Water intake of red deer stags consuming dryland pasture or indoors on concentrated feeds

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ABSTRACT

Two trials were conducted on water intake of red deer stags to provide a basis on which to determine water requirements for deer farms. In the first trial, water intake from a trough by 13 15-month- old red deer stags was monitored for 16 days while they grazed dryland pasture during a spell of dry weather (March - April 1988) in Canterbury. Voluntary water intake (VWI) from the trough was 2.6 litre/hd/d and intake of water ingested in feed (40% DM) was estimated to be 4.2 litre/hd/d, giving a total water intake (TWI) of 6.8 litre/hd/d (or 0.19 litre/kg $W^{0.75}$/d).

In the second trial, 12 3- to 5-year-old stags were held indoors in pens and fed (n = 6) either pasture silage (27% DM) or pellets (88% DM) in a crossover design with Period 1 of 33 days duration and Period 2 of 25 days. VWI and DMI were monitored daily for 15 days in Period 1 and 14 days in Period 2. TWI for silage was greater than for the pellets (10.6 v 4.6 litre/hd/d, respectively) but the stags drank more water when consuming pellets. There was evidence of a linear relationship between TWI and DMI.

Keywords Water intake; red deer; stags; dry matter intake

INTRODUCTION

Knowledge of water requirements of livestock is essential for the design of stock watering facilities on farms, feedlots, transport vessels, etc. In the case of red deer there are no published data on water intake and calculations of requirements have to be based on information from other species. This study records water usage by young red deer stags on pasture during a dry season and indoors whilst consuming silage or deer pellets.

MATERIALS AND METHODS

Trial 1 - on Pasture

Thirteen 15-month-old red deer stags (mean live weight 120 kg) were grazed as a single mob on ryegrass/white clover pasture at the Research Farm, Lincoln College. Grazing was alternated between two 0.5 ha paddocks which had no sources of free water other than from precipitation and that supplied by a drinking trough. The mob had access to a water trough which was partially covered to minimise spillage and wastage. The trough was refilled to a fixed mark at 1700 h each day and the volume of water required to do this was recorded. A similar water trough, placed nearby but not accessible to the stags, was utilised to provide corrections for water lost by evaporation or gained as rain water. This study was carried out in a warm dry season (March - April 1988) when the Canterbury region was experiencing a drought. As a consequence of the weather conditions the pasture cover was low (approximately 1200 kg DM/ha) and dry (approximately 40% DM). It proved to be difficult to obtain reliable estimates of pasture cover from daily pasture probe measurements and weekly pasture cuts. Under these circumstances intake determination by the pasture difference technique was impossible. Total volume of water drunk by the mob was measured daily for 18 d after an initial settling down period of 5 d. Live weight of stags (non-fasted) was recorded at the start and finish of the trial.

Trial 2 - Indoors

Twelve 3- to 5-year-old red deer stags (mean live weight 164 kg) were housed in individual concrete-floored wooden pens (1.6 x 2.4 m) with sawdust as lairage which was cleaned out twice weekly. The pens were under cover and sheltered but exposed to natural lighting and temperature changes. Stags were allocated randomly to two groups (n = 6) and offered either grass silage (27% DM) or deer pellets (Deer Nuts, Integrity Feeds, Rolleston, 88% DM) respectively to provide 0.75 MJME/kg $W^{0.75}$/d which was calculated to achieve

a maintenance level of diet using data from Fennessy and Milligan (1987). These diets were offered for 33 d until mid June 1988 (Period 1) when the diets and groups were crossed-over for a further 25 d during July and August 1988 (Period 2). At 08.00 h each day for 15 d in Period 1 and 14 d in Period 2 individual voluntary water intakes (VWI) were measured. At the same time individual daily feed intakes were determined. DM of diets was determined by drying samples at 60°C for 48 h and their organic matter digestibility (OMD) was estimated by a cellulase *in vitro* digestibility technique (McLeod and Minson 1980).

RESULTS

Trial 1

Rain fell on two occasions (4.5 and 9.5 mm per 24 h) and data from these two days have been excluded. On the remaining 16 d conditions were warm (daily maxima: range 12.2°C-23.8°C, mean = 19.0°C daily minima: range 1.3°C-12.6°C, mean = 7.0°C) and dry. Dew was not detected on the pasture.

Non-fasted live weight (W) of stags did not differ between the start (16 March) and end (6 April) of the trial (mean ± SEM, 120 ± 2.0 and 119 ± 1.9 kg respectively). Water drunk from the trough (VWI) ranged from 1.4 to 3.9 litre/hd/d (mean ± SEM, 2.6 ± 0.18 litre/hd/d) or 0.04 to 0.11 litre/kg $W^{0.75}$/d (mean ± SEM, 0.075 ± 0.005 litre/kg $W^{0.75}$/d).

Trial 2

Air temperatures measured indoors during Trial 2 ranged from -2 to 15°C. Generally, dry matter intake (DMI) and total water intake (TWI) were higher and volume of water drunk (VWI) was lower for deer offered silage than for those offered pellets (Table 1). Consumption of pellets in Period 2 was less than in Period 1. TWI was related to DMI in all cases (Table 1, Fig 1) although the regressions of TWI on DMI for separate feeds and periods were not statistically significant. Live weight of stags declined steadily throughout the trial (mean ± SEM, 164 ± 3 kg on 2 June and 151 ± 3 kg on 23 July).

TABLE 1 Mean (±SEM) daily intake per stag of dry matter (DMI), water in feed (FW), water drunk (VWI) and total water intake(TWI) for red deer stags indoors consuming grass silage or pellets in Period 1 (n = 15) and after crossing over the diets (Period 2, n = 14). Values from individual stags (n = 6) were pooled prior to calculation of daily means.

	Silage		Pellets	
Period 1				
DMI (kg/d)	3.1 ±	0.03	1.9 ±	0.07
FW (litre/d)	8.3 ±	0.09	0.3 ±	0.01
VWI (litre/d)	2.9 ±	0.18	5.3 ±	0.25
TWI (litre/d)	11.2 ±	0.20	5.6 ±	0.25
TWI:DMI(litre/kg)	3.66		2.95	
Period 2				
DMI (kg/d)	3.1 ±	0.02	1.4 ±	0.07
FW (litre/d)	8.3 ±	0.06	0.2 ±	0.01
VWI (litre/d)	1.8 ±	0.18	3.5 ±	0.25
TWI (litre/d)	10.1 ±	0.32	3.7 ±	0.26
TWI:DMI(litre/kg)	3.31		2.64	
Overall				
TWI (litre/d)	10.6		4.6	
TWI (litre/kg $W^{0.75}$/d)	0.24		0.10	
TWI:DMI(litre/kg)	3.49		2.80	

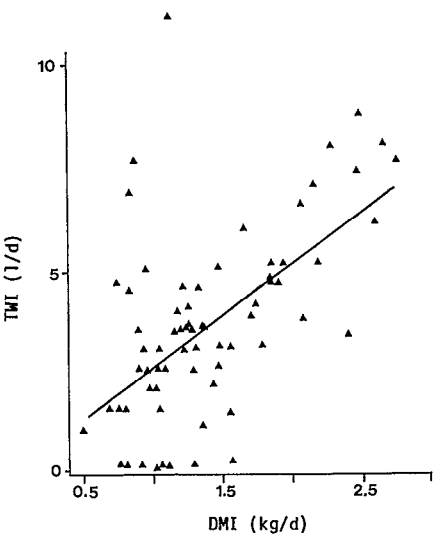

FIG. 1 Relationship between daily total water and dry matter intakes for red deer stags consuming pellets in Period 2. See Table 2 for regression parameters

DISCUSSION

On dryland pasture the young red deer stags in

this study consistently drank about 2.6 litre/hd/d of water from a trough. However, water requirements of ruminants are met from three sources: that consumed voluntarily (VWI), that contained in feed (FW) and that formed within the animal's body as a result of metabolic oxidation (ARC, 1980). VWI as measured in Trial 1 thus represents only part of the water intake of these deer. The other component of TWI (apart from water formed from metabolic oxidation) is the water contained in feed. Assuming M/D for this pasture to be 9.5 it is possible to estimate maintenance DM intake for stags during autumn (Fennessy and Milligan, 1987). Each stag in the present study may have consumed, on average, 2.8 kg DM/d of the pasture (40% DM). This represents 4.2 litre/hd/d of FW and, thus, TWI = 6.8 litre/hd/d (or 0.19 litre/kg $W^{0.75}$/d). Voluntary water consumption apparently provided less of TWI than the contribution of water from the dry pasture.

The value for VWI measured from these stags provides a crude estimate of the amount of water such animals drink under dry weather conditions when they are merely maintaining live weight. When drinking water supplies are reduced below the *ad libitum* value, ruminants can survive dehydration although this can cause losses in live weight (Taylor, 1968). Since the stags in Trial 1 did not lose weight, it can be assumed that their minimum requirement for drinking water (for survival) must be less than 2.6 litre/hd/d. Nevertheless increases in ambient temperature or in metabolic activity arising from body or antler growth may elevate water requirements above this value, so it is important to recognise this figure as a level for maintenance only.

Precise data for TWI of deer on two diets chosen for their widely divergent DM contents were provided by Trial 2. Water consumption was greater in stags offered the relatively dry pelleted diet (88% DM) than in those consuming grass silage (27% DM). Nevertheless, TWI was greater for the silage because of the larger volume of water contained in this diet. Stags on the pelleted diet lost 11.5 kg live weight, compared with a mean loss of only 1 kg for those on silage, reflecting their lower DMI. The relationship between TWI and DMI recorded here, notwithstanding the large variation (Fig. 1) and wide range of mean values for TWI:DMI (from 2.43 in Trial 1 to 3.66 in Trial 2) reflects the general association between DMI, metabolic activity and therefore water requirement. The higher value for TWI:DMI for stags on silage supports the view (ARC, 1980) that animals fed on low dry matter diets may have total water intakes in excess of apparent needs. Also it should be noted that both of the trials in this study have shown that the amount of water drunk by deer (VWI) bears no relationship to TWI.

TABLE 2 Regression equations of TWI (litre) on DMI (kg) for red deer stags indoors consuming grass silage or pellets in Trial 2.

	Slope	Intercept	r^2	RSD
Silage				
Period 1	3.91	0.02	0.25	1.62
Period 2	3.71	-0.52	0.71	1.64
Pellets				
Period 1	1.83	2.12	0.37	1.95
Period 2	2.76	-0.20	0.29	1.95

Comparison of water intakes with those of other ruminant livestock shows similarities between red deer, sheep and goats (Table 3), even though there is considerable variation between diets. On comparable diets cattle appear to consume larger amounts of water (Table 3) and preliminary results from a grazing study at Lincoln College indicate that Angus-Friesian steers consume three times as much water as red deer on an equivalent metabolic live weight basis (G.L. Alexander, pers. comm.). Some of the variation in water intake between mammalian species is due to differences in urinary and faecal excretion of water. In ruminants the faeces provide a potentially larger source of water loss than urine (Squires, 1988). Those species which form faecal pellets (e.g. sheep, deer, goats) lose less water via this route than those which do not, for example cattle. This is related to differences in water absorption from the large intestines (Church, 1971) and it is conceivable that the latter activity is regulated in ruminants to maintain water homeostasis. In conclusion, the results of this study indicate that

TABLE 3 Total water intake (litre/kg $W^{0.75}$/d) and TWI:DMI (litre/kg) ratio for ruminant livestock.

Species	Diet	TWI	TWI:DMI	Reference
Red deer				
	Pellets	0.10	2.80	Present study
	Hay	0.14	2.97	P.F. Fennessy, pers. comm.
	Dry pasture	0.19	2.43	Present study
	Pasture	0.10		G.L. Alexander, pers. comm.
	Silage	0.24	3.49	Present study
Sheep				
	Hay/straw		2.9	Alam *et al.* 1985
	Hay/straw	0.10-0.26		Alam 1985
	Dried grass	0.27		Bass 1982
	Hay	0.15	2.2	Bass 1982
	Hay	0.13	2.99	P.F. Fennessy, pers. comm.
Goats				
	Hay/straw		2.1	Alam *et al.* 1985
	Hay/straw	0.06-0.18		Alam 1985
Cattle				
	Concentrates	0.26		Utley *et al.* 1970
	Pasture	0.31		G.L. Alexander, pers. comm.
	Silage		3.4	Blosser & Soni 1957
	Silage		3.8-5.0	Owen *et al.* 1968

red deer have similar water requirements to sheep and goats (on a metabolic live weight basis) and, in keeping with other ruminant livestock, that their TWI is directly related to DMI.

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