

World Congress on **APPLIED MICROBIOLOGY**
&
World Congress on **ANTIBIOTICS**

August 13-14, 2018
Rome, Italy

Seasonal variations in water-quality, antibiotic residues, resistant bacteria and antibiotic resistance genes of *Escherichia coli* isolates from water and sediments of a River Kshipra in Central India

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Objectives: To characterize the seasonal variation, over one year, of water-quality, antibiotic residue levels, antibiotic resistance, and antibiotic resistance genes of *Escherichia coli* (*E. coli* isolates from water and sediment in Kshipra River in Central India).

Methods: Water and sediment samples were collected from seven selected points from Kshipra River in Ujjain city of India in the summer, rain, autumn and winter seasons in 2014. Water quality parameters (physical, chemical and microbiological) were analysed by applying standard methods. High Performance liquid chromatography–tandem mass spectrometry was used to determine the concentrations of antibiotic residues. In river water and sediment samples, antibiotic resistance and multidrug resistance patterns of isolated *E. coli* to 17 antibiotics were tested and genes coding for resistance and phylogenetic groups were detected using multiplex polymerase chain

reaction. One-way ANOVA and Fisher test were applied to determine seasonal variation.

Results: In river water, seasonal variation was significantly associated with different water quality parameters, presence of sulfamethoxazole residues, antibiotic resistant bacteria for ampicillin, cefepime, meropenem, amikacin, gentamicin, tigecycline, multidrug resistance and CTX-M 1 gene. Majority of the Extended Spectrum Beta-Lactamase (ESBL)-producing *E. coli* isolates from river water and sediment in all different seasons belonged to phylogenetic group A or B1.

Conclusions: Antibiotic pollution, resistance and resistance genes in Kshipra River showed significant seasonal variation. Guidelines and regulatory standards are needed to control environmental dissemination of these “pollutants” in this holy river.

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