

CHANGES IN ERYTHROCYTE Cu-Zn SUPEROXIDE DISMUTASE ACTIVITY FOLLOWING
THIOMOLYBDATE ADMINISTRATION TO SHEEP

DAVID I. PAYNTER,^{*} DAVID A. HUCKER^{**} and DANIEL N. MCOWAN^{**}

Interactions of copper, molybdenum and sulphur in ruminants appear to be mediated through the formation of thiomolybdates (Dick et al. 1975). These compounds are absorbed from the gut, and have been shown to reduce liver copper and plasma ceruloplasmin activities and to increase plasma TCA-insoluble copper (Mason et al. 1980; Gordon and Hill 1981). Apart from ceruloplasmin, there have been few reported studies on effects of thiomolybdates on other copper-containing enzymes. In the present study, activities of the erythrocyte Cu-Zn superoxide dismutase enzyme (CuSOD) and plasma ceruloplasmin were studied in sheep treated with thiomolybdates.

Ammonium tetrathiomolybdate (ATM), prepared by the method of Gordon and Hill (1981), was administered as a solution of 20 mg ATM/mL in saline to sheep fed a pelleted diet. Dose rates of 1.5, 3.0 and 6.0 mg ATM/kg body-weight were used. Activities of ceruloplasmin and CuSOD in plasma and packed cells of heparinised whole blood were measured as described previously (Paynter and Allen 1981).

Intravenous administration of ATM decreased CuSOD activity from 500-600 U/g Hb to less than 50 U/g Hb within 2 min of the administration of 6 mg ATM/kg body-weight. Activities remained decreased for at least 2 d, with pre-treatment values being regained within 21 d. Ceruloplasmin activities decreased from values greater than 50 mU/mL to less than 5 mU/mL, but returned to pre-treatment values within 60 min. Effects of ATM on CuSOD activities, and on immediate post-treatment ceruloplasmin activities, were dose-dependent to a dose of at least 6 mg ATM/kg body-weight and differences between pre- and post-treatment CuSOD activities appeared to be linearly related to the dose of ATM. Subcutaneous administration of ATM resulted in comparatively slower and smaller changes in CuSOD than either intravenous or intramuscular administration. Effects of ATM on CuSOD appeared to be specific to copper rather than zinc; activities of plasma alkaline phosphatase, a zinc-containing enzyme, were unaffected by ATM treatment. Similarly, effects on CuSOD could not be attributed to in vitro effects of ATM in the CuSOD assay; addition of purified bovine CuSOD to assays containing extracts of erythrocytes from ATM-treated sheep gave 100% recovery of added CuSOD.

These results indicate that erythrocyte membranes are readily permeable to ATM and that this compound is particularly effective in the reduction of CuSOD. Effects on ceruloplasmin activity are more transient, even though ceruloplasmin is more sensitive to dietary copper deficiency (Paynter and Allen 1981). This suggests that, in ruminants, high dietary molybdenum is likely to have different effects on different tissue copper enzymes and that these changes may not be the same as those observed with simple copper deficiency.

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* Department of Agriculture, 'Attwood', Mickleham Road, Westmeadows, Victoria 3047

**Department of Agriculture, Regional Vet. Lab., Hamilton, Victoria 3300

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