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Influence of low molecular weight fractions of humic substances on reducing capacities and distribution of redox functional groups

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Humic substances (HS) are redox-active organic compounds and their reducing capacities depend on their molecule structure and distribution of redox functional groups (RFG). During dialysis experiments, bulk humic acids (HA) were separated into low molecular weight fractions (LMWF) and retentate. LMWF account for only 2% of the total organic carbon content of HA molecules, however, their reducing capacities are up to 33 times greater than either those of the bulk HA or retentate. Furthermore, the total reducing capacity of the bulk HA accounts for less than 15% of the total reducing capacity of bulk HA, retentate and LMWF combined, suggesting that releasing of LMWF cannot reduce the number of RFG. RFG are neither in fixed amounts nor in uniformly distributed in bulk HA. LWMF have great fluorescence intensities for humic-like fluorophores (quinone-like functional groups), where quinonoid π-π* transition is responsible for the great reducing capacities of LMWF, and protein-like fluorophores. The 3,500 Da molecules (1.25 nm diameter) of HS could stimulate transformation of redox-active metals or potential pollutants trapped in soil micropores (< 2 nm diameter). A development of relationship between reducing capacity and Ex/Em position provides a possibility to predicate relative reducing capacities of HS in environmental samples.