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BIURET AND UREA FOR GROWING CATTLE

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The majority of the weaner calves in the western range area are wintered on native meadow hay and require additional protein and energy to make economical gains. Castle et al. (1961) reported that the optimum gain for weaner calves is between 0.55 and 0.82 kg. per day over the wintering period for an economic return on the winter feed, without adversely effecting subsequent summer gains, to give the greatest return over both periods.

Urea has been used as a substitute for protein in the diet of ruminants for many years. Although urea has been successfully fed, problems with toxicity and palatability, when fed with low levels of energy and low quality roughages, are prevalent. However, it has been shown that urea will increase the intake of low quality roughage by livestock (Raleigh and Wallace, 1963).

Biuret 2/, a condensation production of urea, is being investigated as a nonprotein nitrogen (NPN) 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 product than urea. Meiske et al. (1955) and Mies et al. (1967) reported gains from feeding biuret comparable to those with urea. Hatfield et al. (1959) obtained positive N balances with sheep and steers fed rations in which biuret furnished a major part of the total N intake.

The purpose of this study was to compare the use of biuret, urea, and cottonseed meal as supplemental N sources in winter growing rations of weaner calves.

EXPERIMENTAL

Trial 1. Fifty-four steer calves were divided into 3 size-groups of 18 each and then randomly allotted to each treatment-group with each size-group. The 3 treatments consisted of cottonseed meal, Kedlor feedgrade biuret, and urea as N supplements. Hay was fed free choice with barley added in the amount calculated to provide for daily gains of 0.57 kg. All diets were isocaloric on a digestible energy basis and isonitrogenous. Each treatment was replicated 3 times, with replications comprised of large, medium, or small weaner steers. One-half of the steers on each treatment received an implant of 12 mg. of diethylstilbestrol.

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2/ Kedlor feedgrade biuret and financial assistance was provided by The Dow Chemical Company

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Composition of the daily rations is presented in table 1. Fresh water, salt, and a salt-bonemeal mixture were available free choice in all lots. Hay was weighed into mangers daily with refusals weighed out each week. Trace minerals and sulfur were added to all diets. The Kedlor feedgrade biuret or urea and minerals were premixed with a small amount of ground barley. Supplements were fed daily in feed troughs. The animals were weighed at 28-day intervals, after an overnight restriction from water and before the morning feeding. The trial was initiated in mid-December and continued for 113 days.

Table 1. COMPOSITION OF EACH DIET IN TRIAL 1

Ingredient	Nitrogen supplement 1/		
	Cottonseed meal	Biuret	Urea
	kg.	kg.	kg.
Hay 2/	4.36	3.96	4.27
Barley	0.77	1.21	1.22
Cottonseed meal	0.52	----	----
Biuret	----	0.070	----
Urea	----	----	0.062
Sulfur 3/	0.005	0.006	0.006
TM mix	0.005	0.005	0.005
Total	5.66	5.25	5.56

1/ All diets were isocaloric and isonitrogenous.

2/ Actual hay consumption averaged over the 3 replications for each treatment.

3/ Sulfur was added in the amount that each diet provided .015 kg. of S per head daily.

Trial 2. Thirty-six steer calves averaging 215 kg. were stratified by weight to a 2x3 factorial with 2 sources of energy and 3 sources of nitrogen. Energy sources were: (1) high-roughage, with sufficient supplemental barley to provide for 0.68 kg. daily gain and (2) low-roughage, with sufficient supplemental barley to provide for 0.68 kg. daily gain. Three sources of supplemental N; biuret, cottonseed meal, and a biuret-cottonseed meal mixture (table 2) provided the required N. Experimental procedures were the same as for those described in trial 1, except that the grain portion of the diets was fed twice daily. The trial was conducted over a 112-day feed period.

Trial 3. Twenty-four heifer and 12 steer calves averaging 179 kg. were stratified by weight and sex to 6 lots of 6 animals each and allotted to 1 of 3 treatments. There were 2 replications of 3 N supplementation treatments; cottonseed meal and biuret alone and in combination. One-half of the steer calves on each treatment received an implant of 12 mg. of diethylstilbestrol.

Composition of daily diets is shown in table 3 and composition of feedstuffs used in all trials is given in table 4. Other experimental procedures were the same as described for trial 1. The trial was conducted over a period of 126 days beginning in early November.

Table 2. COMPOSITION OF EACH DIET IN TRIAL 2

Ingredient	Diet number 1/					
	1	2	3	4	5	6
	kg.	kg.	kg.	kg.	kg.	kg.
Hay	4.73	4.73	4.73	2.04	2.04	2.04
Barley	1.14	1.52	1.36	2.44	2.83	2.65
CSM	0.46	----	0.20	0.48	----	0.21
Biuret	----	0.061	0.034	----	0.064	0.037
Sulfur 2/	0.005	0.006	0.006	0.006	0.007	0.006
TM mix	0.005	0.005	0.005	0.005	0.005	0.005
Total	6.34	6.32	6.34	4.97	4.95	4.95

1/ Diets 1, 2, and 3 are high-roughage diets with the nitrogen source being cottonseed meal, biuret, and cottonseed meal with biuret, respectively and diets 4, 5, and 6 are low-roughage with nitrogen from the same sources as diets 1, 2, and 3, respectively. Diets were as nearly isocaloric and isonitrogenous as possible.

2/ Sulfur was added in the amount that each diet provided .015 kg. of S per head daily.

Table 3. COMPOSITION OF EACH DIET IN TRIAL 3

Ingredient	Diet number 1/		
	1	2	3
	kg.	kg.	kg.
Hay	4.36	4.46	4.55
Barley	0.91	1.21	1.02
Cottonseed meal	0.46	----	0.22
Biuret	----	0.070	0.039
Sulfur 2/	0.005	0.006	0.005
TM mix	0.005	0.005	0.005
Total	5.74	5.75	5.84

1/ Diets 1, 2, and 3 are isocaloric and isonitrogenous with supplemental nitrogen supplied by cottonseed meal, biuret, and equal parts of nitrogen from cottonseed meal and biuret, respectively.

2/ Sulfur was added in the amount that each diet provides .015 kg. of S per head daily.

RESULTS AND DISCUSSION

Trial 1. Results of this trial are presented in table 5. The average daily gain of the steers receiving cottonseed meal was 0.55 kg. which was significantly greater ($P < 0.05$) than gains of 0.48 and 0.47 kg. of the steers receiving biuret or urea, respectively. Feed required per kg. of gain followed the pattern of gain, with those making the greatest gain requiring the least feed per unit of gain.

Table 4. COMPOSITION OF FEEDSTUFFS USED IN ALL TRIALS

Ingredient	Nutrients			
	N	TDN	D.E.	S
	%	%	kcal/kg.	%
Hay	1.28	50	2110	0.15
Barley	1.92	78	3300	0.15
Cottonseed meal	6.56	66	2800	0.46
Biuret	38.00	--	----	----
Urea	42.00	--	----	----

Table 5. RESULTS OF TRIAL 1 COMPARING BIURET, UREA, AND COTTONSEED MEAL AS SUPPLEMENTAL NITROGEN SOURCES FOR WINTERING GROWING STEER CALVES 1/

Nitrogen source	No. of animals	Initial wt.	Final wt.	Total gain	Daily gain	Feed/kg. gain
		kg.	kg.	kg.	kg.	kg.
Biuret	18	184	239	55	0.48[a]	10.8
Urea	18	194	247	53	0.47[a]	11.7
CSM	18	189	251	62	0.55[b]	10.2

1/ Means with same superscript are not significantly ($P < 0.05$) different

Hay consumption was greater with the cottonseed meal and urea diets than with the biuret diet. No basis is apparent for explaining this difference. There were no palatability or toxicity problems, however, animals fed urea required more time for going onto full feed and took longer to clean up their feed than did animals fed cottonseed meal or biuret.

Stilbestrol implanted steers gained 0.53 kg. per day and the controls 0.47 kg., representing a 10% increase in gain resulting from stilbestrol.

Results of this trial indicate that animals perform better on cottonseed meal than on either urea or biuret, with biuret being equal or superior to urea as a source of N supplement for calves on a growing ration where most of the diet is of poor quality roughage. In previous work biuret was shown to be superior to both cottonseed meal and urea, in terms of animal performance and economic returns, when fed with a low level of energy, and superior to urea and equal to cottonseed meal at higher levels of energy in range supplements (Raleigh and Turner, 1968).

Trial 2. Results of trial 2 are given in table 6. When fed with a high-roughage diet, the steers on cottonseed meal and a combination of biuret and cottonseed meal gained 0.64 kg. per day whereas biuret-fed steers gained 0.59 kg. per day; feed requirement per kg. of gain were 10.2, 10.1, and 10.8, respectively. None of these differences were significant.

When fed with the low-roughage diet, the animals fed the cottonseed meal-biuret combination gained 0.57 kg. per day followed by cottonseed meal at

0.53 kg. and biuret at 0.51 kg. with the better gaining animals requiring less feed per unit of gain.

Table 6. RESULTS OF TRIAL 2 COMPARING BIURET, COTTONSEED MEAL, AND A COMBINATION OF THE TWO WITH TWO SOURCES OF ENERGY 1/

Treatment Energy Nitrogen	No. of animals	Initial wt.	Final wt.	Total gain	Daily gain	Feed/kg. gain
		kg.	kg.	kg.	kg.	kg.
High-roughage						
Cottonseed meal	6	219	291	72	0.64	10.2
Biuret	6	212	279	66	0.59	10.8
CSM-biuret	6	215	286	71	0.64	10.1
Low-roughage						
Cottonseed meal	6	218	277	59	0.53	10.4
Biuret	6	212	269	57	0.51	10.6
CSM-biuret	6	214	278	64	0.57	9.5
Average of roughage level						
High-roughage	18	215	285	70	0.62[a]	10.4
Low-roughage	18	214	274	60	0.54[b]	10.2
Average of N source						
Cottonseed meal	12	218	284	66	0.58	10.3
Biuret	12	212	274	62	0.55	10.7
CSM-biuret	12	214	282	68	0.61	9.8

1/ Energy sources were: (1) high-roughage, with energy for maintenance calculated to come from meadow hay and the energy for 0.68 kg. daily gain to come from barley and (2) low-roughage, with half of the energy for maintenance to be provided by meadow hay and the energy for the other half of maintenance and 0.68 kg. daily gain from barley. Means with the same or no superscripts are not significantly ($P < 0.05$) different.

Averaging the N sources over the two sources of energy, gains were 0.61, 0.58, and 0.55 kg. per day for the cottonseed meal-biuret combination, cottonseed meal, and biuret-fed steers, respectively. Feed efficiency followed the same trend as gain with the steers fed biuret and cottonseed meal requiring 9.8 kg., those fed cottonseed meal 10.3, and those fed biuret 10.7 kg. of feed per kg. of gain.

The steers on the high-roughage diet gained significantly more than those on the low-roughage when the data were averaged over N sources, the steers on the high-roughage diets gained 0.62 kg. and those on the low-roughage diets gained 0.54 kg. per day. There were no significant interactions between protein source and roughage level. There were no toxicity or palatability problems with any of the diets.

The results of this trial would indicate that biuret can be effectively used as a supplemental nitrogen source and that biuret in combination with a natural protein will enhance the utilization of both. Raleigh and Wallace (1963) reported that at 9 and 12% protein levels, steers on cottonseed meal supplement

alone outperformed steers on a cottonseed meal-urea combination at both levels or protein. Raleigh and Turner (unpublished data) found no significant difference in gains of heifer calves fed cottonseed meal and those fed a urea-cottonseed meal combination. In both cases weaner calves supplemented with urea gained significantly less than calves fed either cottonseed meal or a combination of the two.

Trial 3. Daily gains were 0.48, 0.45, and 0.43 kg. per day and feed required per kg. gain were 12.2, 12.9, and 13.4 kg. for weaner calves on the cottonseed meal-biuret combination, cottonseed meal, and biuret, respectively (table 7). Although not statistically significant, these gains follow the same trend as those in trial 2. No problems were encountered with palatability or toxicity on any of the diets. As in trial 2, this trial also indicates that biuret is a promising source of N and, in combination with a natural protein may enhance the utilization of both. There were no interactions between protein source and sex. The 12 mg. stilbestrol implant resulted in a 10% increase in gain over control steers.

Table 7. RESULTS OF TRIAL 3 COMPARING BIURET, COTTONSEED MEAL AND A COMBINATION OF COTTONSEED MEAL AND BIURET

Nitrogen source	No. of animals	Initial wt.	Final wt.	Total gain	Daily gain	Feed/kg. gain
		kg.	kg.	kg.	kg.	kg.
Cottonseed meal	12	180	237	57	0.45	12.9
Biuret	12	177	231	54	0.43	13.4
CSM-biuret	12	178	238	60	0.48	12.2

SUMMARY AND CONCLUSIONS

A total of 3 trials were conducted using 126 weaner Hereford range calves, with 2 trials comparing biuret, cottonseed meal, and a biuret-cottonseed meal combination as supplemental N sources for wintering calves and another trial comparing urea, biuret, and cottonseed meal as the sole sources of supplemental N.

In all trials animals were group fed with 6 animals per treatment group. All diets within each trial were formulated to be isocaloric and isonitrogenous. The calves were fed native meadow hay free choice and rolled barley in amounts to provide for the desired gain in each trial.

In trial 1, 3 N sources consisting of urea, biuret, or cottonseed meal were compared. The steers fed cottonseed meal gained 0.55 kg. per day which was significantly higher than those fed urea or biuret with gains of 0.47 and 0.48 kg., respectively.

Biuret, cottonseed meal, and a combination of the two fed with two levels of roughage were compared in trial 2. Gains were 0.61, 0.58, and 0.55 kg. per day for the cottonseed meal-biuret combination, cottonseed meal, and biuret diets, respectively. Steers on the high-roughage diets gained significantly more than those on the low roughage level, however, there were no significant interactions between roughage level and protein source.

In trial 3, the same nitrogen sources as were used in trial 2 were compared, but without the two energy sources. Daily gains were 0.48, 0.45, and 0.43 kg. for the cottonseed meal-biuret combination, cottonseed meal, and biuret, respectively, following the same trend as in trial 2.

An implant of 12 mg. of diethylstilbestrol to steer calves resulted in a 10% increase in gains.

Results of these trials indicate that biuret is at least equal to or superior to urea and can effectively be used as supplemental N in the ruminant diet. Also, biuret in combination with a natural protein may enhance the utilization of both. Cottonseed meal was superior in terms of animal gain to either biuret or urea as the sole source of supplemental N.

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