Abstract

PRESENCE AND INFLUENCE OF PHARMACEUTICAL POLLUTANTS IN THE ENVIRONMENT

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Abstract

Pharmaceutical substances constitute a significant group of modern environmental pollutants, with their presence in soil and air becoming more pronounced due to intensive production and widespread use of drugs in human and veterinary medicine, as well as in agriculture. Although they were originally developed to preserve human and animal health, their biological activity and chemical stability contribute to their persistence in various environmental components. In recent decades, pharmaceutical substances have been recognised as so-called emerging pollutants, whose effects on ecosystems and human health are increasingly being investigated within the framework of environmental protection.

The paper analyses the main sources and pathways by which pharmaceutical substances reach the soil and air. The pharmaceutical industry, healthcare institutions, households, and agricultural and veterinary activities are identified as significant sources. During the production, use, and disposal of medicines, these substances enter wastewater, from which, due to the insufficient efficiency of standard purification systems, they spread further into the environment. The role of improper disposal of unused medicines, as well as the use of veterinary antibiotics that reach the soil through manure, is particularly emphasised. Atmospheric deposition is also an important, but often neglected, route for the dissemination of pharmaceutical substances.

The paper provides an overview of the most frequently detected groups of pharmaceutical substances in the environment, including antibiotics, analgesics and non-steroidal anti-inflammatory drugs, hormones, and other biologically active substances. Special attention is given to antibiotics due to their link with the development of microorganism resistance, which represents one of the greatest global health and environmental challenges. Hormonal preparations are also analysed for their potential to cause endocrine disruption in animals and humans.

The paper examined the behaviour and fate of pharmaceutical substances in the environment, including processes such as adsorption in the soil, microbiological and chemical decomposition, air transport, and bioaccumulation in organisms. It was noted that

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long-term exposure to even low concentrations of these substances can disrupt the microbiological balance, reduce biodiversity, and pose potential risks to human health through the food chain.

Based on the analysed data, it was concluded that the problem of pharmaceutical pollutants is complex and requires an integrated approach within the framework of environmental protection. Improving wastewater treatment technologies, proper management of pharmaceutical waste, stricter regulation, and public education are key measures to reduce their negative impact. Continuous monitoring and further research are necessary to ensure effective management of these modern pollutants and to preserve the stability of the ecosystem.

Keywords: pharmaceutical substances, environmental pollutants, monitoring

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REFERENCES

1. Mosharaf, M.K., Gomes, R.L., Cook, S., *et al*. Chemosphere 2024, 364, 143055.
2. Eapen, J.V., Thomas, S., Antony, S. Explor. Drug Sci. 2024, 484–507.