WATER INTAKE BY FEEDLOT STEERS

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Story in Brief

Water intake of six pens of 47 crossbred yearling steers (733 lb) fed either 0, .25 or .5% percent dietary salt was monitored over a 92-day period during the summer in the Oklahoma Panhandle. Daily water intake of a group of 120 steers also was recorded. Daily water intake averaged 9.8 gallons per head. Temperature and dry matter intake were the major factors effecting water intake. For each one degree increase in daily maximum temperature, water intake increased by 0.1 gallons. Water intake increased by 0.3 gallons for each one pound increase in dry matter intake. Increasing amounts of precipitation and dietary salt both caused water intake to decrease slightly. The following water intake prediction equation was developed: water intake, gallons/day = -4.939 + (.104 * maximum temperature, °F) + (.292 * dry matter intake, lb/day) - (2.597 * precipitation, in) - (1.174 * dietary salt level, %).

(Key Words: Feedlot Steers, Water Intake, Dietary Salt Level)

Introduction

Little information is published concerning water intake of feedlot cattle. The minimum requirement of cattle for water is a reflection of that needed for body growth and of that lost by excretion in the urine, feces, or sweat or by evaporation from the lungs or skin (NRC, 1984). Several factors are known to modulate water intake of cattle including dry matter intake, nature of the diet and temperature (Winchester and Morris, 1956; ARC, 1980; Murphy et al., 1983). The objectives of this study were to determine the water intake patterns of feedlot steers and the effects of dry matter intake, dietary salt levels and environmental factors (temperature, rainfall, wind) on these patterns.

Materials and Methods

A group of 239 crossbred yearling steers which had been wintered on wheat pasture near Dalhart, Texas were trucked to Goodwell, Oklahoma on June 3, 1987. On arrival, all cattle were weighed individually, ear tagged, implanted with Synovex-S and injected with ivermectin and a BRSV vaccine. These steers were divided into two experiments which are reported elsewhere in this publication (Hicks et al., 1988a, 1988b).

Steers were fed a cracked corn high concentrate ration twice daily (0700 and 1600) for the 95 day trial. Chopped alfalfa hay was used to dilute the ration to 60 percent concentrate to start the cattle on feed. Roughage content of the diet was decreased sequentially in three steps until the cattle were on their final ration by 28 days on feed. The composition of the final ration was 80% cracked corn, 11% chopped alfalfa, 3.9% cane molasses and 5.1% supplement.

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Daily water intake was monitored with in-line water meters over a 92-day period in these experiments in three pairs of pens (pens shared water tanks). These three pairs received either no added dietary salt (16 head), .25% dietary salt (15 head) or .5% dietary salt (16 head). In addition, daily water intake was monitored on half the barn (120 head) with a meter in the main line serving the barn. The sodium concentration of this water was 17.5 to 18 parts per million. Daily weather data including maximum temperature, minimum temperature, wind velocity and precipitation were collected from the Goodwell weather station.

Results and Discussion

The effect of dietary salt level on water intake by month are presented in Table 1. Mean water intakes over the entire trial were 10.18, 8.98 and 9.33 gallons per day for the 0, .25 and .5% dietary salt pens, respectively. Water intakes tended to be lowest in June, July and August for cattle receiving .25% dietary salt. These cattle fed .25% salt also tended to consume less feed (19.87, 18.40, 18.80 lb/day for 0, .25 and .5% salt, respectively); although, data presented elsewhere in this publication (Hicks et al., 1988b) indicates that feed intake of feedlot steers was not altered significantly by dietary salt level (0, .25 or .5%). The equations of Winchester and Morris (1956) and Murphy et al. (1983) were used to predict water intake. Those equations predicted that water intake of the steers receiving .25% dietary salt would be lowest (Table 1) due to their lower feed intake.

The system of Winchester and Morris (1956) predicts water intake based on dry matter intake and ambient temperature (Table 2). For an average temperature of 75½ F as was observed in this experiment, their equation estimated total water intake (including water contained in feed) to be .58 gallons per lb of dry matter consumed. This is 10 to 15% greater than what was measured; however, their equation may be more accurate for diets higher in roughage.

Murphy et al. (1983) developed a water intake prediction equation for Holstein cows based on dry matter intake, milk production, sodium intake and minimum temperature. Their equation excluding the milk

Table 1. Water intakes by month as influenced by dietary salt level.

	0% Salt	.25% Salt	.5% salt
No. Head	16	15	16
Weights, lb:			
Initial	733	732	733
Final	1078	1046	1063
Dry Matter Intake, lb/day	19.87	18.40	18.80
Water Intake, gal/day:			
June (last 22 days)	9.64±1.23	7.43±1.33	8.87±1.54
July	10.48±1.40	10.00±1.50	10.02±1.06
August	10.43±3.32	9.01±2.25	9.16±2.03
Sept. (first 8 days)	9.54±1.53	9.23±1.81	8.55±1.73
Overall	10.18±2.23	8.98±2.00	9.33±1.67
Estimated Water Intake:			
Winchester & Morris, 1956	11.17	10.34	10.57
Murphy et al., 1983	13.07	12.90	13.09

Table 2. Water intake prediction equations.

Winchester and Morris (1956)

Temperature, °F	Gallons of water/lb of DM[a]
40	.37
50	.40
60	.46
70	.54
80	.62
90	.88

Murphy et al. (1983)[b]

Water intake, lb/day = 35.18 + 1.58DMI + .11SODIN + 2.64TMIN

[a]Includes both drinking water and water in feed.
[b]DMI = dry matter intake, lb/day; SODIN = sodium intake, g/day; TMIN = weekly mean minimum temperature, °C.

production factor is also presented in Table 2. Predicted water intakes by their equation were 28 to 44% greater than measured values. Both systems over-predicted intake the most for steers receiving .25% salt.

Monthly weather data and the mean water intake for one half the barn (120 steers) are presented in Table 3. Water intakes of all cattle were greatest in July and August when temperatures were the greatest as would be expected based on the available literature. In a review of data, Winchester and Morris (1956) noted that the rate of water intake per unit of dry matter ingested remains relatively constant from around 10 to 40 F but above 40 F, water intake increases with ambient temperature at an accelerating rate. The NRC (1981) reported that under controlled temperature conditions that cattle tend to increase water intake as temperature rises, with 80.6 F being the temperature where a marked changes in water intake by lactating cows is noted. Below that point water consumption is considered to be primarily a function of dry matter intake (NRC, 1981).

Stepwise regression of the daily weather variables vs daily water intake indicated that at all three salt levels maximum temperature was the major variable effecting water intake. However, the percentage of variation explained by maximum temperature was low (13, 13 and 34% for 0, .25 and .5% salt). Stepwise regression of weekly mean weather data and weekly mean dry matter intakes vs weekly water intake yielded the equations presented in Table 4. For the 0 and .5% salt groups, maximum temperature explained about 81% of the variation in water intake.

Table 3. Monthly weather data and mean water intake.

	June	July	August	September	Overall
Daily Temperature, °F					
Mean maximum	88.1±6.7	91.2±6.8	89.4±11.5	84.6±7.7	89.3±8.8
Mean minimum	60.1±3.2	61.3±3.7	62.4±5.9	57.1±1.4	61.0±4.5
Mean wind speed, mph	5.1±1.3	7.0±2.3	6.1±3.0	4.9±2.3	6.0±2.5
Precipitation, inches	3.39	1.51	3.01	.87	8.78
Daily water intake, gal/steer					
for 120 steers	8.9±1.5	10.0±2.7	10.5±4.1	8.5±1.4	9.8±3.0

Table 4. Equations for different dietary salt levels.

	Coefficients (Standard Error)		
	0% Salt	.25% Salt	.5 % Salt
Intercept	-2.305 (2.156)	-2.584 (2.486)	-11.035 (2.000)
TMAX[a]	0.1416 (0.0237)		0.1846 (0.0224)
DMI[a]		0.6415 (0.1335)	0.2015 (0.0629)
PREC[a]	-2.019 (1.007)	-5.097 (1.407)	
r^2	.8671	.7557	.9032

[a]TMAX = weekly mean maximum temperature, °F; DMI = dry matter intake, lb/day; PREC = weekly mean precipitation, in.

However, for the .25% salt group, maximum temperature did not enter the model.

Stepwise regression across all salt groups combined yielded the following equation: Water intake, gallons/day = -4.939 + .1040TMAX + .2923DMI - 2.5971PREC - 1.1739SALT. Additional factors offered but not selected by the computer for including in the regression were weekly mean minimum temperature and weekly mean wind velocity. A summary of the steps leading to this equation are presented in Table 5. The major factors affecting water intake in this equation are maximum temperature and dry matter intake (explain 65% of variation). In contrast to the equation of Murphy et al. (1983), maximum temperature instead of minimum temperature entered the model, and increasing dietary salt levels caused a decrease, not an increase in water intake. Murphy et al. (1983) noted that water intake increased by .013 gallons for each additional gram of sodium fed, whereas, our data shows water intake to decrease by approximately .03 gallons for each additional gram of sodium fed. In comparison with our maximum salt intake of 43 grams with .5% dietary salt, dairy cows often consume 100 grams of salt daily from diets containing .45% added salt.

In summary, feedlot cattle fed during the summer (maximum daily temperatures of about 90 F) required about 10 gallons of water per day. The major factors affecting water intake in these cattle were maximum temperature and dry matter intake. Based only on water intake data from three groups of cattle (16 head/group) fed 0 to .5% supplemental salt, increasing dietary salt levels tended to decrease water consumption. With higher levels of salt, water intake probably would have increased.

Table 5. Summary of stepwise regression.

Step	Variable entered[a]	Partial r^2	Model r^2
1	TMAX	.4996	.4996
2	DMI	.1501	.6497
3	PREC	.0527	.7024
4	SALT	.0337	.7361

[a]TMAX = weekly mean maximum temperature, °F; DMI = dry matter intake, lb/day; PREC = weekly mean precipitation, in; SALT = dietary salt level, %.

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