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Enzootic geophagia of calves and lambs in Northern Cape and Northwest and the possible role of chronic manganese poisoning

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Introduction

Geophagia, or the deliberate ingestion of soil, has been classified as a form of pica. Geophagia can be symptomatic for deficiencies of elements such as P, Na, Mg, S, Cu, Co or Mn (Kreulen & Jager, 1984). Geophagia may also be an instinctive behavioural response to gastro-intestinal disturbances (Kreulen 1985: Johns & Duquette 1991; Reid 1992). In this communication a specific enzootic form of geophagia is reported which occurs in young calves and lambs on farms in the Barkley West, Postmasburg and Vryburg districts of the Northern Cape- and Northwest Provinces of the RSA.

Materials and Methods

A questionnaire was distributed to landowners in the Vryburg and Kuruman districts to determine the incidence and geographical distribution of geophagia in cattle and sheep. This was followed by an investigation. Clinical-, macroscopical- and histopathological examinations were carried out on affected calves and lambs. The concentration of Mn, Fe, Zn, Pb, Co and Cu in liver specimens was determined. Feeding trials were conducted to investigate the appetite of 3 days-old- calves offered soil from affected and unaffected farms. A calf- and a lamb were dosed with manganese sulphate, euthanased to compare histopathological changes and the mineral composition of the liver with livers from natural cases of enzootic geophagia and hepatitis. Soil, edible plants as well as faeces and milk specimens from cows were analysed for Mn, Fe, Zn, Pb and Cu concentrations.

Results and Discussion

The problem apparently occurs only on a limited number of farms in the Vryburg, Postmasburg and Barkley West districts. They are situated in an area known as the Ghaap Plateau, and have superficial outcrops of manganese-rich dolomitic or carboniferous rock of the Reivilo Formation (Astrup & Tsikos, 1998). The soil on the affected farms contains numerous small round to ovoid black-grey Mn rich carboniferous concretions ca. 1-10 mm. in diameter. Suckling calves display an insatiable appetite for the Mn rich soil and sometimes lick iron poles. The consequence is severe constipation, dehydration and death within 7-10 days. The highest frequency occurs in calves of 7 – 14 days of age. Calves older than *ca* 2 months are rarely affected. Morbidity and mortality rates were difficult to estimate, since farmers could reduce the occurrence of geophagia by keeping the cows with young calves on deep litter in pens, allowing cows limited grazing during the day time. Prophylactic injections of iron dextran preparations shortly after birth showed some measure of success. Macroscopical pathological changes consisted of moderate to severe jaundice, marked enlargement and yellow discolouration of the liver, as well as the presence of variable amounts of dark brown to black soil, largely consisting of Mn-rich concretions, in the stomach and intestine. Histopathology revealed a chronic hepatitis, characterised by a marked proliferation of bile-duct epithelium. Livers from 23 calves and 1 lamb with soil in their digestive tracts or a history of geophagia, contained high concentrations of Mn, ranging from 10-1800 mg/kg wet mass [(normal range 2-3 mg/kg) (Hurley & Keen 1986)]. The concentrations of the other minerals in the liver were inconclusive. Experimental calves offered Mn-rich soil from an affected farm displayed marked geophagia with a strong appetite for this soil. They developed severe hepatitis, while the control calves, offered "normal" soil, also ingested small quantities of soil, but failed to develop severe geophagia or any of the other complications associated with enzootic geophagia. None of the three calves which received prophylactic injections of iron dextran and vitamin B_{12} intramuscularly, developed geophagia or any other complications. A calf dosed with manganese sulphate developed identical histopathological lesions in the liver to those of natural cases of enzootic geophagia. Grazing plants from affected farms had higher concentrations of Mn and a higher ratio of Mn to Fe than plants from unaffected areas. Soil specimens collected from three affected farms contained more Mn (7,8% vs. 0,39%) and less Fe (2,4% vs. 7,8%) than specimens collected at the control sites.

Faecal samples from cows also had a higher Mn concentration compared to control levels, while the results of the milk analyses were inconclusive. The initiating cause of the urge in the calves and lambs to consume soil is not clearly understood.. On the affected farms, calves temporarily abandoned while their dams are grazing, tend to start licking the soil. It was demonstrated that geophagia did occur in new-born calves when soil was offered, but severe geophagia with hepatitis occurred only when Mn-rich soil from the enzootic area was offered. Manganese interferes with Fe, Co and Zn absorption in the digestive tract (Hurley & Keen 1987; Morris, 1987). A deficiency of Co has been associated with geophagia (Kreulen & Jager 1984) and pica in cattle (Valli & Parry 1994), while Zn deficiency has been implicated as a cause of geophagia in children (Hambidge, Casey & Krebs 1987). In the present study the parenteral treatment of calves with iron-dextran compounds and vitamin B_{12} at 1-2 days after birth and at 14 days had a significant preventative effect on the occurrence of geophagia. The histopathological changes in the liver, which could be induced experimentally by dosing manganous sulphate, were indistinguishable from the lesions observed in natural cases of enzootic geophagia, and corresponded to the changes induced by the dosing and injection of manganous sulphate and manganous chloride in rodents (Findlay, 1924; Witzleben et al., 1968).

Conclusions

It is concluded, that although the cause of geophagia may not be completely understood, the characteristic lesions in the liver can be attributed to a subacute to chronic form of manganese poisoning.

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