WATER TURNOVER OF GROWING CATTLE FED FRESH CUT GRASS OR HAY AND GRAZED ON PASTURE

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Summary

Water turnover and consumption of steers fed either fresh cut grass or hay and water turnover of steers grazed in summer or in fall were determined using 18 Holstein steers weighing 226 to 382 kg. Steers consumed 7.0 or 7.5 kg of dry-matter from hay or fresh cut grass. Animals fed hay drank significantly more water than those given fresh cut grass ($P < 0.01$). Total water consumption, however, was greater in steers fed fresh cut grass than those given hay ($P < 0.05$). Water turnover was about the same as total water consumption with a tendency for slightly higher values in water turnover irrespective of feeding regimes. Steers grazed in summer had greater water turnover than those grazed in fall. Water turnover was about the same in steers fed fresh cut grass and grazed in summer but decreased in steers on the dry ration or grazing in a cool season of the year.
(Key Words: Water Intake, Water Turnover, Steers, Fresh Cut Grass, Hay, Grazing)

Introduction

Water consumption of grazing animals is technically difficult to measure in the field. The dilution technique lends itself to the determination of water consumption when the direct measurement is associated with difficult and laborious work (Springell, 1968, Sekine et al., 1972). The tritium dilution technique is generally regarded as the most reliable method for body water determination (Springell, 1968).

Water intake has been related to dry matter consumed and to environmental temperature (ARC, 1965). The measurement of dry-matter consumption is difficult when animals are grazed on pasture with uneven forage distribution. The water turnover of grazing cattle measured by the dilution technique, therefore, is used to estimate the water consumption of grazing animals. The water turnover of animals given fresh forage may be comparable to that of grazing ones. Thus, water intake of grazing animals related to dry-matter intake may be estimated by the comparison of the water turnover measured in those circumstances.

The present study determined the water turnover of growing cattle fed either hay or fresh cut grass or grazed on hoof-cultivated pasture in summer and fall.

Materials and Methods

As shown in table 1, 18 Holstein-Friesian steers weighing 226 to 382 kg were allocated to one of the following feeding regimes; 1) first cut hay *ad lib.* plus 2 kg of concentrate mixture (Hay), 2) fresh cut forage *ad lib.* plus 2 kg of concentrate (Fresh grass) and 3) grazing without concentrate supplementation on hoof-cultivated pasture either in summer or fall (G-S or G-F). After a 10-day standardization period, intakes of feed and water were recorded daily for 8 days in steers of Hay and Fresh grass groups, while no record for intakes of feed and water was collected on those of the grazing group. Environmental temperature was recorded hourly throughout the experimental period. First cut hay, fresh cut forage and the pasture used in the experiment consisted mainly of orchardgrass. Dry-matter content of fresh cut grass was determined daily and, on the hay and concentrate by drying to constant weight at 105°C but not on the herbage which was grazed. Animals were weighed twice at the beginning and at the end of the experimental period.

Tritiated water (HTO, 20μCi/ml) was injected into the jugular vein at the rate of approximately

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TABLE 1. THE FEEDING REGIME AND ENVIRONMENTAL TEMPERATURE IN THE EXPERIMENTAL PERIOD

Feeding regime	Number of steers	Age	Live wt.	Average environmental temp.			
				Mean	Range		
		mo.	kg	°C			
1st cut orchardgrass hay *ad lib.* + 2.0 kg of concentrate (Hay)	4	15±1	332±37	14.2	11.6	–	16.6
Orchardgrass fresh cut *ad lib.* + 2.0 kg of concentrate (Fresh grass)	4	15±1	335±29	14.2	11.6	–	16.6
Grazing on hoof cultivated pasture							
in summer (G-S)	5	11±0	247±14	19.3	12.1	–	20.8
in fall (G-F)	5	13±0	268±18	8.6	6.4	–	12.7

1 mCi/steer irrespective of live weight on the day that recording of intakes began. Approximately 10 ml of blood samples were collected in heparinized test tubes from the opposite jugular vein to that used for injection at 6, 24, 48, 72, 96, 120, 144 and 168 hours after the injection. Determinations of tritium activity were done using the method described by Springell (1968).

Behavioral observations were made after injection of tritiated water on steers in the grazing group for 3 days from dawn to sunset to record the frequency of drinking.

Results and Discussion

Dry-matter contents of hay and concentrate were 88.2 and 89.0%, respectively and those of fresh cut grass averaged 24.3% with a range from 17.3 to 32.8%. Table 2 shows the mean dry-matter intake (DMI), consumption of drinking and total water (DWC and TWC) and water turnover (WT) of the group. Total water consumption was the sum of DWC and water contained in feed. Steers completely consumed concentrate (1.8 kg of DM). Thus, DMI from hay or fresh cut grass was 7.0 or 7.5 kg which corresponded to 2.1 or 2.3% of live weight. The difference in DMI, however, was not statistically significant between hay and fresh cut grass. Steers in the Hay group drank significantly more water than those in the Fresh grass group ($P < 0.01$). The dry-matter content of feed may be responsible for greater DWC in Hay group. Total water consumption, however, was greater in the Fresh grass group than the Hay ($P < 0.05$). The DWC supplied 96.7% and 35.1% of TWC for Hay and Fresh grass groups, respec-

TABLE 2. THE MEAN AND STANDARD DEVIATION OF DRY-MATTER INTAKE (DMI) AND CONSUMPTION OF DRINKING WATER (DWC) AND TOTAL WATER (TWC), AND WATER TURNOVER OF STEERS UNDER DIFFERENT FEEDING REGIMES

Feeding regime	DMI	DWC	TWC	Water turnover
	kg/day	ml/kg/day	ml/kg/day	ml/kg/day
Hay	8.8±0.8	118±14	122±14	130±15
Fresh grass	9.3±0.4	53± 4	151±13	162± 7
G-S	–[1]	–	–	158±31
G-F	–	–	–	119±10

[1] Not determined

tively. A large proportion of TWC was provided by water contained in the feed for the Fresh grass group. The ratios of TWC to DMI (TWC/DMI) were 4.61 ± 0.33 and 4.57 ± 0.17 for Hay and Fresh grass groups, respectively and averaged 4.59 ± 0.25 for results pooled. Difference in TWC may have resulted from the greater water intake associated with feed in Fresh grass group than Hay.

Water turnover was about the same as TWC with a tendency for slightly higher values in WT irrespective of feeding regimes. Animals have three sources of water supply, of which metabolic water was not determined in the present study. Differences between TWC and WT were supposed to be metabolic water supply. It amounted to about 6 to 7% of WT. Young and Degen (1980) have studied water turnover of beef steers and cows, and reported that metabolic water was 6 to 9% of total water intake measured by tritiated water. Thus, the difference between TWC and WT may have corresponded to the amount of metabolic water with some inclusions of possible errors in the present study. The ratios of WT to DMI (WT/DMI) were 4.9 ± 0.5 and 5.7 ± 0.3 for Hay and Fresh grass group, respectively. There was a significant difference in WT/DMI between the Hay group and The Fresh grass ($P < 0.05$).

Steers grazed in summer have greater WT than those in fall. The mean of environmental temperature in summer was much higher (19.3°C) than in fall (8.6°C). The higher environmental temperature may be partly responsible for the greater WT in G-S than G-F. Considering the results observed in Hay and Fresh grass groups, dry-matter content of herbage on pasture may be lower in summer than in fall, which may have partly caused a decreased WT in G-P.

Dry-matter intakes estimated using TWC/DMI, WT and live weight were 8.5 and 6.9 kg for steers grazed in summer and fall, respectively. The composition of the herbage may differ in summer and fall. Generally, the quality of herbage is lowered as the stage of maturity increases, which may cause a decrease in intake of herbage in fall. Thus, decreased WT may have been due partly to a decreased DMI. Behavioral observations revealed that steers grazed in summer visited watering area 2 to 3 times a day but those in fall once or seldom twice a day.

Water turnover in G-S was similar to that in Fresh grass and that in G-F to Hay. The range of environmental temperature was fairly close between Fresh grass and G-S (table 1). Thus, water intake of steers in the Fresh grass group is to be the estimate of those in the G-S group. Grazing beef cattle require 5.0 to 5.6 kg of water per kg of DM to meet their requirement at environmental temperature of 20°C (NRCMAFF, 1987). The water allowance of grazing cattle has been 1.5 times of that of non-pregnant, non-lactating cattle (ARC, 1965). Also, ARC (1965) has recommended the suggested water intake to meet requirement of non-pregnant, non-lactating cattle to be 3.6 kg/kg DM consumed at a range of environmental temperature from 10 to 15°C. Thus, it is calculated that grazing animals require 5.4 kg of water per kg of DM consumed. The mean WT/DMI in the Fresh grass group agreed well with those recommendations. The water requirement of growing steers at grass, therefore, may be estimated to be 5.7 kg/kg DM consumed. Dry-matter content (DMC, %) of fresh cut grass increased as the day of the experimental period (D) progressed. The regression analysis resulted in the following equation:

$$DMC = 0.96(\pm 0.25)\, D + 17.2,$$

$$r = 0.74,\ P < 0.01.$$

Thus, DMC of the herbage which was grazed in the present study may have increased as the grazing period progressed. A reciprocal of the estimated water requirement for growing steers (5.7 kg/kg DM) is 0.175 which may imply that steers grazed on the herbage containing less than 17.5% of DM require no supplementation of extra water while they are grazing provided the environmental temperature was ranging 12 to 17°C. Growing steers consuming forage with 14% of DMC or less are inferred to consume no additional water other than that contained in the herbage at environmental temperature ranging 12 to 15°C (Sekine et al., 1988). Calves at 3 to 4 months of age drank water at a constant level when the environmental temperature was 10°C or less (Sekine et al., 1986). Their consumption of drinking water, however, markedly increased when the environmental temperature increased well over 10°C. These evidences suggest that drinking water is needed to supply to grazing steers under conditions of higher environmental temperature than 10 to 15°C or increased DMC in the herbage to be grazed even though animals have a free access to the fresh herbage.

It was concluded that WT is about the same in

steers either fed fresh cut grass or grazed in summer but decreases in steers on dry ration or grazing in a cool season of the year.

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