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BRIEF COMMUNICATION: Methods of delivering salt to cattle

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INTRODUCTION

Urine from farmed livestock contributes significant quantities of nitrate nitrogen (N) to water bodies, resulting in elevated phytoplankton and nuisance plant growth. Heavily nitrate-contaminated groundwater can impair animal and human health. Ammonia and nitrous oxide also emit from urine patches, especially in anaerobic soil conditions (Ledgard and Luo, 2008). Several N leaching mitigation treatments are being evaluated in the Lake Taupo catchment (Ledgard *et al.*, 2007) with salt, fed as a diuretic to cows during winter, showing most promise in modelling research (Bryant *et al.*, 2007). This is probably because leaching losses from urine patches decrease exponentially as the load of N in urine patches decreases (Ledgard, 2001). In an indoor study, 200 g/d of salt (NaCl) fed to cows as a diuretic increased water consumption 24% and doubled urine volume excreted, more than halving urinary nitrogen concentration (Ledgard *et al.*, 2007). In the N mitigation grazing trial (Ledgard *et al.*, 2007), daily salt administration during winter increased water consumption by over 50% and increased urination frequency by 34% compared to cattle without salt over one 10-day period (K. Betteridge, Unpublished data). The purpose of the research reported here was to determine a practical way to feed NaCl to cows on commercial farms to achieve a daily intake of about 200 g/d sufficient to potentially reduce N leaching by 48% (Bryant *et al.*, 2007) through a wider spread of more dilute urine within the paddock.

MATERIALS AND METHODS

The trial was conducted over 30 days in November and December 2008 at the AgResearch Aorangi research farm near Palmerston North.

Three methods of salt delivery treatments were assessed:

1. Salt (Dominion Salt Ltd., Mt Maunganui, New Zealand) alone.
2. Salt + dehydrated molasses (50:50 a mix by weight).
3. Salt + silage (Supplied in 20 kg sealed bales, by Denver Stock Feeds Ltd., Palmerston North) with the salt sprinkled over the silage.

Each treatment was replicated three times in a randomised design, using nine separate paddocks. Each paddock was stocked with a mob four Friesian/Hereford cross-bred heifers (n = 36 (3 x 3 x 4)) with an average live weight of 231 ± 20 (standard deviation) kg. All mobs were offered a daily allowance of 2 kg DM/head of fine chopped lucerne silage to standardise total daily DM intake amongst groups. In addition a daily allowance of 200 g NaCl/animal was offered to each mob of cattle. Fine chopped silage was used to minimise salt loss to the ground in the salt+silage treatment where silage was fed in a long trough and the salt was sprinkled over it. The other salt treatments were fed in a small weather-protected trough fixed to the fence. There was no acclimatization period before the start of data collection.

Residual salt from the previous day's allowance was collected, dried and contaminants removed to estimate the previous day's salt intake. Spillages occurred in the first three days due to the long troughs being overturned. Most of this spillage was able to be collected off the ground. Thereafter, these troughs were fixed to the fence and little if any salt was observed on the ground. Fresh water was available at all times.

Mobs were grazed behind an electric fence that was moved forward every three to five days, to simulate winter maintenance feeding. These shifts were carried out on the same day for all mobs when residual pasture cover approached 1,000 kg DM/ha, as visually assessed by the farm staff. Size of grazing break, pasture mass and weather conditions determined when more pasture was offered. As there was no back fence the area available to the mob increased progressively during the trial, with regrowth having the effect of increasing the time before the fence was next shifted.

Average daily apparent salt intake (ASI), calculated as the total salt intake of the mob divided by 4, was the unit of measurement analysed in GenStat, Version 11.1 (VSN International Ltd., Hemel Hempstead, Hertfordshire, UK) with treatment, days-in-break and sub-group or replicates, as factors. A quadratic model was fitted to the data to test for main effects, while a two-way ANOVA was used to compare intake by treatment on Day 1 and Day 4 to elucidate the treatment by days-in-break interaction.

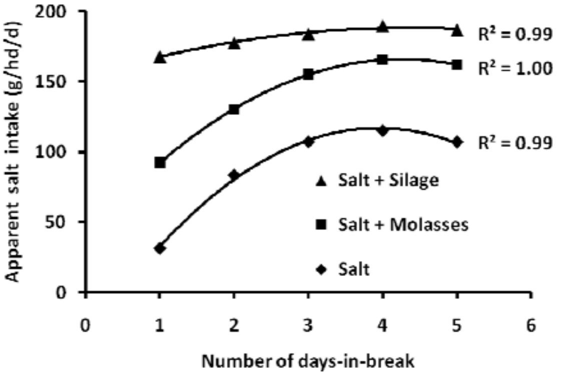
RESULTS

Apparent salt intake varied by treatment (P <0.001), by days-in-break (P <0.001) and the treatment x day interaction (P <0.001). Mean ASI over the trial period was greater for salt+silage (178.6 g/hd/d) than salt+molasses (131.4 g/hd/d), which in turn was greater than for salt alone (79.5 g/hd/d) with a pooled standard deviation of 49.0 g/hd/d. Daily mean ASI increased with each day in a given break (P <0.001; Figure 1). The treatment by days-in-break interactions were best represented by the fitting of quadratic polynomial functions to each treatment. On Day 1 ASI was significantly different amongst all treatments but on Day 4, salt alone was significantly lower than in salt+silage and salt alone groups (P <0.001). There was a greater variation amongst replicate mobs within treatments in daily ASI of salt alone and salt+molasses than for salt+silage. This was most pronounced on Days 1 and 2 after cattle were given a new break of pasture, than on Days 3 to 5 on a pasture break (K Betteridge, Unpublished data). As cattle spent five days without a new pasture allocation on one occasion only, the indication of a declining ASI on the fifth day (Figure 1) may be misleading.

Salt+silage animals ate most of their salt each day, with recovered spillage accounting for some of the salt not eaten. The graphs in Figure 1 show that the cattle which had the opportunity not to eat salt (salt alone, salt+molasses) had a lower salt intake on the first and second days after new pasture was offered compared to salt+silage cattle which had high intakes on all days, as they could not avoid the salt when eating their silage. In the salt alone mobs all offered salt was consumed only on three days.

Little salt remained on the ground after spillages had been recovered and the only uneaten silage was that trampled into the soil or blown away by strong winds that occurred on several days during the trial. Residual silage was not measured.

FIGURE 1: Mean daily apparent salt intake across treatments versus number of days-in-break before cattle were shifted to new pasture with an overlaid quadratic line of "best-fit". There were 27, 27, 27, 15 and 3 observations for each data point with an increasing number of days-in break.



DISCUSSION

The greatest ASI occurred when 200 g salt/hd/day was spread onto the fine chopped silage in a long trough. This was to be expected given that cattle were on a simulated winter grazing regime where silage was a significant part of their daily diet and the animals could not avoid eat the salt sprinkled on the silage. Where salt was offered in a molasses mix, the dehydrated molasses proved to be a beneficial feeding attractant that increased salt intake, particularly in the first two to three days after a new break of pasture was offered. The least satisfactory means of supplementing salt to achieve higher-than-nutritionally-required intakes was by offering salt alone.

Apparent daily salt consumption per animal was determined as the mean of the total amount eaten by the mob of four cattle. Thus, any variation in ASI within treatment mobs that might have occurred could not be determined. As ASI between mobs within treatments was sometimes high, we believe that on some days some cattle ate little or any of the salt offered while others may have eaten their full allocation, or more. However, Ledgard *et al.*, (2007) showed a near linear increase in urine volume as salt intake increased from 0 through 200 to 400 g/hd/d, hence with respect to salt being used to mitigate N leaching, even if some cattle in the herd have relatively low salt intakes, a useful reduction in N leaching might still be obtained.

While the amount of salt that needs to be offered to cattle to achieve a given reduction in N leaching has not been determined, doubling the number of urination events and halving the urinary nitrogen concentration through the diuretic effect of 150 g salt/hd/d, has been modelled as causing a 48% reduction in leached N, compared to the 51 kg N leached/ha/yr in the control treatment (Bryant *et al.*, 2007).

Our data which showed molasses improved the intake of salt when fed as a molasses+salt mix, is similar to studies where molasses is used to increase palatability of supplements offered to cattle (Meeske *et al.*, 2006) and where dehydrated molasses has been used to lure cattle to rangeland areas in which pastures were poorly utilised (Bailey & Welling, 1999). Using molasses to attract animals to salt has the added benefit of potentially increasing the N utilisation by cattle through providing more readily available carbohydrate for use by the rumen microflora (Pacheco *et al.*, 2007), thereby reducing urinary N excretion.

We do not know why the cattle increased their ASI with increasing time without being offered new pasture. Farmers have commented that salt intake of cattle fluctuate greatly over time, possibly related to the time animals have been in the paddock.

A feed wagon was used to prepare the silage+salt ration for the animals. This wagon, which is used to mix additives with silage, mixed the salt and silage thoroughly and almost no salt remained when the next day's ration was fed.

To achieve a salt intake of about 200 g NaCl/hd/d we suggest salt be mixed with silage prior to feeding-out or, be added to silage as it is fed out. Where this is impractical, offering salt as a 50:50 mix with dehydrated molasses will be a simple option for farmers, but will result in a lower daily intake of salt than when the salt is sprinkled on the silage.

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