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BIURET AND UREA IN RANGE CATTLE SUPPLEMENTS 1/

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Previous studies at this Station (Raleigh and Wallace, 1965) have shown that range forage decreases in quality with forage maturity so that by mid-June both protein and energy become limiting for economical yearling gains. Gains by yearling cattle on this type of range feed are 1.0 kg. or more during May and June, 0.7 kg. or less during July, less than 0.5 kg. during August, and very little gain after the first of September.

Raleigh et al., (1967) have shown that supplementation with protein and energy to yearling cattle on range will give economic returns to about mid-August. The use of nonprotein N compounds as a replacement for the supplemental protein could provide more economical gains. It has been generally believed that for proper utilization of urea an adequate supply of readily available carbohydrate is necessary. However, it has been shown that urea will increase the intake of low quality roughage with livestock (Raleigh and Wallace, 1963).

Biuret 3/, a condensation product of urea, is being researched as a non-protein source. Berry et al., (1956) found it to be nontoxic to ruminants even in large amounts and Hatfield et al., (1959) reported it to be a more palatable feed than urea. Meiske et al., (1955); Mies et al., (1967) report gains from feeding biuret comparable to those from urea. Hatfield et al., (1959) obtained positive N balances with sheep and steers fed rations in which biuret N furnished a major part of the total N intake. These results indicated that biuret can be used to provide flexibility of feeding nonprotein N to ruminants.

The purpose of this study was to compare biuret, urea, and cottonseed meal as N supplements to yearlings on range feed with and without additional energy supplements.

Experimental Procedure

Forty yearling heifers averaging 253 kg. were stratified by weight to treatments in a 2 x 4 factorial trial with two levels of energy and four sources

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3/ Biuret was provided by the Dow Chemical Company under the trade name "Kedlor" and is not yet approved in the United States by the FDA for use in livestock feeds. The Dow Chemical Company also provided financial assistance for this research.

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of N (table 1). Energy levels were (1) energy consumed by the animal that occurred naturally in the forage plus the energy from 300 grams of barley that was used as a carrier for the biuret and urea, and (2) supplemental barley calculated to provide the additional energy for gains of about 0.9 kg. per head throughout the season. The barley was increased as the forage matured and the energy content of the forage decreased.

Table 1. Experimental design with two levels of energy and four single sources of N 1/

Source of N	Energy level 1	Energy level 2	Number of animals
None	5	5	10
Biuret (38% N)	5	5	10
Urea (42% N)	5	5	10
Cottonseed meal (6.55% N)	5	5	10
Number of animals	20	20	40

1/ N and energy supplements started at low levels and increased as forage nutrients decreased to meet the animal's nutrient requirement for about 0.9 kg. daily gain. All diets were balanced for N and energy within energy levels and N sources with the exception of the non-nitrogen supplemented groups.

N sources consisted of (1) a control with no additional N, (2) additional N from biuret, (3) additional N from urea, and (4) additional N from cottonseed meal. N supplements were increased as the season progressed and the forage N decreased. Table 2 shows levels of N and energy supplementation for different periods during the trial.

Table 2. N and energy supplementation levels for different periods during the grazing season 1/

Period	N	Digestible energy
	(g/hd/day)	(kcal/hd/day)
6/21 - 6/27	17.2	1120
6/28 - 7/4	23.2	1420
7/5 - 7/11	28.5	1800
7/12 - 7/25	36.2	2390
7/26 - 8/8	46.3	3550
8/9 - 8/22	50.4	4620
8/23 - 9/5	54.2	5180
9/6 - 9/19	58.0	6150
9/20 - 9/29	62.0	7000

1/ All diets were balanced for N and energy levels and N sources with the exception of the non-nitrogen supplemented groups. The energy supplement was primarily rolled barley, with a small amount of ground barley for premixing with the biuret and urea.

The trial was initiated on June 21 and terminated on September 29, 1967. The heifers grazed together on crested wheatgrass pasture during the entire 100-day trial period. They were gathered daily and put in individual feed pens where they received their respective supplements. Salt and a salt-bonemeal mixture were available to the animals throughout. Sulfur was mixed with the salt in an adequate amount so lack of sulfur would not inhibit utilization of biuret and urea N. The cattle were weighed going onto the trial and at four-week intervals during the trial.

Results and Discussion

The daily gains and cost of supplements per kg. of gain are given in table 3. All animals receiving supplements gained significantly ($P < .05$) more than the control animals. Differences in rate of gain between energy levels were significant ($P < .05$). The heifers receiving biuret with the low level of energy gained 0.11 kg. more per day than the groups receiving either urea or cottonseed meal. However, the animals receiving the low energy level with urea and cottonseed meal gained about 0.23 more per day than the controls. The animals on biuret may have gained more than the animals on urea because of better utilization of N. Biuret is much less soluble than urea and therefore the release of N is much slower, reducing the loss of N as ammonia. Also, as the urea levels increased there was difficulty in getting the animals on urea to consume their entire supplement. The reason for the greater gain by the animals on biuret than those on cottonseed meal has not been determined. Possibly the biuret stimulated a greater intake of forage than did the cottonseed meal.

Table 3. Average daily gain and cost of supplement per kilogram of gain for each treatment

Source of N	Measure of response	Energy level 1	Energy level 2
None	Average daily gain, kg.	0.35	0.58
	Cost/kilogram gain, $ 1/	----	0.11
Biuret	Average daily gain, kg.	0.68	0.77
	Cost/kilogram gain, $	0.05	0.10
Urea	Average daily gain, kg.	0.57	0.68
	Cost/kilogram gain, $	0.05	0.10
Cottonseed meal	Average daily gain, kg.	0.58	0.77
	Cost/kilogram gain, $	0.12	0.11

1/ Cost represents the cost of the supplements only with no cost for forage since animals on all treatments were grazing the same forage. Prices used for supplemental ingredients were: biuret 18¢, urea 13¢, cottonseed meal 10¢, and barley 6¢ per kilogram.

The biuret and cottonseed meal groups with the high energy level gained 0.09 kg. more per day than the group receiving urea with high energy. This

difference was significant at the 0.5 level. The high energy group without additional N gained the same as the urea and cottonseed meal groups with low energy. Due to above average rainfall in May and June, the forage was abundant with much lower nutritive value than usual. As a result gains were somewhat lower than in previous years with comparable animals on similar diets.

The animals readily adjusted to their individual feeding regime and the only problem encountered was with the urea-low energy diet. During the early part of the season the animals on the urea-low energy diet consumed their supplement, but as the urea levels increased several animals refused to consume their entire supplement. Animals on the biuret and cottonseed meal diets readily consumed their entire rations.

Two animals were lost with urea toxicity, one out of the control group and the other out of the biuret-low energy group. These animals worked a hole through the fence and licked an area where refused urea had been dumped. No disturbances were detected in any of the animals from eating their regular rations.

The cost of supplements per unit of gain was essentially the same for urea and biuret within each level of energy. However, at the low level of energy the biuret group gained 0.11 kg. more per day. If these animals are valued at 55 cents per kg., this gain is worth 6.05 cents, giving a return above supplement cost of 5.3 cents per day from the animals fed the biuret over those fed urea. This same difference exists at the higher level of energy although it is not as great. Table 4 shows the cost and comparative value of each supplement.

In this study both urea and biuret replaced cottonseed meal as a N source for range supplements to yearlings. Gains were not as large with urea as with cottonseed meal when used with either level of energy but costs of gains were lower with the urea so that urea fed with low energy gave a better economic return than cottonseed meal with low energy. The reverse was true when comparing the high energy-urea, and high energy-cottonseed meal diets.

When fed with low energy the biuret supplemented group gained more and returned significantly ($P < .05$) more per animal than either the urea or cottonseed-meal fed groups. When fed with high energy, gains from animals receiving biuret were essentially the same as those from the animals receiving cottonseed meal with the high level of energy. However, the economic returns from the biuret fed group was slightly higher than from the cottonseed meal fed animals. The additional return from the supplemented animals was significantly ($P < .05$) greater than from the controls. Averaged for both levels of energy within each source of N supplementation this return was \$14.77, \$10.03, and \$10.06 per head for the biuret, urea, and cottonseed meal fed groups, respectively. The higher level of energy averaged over the N treatments returned \$4.47 over the low level of energy.

This trial indicates that we can get an economical response from both energy and protein supplements with growing animals on range. It also points out some of the toxicity and palatability problems we can have feeding urea

Table 4. Economic evaluation of supplemental treatments

Source of N		Energy level 1	Energy level 2	Comparison of energy levels 2 over 1
None	Gain, kg.	35	58	23
	Value, $ 1/	19.50	31.75	12.25
	Cost, $ 2/	-----	6.27	6.27
	Return, $	19.50	25.48	5.98
	Value of suppl., $ 3/	-----	5.98	5.98
Biuret	Gain, kg.	68	77	9
	Value, $	37.25	42.00	4.75
	Cost, $	3.45	7.35	3.90
	Return, $	33.80	34.65	0.85
	Value of suppl., $	14.30	15.15	0.85
Urea	Gain, kg.	57	68	11
	Value, $	31.25	37.50	6.25
	Cost, $	2.75	6.93	4.18
	Return, $	28.50	30.57	2.07
	Value of suppl.,	9.00	11.07	2.07
Cottonseed meal	Gain, kg.	58	77	19
	Value, $	31.75	42.50	10.75
	Cost, $	6.68	8.44	1.76
	Return, $	25.07	34.06	8.99
	Value of suppl., $	5.57	14.56	8.99
Comparison of protein treatments				
Biuret over control, $		14.30	9.17	
Urea over control, $		9.00	5.09	
Cottonseed meal over control, $		5.57	8.58	
Urea over biuret, $		-5.30	-4.08	
Cottonseed meal over biuret, $		-8.73	-0.59	
Cottonseed meal over urea, $		-3.43	3.49	

1/ Value of gain figured at 55¢ per kilogram liveweight gain.

2/ Cost represents the cost of the supplements only with no cost for forage since animals on all treatments were grazing the same forage. Prices used for supplemental ingredients were biuret 18¢, urea 13¢, cottonseed meal 10¢, and barley 6¢ per kilogram.

3/ Value of supplement is value of gain minus cost of supplement minus return without supplement.

as a range supplement. However, biuret compared very favorably with cottonseed meal and indicates that a nonprotein N source can be used to lower our supplemental protein costs.

Summary

Forty yearling heifers were used in a range supplement study to compare biuret, urea, and cottonseed meal as N supplements, with and without additional energy supplements. A control group was maintained which received no supplement.

The heifers receiving biuret with the low level of energy gained 0.11 kg. more per day than the groups receiving either urea or cottonseed meal. However, the animals receiving the low energy level with urea and cottonseed meal gained about 0.23 more per day than the controls.

The biuret and cottonseed meal groups with the high energy level gained 0.09 kg. more per day than the group receiving urea with high energy. The high energy group without additional N gained the same as the urea and cottonseed meal groups with low energy.

When fed with low energy level economic returns was greatest from the animals on biuret followed by those fed urea with cottonseed meal giving the lowest returns. The biuret fed animals also returned the most at the higher level of energy, but the position of urea and cottonseed meal reversed. The additional return from the supplemented animals over the controls averaged for both levels of energy within each source of N supplementation was $14.77, $10.03, and $10.06 per head for the biuret, urea, and cottonseed meal fed groups, respectively. The higher level of energy averaged over the N treatments returned $4.47 per head over the low level of energy.

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