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Ecological effects of antibiotics on natural ecosystems: a review.

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Abstract

Among the different pharmaceuticals present in soil and water ecosystems as micro-contaminants, considerable attention has been paid to antibiotics, since their increasing use and the consequent development of multi-resistant bacteria pose serious risks to human and veterinary health. Moreover, once they have entered the environment, antibiotics can affect natural microbial communities. The latter play a key role in fundamental ecological processes, most importantly the maintenance of soil and water quality. In fact, they are involved in biogeochemical cycling and organic contaminant degradation thanks to their large reservoir of genetic diversity and metabolic capability. When antibiotics occur in the environment, they can hamper microbial community structure and functioning in different ways and have both direct (short-term) and indirect (long-term) effects on microbial communities. The short-term ones are bactericide and bacteriostatic actions with a consequent disappearance of some microbial populations and their ecological functioning. The indirect impact includes the development of antibiotic resistant bacteria and in some cases bacterial strains able to degrade them by metabolic or co-metabolic processes. Biodegradation makes it possible to completely remove a toxic compound from the environment if it is mineralized.

Several factors can influence the significance of such direct and indirect effects, including the antibiotic's concentration, the exposure time, the receiving ecosystem (e.g. soil or water) and the co-occurrence of other antibiotics and/or other contaminants.

This review describes the current state of knowledge regarding the effects of antibiotics on natural microbial communities in soil and water ecosystems.

Keywords: antibiotic effects; natural microbial communities; biodegradation; antibiotic resistance genes.

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