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Humic substances interfere with the determination of ciprofloxacin in soil

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Ciprofloxacin has been designated by the World Health Organization as a critically important antibiotic in fresh surface water, groundwater, saltwater, treated municipal wastewater, untreated municipal wastewater, treated hospital wastewater, and untreated hospital wastewater worldwide. Rapid urbanization leads to the fact that not only the wastewater treatment from drugs is not being resolved promptly, but also soils become polluted as a result. In addition, the spread of antibiotics used in animal husbandry and crop production is a real ecological disaster for soils. The danger of this phenomenon lies not only in the increase in antibiotic resistance of pathogenic bacteria, but also in the disruption of the functioning of all links of the trophic chain in natural ecosystems [1]. The relevance of the studying the ecotoxicological characteristics of soils exposed to pharmaceuticals is beyond doubt.

In this work, we found different degrees of impact of the same doses of ciprofloxacin on living organisms when added to soil samples with different humic status. To explain the obtained data on the effect of aqueous extracts of soils on the survival of aquatic organisms, we need to measure the actual concentrations of the antibiotic in the samples of aqueous extracts of soils studied in biotests. However, the qualitative measurements of low doses of ciprofloxacin in presence of high concentrations of soil humic substances is very sophisticated task. The resolution of high-performance liquid chromatography is not always adequate. Spectrophotometric measurement of ciprofloxacin in soil extracts is complicated by the presence of humic substances in concentrations several orders of magnitude higher than the concentration of the antibiotic.

To determine ciprofloxacin in aqueous soil extracts in small quantities, a new approach was developed using synchronous fluorescence spectra with a difference in excitation and recording wavelengths of 160 nm. This corresponds to the shift in the maximum of the ciprofloxacin emission spectrum (435 nm) relative to the maximum in the fluorescence excitation spectrum (275 nm). To determine the concentration of the antibiotic, synchronous fluorescence spectra were measured in a sample without the antibiotic and with an antibiotic of unknown concentration, the difference spectrum was calculated, and the antibiotic content in the sample was determined from its integral intensity using a calibration dependence. Despite the fact that the fluorescence spectra of humic substances and ciprofloxacin in water are close in the position of the maximum and bandwidth, the measurement of synchronous fluorescence spectra made it possible to identify the presence of the antibiotic in fairly low concentrations, about 5 μg/l, by routine screening without preliminary sample preparation.

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