Molybdenum and sulfur reduce cadmium accretion in tissues of sheep

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Recent abattoir surveys in Australia have shown that a significant proportion of ovine and bovine liver and kidney samples have concentrations of Cd that exceed the NH&MRC maximum allowable limit of 1.25 mg/kg fresh weight (FW) (1). It is therefore important to gain an understanding of the factors controlling entry of Cd into the food chain.

Copper (Cu) is chemically similar to Cd, and Cu availability in ruminants is reduced by high dietary levels of sulfur (S) and molybdenum (Mo). This experiment aimed to determine whether increased dietary concentrations of Mo and S would reduce Cd accretion in sheep.

Forty sheep were fed for three weeks on a pre-treatment diet containing 0.016 mg Cd/kg, 0.45 mg Mo/kg, 3.4 mg Cu/kg and 1.9 g S/kg. On day 0 of treatment eight sheep were killed and tissues were sampled for Cd and Cu. The remaining sheep were divided into four dietary treatment groups: Control (pre-treatment diet plus 4 mg Cd/kg), +Mo (Control diet plus 15 mg Mo/kg), +S (Control diet plus 4 g S/kg) and +Mo+S (Control diet plus 15 mg Mo/kg plus 4 g S/kg). Sheep were killed on day 80 of treatment and tissues were sampled for Cd and Cu.

There were no effects of treatment on liveweight gain. Cd accumulated in liver and kidney relative to pre-treatment values and S reduced the accretion of Cd in liver and kidney by about 60%. Mo reduced it by 30-40%. When Mo and S were provided together (+Mo+S treatment) the effect was equivalent to feeding Mo alone, showing that Mo blocked the effect of S. The effects of Mo and S on Cu were different from those on Cd. Sulfur treatment reduced liver Cu by only 25%, and this was not significantly different from control sheep. The +Mo+S treatment caused a marked increase in kidney Cu concentration, compared with no effect on Cd.

	Liver cadmium	Kidney cadmium	Liver copper	Kidney copper
Pre-treatment	0.27^{a}	0.69^{a}	88^{a}	4.1^{a}
Control	2.53^{b}	6.40^{b}	160^{b}	4.1^{ab}
+Mo	1.68^{c}	4.52^{c}	95^{ac}	4.7^{a}
+S	1.18^{d}	2.77^{d}	125^{bc}	3.5^{b}
+Mo+S	1.67^{c}	4.99^{bc}	85^{a}	22.4^{c}

Values are backtransformed; mg/kg fresh weight. Means without common superscripts are different ($P<0.05$)

The results show that both S and Mo reduce Cd accretion in tissues, and that S has a greater effect than Mo. This response is different from that of Cu, suggesting that the mechanism is also different and perhaps not via thiomolybdates. Many dry pastures contain levels of S and Mo below that in the control diet in this experiment, and the results may be useful in formulating practices for reducing the entry of Cd into the food chain.

1. Langlands JP, Donald GE, Bowles JE. Cadmium concentrations in liver, kidney and muscle in Australian sheep and cattle. Aust J Exper Agric 1988;28:291.