Interaction of humic substances with biomembranes

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Humic substances possess a surfactant-like structure, containing both hydrophilic domains, such as carboxylic and phenolic groups, and aliphatic and aromatic moieties. Because of this amphiphilic character, HS behave as natural surfactants and can sorb on a large amount of natural surfaces, including biological membranes. Sorption of HS on biological surfaces has been demonstrated directly, by loss of dissolved carbon from solution, and indirectly, by following changes in the electrophoretic mobility of individual cells in the presence or absence of HS. Biological surfaces that have been studied included phytoplankton, isolated fish gill cells, bacteria, fungi, and plants. The diversity suggests that the sorption of HS on biological membranes is a general process. In spite of many studies demonstrating HS sorption onto different biological membranes, there are only a few data on quantitative estimation of this process. The objectives of the study were to quantify HS interaction with biomembrane using bacteria *Escherichia coli* XL1 with tetracycline resistance as a model. A set of studied tritium labeled preparations of HS of different origin included coal HA, peat and soil HA and FA. HS accumulation by bacteria was measured over concentration range of 5-50 mg/L. These activities were selected because those included HS concentration that can occur naturally in the environment and therefore are more physiologically relevant than higher concentrations. The experimental results indicated that HS sorption onto bacterial surfaces could be extensive, and that the adsorption behavior depended greatly on a preparation used. HS sorption onto bacterial surfaces was the highest in case of peat HA, and decreases to negligible amounts of sorption in case of both peat and soil FA. The obtained results illustrated a linear relationship between the HS concentration and the amount of HS sorbed by cells. Calculated values of bioconcentration factor (BCF) varied in the range 0.94-13.1 L/kg what corresponded to 1-61 g of HS per squared meter. Positive correlation ($r^2 = 0.91$) between HS surface activity and sorption was observed. This research was supported by the Russian Foundation for Basic Research (#06-04-49017a).