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Accumulation of cadmium in kidney and liver tissue of the suckling Romney lamb from parturition to early weaning

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INTRODUCTION

In earlier work we investigated the accumulation of cadmium (Cd) in the developing foetus and compared the movement of Cd with that of zinc (Zn) into the liver and kidney. Concentrations of Cd in foetal tissue were extremely low, although there was a small flux across the placenta at about 100d of development concomitant with that for Zn. There was no relationship of foetal Cd with the Cd status of the mother. It was only after parturition that Cd concentrations in liver and kidney started to increase (Rounce *et al.,* 1995). We also showed that the rate of Cd accumulation in weaned animals was greatest at an early age when growth rates were also at or near their peak (Lee *et al.,* 1996). The aim of this study was to define Cd accumulation in tissues of Romney neonates, as affected by relative Cd concentrations in pasture and milk from parturition to weaning.

MATERIALS AND METHODS

Six groups of 8 Romney ewes and their offspring were raised on either a low Cd (0.21±0.07 µg Cd/g DM) or high Cd (0.33±0.03 µg Cd/g DM) pasture in 3 replicates. Subgroups of lambs of known birth date were slaughtered every 3 weeks over the experimental period. Cadmium in liver, kidney, milk and faeces was determined by Zeeman electrothermal atomic absorption spectrometry.

RESULTS

Cadmium concentrations (mean±se) in the ewes milk were 0.26±0.02 and 0.40±0.08 ηg Cd/g DM for animals from the low and high Cd pastures respectively. There was a significant relationship between Cd in the ewes milk and pasture Cd. Cadmium in milk was a major portion of total dietary Cd for the lambs up to about 25 days of age, after which Cd in pasture increasingly became the major dietary source. Intake of Cd from pasture was estimated from Cd in faeces, which was measurable only after 25 days. Overall mean (±se) faecal Cd concentrations were; 0.50±0.09 and 1.16±0.18 µg Cd/g DM for lambs raised on the low and high Cd pastures respectively. Combined Cd intake over the experimental period is shown in Fig 1.

The concentration and total content of Cd in liver and kidney tissue increased with time, but after rumen development (approximately 60 days of age) a marked increase in the rate of Cd accumulation in liver tissue was observed (Fig. 2) concomitant with an accelerated increase in organ weights. This relationship was best described by the function, y = 0.337exp(0.043*Time), R(sq) = 0.77. Overall Cd content in the livers were: 3.92±1.16 and 6.01±1.59 µg Cd (NS), and kidneys; 0.60±0.09 and 1.07±0.16 µg Cd (P<0.001), for lambs from the low and high Cd pastures respectively. The relationship between organ Cd content and Cd intake is given in Figure 3.

FIGURE 1: Total Cd intake (pasture plus milk) for suckling lambs of ewes grazing pasture of either low (❍) or high (■) Cd content.

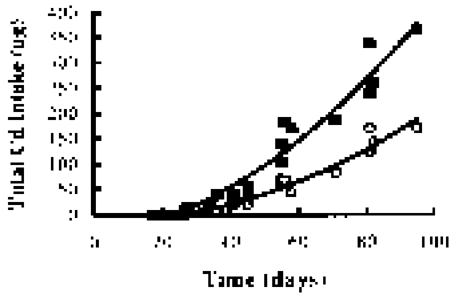


FIGURE 2: Total Cd in the liver of suckling lambs from birth to weaning. Intake of pasture increases from about 30 days onwards.

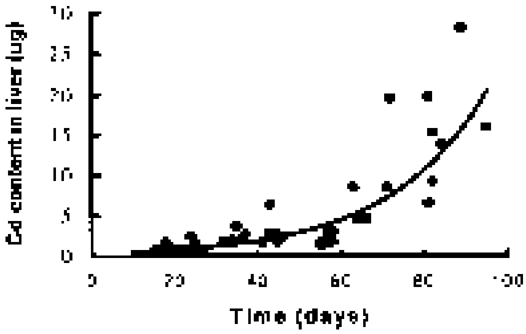
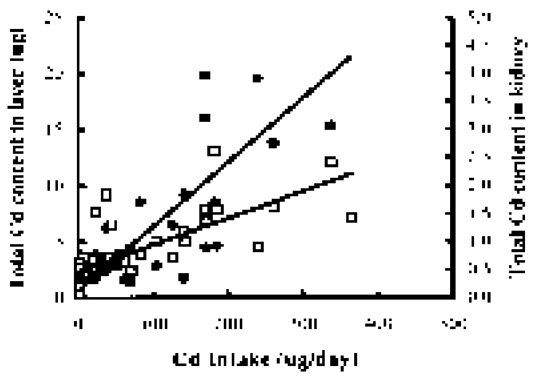


FIGURE 3: Total Cd content in liver (●) and kidney (❑) of suckling lambs as a function of Cd intake, estimated from faecal Cd, pasture and milk intake (Grace and Watkinson 1988). Linear regressions have significant R(sq) values of 0.745 and 0.544 (P<0.001) for liver and kidney respectively.



CONCLUSION

When lambs were predominantly milk fed the Cd content of the milk was sufficient to account for the observed Cd content of liver and kidney only if the proportion of Cd absorbed from the milk was high (>90%). By comparison, although net absorption of Cd from pasture is <1% (Lee *et al.*, 1996), the larger dietary intake of Cd from increasing amounts of pasture incorporated in their diet, resulted in much greater accumulation of Cd in liver and kidney of the suckling lamb.

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