:sulfur ratio of 14:1. Two liquid supplements were fed; one (same formulation as in trial 3) contained 30% CP (28.1% CP equivalent from urea) and the second was cane molasses which served as a negative control for the liquid 30% CP supplement. Aluminum sulfate was added to the two liquid supplements to control consumption while salt was used to control intake of dry supplements.

Fifty-six pregnant-lactating Hereford and Angus cows 4 to 6 years old were used in the 84-day trial. The final weights of 21 cows which had not calved by the end of the trial were adjusted to a calved basis by the same procedure described for trial 3.

The data were analyzed by analysis of variance (with unequal numbers per treatment) as outlined by Snedecor and Cochran (1967). Breed × treatment interaction was not significant ($P>.50$) for the traits studied in any of the trials; breeds were combined for subsequent analysis. The F test was used to test for treatment differences and the T test was used to test for differences between any two treatments.

RESULTS AND DISCUSSION

Trial 1. Cow winter weight loss, cow summer gain and calf performance were not different ($P>.50$) for cows fed supplements containing natural protein or liquid urea-molasses (table 2). Cows receiving the liquid supplement consumed more supplemental nitrogen (91.4 g *vs* 54.5 g per cow daily).

Trial 2. The cows consuming natural protein gained 3.3 kg during the wintering trial while the cows receiving NPN supplements lost weight (table 3). Weight change for cows fed natural protein or urea supplements was not different ($P>.05$), but cows consuming the biuret supplement lost more weight ($P<.05$). Condition of the cows at the end of the wintering period followed the same trend ($P = .10$); cows which lost the most weight were thinnest at the end of winter. Consumption of the urea and biuret supplements was similar,

TABLE 3. PERFORMANCE OF COWS, TRIAL 2

Item	Supplement, % CP Natural 30	Urea[a] 30	Biuret[a] 30	Probability[b]
No. cows	10	11	10	
Daily supplement intake				
Protein supplement, kg	1.33	1.30	1.22	
Salt, kg	.47	.36	.37	
Weight per cow				
Initial, kg	400	412	412	
Winter change, kg	3 ± 4.7[ce]	-8 ± 4.5[e]	-26 ± 4.7[f]	.0007
Winter change, %	.8 ± 1.10[e]	-1.9 ± 1.10[f]	-6.3 ± 1.10[g]	.0004
Condition, end of winter[d]	4.6 ± .26	4.1 ± .25	3.8 ± .26	.105

[a]To furnish one-half of total crude protein.

[b]Probability that differences in means are due to chance.

[c]Standard error of mean.

[d]Based on a scale of 1 to 9, with 1 being the thinnest and 9 the fattest.

[e,f,g]Means with different superscripts are significantly different ($P<.05$).

but level of salt required to control the intake of the natural protein supplement was considerable higher than that required for the NPN supplements.

Trial 3. Results of trial 3 (table 4) were not consistent with results of trials 1, 2 and 4. Cows receiving the dry urea supplement lost less weight during the winter than cows receiving the other supplements, and significantly ($P<.05$) less than cows receiving natural protein and liquid urea-molasses supplements. Cows receiving the liquid urea-molasses supplement lost more weight ($P<.05$) than cows fed the dry supplements. Summer gain was highest for cows which lost the most weight during winter. Condition score at the end of winter was highest for the cows receiving the dry natural protein supplement and lowest for cows consuming the liquid supplement. Calf birth weight ($P = .55$) and weaning weight ($P = .36$) were not affected by treatment.

Supplement intake was approximately equal for all treatments. The level of salt required to control intake of dry supplements was 28.2, 26.8 and 21.7 for natural, biuret and urea supplements, respectively, suggesting the order of palatability. A considerable pasture effect on supplement intake was noted when cows were rotated among pastures. At the beginning of the trial the intake of liquid supplement was very high (4.08 kg per cow daily); aluminum sulfate was added to limit its intake. By the end of the trial the intake of liquid supplement had decreased to a low level (.5 kg) without aluminum sulfate additions.

Trial 4. Winter weight loss of cows receiving the 15% natural protein supplement was 17 kg greater ($P = .15$) than that of the cows receiving the 30% natural protein, indicating a need for supplement (table 5). Cows receiving the 30% natural protein lost less weight ($P<.10$) as a percent of initial weight than cows in any other treatment group. Weight loss of cows consuming molasses was greater ($P<.10$) than that of cows fed the protein supplements. As in previous trials, cows which lost the most weight during winter compensated by gaining the most weight during the summer.

Winter treatment did not affect calf birth weight ($P = .67$) or weaning weight ($P = .81$).

The level of salt required to control the intake of dry supplements was highest for the 30% natural protein supplement and lowest for the biuret containing supplement. The intake of molasses was excessively high even after a high level of alluminum sulfate (.5 to 1.0%) was added.

Discussion

Although the effect of type of supplement on weight loss of cows was not completely consistent, cows receiving natural protein supplement tended to lose less weight during the wintering period than cows fed the NPN supplements, in agreement with Clanton (1970),

TABLE 4. PERFORMANCE OF COWS AND CALVES, TRIAL 3

	Supplement, % CP				
Item	Dry natural 30	Dry urea 30	Dry biuret 30	Liquid urea 30	Probability[a]
No. cows	9	10	9	10	
Daily supplement intake					
Protein supplement, kg	1.48	1.47	1.45	1.45	
Salt, kg	.58	.41	.53	...	
Weight per cow					
Initial, kg	471	468	473	460	
Winter loss, kg	68 ± 7.0[be]	39 ± 6.6[f]	58 ± 7.0[ef]	89 ± 6.6[g]	.0002
Winter loss, %	14.4 ± 1.45[e]	8.3 ± 1.37[f]	11.8 ± 1.45[ef]	19.5 ± 1.37[g]	.0001
Summer gain, kg[c]	36 ± 6.9[e]	16 ± 6.6[f]	31 ± 6.9[ef]	56 ± 6.6[g]	.002
Condition, end of winter[d]	4.3 ± .24	4.2 ± .23	4.0 ± .24	3.5 ± .23	.12
Calf performance					
Adj. birth wt, kg	30.5 ± 1.7	32.2 ± 1.6	34 ± 1.7	32.6 ± 1.6	.55
Adj. weaning wt, kg	206 ± 6.2	209 ± 5.9	200 ± 6.2	195 ± 5.9	.36

[a]Probability that differences in means are due to chance.

[b]Standard error of mean.

[c]Gain from end of wintering trial to weaning date of calf.

[d]Based on a scale of 1 to 9, with 1 being the thinnest and 9 the fattest.

[e,f,g]Means with different superscripts are significantly different ($P<.05$).

TABLE 5. PERFORMANCE OF COWS AND CALVES, TRIAL 4

	Supplement, % CP						
	Dry				Liquid		
Item	Natural 15	Natural 30	Urea 30	Biuret 30	Urea 30	Molasses 30	Prob.[a]
No. cows	10	10	9	9	9	9	
Daily supplement intake							
Protein supplement, kg	1.22	1.18	1.33	1.23	1.55	3.08	
Salt, kg	.39	.45	.39	.31	...	...	
Weight per cow							
Initial, kg	470	488	465	477	464	482	
Winter loss, kg	89 ± 8.51[be]	72 ± 8.51[f]	79 ± 8.9[ef]	92 ± 8.9[e]	96 ± 8.9[eg]	117 ± 8.9[g]	.02
Winter loss, %	18.9 ± 1.57[e]	14.8 ± 1.57[f]	17.2 ± 1.65[ef]	19.0 ± 1.65[e]	20.8 ± 1.65[eg]	24.3 ± 1.65[g]	.005
Summer gain, kg[c]	72 ± 10.8	55 ± 10.8	71 ± 11.4	87 ± 11.4	87 ± 11.4	95 ± 11.4	.15
Condition, end of winter[d]	3.6 ± .29[e]	4.0 ± .29[e]	3.9 ± .31[e]	3.3 ± .21[ef]	3.1 ± .31[fg]	2.6 ± .31[g]	.02
Calf performance							
Adj. birth wt, kg	34.5 ± 1.4	36.3 ± 1.4	36.8 ± 1.5	33.4 ± 1.5	35.8 ± 1.5	35.2 ± 1.5	.67
Adj. weaning wt, kg	236 ± 6.7	245 ± 6.7	246 ± 7.1	250 ± 7.1	248 ± 7.1	246 ± 7.1	.81

[a]Probability that differences in means are due to chance.

[b]Standard error of mean.

[c]Gain from end of wintering trial to weaning date of calf.

[d]Based on a scale of 1 to 9, with 1 being the thinnest and 9 the fattest.

[e,f,g]Means with different superscripts are significantly different ($P<.10$).

Raleigh and Wallace (1963), Tollett *et al.* (1969) and Turner and Raleigh (1969). It is not readily apparent why the cows receiving the dry urea supplement in trial 3 lost significantly less weight than cows receiving natural protein. However, it was noted that most of the difference in weight loss occurred during the last 42 days of the trial. During the earlier and more severe part of the winter, cows fed natural protein supplement lost less weight ($P<.05$). Pasture differences in growth of early spring grass could have caused the difference in weight loss observed during the last 42 days.

These trials suggested that nitrogen utilization in dry supplements was greater from urea than from biuret. Cows fed urea supplements lost less winter weight than cows receiving isonitrogenous supplements containing feed grade biuret, an average of 42 *vs* 57 kg in three trials. In trial 4, with negative and positive controls to provide reference points, weight loss of cows fed urea was intermediate between controls while weight losses of cows fed biuret and the negative control were similar. These results are in agreement with results of Berry *et al.* (1956) and Campbell *et al.* (1963) but in contrast with results of Raleigh and Turner (1968) and Turner and Raleigh (1969).

Winter weight loss of cows consuming the liquid urea-molasses supplement was greater than that of cows consuming any of the dry protein supplements except in trial 1. In trials 3 and 4 when cows subsisted entirely on dry range grass, cows fed 30% natural protein supplements lost less winter weight (an average of 70 *vs* 92 kg) than cows fed isonitrogenous urea-molasses liquid supplements. During the first 28 days of trial 1, liquid supplement cows lost 22 kg while natural protein cows gained 4 kilograms. The liquid supplement cows compensated later in the trial, particularly during the last 84 days when 4.5 kg prairie hay was fed per cow daily. Even so, the apparent condition of cows fed liquid supplement was noticably poorer at the end of the trial. Cows in the other trials subsisted entirely on dry grass, when utilization of urea could be expected to be the poorest (Nelson and Waller, 1962).

Intake of liquid supplement in trial 1 was greater than that of the dry natural protein supplement; consequently, the supplemental nitrogen intake was considerably higher on the liquid supplement (91 *vs* 54 g per cow daily). Apparently the utilization of the larger quantity of nitrogen in the liquid supplement was not sufficiently high to elicit a beneficial weight response.

The generally greater weight loss of cows consuming liquid urea-molasses supplement compared to cows consuming dry urea supplements was probably due to the higher (94%) level of NPN in the liquid supplement and its poor utilization (Clanton, 1970; Raleigh and Wallace, 1963). It is also possible that starch, present in the dry supplements, supported greater urea-nitrogen utilization than sugars in the molasses fraction of the liquid supplements (Bloomfield *et al.*, 1958). Some utilization of urea nitrogen supplied by the liquid supplement apparently occurred; the cows consuming liquid urea-molasses lost less weight ($P = .11$) than the cows consuming approximately twice the quantity of liquid cane molasses. This is in agreement with Beames (1959, 1963) and Coombe (1959) and demonstrated that supplemental energy is of little benefit to a low protein diet. However, cows fed liquid supplement lost more weight than negative controls in trial 4, indicating low utilization of urea nitrogen in the liquid supplement.

Winter weight loss did not appear to affect summer gain of cows adversely. Cows that lost the most weight during winter compensated by gaining the most weight during the summer and were in comparable condition by the time calves were weaned at the end of summer grazing.

Condition scores of cows at the end of winter followed the same tread as winter weight changes; cows which lost the most weight had the lowest condition scores. The results of trial 3 were not in agreement with this trend; cows fed the natural protein supplement lost the most weight but had the highest condition score. Although cows were assigned to treatment at random, cows fed the natural protein supplement were in better condition at the beginning of the wintering treatment. It is also possible that body weight change did not accurately reflect body composition changes.

Weaning weight of calves was not affected by the wintering treatment and weight loss of cows. This was not surprising since the majority of cows calved either during the latter part of or subsequent to the wintering trials when experimental treatments were imposed.

Winter weight loss of cows in these trials indicated that neither biuret in a dry supplement nor urea in liquid supplement provided an advantageous alternative to urea in dry supplements for cows wintered on low quality dry winter range grass.

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