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Effects of a

LIQUID UREA • ETHYL ALCOHOL PHOSPHORIC ACID • MOLASSES MINERAL •

MIX on Feeder Lambs

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*MIX on Feeder Lambs**

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A liquid ruminant feed is currently available which contains molasses, urea, phosphoric acid, ethyl alcohol, minerals, and vitamins. A feedlot trial was set up in the spring of 1959 at the Panhandle Agricultural and Mechanical College, Goodwell, Oklahoma, to evaluate the use of such a liquid protein mixture as a suitable protein supplement in lamb fattening rations as compared to other standard lamb fattening rations, and to test its efficacy in preventing the formation of urinary calculi.

Other objectives of the test were to determine effects of the ration on carcass characteristics, economics of the various test lots and the relation of the magnesium content of the blood in the various lots to urinary calculi in the lambs.

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The effects of alcohol and phosphoric acid as a supplement in the ration of ruminants have been recently reported in a few publications. Drori and Loosli (1959) reported that ethyl alcohol could be substituted for starch or corn on an isocaloric basis for steers, and suggested that under certain conditions the above mentioned liquid feed could be an economical feed.

Richardson *et al.* (1958) reported that, although heifers wintered on a high roughage ration and molasses-urea mixtures with and without ethyl alcohol gained less than heifers fed soybean oil meal and sorghum grain, the heifers receiving the liquid supplements subsequently outgained the controls in the fattening lot so that the total gain was essentially equal in both groups. They also showed that carcass quality of the heifers receiving the liquid supplements was equal to that of heifers receiving conventional rations of cereal grains and protein supplements. The results of a test at the Iowa Experiment Station (1957) showed that lambs receiving a molasses, urea, alcohol supplement had lower mortality and a higher profit per lamb than those on standard rations, with and without antibiotics.

Minerals in the diet have been implicated by several investigators in renal calculi of the calcium-magnesium type in sheep. Concentrations of potassium (Cornelius *et. al.,* 1959), potassium and phosphorus (Elam *et al.,* 1956) and dipotassium phosphate (K_2HPO_4) at 2.5 percent of the ration (Cornelius *et al.,* 1959) or 11 grams per pound of feed (Elam *et al.,* 1956, 1957, 1959) have been mentioned most frequently, although this level evidently is not calculi provoking in steers (Elam *et al.,* 1959). Sorghum rations have been implicated, also (Crookshank *et al.,* 1960).

Ammonium chloride in the diet at the rate of one gram per day has been found to be a prophylactic measure for calculi in mink (Loesche *et al.,* 1954). The same substance at a .5 gram level was not effective. A ten percent sodium chloride addition to a ration already containing 11 grams K_2HPO_4 per pound prevented renal calculi in sheep (Elam *et al.,* 1957). Phosphoric acid at the rate of 6 grams per pound of feed was said not to increase the incidence of urinary calculi in sheep (Elam *et al.,* 1956).

Both ammonium chloride and phosphoric acid sharply reduced stone formation in steers and generally increased the acidity of the urine when either ammonium chloride was added to the ration at the rate of 90 grams per head per day or phosphoric acid at 80 grams (Crookshank *et al.,* 1960).

As a .1 M aqueous solution of monosodium phosphate (NaH_2PO_4) at 25° has a pH of 4.5 (Stecher, 1960), it seemed that this compound might be fed *ad libitum* in mineral boxes to alleviate the problem of urinary calculi by lowering the pH of the urine. At the same time it seemed that a liquid feed containing 3 percent phosphoric acid might offer a convenient method of feeding an acid and thus acidify the urine.

Previous unpublished work has shown that heifers fed alcohol had significantly lower blood magnesium levels but not below normal or sufficiently low to cause hypo-magnesemia symptoms (Harris Laboratories, Inc., Report, 1958-59). The feeding of alcohol, then, may also be a contributing factor in controlling urinary calculi by lowering the magnesium level in the blood.

A measure of success was realized by such practices in this feeding test.

Methods and Procedure

One hundred western type lambs from the panhandle area of Oklahoma were divided into five pens of 20 each. They were distributed as equally as possible according to sex and weight. The lambs were a cross from Rambouillet and Corriedale ewes mated to Suffolk and Hampshire rams. The lambs, just weaned, had been on creep feed consisting of sorghum silage, alfalfa hay, and a mixture of 1800 pounds milo and 200 pounds of a commercial 32% supplement with antibiotic. The silage, hay, and concentrate were each fed separately, *ad libitum*. The lambs were drenched with phenothiazine, wool branded, and ear tagged for positive identification. The lambs were individually weighed at the start of the trial and again on the fifth day. Thereafter the lambs were weighed individually every two weeks at approximately 8 a.m. on the day of each weighing.

Minerals consisting of salt, potassium chloride, dolomitic limestone, monosodium phosphate, and calcium sulfate were fed *ad libitum*, separately (cafeteria style), in each lot. All animals were placed on the same standard ration of cracked milo, alfalfa hay, sorghum silage, and the five minerals each separately fed *ad libitum* for the first five days of the trial.

On the fifth day sorghum silage was removed from Lot II and the various protein supplements added in the other lots. All feedstuffs were fed *ad libitum*. Cottonseed meal was admixed with the milo in Lot I (5 lbs. per 100 lbs. milo) and in Lot IV (15 lbs. per 100 lbs. milo). Water was available to the lambs at all times.

Results and Discussion

Performance data are given in Table 1. After 78 days when the majority of the lambs weighed between 90 to 105 pounds, 84 of the 94 lambs completing the test were sent to slaughter at Pueblo, Colorado. Two lambs from each of the 5 lots were slaughtered at Goodwell for additional carcass data.

Rib-eye measurements were taken on the *Longissimus dorsi* between the twelfth and thirteenth ribs. Loin-eye measurements were taken at the juncture of the loin and the leg at the time the carcasses were cut into wholesale cuts.

The results were analyzed by an analysis of variance, and differences in lot means were tested for significance by Tukey's multiple comparison test as outlined by Snedecor (1956).

Carcass data are given in Table 2 and economic analysis in Table 3.

All deaths, except one in Lot I, were attributed to urinary calculi and occurred 30 to 40 days after the beginning of the trial.

Table 1. Performance Data

	Lot I	Lot II	Lot III	Lot IV	Lot V
Number of lambs starting test	20	20	20	20	20
Number of lambs completing test	18	19	20	18	19
Average initial weight[1] (pounds)	61.9	60.7	61.2	60.2	60.1
Average final weight (pounds)	100.0	97.4	101.0	94.6	100.4
Average gain per lamb (pounds)	38.1	36.7	39.8	34.4	40.3
Feed consumption (pounds)	.49	.47	.51	.44	.52
Milo	2900	3063	3272	2784	3562
Alfalfa	1494	1747	1551	1470	1578
Sorghum silage[2]	584		591	558	611
Liquid Feed[3]	299		359		
Cottonseed meal[4]	150			418	
Salt	22.3	20.3	21	20.3	23.5
Potassium chloride	3.5	7	4.5	3	5.5
Dolomitic limestone	7	8	8.75	5.5	9.75
Calcium sulfate	8.5	7.25	6.5	6.25	7.75
Monosodium phosphate	11.75	11.5	10.5	11.75	12.5
Feed per cwt. gain[5] (pounds)	757	698	680	788	702

[1]Lambs completing test only.

[2]Silage figured at 30 percent of total to place it on comparable dry matter basis.

[3]Molasses, urea, phosphoric acid, ethyl alcohol, and trace mineral mix.

[4]Cottonseed meal mixed with the cracked milo at a rate of 5 lb. meal to 100 lb. milo in Lot I, and 15 lb. meal to 100 lb. milo in Lot IV.

[5]Gains based on lambs completing test only.

Table 2. Carcass Data

	Lot I	Lot II	Lot III	Lot IV	Lot V
Average total gain per lamb	38.1	36.7	39.75	34.4	40.3
Average daily gain per lamb	.49	.47	.51	.44	.52
Percent shrink to market	4.94	5.01	5.44	6.00	5.32
Hot carcass weight	49.1	47.05	48.9	46.2	48.5
Chilled carcass weight	48.0	45.9	47.75	45.1	47.6
Percent of carcass shrink	2.21	2.42	2.33	2.36	2.77
Dressing percent[1]	51.32	50.60	51.34	51.86	51.23
Grades[2]					
High choice	2	1	4	3	2
Average choice	8	9	10	6	9
Low choice	5	5	4	4	4
High good	1	1	0	2	1
Average good	0	0	0	0	1
Low good	0	1	0	0	0
High utility	0	0	0	0	0
Average utility	0	0	0	0	0
Low utility	0	0	0	1	0
Average carcass grade[3]	10.7	10.4	11.0	10.3	10.6
Liver weight (pounds)	1.71	1.62	1.89	1.60	1.67
Pelt weight (pounds)	10.9	11.2	11.6	11.4	11.8[4]
Rib-eye area (square inches)[5]	2.31	1.84	1.95	1.98	1.99
Loin-eye area (square inches)[6]	1.3	1.6	1.5	1.6	1.9

[1]$\frac{\text{Hot carcass wt.}}{\text{Slaughter wt.}}$ — Pueblo lambs only.

[2]Pueblo lambs only.

[3]Based on high choice 12, average choice 11, low choice 10, high good 9, average good 8, low good 7, high utility 6, average utility 5, low utility 4.

[4]Three pelts were very wet when weighed.

[5]Two lambs per lot.

[6]Five lambs per lot.

A specimen of the calculus was analyzed by Harris Laboratories, Inc., Lincoln, Nebraska, in the spring of 1959 while the test was in progress. It was found to be composed of magnesium ammonium phosphate and calcium ammonium phosphate. These compounds are soluble only in dilute acids and are practically insoluble at pH 7.0. The soils of the region, according to McGlamery (1960), are high in phosphates and very high in calcium and potassium. The soils are alkaline, the pH ranging from 7.2 to 7.7 and averaging about 7.5. These soils also test quite low in sulfates and chlorides. Feedstuffs grown in this region, therefore, have an alkaline ash content. This condition was considered responsible for an alkaline urine leading to formation of calculi of this type.

Table 3. Economic Analysis of Test

	Lot I	Lot II	Lot III	Lot IV	Lot V
Number of lambs starting test	20	20	20	20	20
Number of lambs completing test	18	19	20	18	19
Total starting weight	1216	1221	1224	1220	1220
Cost of lambs starting test ($19/cwt.) (dollars)	231.04	231.99	232.56	231.80	231.80
Total feed cost[1] (dollars)	97.69	78.92	100.33	89.38	88.34
Cost, lambs plus feed (dollars)	328.73	310.91	332.89	321.18	320.14
Carcass value lambs completing test[2] (dollars)	388.45	391.52	430.54	360.61	407.36
Average feed cost per cwt. gain (dollars)	14.08	11.18	12.49	14.71	11.38
Gross profit per lot (dollars)	59.72	80.61	97.65	39.43	87.22
Average gross profit per lamb marketed (dollars)	3.32	4.24	4.88	2.19	4.59

[1]Cost based on milo, $1.80/cwt.; alfalfa, $25/ton; silage, $8/ton; cottonseed meal, $81/ton; liquid feed, $100/ton; salt, $1.40/cwt.; potassium chloride, $5/cwt.; dolomitic limestone, $1.25/cwt.; calcium sulfate, $1/cwt.; monosodium phosphate, $10/cwt.

[2]Carcass prices

	55 pounds and under	56 pounds and over
Choice	$45.20	$43.20
Good	43.20	41.20
Utility	30.00	30.00

The consumption of minerals, *ad libitum,* particularly monosodium phosphate, was not sufficient to prevent the formation of urinary calculi. There were no deaths in Lot III (Table 4) where each lamb consumed approximately 3.17 grams of 75 percent phosphoric acid per day as contained in the liquid feed. That the lambs in this lot consumed less monosodium phosphate than those in any other lot indicated that these lambs were meeting their phosphorus requirement from the feed. Lot I, which also had the liquid feed, had one death attributable to urinary calculi. Lambs in Lot I averaged consumption of approximately 2.93 grams of 75 percent phosphoric acid per day, although the total consumption of monosodium phosphate was greater than in Lot III. Although there was an average difference of only 0.25 gram of phosphoric acid consumed daily between the lot with one death and that with no deaths, it would appear that the liquid feed containing phosphoric acid may have been helpful in preventing the formation of urinary calculi. The liquid feed provided a convenient method of administering the acid, also.

Table 4. Blood Magnesium Content and Deaths Due to Urinary Calculi

	Average Mg. (percent)	Deaths
Lot No. I	1.9 ± 0.98	1
Lot No. II	2.3 ± 1.01	1
Lot No. III	2.0 ± 0.99	0
Lot No. IV	2.8 ± 1.25	2
Lot No. V	2.2 ± 1.27	1

A blood sample of each animal in the test was taken at the time of slaughter and the serum analyzed for magnesium content by Harris Laboratories, Inc., of Lincoln, Nebraska.[1] A significant serum magnesium level difference ($P<.05$) occurred between Lots I and IV. The difference between serum magnesium levels in Lot III and Lot IV approached significance at $P<.05$.

The liver weights of the lot fed the liquid feed as nitrogen supplement (Lot III) were significantly greater ($P<.05$) than those of Lot IV, which was fed only cottonseed meal as a nitrogen supplement, and of Lot II, which was fed no silage and no protein supplement.

Summary

An experiment was conducted in 1959 to evaluate the effects of a liquid urea-molasses-phosphoric acid-ethyl alcohol-mineral mix and five other minerals fed *ad libitum,* cafeteria style. Various economic and carcass characteristics and the efficacy of these feeds for prevention of urinary calculi of the calcium magnesium type in feeder lambs were studied. An attempt was made to measure the relationship of blood magnesium and the occurrence of urinary calculi.

No deaths occurred in the lot where each lamb consumed approximately 3.17 grams of 75 percent phosphoric acid per day in the liquid feed. One lamb died from urinary calculi in the lot where each lamb consumed approximately 2.93 grams of phosphoric acid. Two animals died in one lot and one in each of the other two lots where the liquid

[1]Method 72, page 373 (Denis, modified) Clinical Laboratory Diagnosis by Levinson and MacFate, 5th Edition.

feed was not offered. Although this work was not considered fully conclusive as to the prevention of urinary calculi, it supports the findings of earlier work on the value of phosphoric acid for this purpose. A convenient method of feeding the acid was also demonstrated.

Lot III with the liquid feed as the sole protein supplement earned more profit than did any of the other lots. Total gain of the lambs in Lot V was largest (.52 lb/day) followed closely by Lot III fed the liquid feed (.51 lb/day). Lot III required the least amount of feed (680 lbs.) for 100 lbs. of gain. Addition of cottonseed meal to the ration in the proportions used in this experiment depressed rates of gain and profit per lot (Lots I and IV). Cost per hundred pounds of gain was slightly less in Lots II and V where alfalfa was the sole protein supplement.

A significant serum magnesium level difference ($P<.05$) occurred between Lots I and IV. The liver weights of the lot fed the liquid feed as nitrogen supplement (Lot III) were significantly greater ($P<.05$) than those of Lot IV, which was fed only cottonseed meal as a nitrogen supplement, and of Lot II, which was fed no silage and no protein supplement.

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