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Fate of prions in soil: longevity and migration of recPrP in soil columns

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Research into transmissible spongiform encephalopathy (TSE) diseases has become a high priority worldwide in recent years yet remarkably little is known about the behaviour of TSE infectivity in the environment. The resilience and stability of prion protein could lead to soil becoming a potential reservoir of TSE infectivity as a result of contamination from activities such as infected carcass burial or the dispersion of effluents from slaughter houses, or by contamination of pastures by infected animals, e.g. scrapie in sheep. Knowledge of the fate of prion protein in soils and any conditions which favour migration can be used to prevent re-infection of animals through grazing, to protect watercourses and define good management practices.

The objective of this research was to determine the mobility of model (non-infectious) recombinant ovine prion protein (recPrP) in soil columns designed to reproduce the physical and physico-chemical conditions at the interface between the saturated sub-surface and the non-saturated surface regions of the soil profile. Soil columns were designed to allow precise control of the water table, in either fixed or rising conditions. recPrP was incorporated into a 1 cm layer of soil in the partially saturated zone above the water table and the columns were fully instrumented to allow detailed monitoring. In two consecutive experiments of 9 and 6 months, the migration of recPrP in soil was followed under contrasting levels of microbial activity (normal versus reduced populations), at different soil water contents and changing redox potentials, and in two different soil types (sand and clay).

A buffer solution capable of extracting recPrP from soils was identified (100 mM

Na_2HPO_4 with 1 % sarkosyl) and, following extraction, protein determination was carried out by SDS-PAGE separation and Western Blot detection. At each analysis time (1, 3, 6 or 9 months), in both soil types, full-length recPrP was detected in the original contaminated layer, indicating the resilience and stability of recPrP under changing soil conditions, even in the presence of active soil microbial populations. The column instrumentation provided evidence of differences in soil chemistry (pH, redox, ammonium concentration) between the experiment treatments (normal and reduced microbial activity, fixed and rising water table, sand and clay soils). Evidence of protein migration was found in every soil column at the earliest analysis time (1 or 3 months), but was restricted to a maximum distance of 1 - 2 cm. It is concluded that recPrP has limited initial mobility in soils but that strong adsorption over the following days to weeks severely limits its ultimate migration potential. Nevertheless, the survival of recPrP in the soil over a period of at least 9 months has been demonstrated. In this study recPrP was used as a tracer for TSE infectivity and thus infectivity tests should be carried out before conclusions can be drawn regarding the infection risk posed by prions in soil. However, soil is likely to act as a barrier to the dispersion of contaminated material and could be used for containment at storage or burial sites.