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Sodium requirements of grazing livestock

N. R. TOWERS AND P. W. YOUNG

Ruakura Animal Research Station
Ministry of Agriculture and Fisheries, Hamilton

D. C. SMEATON

Whatawhata Hill Country Research Station
Ministry of Agriculture and Fisheries, Hamilton

ABSTRACT

Responses to sodium supplements have been recorded in trials with weaner Angus calves and mature ewes grazing pastures containing Na concentrations exceeding the minimum dietary levels calculated from recent Agricultural Research Council (1980) recommendations. Increased live-weight gains were noted following supplementation of calves grazing pastures with a Na content of 1 g/kg DM, and in ewes on pasture with 0.7 g/kg DM. These results suggest that either the estimates of daily Na requirements are too low or that for Na availability is too high.

Keywords Growth responses; Na supplementation; calves; sheep

INTRODUCTION

After an extensive survey of the sodium content of New Zealand pastures Smith and Middleton (1978) suggested that the Na intake of a significant portion of the national flock and herd was likely to be inadequate. Based on minimum herbage Na concentrations derived from National Research Council recommendations these authors concluded that of the nearly 3000 sites sampled 9% provided insufficient Na for sheep, 26% insufficient for beef animals while 67% were potentially inadequate for lactating dairy cows (Table 1).

More recently the Agricultural Research Council (1980) has published estimates of the Na requirements of ruminants that are generally 25 to 35% lower than earlier recommendations (Agricultural Research Council, 1965).

TABLE 1 Minimum herbage Na contents (g/kg DM) for maximal production and percentage of sites below minimum levels.

	Minimum herbage Na concentration		Percent sites deficient	
	S and M[1]	ARC[2]	S and M[1]	ARC[3]
Sheep	0.7	0.55	9	5
Beef	1.0	0.65	26	14
Dairy	2.0	1.25	67	35

[1] from Smith and Middleton 1978
[2] calculated from Agricultural Research Council 1980 recommendations
[3] calculated from data of Smith and Middleton 1978.

Recalculating these figures with live weights, DM intakes and production levels typical of New Zealand (Towers and Smith, 1983) suggests that lower minimum herbage Na concentrations than those used by Smith and Middleton are adequate for grazing livestock. Using these revised herbage concentrations to assess the Na status of New Zealand pastures markedly reduces the number of sites considered potentially Na deficient (Table 1).

But in practice how appropriate are these estimates of minimum herbage levels? This can only be assessed by comparing them with data from production response trials. Smith *et al.* (1983) provide data indicating that the revised Agricultural Research Council recommendations are too low. They reported that weaner Angus calves grazed on an area with a history of NaCl fertilisation had higher live-weight gains than similar animals grazing adjacent untreated pasture where the Na content of the pasture fell to 0.8 g/kg DM. The difference in growth rates was attributed to differences in pasture Na levels but, because the experimental groups grazed separately, possible differences in DM intake, herbage composition or digestibility could not be discounted.

METHODS, RESULTS AND DISCUSSION

Fifty weaner cattle were grazed on each farmlet used by Smith *et al.* (1983). Half the animals grazing each area received a drench containing 25 g NaCl twice weekly. The trial lasted 8 weeks and in the first 4 weeks live-weight gains of about 0.5 kg/d were obtained. However drought conditions severely affected feed supplies during the latter half of the trial and during this period mean body weight of all groups fell by 4 to 5 kg. Growth rate data from the first 4-week period only have been presented (Table 2).

TABLE 2 Effects of NaCl fertilisation and NaCl drenching on herbage Na content (g/kg DM) and live-weight gain (kg/d) of weaner cattle.

Treatment		Herbage	Live-weight
Pasture	Drench	Na	gain
− NaCl	− NaCl	1.0	0.34
	+ NaCl		0.54**
+ NaCl	− NaCl	3.2	0.53
	+ NaCl		0.51ns

The NaCl fertilised area again had markedly higher herbage Na than the control area and weaners grazing the area gained 5 kg more than unsupplemented weaners grazing control pastures. This difference was maintained during the second 4-week period. Sodium supplements increased growth rates of weaners on the low Na pasture but did not affect the growth rates of the weaners on the high Na pasture (Table 2), establishing that even at 1.0 g/kg DM the low Na pasture was providing insufficient Na for maximal growth.

In the second trial the effects of Na supplementation on ewe performance were studied as part of a trial that examined the effects of anthelmintic drenching, pasture allowance (3 levels), Se, Co, and Na supplementation in a 2 × 3 × 2 × 2 × 2 factorial design with 10 ewes /cell. The trial was conducted during a 6-week period before mating. As the trial was on a commercial property the Na supplement was provided as a salt lick and no control could be exercised over dose rates or whether all treated animals accepted the lick. Because of misadventure live-weight data from only the 2 higher pasture allowances could be formally analysed but there was no indication that NaCl supplementation affected live weight of animals on the lowest allowance.

TABLE 3 Effects of pasture allowance (kg DM/d) and Na supplementation on live-weight gain (g/d) of ewes.

	Live-weight gain	
Pasture allowance	− Na	+ Na
2.9	72	94**
6.6	144	158**

Access to salt licks resulted in minor improvements in live-weight gain at the 2 higher pasture allowances indicating that the Na content of the pasture (0.7 g/kg DM) was providing a marginally inadequate Na intake (Table 3). However the Na intakes of all ewes, estimated from the measured DM intake and the herbage Na concentration, exceeded the calculated requirements by a large margin (Table 4).

TABLE 4 Calculated daily Na requirement (g/d) and estimated daily Na intakes (g/d) of ewes at 2 levels of pasture allowance (kg DM/d).

Pasture allowance	Na treatment	Calculated Na requirement	Estimated Na intake†
2.9	−	0.42	0.88
	+	0.45	0.91
6.6	−	0.52	0.84
	+	0.54	0.98

† does not include any allowance for Na supplement consumed.

In both trials responses to Na supplementation occurred despite the animals being offered pasture with Na concentrations exceeding those calculated to be fully adequate on the basis of the daily Na requirement estimated using the factorial model and assuming adequate DM intakes (Towers and Smith, 1983). Minimum herbage mineral concentrations depend on the net daily requirement for the mineral, its availability for absorption and the daily dry matter intake.

$$\text{Min. herbage conc. (g/kg DM)} = \frac{\text{mineral requirement (g/d)}}{\text{availability} \times \text{DMI (kg)}}$$

Errors in estimating the value of any of these parameters materially affect the apparent adequacy of the mineral levels in the diet.

The discrepancies between the calculated requirements and the results of field trials indicate that one or more of the parameters are wrong and highlight the major problems with the factorial modelling approach—first the adequacy of the very simple model itself and second the accuracy and applicability of the data inserted into the model.

For example, the model

$$\text{Maintenance Reqt.} = (LW \times F) + (LW \times U) + (LW \times S)$$

where F = endogenous faecal loss
U = urinary losses
S = sweat and saliva losses

assumes that the inevitable endogenous mineral losses via faeces and urine are directly dependent on body weight and not affected by variations in intakes. But recent work (Braithwaite, 1982) has shown endogenous faecal Ca losses in sheep—while not affected by Ca intake—are dependent on DM intakes. Similar effects may operate for other minerals including Na.

The problem is further compounded by both the paucity and variability in data describing Na metabolism. Much of the available information dates back 70 years—and in an earlier publication the Agricultural

Research Council (1965) candidly admitted that their estimates of inevitable Na losses were 'subject to considerable error'.

Estimates of the Na required for live-weight gain or to replace losses in milk are also subject to error. Aitken (1976) noted a fourfold range in the reported mean values for the Na incorporated into body tissue for each kg live-weight gain. Similarly the reported Na content of milk, which accounts for as much as 75% of the Na requirement of a lactating cow, varies widely.

Thus until improved models and more and better data are available recommendations for the sodium requirements of grazing livestock will of necessity be based on a few production response trials and considerable guess work.

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