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Idaho Feeds Provide Ample Protein

The following four conclusions come from this study:

1. Where rations for fattening yearling steers contained alfalfa hay—even as low as 3.8 pounds per steer per day—the use of urea at the rate of 1.5 to 3 percent of the concentrate mixture did not enhance the value of the rations.
2. Urea did not replace an equivalent quantity of protein from alfalfa hay or soybean oilmeal for the wintering of steer calves when wheat straw was used as the roughage.
3. Beet molasses, fed at the rate of 1 pound per day per steer, gave results comparable to the same rations with urea included at the rate of 3 and 1.5 percent of the concentrate mixture.
4. Urea may be conveniently and safely used to replace a portion of the protein of steer fattening rations in areas with limited quantities of legume hay and during periods of legume hay shortages.

Beef Cattle Feeding Experiments With Urea

R. F. JOHNSON, T. B. KEITH, and W. P. LEHRER, JR.*

UREA is being used for cattle feeding in many areas of the United States as a source of nitrogen where rations are composed largely of low-grade roughages, such as corn cob meal, corn fodder and straws. Urea is classified as a non-protein source of nitrogen. Plants contain numerous compounds of the most varied nature that belong to this classification. These include alkaloids, nitrogenous glucosides, amino acids and amides, phosphatids, nitrates, ammonium sulphate, and other ammonium salts. However, only a small proportion of the nitrogen supply of herbivorous animals may be derived from these substances. Although the ruminant is capable of utilizing these non-protein nitrogen compounds, urea appears to be the principal substance in this category that is adaptable for use in commercial feeds for ruminants. Ammonium bicarbonate and ammonium phosphate have been used in the rations of ruminants to replace a portion of the protein needs, but have not been satisfactory. Urea is acceptable as a feed ingredient because it is an economical, odorless substance of high nitrogen content.

A steer, by virtue of the presence of microflora in the spacious paunch, is capable of converting simple nitrogen compounds to proteins. This function is in addition to its ability to utilize the cellulose material in the ration and to synthesize the requirement of water-soluble vitamins.

Urea is the end product of protein metabolism. It is present in the urine of all animals. Crystalline urea is produced synthetically by combining ammonia with carbon dioxide at several thousand pounds of pressure in equipment that withstands high temperatures. It is a pure white crystalline, odorless substance containing 46 percent nitrogen. The urea used for feeding is prepared with a conditioner and contains 42 per cent nitrogen. This is equivalent to 262 percent protein ($42 \times 6.25 \dagger = 262$). The quantity that may be used in a feed is controlled by the rate at which it may be converted to ammonia in the rumen.

Objectives

The objectives of the experiments were to:

- (1) Determine the value of urea as a protein equivalent for fattening yearling steers with limited quantities of alfalfa hay and unlimited quantities of corn silage.

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The urea was supplied by the Nitrogen Division, Allied Chemical and Dye Corporation, New York City.

† Protein contains 16 percent nitrogen ($\frac{100}{16} = 6.25$)

(2) Determine the comparative value of urea as a supplement to cereal straws for the wintering of cattle with the proteins of alfalfa hay and soybean oilmeal.

(3) Evaluate the contribution of beet molasses when fed in combination with urea for fattening steers.

Outline of Tests

Three series of trials were conducted at the University of Idaho Branch Experiment Station at Caldwell over a period of two years, 1952-53 and 1953-54 (Table 1) as follows:

(1) Thirty-nine yearling grade Hereford steers were divided into 4 groups of 9 and 10 each to study the value of urea as a source of protein for fattening.

(2) Thirty-nine grade Hereford steer calves were divided into 3 groups of 13 each to study the value of urea as a source of protein for wintering when fed with wheat straw.

(3) Sixty-nine grade Hereford yearling steers were divided into 7 groups of 9 or 10 each to study the value of urea when used in combination with beet molasses.

TABLE 1. Outline of tests

Lot No.	Ration	Number Steers	Purpose	Kind of Steers
1952-53				
1	High urea.....	9	Fattening	Yearling
2	Low urea.....	10	"	"
3	Soybean oilmeal.....	10	"	"
4	No protein supplement.....	10	"	"
5	Soybean oilmeal.....	13	Wintering	Steer Calves
6	Urea.....	13	"	" "
7	Alfalfa.....	13	"	" "
1953-54				
1	Low molasses, high urea.....	9	Fattening	Yearling
2	Low molasses, low urea.....	10	"	"
3	Low molasses, soybean oilmeal.....	10	"	"
4	Low molasses, no protein supplement.....	10	"	"
5	High molasses, low urea.....	10	"	"
6	High molasses, no protein supplement, ground barley..	10	"	"
7	High molasses, no protein supplement, rolled barley..	10	"	"

In comparing urea nitrogen with the alfalfa hay and soybean oilmeal sources of nitrogen, an effort was made to keep the total protein content of each ration approximately the same. This was accomplished by varying the alfalfa intake and the feeding of soybean oilmeal (Tables 2 and 4).

Two levels of beet molasses were used to determine the value of this feed as a source of carbohydrate for the efficient utilization of urea (Table 4). The allotment of corn silage was unlimited for all groups on all fattening tests. Crystalline urea was fed at the rate of 3 and 1.5 per cent of the concentrate mixture. These percentages of urea were selected because previous studies at other experimental stations have shown that urea is toxic when fed in large quantities.

Results

Fattening Tests, 1952-53

The results of the studies on the comparative value of urea and alfalfa hay as a source of protein for fattening steers have shown that the average daily gain ranged from 2.12 pounds for the group fed alfalfa hay as the major source of protein to 2.21 pounds for the group fed soybean oilmeal with alfalfa hay as compared to 2.20 pounds and 2.15 pounds for the groups fed 3 percent and 1.5 percent urea, respectively. This is shown in Table 2. The greatest difference in average daily gain was 0.06 pound per day. The minimum required in this study, to demonstrate a real difference, would be 0.3 pound per day. The total feed required for 100 pounds gain of each group was approximately the same.

TABLE 2. Comparative gains and feed requirements of steers fed urea, soybean oilmeal and alfalfa as a source of protein—159 days (1952-53)

Group	High Urea	Low Urea	Soybean Oilmeal	No Protein Supplement
Lot.....	1	2	3	4
Initial weight, av. lb.....	727	739	739	747
Final weight, av. lb.....	1077	1080	1090	1084
Total gain, av. lb.....	350	341	351	337
Daily gain, av. lb.....	2.20	2.15	2.21	2.12
Daily ration, av. lb.—				
Corn silage.....	28.6	25.9	26.0	24.2
Chopped alfalfa.....	3.8	5.9	6.8	7.5
Ground barley.....	8.7	8.7	8.7	8.7
Beet molasses.....	.55	.55	.55	.55
Urea, oz.....	4.48	2.88	.....	.....
Soybean oilmeal.....	.....	.....	1.07	.....
Bonemeal.....	.09	.09	.09	.09
Salt.....	.13	.14	.13	.14
Feed for 100-lb. gain, av. lb.				
Corn silage.....	1296	1204	1185	1141
Chopped alfalfa.....	190	275	311	355
Ground barley.....	393	403	393	409
Beet molasses.....	25	26	25	29
Urea.....	12.7	8.4	.....	.....
Soybean oilmeal.....	.....	.....	48.7	.....
Bonemeal.....	3.9	4.0	3.9	4.1
Salt.....	5.9	6.3	5.9	6.4
TOTAL.....	1926.5	1926.7	1972.5	1944.5

Wintering Tests, 1952-53

The average daily gain of the group of steers fed urea as a source of nitrogen was 0.05 pound (Table 3.). The same calculated level of protein fed in the form of soybean oilmeal with wheat straw gave an average daily gain of 0.68 pound. The group of steer calves receiving alfalfa hay gained at the rate of 1.10 pounds per day.

TABLE 3. Weights, gains and feed requirements of steer calves fed soybean oilmeal, urea, and alfalfa hay as a source of protein for wintering calves—168 days (1952-53)

Ration	Soybean Oilmeal	Urea	Alfalfa
Lot Number	5	6	7
Number of calves	13	13	13
Initial weight av. lb.	417.9	408.6	418.8
Final weight av. lb.	532.3	417.3	604.1
Gain, av. lb.	114.4	8.7	185.3
Daily gain av. lb.	.68	.05	1.10
Daily ration av. lb.			
Chopped alfalfa hay	2.0	2.0	12.1
Straw	6.9	6.6	.....
Soybean oilmeal	2.0	.....	.....
Urea, oz.	.....	2.4	.....
Salt, lb.	.04	.05	.04
Feed for 100-lb. gain:			
Chopped alfalfa hay, lb.	294	3845	1115
Straw, lb.	1014	12749	.....
Soybean oilmeal, lb.	294	.....	.....
Urea, lb.	.....	29.2	.....
Salt, lb.	6	105	4
TOTAL, lbs.	1608	16728.2	1119

Fattening Tests of 1953-54

The results of the studies on the value of two levels of urea fed with two levels of beet molasses and compared with soybean oilmeal as a source of protein for fattening steers are presented in Table 4. Two groups of yearling steers were used to compare dry rolled barley with ground barley for fattening purposes. The difference in average daily gains ranged from 2.10 pounds for group 2 receiving 1.5 percent urea in the concentrate mixture with 0.5 pound of molasses per steer per day to 2.40 pounds for the group of steers fed the dry rolled barley with 1 pound of beet molasses per steer per day. An average difference of 0.3 pound daily gain per steer is required to demonstrate an actual difference in the value of these rations. The data of Table 4 shows that there were no actual differences in the rate of gain of: (1) steers fed 3 percent urea in concentrate mixture when compared with steers fed 1.5 percent urea in the concentrate mixture, (2) steers fed 2 pounds of

soybean oilmeal when compared to steers fed either 3 percent or 1.5 percent urea concentrate mixture, (3) steers fed alfalfa hay as the major source of protein when compared to steers fed either soybean oilmeal, 3 percent or 1.5 percent urea concentrate mixture, (4) steers fed 1 pound of beet molasses daily with 1.5 percent urea in concentrate mixture when compared to steers fed the beet molasses without urea, (5) steers

TABLE 4. Comparative gains of steers fed molasses with the basal ration and two levels of urea and soybean oilmeal—140 days (1953-54)

Ration	High urea	Low urea	Soybean oilmeal	No protein supplement	High molasses low urea	High molasses ground barley	High molasses rolled barley
Lot Number	1	2	3	4	5	6	7
Initial wt. av. lb.	746	747	749	745	792	782	780
Final wt. av. lb.	1011	996	1022	1019	1124	1098	1116
Total gain av. lb.	265	249	273	274	332	316	336
Daily gain av. lb.	2.23	2.10	2.29	2.30	2.37	2.25	2.40
Daily rations av. lb.							
Silage	28.9	26.1	27.4	26.6	26.1	25.6	25.6
Alfalfa	2.4	4.7	4.7	4.8	5.1	5.1	5.1
Barley	8.4	8.4	8.4	8.4	7.8	7.8	7.8
Beet molasses	.5	.5	.5	.5	1.0	1.0	1.0
Urea, oz.	4.55	2.41			2.02		
Soybean oilmeal			1.0				
Salt, oz.	1.94	1.94	1.94	1.94	1.06	1.19	1.19
Bonemeal, oz.	1.34	1.36	1.36	1.36	1.23	1.23	1.23
Feed for 100-lb. gain av. lb.							
Silage	1296	1247	1182	1156	1104	1138	1069
Alfalfa	106	223	207	210	216	227	213
Barley	379	403	369	368	327	343	322
Beet molasses	23	24	22	22	43	45	43
Urea	12.7	7.2			5.3		
Soybean oilmeal			46				
Salt	5.4	5.7	5.2	5.2	2.8	3.2	3.1
Bonemeal	3.8	4.1	3.7	3.7	3.3	3.4	3.2
TOTAL	1825.9	1914.0	1834.9	1764.9	1701.4	1759.6	1653.3

fed ground barley as compared to dry rolled barley. However, all groups of steers fed 1 pound of molasses made rapid gains. One group fed dry rolled barley and 1 pound of molasses per day (Lot 7, Table 4) made 2.40 pounds average gain. This rate of gain was significantly greater than the steers of Lot II fed 1.5 percent urea in concentrate mixture with only 0.5 pound of molasses per day. The group of steers fed 1.5 percent urea with 1 pound of molasses per day (Lot 5, Table 4) made approximately the same rate of gain as the steers fed 1 pound of molasses without the urea. This would indicate that the molasses contributed more nourishment than the urea. However, the results reported in Table 4 show that urea may be used to replace the protein of alfalfa for fattening steers.

**Other University of Idaho
Publications on Beef Cattle Feeding**

The optimum ratio of concentrate to alfalfa hay for fattening steers. Experiment Station Bulletin 290.

A system of wintering, pasturing, and finishing beef calves for Idaho. Experiment Station Bulletin 292.

Potato silage for beef steers. Experiment Station Bulletin 293.

Sun-dried potatoes for fattening steers. Agricultural Bulletin 201.

Optimum ratio of concentrate to alfalfa hay for steers as affected by protein level and method of feeding. Research Bulletin 26.

Copies may be obtained from county agricultural agents; or by writing to the University of Idaho, College of Agriculture, Moscow; or the University Agricultural Extension Service, State House, Boise. Give both name and number of publication desired.