AMMONIUM CHLORIDE AND AMMONIUM SULFATE IN CATTLE FEEDLOT FINISHING RATIONS

H. R. Crookshank,[1] *H. E. Smalley,*[1] *Dale Furr* [2] *and George F. Ellis, Jr.*[3, 4]

U. S. Department of Agriculture, College Station, Texas 77840

Summary

TWO levels of ammonium chloride or of ammonium sulfate were added to the rations of commercial feeder cattle. The rations were made isonitrogenous, essentially isocaloric and to contain the same level of calcium, phosphorus and salt. Total gains were essentially the same for all lots, varying only 15.6 lb (7.1 kg) over a 112 day feeding period. Feed conversion was increased only on the ration containing the higher level of ammonium chloride. The cost of gain was approximately $3.77 less per head for this group, compared to the next least expensive group. Carcass grade was increased in all but the low level ammonium sulfate lot. A 50% increase in the incidence of condemned livers due to liver abscess was observed in the cattle fed the higher level of ammonium sulfate. The addition of ammonium chloride had little, if any, effect upon the incidence of condemned livers. Both ammonium chloride and ammonium sulfate apparently may be used as sources of NPN without clinical signs of ammonia toxicity when added up to 1% of the total ration, which is in excess of the presently permitted level of ammonium chloride in the feed. On the basis of feed conversion, cost of gain, and incidence of condemned livers, the higher level of ammonium chloride seemed preferable.

Introduction

Both ammonium chloride and ammonium sulfate have been used in cattle feedlot finishing rations as a source of non-protein nitrogen and to help control urinary calculi. Comparative tests (Crookshank, 1970) have indicated that ammonium chloride is more effective than ammonium sulfate in controlling calculi in wether lambs. Ammonium chloride significantly increased feed conversion while ammonium sulfate produced a slight increase. An increase in feed conversion in swine has been reported when ammonium chloride was added to the diet (Clawson and Alsmeyer, 1971).

This study compares the effect of the addition of ammonium chloride or ammonium sulfate to cattle finishing rations on gain, feed conversion, incidence of condemned livers, and on ammonia toxicity.

Experimental Procedure

Four-hundred and sixty-six commercial feedlot cattle of mixed breeds were used in the test. The cattle were purchased through commercial channels in five different drafts. Each draft was randomly allotted to the test groups so that each test group contained approximately the same number of animals from each draft. The test was conducted at a West Texas feed yard and, insofar as possible, the cattle were handled in accordance with the standard practices of the feed yard. The control ration was essentially that used by the yard except that no ammonium salts were included and, in keeping with the existing FDA clearance for ammonium chloride, no tetracycline or growth hormones were included. Actual ration composition was determined by a computer on a least-cost basis. The primary components were milo grain, alfalfa and fat to which was added a supplement containing cottonseed meal, urea, salt, calcium carbonate, rock phosphate, vitamins A, D and E, choline chloride and trace minerals. Ammonium chloride or ammonium sulfate was added as appropriate. The composition of the supplement was varied for each diet so that all rations were calculated to contain the same level of crude protein (11.4%), digestible protein (8.62%) and NPN (1.64%). In addition, the rations were calculated to be isocaloric and to contain essentially the same level of calcium, phosphorus and salt. Dry matter content was as-

[1] Veterinary Toxicology and Entomology Research Laboratory, A.R.S., U.S.D.A., College Station, Texas.
[2] Hi-Pro Feeds, Inc., Friona, Texas.
[3] Baca Cattle Feeders, Midland, Texas.
[4] Reference to a company or product name does not imply approval or recommendation of the product by the U. S. Department of Agriculture to the exclusions of others that may be suitable.

TABLE 1. EFFECT OF AMMONIUM CHLORIDE AND OF AMMONIUM SULFATE ON GAIN, FEED CONSUMPTION, AND FEED CONVERSION

Item		Treatment				
		Control	Low ammonium chloride [0.75 oz (21.3 g) hd/day] [a]	High ammonium chloride [3.0 oz (85.1 g) hd/day] [a]	Low ammonium sulfate [0.9 oz (25.5 g) hd/day] [a]	High ammonium sulfate [3.6 oz (102.1 g) hd/day] [a]
No. animals		92	91	93	93	93
Days on test		112	112	112	112	112
Final weight [b]	(lb)	609	624	612	621	628
	(kg)	442	444	438	447	443
Initial weight [b]	(lb)	365	354	354	364	350
	(kg)	276	283	278	282	285
Avg daily gain	(lb)	3.26	3.16	3.16	3.25	3.12
	(kg)	1.48	1.43	1.43	1.48	1.41
Feed consumption 88% dry matter	(lb)	23.69	24.18	21.24	23.46	23.29
	(kg)	10.75	10.97	9.63	10.64	10.56
Feed conversion		7.26	7.67	6.73	7.19	7.49
Cost feed $/ (lb) (kg) gain		0.1679	0.1775	0.1586	0.1668	0.1716
		0.3702	0.3913	0.3496	0.3677	0.3783
Cost total gain $		61.27	62.88	56.15	60.78	59.92
Advantage over control $		0	−1.61	+5.12	+0.49	+1.35

[a] Actual consumption 0.91 oz (25.8 g), 3.19 oz (90.4 g), 1.06 oz (30.1 g), and 4.19 oz (118.8 g).
[b] Weights adjusted for 4% shrink.

sumed to be 88% per ton of ingredients. The "low" level of ammonium chloride,[5] 0.75 oz (21.3 g) per head per day, was the amount used to control calculi, while the "high" level, 3.0 oz (85.1 g) per head per day, was used to test for possible ammonia toxicity. Ammonium sulfate was added at an equivalent nitrogen level, 0.9 oz (25.5 g) and 3.6 oz (102.1 g), respectively.

The cattle were weighed by lot every 28 days. The animals were self-fed the appropriate ration and consumption on a lot basis recorded. Water was available at all times. At the end of 112 days on test, the animals were marketed through commercial channels. At the time of slaughter, the carcasses were inspected by the U.S.D.A. and the number of condemned livers recorded. Samples of visceral fat were randomly taken from 10 animals in each treatment group as part of a pesticide residue study which will be reported separately. The hot carcass weight was recorded and a chilled carcass weight calculated, allowing a 2% shrink. Dressing percent was calculated, using average final live lot weights with a 4% shrink. Carcass grades were determined by a grader from the C&MS, U.S.D.A.

Results and Discussion

No particular management problems developed in any of the lots. Only four cattle were lost during the test period. Two developed pneumonia (control and low ammonium sulfate); one had respiratory problems (control); and one was removed because of a physical injury not related to the experiment (high ammonium chloride). No clinical signs of ammonia toxicity were observed in the cattle.

Feed and gain data are given in table 1. Total gain was essentially the same for all lots with only 15.6 lb (7.1 kg) separating the high and low lot. The maximum difference in average daily gain was 0.16 lb (0.07 kg). Feed conversion was increased only in the high ammonium chloride lot and was decreased slightly in the low ammonium chloride and high ammonium sulfate lots.

Feed consumption was essentially the same for all but the high ammonium chloride lot which was reduced approximately 2.5 lb (1.1 kg) per head per day when compared to the control lot. The cost of total gain was much less for the high ammonium chloride lot, being $3.77 per head less than the next lot. Ration costs were calculated from the current price of the ingredients at the time of the test and would vary as current prices vary. The improved feed conversion for the high ammonium chloride ration agrees with previously reported tests with sheep (Crookshank, 1970) and with swine (Clawson and Alsmeyer, 1971). Crookshank (1970) also observed a

[5] Supplied by Allied Chemical Corporation.

TABLE 2. EFFECT OF AMMONIUM CHLORIDE AND OF AMMONIUM SULFATE ON DRESSING PERCENT, CARCASS GRADES AND INCIDENCE OF CONDEMNED LIVERS

Item	Treatment				
	Control	Low ammonium chloride	High ammonium chloride	Low ammonium sulfate	High ammonium sulfate
No. animals	82	79	82	80	93
Dressing %					
Hot[a]	63.9	63.4	62.6	64.3	64.1
Chilled[b]	62.6	62.1	61.4	63.0	62.8
Carcass grades %					
Prime	...	1.2	...	2.5	...
Choice	61.0	65.9	67.5	57.0	71.2
Good	39.0	32.9	32.5	40.5	28.8
Condemned livers %	25.6	24.4	26.5	22.0	37.5

[a] Calculated against 4% shrink of average final live weight.
[b] Cooler shrink of 2% used.

small increase in feed conversion with ammonium sulfate. No explanation is readily available for the differences in conversion observed between the low and high levels of the two ammonium salts. However, it appears that either salt can be utilized at these levels as a source of NPN without toxic side effects.

Carcass data is given in table 2. Dressing percent showed little variation. The cattle fed the rations containing ammonium chloride had a slightly smaller dressing percent than the controls, while those cattle fed ammonium sulfate had a slight increase. Carcass grade was increased in all but the low ammonium sulfate lot. The increase in carcass grade in those cattle fed ammonium chloride agrees with that reported by Brethour and Duitsman (1966). While those animals fed the high level of ammonium sulfate showed the largest increase in carcass quality, they also had a 50% increase in the incidence of condemned livers due to liver abscesses. A slight decrease in incidence was observed in the low ammonium sulfate ration. The addition of ammonium chloride at either level apparently had little effect on the incidence. No explanation is available for the differences observed.

Literature Cited

Brethour, John R. and W. W. Duitsman. 1966. Beef cattle investigations, 1965–66. Bul. 492, Kansas Agr. Exp. Sta.

Clawson, A. J. and W. L. Alsmeyer. 1971. Ammonium phosphate as a source of nitrogen and NPN for pigs. Anim. Sci. 33:228.

Crookshank, H. R. 1970. Effect of ammonium salts on the production of ovine urinary calculi. J. Anim. Sci. 30:1002.