Microbiology of Soil Organic Matter

OBSERVATIONS ON THE HYPOCHLORITE OXIDATION OF DECOMPOSED PLANT RESIDUES

Abstract

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It is now generally accepted that of the major constituents of plants, lignin is the least readily attacked by microorganisms and that as a result the lignin content of decomposing material steadily rises. Concurrently, there is under aerobic conditions a synthesis of microbial tissue made evident by the increase in organic nitrogen content. Many of the properties of humified materials and soil humus can be accounted for on the assumption that residual lignin and synthesized nitrogenous complexes are the active components, the former outweighing the latter in importance. It would be advantageous to have some simple means of determining or obtaining a measure of the lignin or lignin-derived fraction and nitrogenous complexes of decomposing residues that could also be applied to soils.

Although the lignin molecule is inert or resistant to many reagents, it is peculiarly susceptible to oxidation and reacts rapidly with such oxidants as hypochlorite. The rate and extent of oxidation of lignin preparations from different sources are not identical. The reaction with hypochlorite is most rapid in the first few hours but continues slowly for days. The reaction is influenced by the relative concentration of the reactants and the degree of alkalinity or acidity of the solution. Proteins also react rapidly with this reagent.

In decomposed residues, such as peat or forest litter layers in which lignin has accumulated to a considerable extent, the activity of the lignin accounts almost completely for the activity of the whole residue. No indication was obtained of any increase in susceptibility of the lignin to oxidation with hypochlorite as a result of decomposition of the material containing it.

Since it has been suggested that the lignin and nitrogenous compounds in plant residues are combined or associated into some complex from which the nitrogen is biologically less available, the behavior of lignin-protein mixtures, precipitated together from mixed solutions was determined. One of the results of such mutual precipitation is that the complex is initially less readily oxidized by hypochlorite, though over a longer period this difference is not maintained.

Oxidation by hypochlorite may apparently be employed in following the progress of aerobic decomposition or in comparing residues obtained from the same parent material and is particularly applicable to such residues as the successive layers of raw humus on the forest floor. This reaction would not seem to be very suitable for the comparison of residues from entirely different sources, mainly because of the differences in reactivity of the lignin which they contain. As the reaction is an incompletely one the values obtained in any case are not absolute and comparisons should always be made at equal dilutions and with excess of hypochlorite, approximately the same initial ratio of chlorine to oxidizable material being maintained. No attempt should be made to interpret the results as indicating the amount of “humified organic matter” present or the “degree of humification”, but the increase in reactivity may be taken as a measure of the accumulation of those components.—Author abstract.

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