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Sodium Levels in Beef Cattle Finishing Rations as Related to Performance and Concentration in Feedlot Solid-Waste[1]

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Abstract

One-hundred-eight steers were divided equally into six treatments with three replications of six steers each and fed rations containing 1.0%, 0.5%, 0.25%, 0.125%, 0.0625% and 0.0% salt (NaCl). Animal performance was measured by individual 28 day weights, feed consumption, feed conversion by pens, and carcass traits. Sodium (Na) concentration and build-up in the solid-waste was measured periodically by sampling the feedlot with a coring device. Sodium concentration in the rations was not significantly related to average daily gain, feed intake, or carcass traits. There was a significantly (P .05) poorer feed conversion at the 1.0% level, but the effect was attributed to animal variations. Data suggested that Na content of feedstuffs in finishing rations provide sufficient levels to meet requirements without supplemental sodium. Sodium intake per day for treatments 1 through 6 was 37.1, 18.9, 10.0, 5.3, 2.8 and 0.7 g per head daily and was not related to ration consumption. Sodium concentration in the solid-waste was linearily related to Na intake. Levels of Na accumulation in the solid-waste appeared to be sufficiently low so as not to be harmful in runoff or to croplands if applied at 10-15 tons per acre every 3-4 years.

Introduction

Sodium (Na) is considered a macro-element in the nutrition of animals and is necessary for the proper functioning of many major systems in the body, however, its exact requirements have not been established since most research has focused on the value of salt in the diet. The N.R.C. (1970) recommends salt levels of 0.25% added to feedlot rations. A common practice in feeding ruminants is to add 0.5% salt to rations.

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Recent expansion of the feedlot industry within the Texas High Plains coupled with the urgency to comply with newly established state and federal laws dealing with pollution has brought a need for reducing components of solid-waste materials from feedlots that might contaminate underground water supplies or adversely affect soil or plants when used as a fertilizer. This has resulted in a re-evaluation of a number of feeding and management practices associated with nutrition of feedlot cattle and subsequent use of the solid-waste materials.

Objectives in the present study were to relate sodium levels in beef cattle finishing rations to animal performance and concentration in feedlot solid-waste.

Experimental Procedure

One-hundred-eight steers were divided into weight groups and randomly assigned to the following salt (NaCl) levels.

Treatments	Salt Level, %
1	1.00
2	0.50
3	0.25
4	0.125
5	0.0625
6	0.0000

Three replications of six steers each were fed the above rations for a 165-day finishing period. Salt levels were incorporated into the rations by replacing an equal portion of milo. Ingredient and chemical composition of the rations are given in table 1.

All steers used in the trial were individually identified, implanted with 24 mg of diethylstibestrol, given routine vaccinations, individually weighed and allotted to treatments after a 21 day adjustment period. Animal performance was measured by individual 28 day weights, feed consumption and feed conversion by pens. Carcass characteristics including dressing percent, backfat thickness, marbling score, carcass weight, conformation score, abscessed livers, and carcass grades were recorded for each animal.

Sodium accumulation in the solid-waste material was ascertained from periodic samples taken in the feedlot with a coring device. Lots used in the trial were concrete surfaced which prevented percolation of materials into the soil and provided an accounting of Na accumulation in relation to intake and excretion by the steers.

TABLE 1. BASAL EXPERIMENTAL RATION

Item	Percent
Ingredient composition	
Dry rolled milo	86.50
Cottonseed hulls	7.50
Cottonseed meal	4.30
Urea	0.70
Sulfur	0.10
$CaCO_3$	0.50
Salt[a]	1.0-0.0
Vitamin A[b]	+
Antibiotics[c]	+
Chemical composition	
Dry matter	87.98
Composition of dry matter	
Crude protein	13.16
Crude fiber	5.23
Ether extract	2.65
Nitrogen-free extract	76.81
Ash	2.16
Organic matter	97.85

[a]Salt levels in rations 1 through 6 were 1.0%, 0.5%, 0.25%, 0.125%, 0.0625% and 0.0000%, respectively and was added to each ration by replacing an equal portion of milo.

[b]Vitamin A added to provide 40,000 IU per head daily.

[c]Antibiotics included to provide 70 mg per head daily.

Results

Feedlot performance and carcass data are presented in table 2. Sodium concentration when fed as NaCl in steer finishing rations at 1.0, 0.5, 0.25, 0.125, 0.0625, and 0.00% did not significantly affect average daily gain, feed intake or carcass traits. There was a tendency for reduced gains in treatment 1 when salt was added at 1.0% of the diet. This was not related to ration intake, but was associated with a significantly ($P < .05$) poorer feed conversion than in treatments 2 through 6. Data are not available to show physiological responses to salt levels of 1.0% or less. It is assumed that the reduced performance in treatment 1 was related to animal variations. Nelson et al (1955) indicated that rations containing up to 6.0% NaCl were not

TABLE 2. EFFECT OF ADDED SODIUM ON THE PERFORMANCE OF FINISHING STEERS

Treatment	1	2	3	4	5	6
% Salt (NaCl)	1.0	0.5	0.25	0.125	0.0625	0
No. head	18	18	18	18	18	18
Initial wt., lb.	601.7	594.5	593.3	586.6	593.2	596.3
Final wt., lb.	959.4	989.9	1004.7	976.6	989.2	1000.2
Days on feed	165.3	165.3	165.3	165.3	165.3	165.3
A.D.G., lb.	2.17	2.39	2.49	2.37	2.39	2.44
Avg. daily feed, lb.	20.4	20.4	20.6	20.8	20.5	21.0
Feed conversion, lb.	9.40[a]	8.54[b]	8.27[b]	8.81[a,b]	8.59[b]	8.62[b]
Warm carc. wt., lb.	615.9	631.3	649.4	626.7	636.9	645.8
Dressing percent	64.2	63.8	64.6	64.2	64.4	64.6
Marbling score[1]	5.4	5.5	5.1	5.0	5.6	4.9
Conformation score[2]	14.8	15.4	15.2	15.2	15.1	15.1
Carcass grade, 24 hr.[2]	12.4	12.3	12.0	11.8	12.5	11.7
Fat thickness, in.	0.57	0.50	0.64	0.58	0.59	0.61
Fat/cwt, in.	0.093	0.080	0.099	0.093	0.093	0.095
Liver abscesses	4	2	3	5	4	4

[a,b]Means on the same line with different superscripts are significantly different at the 5% level.

[1]Slight = 4; Small = 5; Modest = 6, etc.

[2]Good plus = 11; Choice minus = 12; Average choice = 13, etc.

detrimental to range cattle, but was effective in limiting consumption of supplements. Carpenter and Klett (1969) used salt at 10.0% levels in concentrate mixes to limit feed consumption to approximately 1.0% of body weight in steers grazing pastures. Weeth (1968) showed that heifers tolerated 1.0% NaCl in water but exhibited toxic symptons to levels of 2.0% in the water. It appears that salt levels in routine feeding programs simply reduces intake which prevents toxity problems.

Sodium intake per day for treatments 1 through 6 was 37.1, 18.9, 10.0, 5.3, 2.8 and 0.7 grams (g) per head daily. Intake was not significantly related to ration consumption. The N.R.C. recommends salt levels of 0.25% in finishing rations for feedlot cattle. Horrocks (1964) reported that diets containing 0.2 g of Na per day were inferior to diets containing an additional 10 g of Na per day. Morris and Gartner (1970) studied the effect of daily Na supplementation of 0.1, 3.25, 6.30 and 13.0 g as bicarbonate in steer finishing rations.

Their data showed that steers ingesting 0.1 g of Na per day had significantly slower rates of body weight gain, produced lighter-weight carcasses, and had lower concentrations of Na and higher concentrations of K in the saliva and ruminal fluid than steers fed 3.25 g or more of Na daily. They concluded that steers weighing 200 to 300 kg and gaining 0.9 kg daily required between 0.13 g (deficient) and 3.1 g (adequate) Na per day. Data from the present trial showed similar results since Na level did not appear to exhibit a real effect on performance when comparing a wide range of intakes. These data suggest that the sodium content of ingredients in feedlot rations is sufficient to supply the animals requirement. This is further supported by data reported in 1971 by Harbers and Warren showing little response from feedlot cattle on high concentrate rations to salt added in the diet. Cattle on rations without salt performed as well as those supplemented with 0.5%.

The relationship of Na concentration in solid-waste materials to intake is presented in Figure 1. Sodium concentration in the solid-waste was 0.86, 0.59, 0.39, 0.26 0.20 and 0.15% for intakes of 37.1, 18.9, 10.0, 5.3, 2.8 and 0.7 g of Na per head daily, respectively. These data show a linear decline of Na in the solid-waste with decreasing levels of supplemental NaCl in the diet. Sodium in the solid-waste increased approximately 475% from treatment 6 (0.0% NaCl) to 1.0% NaCl added to the ration. This is an important consideration in planning feeding regimes since federal and state regulatory agencies are now emphazing the reduction of materials in solid-waste from feedyards that might prove detrimental to underground water supplies and croplands when incorportated into the soil as a fertilizer.

Bennett (1970) reported from the analysis of a series of samples from feedlot manure that Na concentration ranged from 0.15% to 1.50% with an average of 0.80%. He projected that at a rate of application of 10-15 tons of manure per acre every 3 to 4 years that the level should not have adverse effects on the physical condition of the soil or affect plant growth. Levels of solid-waste Na in the present study corresponds closely to levels reported in the previous report. These data suggest that Na levels in the solid-waste materials from feedlots can be regulated through levels of intake and can be reduced by restricting levels of Na in the ration, however, with increased levels of feeding and prolonged accumulations of manure, increased concentrations may result that might prove harmful in runoff and to croplands.

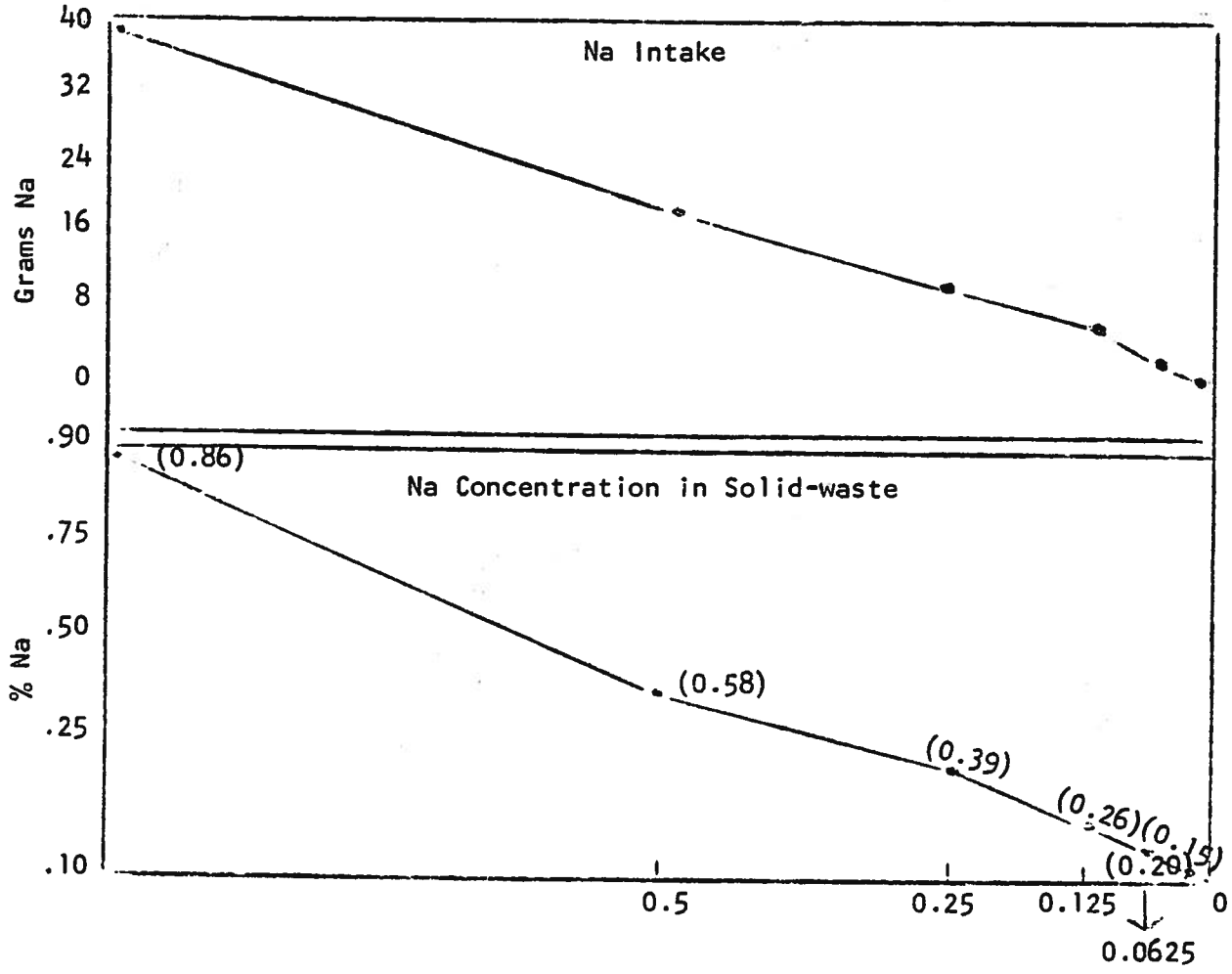

Figure 1. Relationship of daily Na intake to Na concentration in the solid-waste.

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