CHARACTERISATION OF THE MICROBIAL WATER QUALITY OF THE DANUBE RIVER AT VIENNA

Katalin Demeter[a,d*], Rita Linke[a,f], Simone Ixenmaier[a,f], Rene Mayer [a,f], Regina Sommer[b,f], Gerhard Lindner[b,f], Christa M. Zoufal-Hruza[c,] Christina Frick[c], Alexander Kirschner[b,f], Julia Derx[f,g], Alfred Paul Blaschke[f,g], Andreas H. Farnleitner[a,e,f]

[a] E166 Institute of Chemical, Environmental and Biological Engineering
[b] Institute for Hygiene and Applied Immunology, Medical University of Vienna, Austria
[c] Municipal Department 39, Laboratories of Environmental Medicine, Vienna City Administration, Austria
[d] Center for Water Resource Systems, TU Wien, Karlsplatz 13, A-1040, Vienna, Austria
[e] Research Unit Water Quality and Health, Karl Landsteiner University of Health Sciences, Krems, Austria
[f] Interuniversity Cooperation Centre for Water and Health, Austria, www.waterandhealth.at
[g] E222 Institute of Hydraulic Engineering and Water Resource Management
* demeter@waterresources.at

INTRODUCTION

Faecal pollution of water resources intended for human use represents a health risk because of the possible presence of pathogens. Monitoring, risk assessment and management of such pollution is therefore imperative. Although detection of pathogens would seem a logical basis to estimate health risk, for practical reasons they are rarely monitored directly. Instead, microbial water quality has traditionally been assessed using faecal indicator bacteria, a selection of general intestinal bacteria that commonly occur across many animal species but do not live or survive in the environment. Viruses have special characteristics that bacterial indicators only represent to a limited extent. This led to the development of viral indicators.

While these general indicators give a good overall picture about microbial water quality, they do not allow the identification of the pollution source. The microbial source tracking (MST) method consists in the genetic detection of intestinal microbes specific to their host species. It may be applied as a forensic tool to identify the pollution sources, it can be integrated into larger environmental investigation designs or into health risk assessment models. In all of these applications MST can give a crucial contribution in terms of the quantitative apportionment of pollution sources.

Comprehensive management of drinking water resources requires a catchment-to-tap principle. A fundamental first step is to gain a deep understanding of the spatial and temporal dynamics of fecal pollution within the catchment. Riverbank filtrate of the Danube serves as the alternative drinking water resource for the City of Vienna (1.8 million inhabitants). Since numerous pressures affect the Danube during its course to Vienna, the characterization of its water quality requires a complex set of tools as well as an extensive spatial and temporal monitoring.

STUDY DESIGN

Five surface water sampling sites were selected to cover the spatial heterogeneity of this river section. Additionally, samples were taken from major wastewater treatment plants in the greater area of Vienna. Standard and alternative fecal indicators (*E. coli*, intestinal enterococci, *Clostridium*

perfringens, somatic coliphages), genetic MST markers (human-, ruminant- and pig-associated *Bacteroidetes* markers), pathogens (enteric viruses) as well as physicochemical parameters were monitored monthly over a 2.5-year period (2013-2015) to determine the characteristics of the raw water resource.

PRELIMINARY RESULTS

Statistical analysis of this multi-parametric data will be performed to reveal the spatial and temporal patterns, to elucidate which environmental parameters drive these patterns and to gain an insight into the interplay among the various indicators, markers and pathogens. Preliminary results show a moderate level of faecal pollution in the Danube River (*E. coli* median concentration 76 CFU/100ml, range 11-4901 CFU/100ml; intestinal enterococci median concentration 24 CFU/100ml, range 2-1901 CFU/100ml). The pollution is predominantly of human origin (95% occurrence of human MST marker); ruminant and pig sources play only a minor role (44% and 25% occurrence, respectively). Detailed analyses will be presented at the conference.

OUTLOOK

Here we will present the comprehensive characterization of the microbial water quality of the Viennese Danube stretch. Results from this long-term study will also serve as a unique basis for further catchment-based modeling using the QMRAcatch approach[1]. Analysis of current and future pollution and risk scenarios by QMRAcatch will allow to guide target-oriented remediation efforts in the catchment and to estimate required water treatment levels to provide safe drinking water.

This is a joint publication within the Interuniversity Cooperation Centre for Water and Health (www.waterandhealth.at). This study was supported by FWF (Vienna Doctoral Program on Water Resource Systems W1219-N22 and P23900-B22) and the Ground Water Resource Systems (GWRS) project (Vienna Water) as part of the "(New) Danube-Lower Lobau Network Project" (LE07-13).

REFERENCE

[1] Schijven *et al.*, QMRAcatch: Microbial Quality Simulation of Water Resources including Infection Risk Assessment, Journal of Environmental Quality, 44(5), 1491-1502, 2016