

MOBILITY OF PHARMACEUTICALS IN SOIL

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EXTENDED ABSTRACT

Pharmaceuticals are well described as far as their medical effects and their metabolism in human tissues are concerned. On the other hand, scientific work on the environmental fate of pharmaceuticals is sparse, even though a significant proportion of the drugs may pass through the organisms and become spread in terrestrial and aquatic environments influencing the quality of water.

The objective of this study was to investigate the sorption and mobility of six pharmaceuticals in two different soil types: soil type 1 (low organic carbon and high clay content) and soil type 7 (high organic carbon and low clay content) according to the classification made in OECD test Guideline 106. The pharmaceuticals examined were carbamazepine, propranolol, diclofenac sodium, clofibric acid, sulfamethoxazole and ofloxacin.

The sorption experiments were performed according to the OECD test Guideline 106 and aimed at estimating the adsorption-desorption behavior of the pharmaceuticals in each type of soil. The distribution coefficients determined by this batch equilibrium method varied with the pharmaceutical tested and the soil type. Adsorption seemed to be positively correlated with the organic carbon content of the soil. Ofloxacin was particularly strongly adsorbed while clofibric acid was found to be weakly adsorbed.

The fate of pharmaceuticals in soil was also assessed using lysimeters. Important parameters that were studied were: the pharmaceuticals loading rate, the hydraulic loading rate and the rain effect. For this purpose columns made of glass were packed with soil (length 10 cm), saturated and equilibrated with CaCl₂ (0.01 M) and allowed to drain. Solution of CaCl₂ with the appropriated amount of each tested compound was applied to the soil columns and the leachate was collected. Then fresh solution of CaCl₂ was applied to the columns simulating the rainfall and the leachates were analyzed. These experiments indicated major differences in the mobility of the six pharmaceuticals that were correlated with the adsorption/desorption properties of the compounds. For the most weakly adsorbed substance, clofibric, the total amount added in the lysimeters was fully recovered in the leachate, while for the strongly adsorbed ofloxacin, diclofenac and propranolol; there was no recovery in the leachate, indicating a much lower mobility of these compounds. Sulfamethoxazole and carbamazepine recoveries were between 19% and 11% of the initially added amount respectively.

Key words: adsorption, soil, pharmaceuticals