Ad Libitum Water Intake by Neonatal Calves and Its Relationship to Calf Starter Intake, Weight Gain, Feces Score, and Season

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ABSTRACT

Water intakes and other experimental data over 3 yr encompassing 335 calves raised under an early weaning program at the Purina Research Farm were summarized. Water intake closely paralleled calf starter intake particularly during the last 2 wk of the 4-wk feeding period. Calves with weight gains below the median daily gain of 272 g had reduced water and starter intake. Scouring, due apparently to rotavirus infection, peaked at the end of the 1st wk. Water intake did not change appreciably prior to or after peak scouring. Season of year had minor effect on both water and starter intake.

In a feeding study with 41 calves, weight gain was reduced by 38% and starter intake by 31% for calves deprived of water. Extent and duration of scouring did not differ between treatments.

Calf feeding and management systems should include ad libitum water to maximize starter intake and weight gain. There is no evidence that scouring will be affected negatively by water intake.

INTRODUCTION

Preweaned calves often are not provided water in addition to that consumed with milk replacer. Opinions differ as to the value of providing water ad libitum to calves under an early weaning program at age 4 to 5 wk. Data are limited for water intake by calves under 4 to 5 wk of age. Pettyjohn et al. (5) measured water intake only during the last week of a 6-wk trial. Thickett et al. (8) observed a significant correlation of both liveweight gain and calf starter intake with water intake prior to weaning at age 5 wk. Jenny et al. (2) measured daily ad libitum water intake of calves from 3 through 23 days of age. Water intake increased with increasing dry matter concentration of the milk replacer, but no calf starter was provided. Appelman and Owen (1) hypothesized that supplemental water may be advantageous in encouraging early intake of calf starter for calves weaned at 3 wk of age. They acknowledged the need for more research in this area of feeding and management.

Some dairy producers feel supplemental water causes calves to scour. Jenny et al. (2) noted daily water intake increased 25 to 50% when calves scoured. However, it is uncertain whether calves drank more water because of scouring or whether increased water intake caused scouring.

A variety of feeding, management, and housing conditions were in the cited studies. In our report, we summarized 3 yr of data from our calf starting research unit to evaluate relationships between ad libitum water intake and scouring, body weight gain, calf starter intake, age, and season under a common feeding, management, and housing program. A subsequent feeding trial was to determine effects of water restriction and is reported also.

MATERIALS AND METHODS

A detailed description of the facility and the overall feeding and management program at our Gray Summit, MO unit is in (3). Data reported here included 335 calves in six experiments (19 treatments) over 3 yr from September 1978 through January 1981. Milk replacers contained 22% protein and 10 to 12% fat. Variables were a variety of fish and soy proteins replacing part of milk protein in milk replacers. Our standard commercial calf starter, which averaged 16% crude protein and 6 to 7% crude fiber, was also fed for ad libitum intake.

Newborn calves were allowed to nurse their dams during the 1st day of life. After being moved to the calf starting unit, they continued to receive colostrum for 2 more days. At 4 days of age, they were fed milk replacer for the following 4 wk. For the first 3 wk, they were

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fed 1.89 liters (containing .216 kg milk replacer dry matter) twice daily. During the 4th wk, they received 1.89 liters one daily. Milk replacer, water, and calf starter were fed in round-bottom, seamless, aluminum pails. Weight gain and height at the withers were recorded weekly during the experimental period. Water and calf starter were available ad libitum during all 4 wk, but no hay was fed. Daily intake of milk replacer, calf starter, and water were recorded. Feces were scored daily for each calf on the basis of: 1 to 2 firm, 3 normal, 4 to 5 thin, and 6 scours.

Total body weight gain was regressed on average daily intake of calf starter. Ad libitum daily water intake also was regressed on daily calf starter intake. Daily data were grouped by calves gaining less than or greater than the median daily gain of 272 g during the 28 days. In 1983, a feeding study under the same conditions described was conducted comparing calf performance with or without supplemental water. Data were analyzed by analysis of variance and highest significant difference (6).

RESULTS AND DISCUSSION

The regression of daily body weight gain (Y) on average daily starter intake (X) (kg) was Y = .0913 + .613X(Sy^*x = .98 r^2 = .49, $P<.001$). Thus, 49% of the variation of gain was due to starter intake compared with 65% in (4). Ad libitum water intake tended to be slightly greater for calves with lower gains up to 21 days, after which water intake progressively increased for the calves with higher gains (Figure 1). Greater calf starter intake was associated with calves with higher gains throughout the 28 days (Figure 2). Daily water intake was high initially (Figure 3) and dropped off rapidly after 3 to 4 days on experiment. This rapid drop may have been due to the change from feeding colostrum with a high mineral content to initial feeding of milk replacer. Because the amount of colostrum fed was the same as later feeding of milk replacer, composition rather than amount of colostrum was likely the key factor. Thickett et al. (8) also noted high initial water intake, but this may have resulted from their calves being moved to the research unit prior to the experiment. Also age and prior colostrum intake of calves were

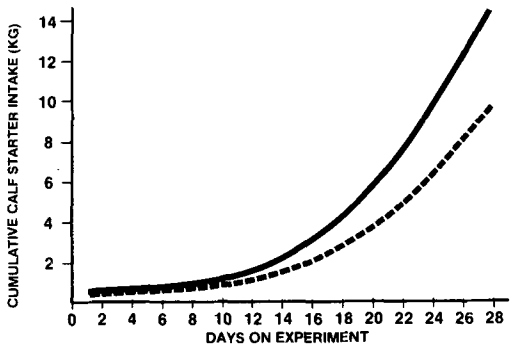

Figure 2. Cumulative calf starter intake for 335 calves averaging less than (■ ■ ■) or equal to or greater than (▬▬) 272 g daily gain.

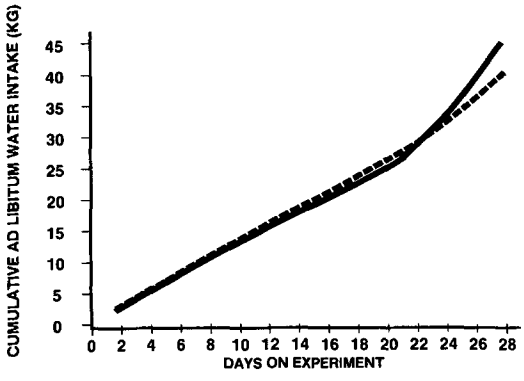

Figure 1.Cumulative ad libitum water intake for 335 calves averaging less than (■ ■ ■) or equal to or greater than (▬▬) 272 g daily gain.

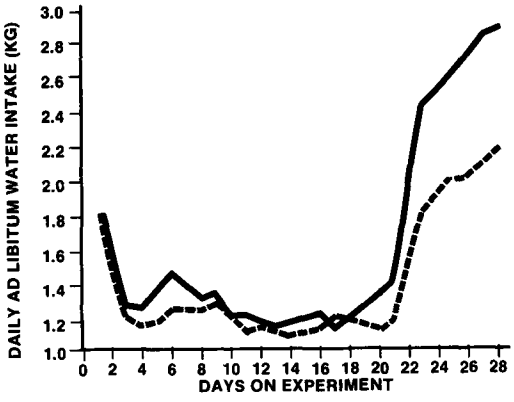

Figure 3. Daily ad libitum water intake for 335 calves averaging less than (■ ■ ■) or equal to or greater than (▬▬) 272 g daily gain.

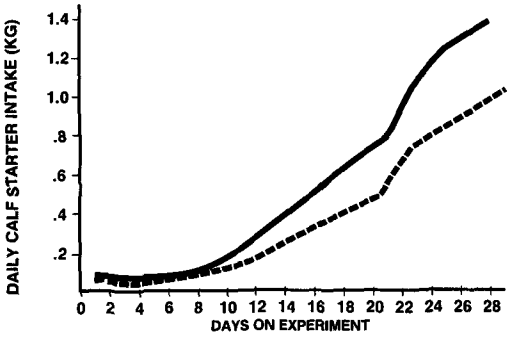

Figure 4. Daily calf starter intake for 335 calves averaging less than (■ ■ ■) or equal to or greater than (▬▬) 272 g daily gain.

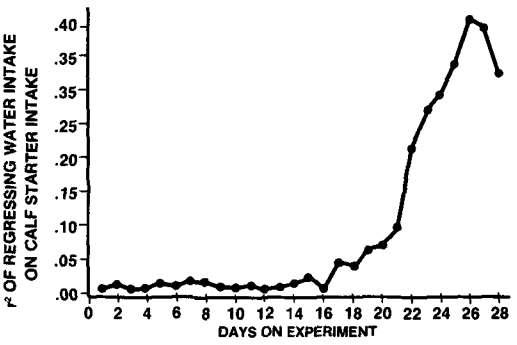

Figure 6. The r^2 of regressing daily water intake on daily calf starter intake for 335 calves.

not given, although most calves had adequate antibody titers from presumed colostrum intake. There was a small increase of water consumption beginning at day 4 and peaking at day 6 before declining again. This peak was higher for the high-gain group of calves. Water intake remained low and variable for both gain groups until after day 18. Water intake was greater and progressively increased after day 21. This paralleled increasingly more calf starter intake on both gain groups (Figure 4). These changes appear to correspond to the end of twice-daily milk replacer feeding and initiation of once-daily milk replacer feeding that occurred on day 22. Increased water intake was likely due to both decreased water intake from less milk replacer fed and to increased calf starter dry matter intake.

Daily regressions of water intake on calf starter intake tend to confirm the above explanations. Figure 5 shows large changes of water intake relative to calf starter intake from days 1 through 8. This was due both to initially higher water intakes (Figure 3) and low calf starter intakes (Figure 4). As water intake and calf starter intake remained low, their ratio continued to decrease until later in wk 3 when the low point was reached. During wk 4, the ratio remained nearly constant altough both water intake and starter intake were high and increasing, but at the same rate. Variability of water intake with calf starter intake continued (Figure 6) until the end of wk 3. As calves began the weaning process after wk 3 and consumed more calf starter (Figure 4) and water (Figure 3), this relationship, having actually

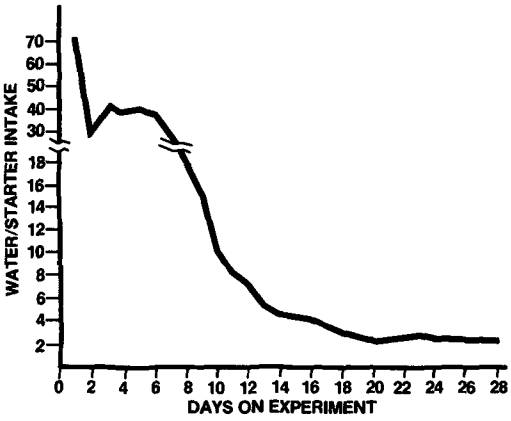

Figure 5. The ratio of daily water intake to daily calf starter intake for 335 calves.

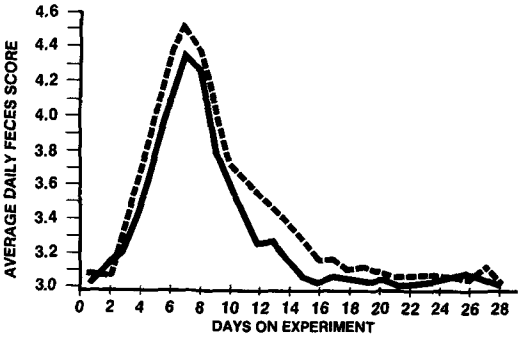

Figure 7. Average daily feces score for 335 calves averaging less than (■ ■ ■) or equal to or greater than (▬▬) 272 g daily gain.

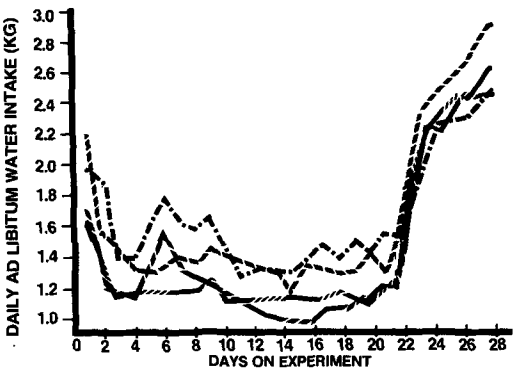

Figure 8. Daily ad libitum water intake for 335 calves born in (▬▬▬) fall, (▬▬▬) winter, (▬ ▪ ▬) spring, or (▬▬▬) summer.

begun earlier at day 17, became strong ($P<$ .0001). Thickett et al. (8) also observed simultaneous increases of water and calf starter intake.

Figure 7 shows a slight increase of average daily feces score for the high gain group compared to the low gain group. The major observation was a marked peak in scouring for both groups at day 7. Calves were then 10 days old. Feces scores for both groups returned to normal at nearly the same rate at which the problem occurred. The consistency with which this problem occurred suggests a possible infectious agent requiring an incubation period. Rotavirus was the agent. No carryover effect seemed to occur. Although there was a major increase of scouring, peak of water intake was only minor (Figure 3). As a result, the change of water intake was more likely an effect of scouring rather than a cause. Calves that scour and dehydrate likely increase water intake to prevent further dehydration. Jenny et al. (2) noted similar relationship.

The effect of climate on water and starter intake was explored by grouping calves within seasons by the following birth dates: September, October, and November for fall; December, January, and February for winter; March, April, and May for spring; and June, July, and August for summer. Figure 8 shows there was considerable variation of water intake but a tendency for spring and summer intakes to be higher. Starter intakes were low during the first 2 wk of age and were not affected by season (Figure 9); however, intakes during wk 3 and 4 were highest for summer and lowest for spring. Highest starter intake during the summer would not be expected as hotter weather normally decreases dry matter intake while increasing water intake. Because the calf starting unit was semi-environmentally controlled (3), seasonal effects likely would be minimized so extrapolation to more environmental extremes would be tenuous.

Calves not fed supplemental water gained less ($P<.05$) body weight and consumed less ($P<.05$) calf starter (Table 1) as compared with calves with ad libitum access to water. Nearly all of these differences occurred during wk 4 with some starter intake difference during wk 3. Although it may be presumed that difference in weight gain was due to gut fill and not empty body weight, Stobo et al. (7) found increased starter intake actually decreased gut fill. Water intake began to increase during wk 3 with a major increase during wk 4. Nearly 75% of this increased water intake would be equivalent to the reduction of water intake resulting from eliminating one milk replacer feeding during wk 4. However, this nonmilk replacer water intake initially would enter the rumen, as would the dry calf starter, rather than the abomasum (9). The ratio of water intake to calf starter intake was similar during wk 3 and 4 for the ad libitum water group. This indicates the close relationship between water and starter intake (Figures 3 and 4), particularly as starter intake increases. Consequently, when water is not available, starter intake is reduced (Table 1).

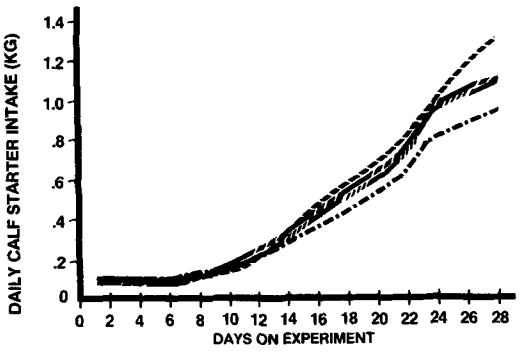

Figure 9. Daily calf starter intake for 335 calves born in (▬▬▬) fall, (▬▬▬) winter, (▬ ▪ ▬) spring, or (▬▬▬) summer.

TABLE 1. Performance and intake of calves fed water for ad libitum intake or no water.

	Water		Coefficient of variation
	Ad libitum	None	
			(%)
No. calves	20	21	
Initial weight, kg	44.2	43.1	
Weight gain, kg/4 wk	8.45[a]	5.26[b]	45.4
Wk 1	.23	.27	
Wk 2	−.32	−.64	
Wk 3	3.09	3.13	
Wk 4	5.45	2.50	
Calf starter intake, kg/4 wk	11.72[a]	8.08[b]	36.0
Wk 1	.23	.27	
Wk 2	.95	.64	
Wk 3	3.50	2.72	
Wk 4	7.08	4.45	
Water intake, kg/4 wk	41.33		
Wk 1	7.95		
Wk 2	6.99		
Wk 3	8.27		
Wk 4	18.12		
Increased withers height, cm	3.0	2.6	
No. calves with scours	19	21	
Average number scour days/calf	4.5	5.4	

[a,b]Means with different superscripts within a row differ ($P<.05$).

Calves from either water treatment did not differ in number experiencing scours or in extent of scouring (Table 1). These data do not support the hypothesis that restricting water decreases incidence of scouring.

Both the 3-yr summary and the study with water restriction illustrate the strong relationship among water intake, calf starter intake, and body weight gain. No causative effect of water intake on scouring was found. Water intake would be particularly limiting in facilities where dairy producers typically provide little or no water. This would be most critical in calf hutches during hot summer months when water needs would be increased and in cold winter months when available water freezes and becomes unavailable.

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