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Editorial



# Thematic issue on Human Pathogens in the Environment: biology and risk factors

Many of the most serious human infectious agents are either derived from the wider environment or have environmental reservoirs. In this issue, we explore the underlying biology, transmission cycles and risk factors for a breadth of microbes, presented as a series of original research and mini-reviews.

Microbes that cause human disease derived from environmental sources include notifiable food-borne pathogens as well as bacteria and fungi that are resistant to antimicrobials and recognized as emerging pathogens. They are transmitted through a range of environmental sources such as horticultural ready-to-eat fresh produce, or from direct contact with contaminated soil or various water sources. In general, pathogens in the wider environment can be broadly divided into two groups: those that are normally associated with farmed or wild animals; and those that normally exist in environmental habitats. The aim of those working in this area is to better understand the routes of transmission and the risks associated with the environmental sources ultimately to improve human health.

This thematic issue covers a range of pathogens derived from environmental sources. Microbes that are considered 'environmental' are normally found in habitats such as soil or water. *Listeria* are ubiquitous in soil, but *L. monocytogenes* is also considered a priority human pathogen in many countries, associated with high fatality rates. Its ability to switch lifestyles is well reported, where it can act as a saprophyte on plant tissue and can invade mammalian cells manipulating host actin to aid cell-to-cell transmission. Here, Marinho *et al.* (2020) investigate aspects of the regulatory network that allows *L. monocytogenes* to persist in soil microcosms and plant roots, showing the interactions between the general stress response regulator, $\delta^B$ and the communicator regulator, Agr. Other environmental microbes are of concern because they have intrinsic or acquired resistance to antimicrobials, making them difficult to treat. Here, van Hamelsveld *et al.* (2020) describe the antibiotic profiles of river water-associated *E. coli* and show the presence of clinically relevant resistance, including ESBL and multidrug resistance. Antimicrobial resistance is also relevant for soil-associated fungi that can become pathogenic, including *Trichoderma* species. Hatvani *et al.* (2019) describe anti-fungal resistant *T. longibrachiatum* and its phylotype *T. longibrachiatum* f. sp. *bissettii*, with no distinguishing differences between clinical and agricultural isolates. Drinking water is normally defined by a minimum set of standards for microbial quality. However, Chen *et al.* (2019) show that human pathogens including *Salmonella* and *Shigella* can be detected in biofilms that build up in the pipework used for drinking water transport. How pathogens that are normally associated with farmed animals contaminate crop plants is considered more widely by Schierstaedt, Grosch and Schikora (2019), with a focus on food-borne bacteria. The ability of food-borne toxigenic *E. coli* to grow on plant or soil extracts is described by Merget *et al.* (2020), showing a wide range of the response between a group of clinical isolates. The presence of the food-borne parasite *Toxoplasma gondii* in fresh vegetables is quantified by Slany *et al.* (2019), with a difference in prevalence evident between harvested and stored vegetables that needs to be considered for risk analysis. Finally, the role of the plant in the plant-microbe interactions is discussed by Rodrigues Oblessuc, Vaz Bisneta and Melotto (2019), describing the similarities in stomatal pore responses to *S. enterica* compared to the plant pathogen *Pseudomonas syringae*, highlighting the versatility of some human pathogens in environmental sources.

Together this collection expands our understanding of the scope of human pathogens that can arise from environmental sources, exploring aspect that range from underpinning mechanisms to the interactions with environmental habitats and hosts, to the drivers of emerging pathogens and pathogenicity.

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*Nicola Holden*
*Cell & Molecular Sciences, the James Hutton Institute, Dundee, DD2 5DA, UK*

*László Kredics*
*Department of Microbiology, Faculty of Science and Informatics, University of Szeged, Közép fasor 52 H-6726 Szeged, Hungary*

*Jeri Barak*
*University of Wisconsin, Department of Plant Pathology, 790 Russell Labs, 1630 Linden Dr, Madison, WI 53706, USA*