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Biodegradation of soil humus substances by autochtonous microorganisms

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Investigations on the mechanisms of degradation of humic compounds are important because of the role of these substances in the global cycling of carbon in the biosphere and their role in plant growth. To elucidate transformation of humic substances that is characterized a high biological stability and activity, bioavailability of microbial populations and HS with a high aromaticity should be investigated. Following the goal, the aim of our study was to investigate abilities of natural microbial populations to enhance degradation of HS and plant growth activity.

Coal humic acids (HA) from oxidized brown coal (Kyrgyz deposits) were isolated and added to a Czapek nutrient broth which was used either in full strength or without $(NH_4)_2SO_4$. The individual flasks were inoculated with natural microbial populations of corresponding cultivated soil, biohumus and wood rot samples for 3, 6, 9, 12 months.

According to the elemental composition of HS recovered from microbial cultures, a decrease in carbon and a significant increase of nitrogen in HS reisolated from the full strength broth inoculated with wood-decay microorganisms has been found. If biohumus microorganisms were used as inoculum, only minor changes were detected in the elemental composition of HS. A significant increase of H/C and O/C was also found in the HS. It can be attributed to formation new aliphatic and O-containing structures and decrease aromatic ones. Accumulation of fulvic acids was recorded after 6 months incubation. At the end of month 9, natural microbial populations from soil, biohumus, and wood rot had reduced the absorbance of HS media by 79, 75, and 62%, respectively.

A relative reduction of the molecular weight was noticed after 3 months incubation,

and accumulation of new low molecular weight fraction after 6 months incubation was recorded after chromatography on Toyopearl HW-50S. Reductions in amount were due to a random degradation of substances in all molecular size classes. An formation the high molecular weight fraction has been found. It can be caused by cross-linking of structural constituents of molecules due to radicals forming after biodestruction or by their interaction with metabolites.

Data obtained by spectroscopic methods (UV/vis/FTIR) and element analysis indicated a decrease in particle size and a loss in aromaticity and aliphatic carbon in HS reisolated from microbial cultures. Simultaneously an increase in the N content of HS was observed, which probably from some constituents of microbial biomass such as proteins and amino sugars. The microbial degradation of HS strongly depended on the composition of the HS, the species selection of the microorganisms, and to a lesser extent on the culture conditions.

A hormone-like activity has been showed by HS preparations which were characterized with low molecular weights (∼5-15 kD). Each of these preparations was endowed with a single specific (auxin-like or gibberellin-like) activity. Biosolubilized HS with low molecular weight were displayed two kinds of activity. The absence of hormon-like activity in the parent humic substances could be explained by "burying" effect of the interaction among humic constituents.

Undoubtedly, degradation of HS in soil environment caused by associations of microorganisms, and this process runs more intence than in lab conditions.

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