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The relationship between daily Se intakes and blood Se concentrations in pregnant dairy cows

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ABSTRACT

Three groups of pregnant (3rd trimester) cows grazing low Se pastures were given daily Se intakes of 0.44, 0.94 and 1.44mg respectively as pasture plus a drench. A significant relationship between blood Se concentration (nmol/l) [y] and daily Se intakes (mg/day) [x] was described by the equation Y=147(44.0+(359(42.1)X***. Given that a mean blood Se concentration of 250 nmol/l reflects an adequate Se status, that is *there is no production response to Se supplementation, then the daily Se intake of pregnant cows was determined to be 0.29mg or pasture should* contain 0.037mg Se/kg DM to prevent Se deficiency.

Keywords: dairy cows; selenium; blood; intake.

INTRODUCTION

Responses to Se supplementation in terms of milk yields and reproductive performance in dairy herds have been reported when the mean herd blood Se concentrations were less than 130 nmol Se/l (Fraser *et al.* 1987; Tasker *et al.* 1987). Likewise responses in the liveweight gains of calves to Se supplementation were observed when the mean blood Se concentration of the groups were less than 250 nmol Se/l (Fraser and Wright 1984). However in the above studies it was not possible to assess the Se intakes of the cows and calves because the Se content of the pasture grazed was not reported.

A relationship between daily Se intakes and plasma Se concentrations in housed dairy cattle fed corn silage and grain has been defined (Maus *et al.* 1980; Weiss *et al.* 1990). As Se intakes increased from 1 to 5mg/day plasma Se concentrations increased from 760 to 1050 nmol/l (calc. 1500-2100 nmol Se/l blood) while further increases in Se intakes caused only very small changes in plasma Se concentrations.

Dietary Se requirements of dairy cows can be determined by relating dietary Se intakes to the plasma or blood Se concentrations at which no animal performance responses occur to Se supplementation ie. 250 nmol Se/l blood (Ellison 1992).

In the US and UK dairy cattle diets are supplemented with Se at levels up to 0.3 mg Se/kg DM (Ullrey 1992). Although NZ pasture Se concentrations range from 0.005 to 0.07 mg Se/kg DM (Grant and Sheppard 1983) dairy cattle responses to Se supplementation in terms of milk yields and reproductive performances have only been observed in some herds (Fraser *et al.* 1987; Tasker *et al.* 1987).

Therefore there is a need to evaluate the dietary Se requirements of pasture fed NZ dairy cows as overseas Se recommendations may not be applicable for the NZ situation.

This study was designed to relate increasing Se intakes to changes in blood Se concentrations of pregnant dairy cows grazing low Se pastures as an approach to determine their dietary Se requirements.

MATERIALS AND METHODS

Animals

Twenty one pregnant (3rd trimester) Friesian cows with a mean blood Se concentration of 230 nmol/l and grazing low Se pastures (0.02-0.03 mg Se/kg DM) at the AgResearch, Flock House Research Centre, Bulls were divided into 3 groups in mid May according to age and previous production index. The cows were identified with numbered ear tags and coloured collars and grazed as one group on a low Se pasture.

Treatments

Selenium as sodium selenate (Na2SeO4.10H2O) was administered daily as a 10ml drench for 60 days.
Group 1 (LSe) received 0.2 mg Se/day,
Group 2 (MSe) 0.7 mg Se/day and
Group 3 (Hse) 1.2 mg Se/day.
Pasture provided an extra 0.24 mg Se/day.

Collection of samples

Pasture samples were collected weekly and bulked to give 4 samples for Se analyses. All cows were bled from the coccygeal vein using 10ml EDTA vacutainer just prior to drenching on days 0, 15, 30, 45, 54 and 60 of the study to determine blood Se. The trial was completed about 7 days prior to the start of calving.

Analytical

The Se in the pasture and blood was determined by the fluorometric method of Watkinson (1979). The relationship between daily Se intakes (mg/day) and blood Se concentrations (nmol/l) was determined at days 54 and 60 when the blood Se values had reached a plateau.

Differences between treatments within a sampling date were determined using Analysis of variance.

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RESULTS

The mean pasture Se content was 0.03 (0.005 mg/kg DM over the duration of the trial.

The effect of Se intakes on changes in blood Se concentrations are presented in Table 1.

The initial mean blood Se concentrations of the LSe, MSe and HSe groups were 230(17.4, 237(16.6 and 228(9.6 nmol/l respectively. These increased to 338(22.9, 564(27.1 and 677.0(35.1 at day 54 before decreasing slightly at day 60. At day 15 the blood Se concentrations of the MSe and HSe groups were significantly greater than those of the LSe group while at day 45 the HSe group had the highest blood Se values. The equation relating blood Se concentrations (nmol/l) at days 54 and 60 (Y) to daily Se intakes (mg/day) (X) was Y = 147(44.0 + (359(42.1) X*** and r=0.98*** (P<0.001).

DISCUSSION

At the start of the study in mid May 1994 the mean blood Se concentration of the cows was 230 nmol/l which indicates that many of the cows were still marginally Se deficient after having a mean blood Se concentration as low as 126 nmol/l 3 months earlier when they were grazing pastures containing 0.02 mg Se/kg DM. The biochemical criteria used by MAFQual Animal Health Laboratories to assess the Se status of dairy cattle is < 130 nmol/l deficient, 130-250 nmol/l marginally deficient, and > 250 nmol/l adequate (Ellison 1992).

Assuming that the DM intake of 500 kg pregnant (3rd trimester) dairy cows was 8kg day and the mean pasture Se content was 0.03 mg Se/kg DM then it was calculated that the pasture provided 0.24 mg Se/day to give along with that provided by the Se drench, total daily Se intakes of 0.44, 0.94 and 1.44mg for the LSe, MSe and HSe groups respectively.

The mean blood Se concentrations of the MSe and HSe groups increased over 54 days and then decreased slightly over the next 6 days indicating that an equilibrium situation had been reached. In contrast the LSe group showed little change in mean blood Se concentrations.

Given that this and other studies (Maus *et al.* 1980; Weiss *et al.* 1990) have shown there is a strong relationship between daily Se intakes and blood Se concentrations and that the Se status of cows with blood Se concentrations of 250 nmol/l is adequate (Ellison 1992), then an assessment of the dietary Se requirements of dairy cows can be made. It was calculated from the regression equation based on the data presented in Table 1 that a Se intake of 0.29 mg/day was needed to maintain a mean blood Se concentration of 250 nmol/l in pregnant dairy cows. Further as a DM intake of 8kg/day is needed to meet the energy requirements of pregnant cows then the pasture should also contain 0.037 mg/kg DM to meet their dietary Se requirements.

This value is similar to 0.043 mg Se/kg DM determined by a factorial approach using data from Se balance and metabolism studies which measured the endogenous Se losses from the body, uptake of Se into the conceptus and other tissues and the availability of Se from the diet (Grace 1992).

As some NZ dairy farms will have pastures with Se concentrations of less than 0.037 mg/kg DM there is a need to identify the herds with a low Se status so that these cows can be supplemented with Se to ensure optimum milk yields and reproductive performance.

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TABLE 1: Effect of increasing daily Se intakes on mean blood Se concentrations (nmol/l) in pregnant dairy cows.

Time (day) Se treatement (mg/day)	0	15	30	45	54	60
0.44	230 ± 17.4	288^{a} ± 18.8	296^{a} ± 17.7	266^{a} ± 20.5	301^{a} ± 50.2	283^{a} ± 21.9
0.94	237 ± 16.6	380^{b} ± 22.5	438^{b} ± 32.1	458^{b} ± 19.6	564^{b} ± 27.0	522^{b} ± 18.6
1.44	228 ± 9.6	390^{b} ± 15.6	494^{b} ± 23.9	554^{c} ± 29.7	677^{c} ± 35.1	645^{c} ± 38.8

^{abc} superscripts within a column are significantly different P<0.05