SOIL AND THE ENVIRONMENTAL TRANSMISSION OF PRION DISEASES

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Prion diseases comprise a family of inevitably fatal neurodegenerative diseases that affect a variety of mammalian species and include bovine spongiform encephalopathy ("mad cow" disease) in cattle, scrapie in sheep and goats, chronic wasting disease (CWD) in deer and elk, and Creutzfeldt-Jakob disease in humans. The infectious agents in these diseases, referred to as prions, lack nucleic acid and are composed predominately, if not solely, of a misfolded form of the normal cellular prion protein. Scrapie and CWD appear unique among prion diseases in that animal-to-animal transmission can be mediated by an environmental reservoir of infectivity. Among potential reservoirs for prion infectivity, soil appears the most plausible. The disease-associated prion protein binds to a variety of soil minerals and can persist in soils for years. Attachment to soil particles limits migration of the pathogenic prion protein through fine-grained soils and may increase the potential for animal exposure by maintaining prions near the soil surface. Clay mineral-bound prions remain infectious intracerebrally, and soil particle-associated agent is infectious orally. Prion sorption to clay minerals dramatically enhances oral prion disease transmission suggesting an explanation for disease transmission despite the presumably low levels of prions shed by infected animals. Soil may contribute to the environmental spread of prion diseases by increasing the transmissibility of small amounts of infectious agent in the environment. Prions released into soil environments may be preserved in a bioavailable form, perpetuating prion disease epizootics and exposing other species to the infectious agent.

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