Kostas Konstantinidis, Expert Opin Environ Biol 2016, 5:3(Suppl)
http://dx.doi.org/10.4172/2325-9655.C1.011

Do disinfectants promote bacterial antibiotic resistance?

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Whether disinfectant exposure promotes antibiotic resistance (Ab^R) has been a long debate with major practical consequences. To obtain insights into this issue, we exposed a microbial community originating from River sediment (Calcasieu River, USA) to benzalkonium chlorides (BAC; a family of quaternary ammonium disinfectants) for 3 years in a fed-batch bioreactor receiving Dextrin Peptone plus BAC as the sole carbon source (DPB bioreactor). A bioreactor receiving only Dextrin Peptone (DP) served as control. Bacterial isolates, representing the same ancestral population in the original inoculum were also obtained from both bioreactors and used to study adaptive evolution in response to increasingly higher BAC concentrations. Metagenomics of the bioreactors and genetic manipulation of isolates revealed that BAC exposure induced the spread of AbR in several species via horizontal transfer of mobile DNA elements that encode a BAC efflux pump together with Ab^R genes. Although several BAC-exposed isolates exhibited higher resistance to certain antibiotics, others did not, presumably due to their intrinsic resistance mechanisms. Nonetheless, genomics and transcriptomics analysis of *Pseudomonas aeruginosa* isolates revealed several fixed mutations in BAC-evolved populations such as in the histidine kinase A domain of the *pmrB*, which regulates resistance to polymyxin B, consistent with higher MIC values for polymyxin B and the overexpression of genes regulating tetracycline and ciprofloxacin resistance in response to BAC exposure. Collectively, this result revealed that there is a significant link between disinfectants and Ab^R antibiotics, providing new insights into the long-standing debate and have implications for biotechnological solutions to this problem.

Biography

Kostas Konstantinidis has joined the Faculty at Georgia Tech in November 2007 and he is holding the Carlton S. Wilder Junior Professorship in Environmental Engineering since September 2012. He has earned his BS (1999) in Agriculture Sciences from the Aristotle University of Thessaloniki, Greece and his PhD (2004) from the Center for Microbial Ecology at Michigan State University, where he was a Bouyoukos Fellow. Prior to joining Georgia Tech, he was a Postdoctoral Fellow in the Department of Civil and Environmental Engineering at the Massachusetts Institute of Technology. His education and research interests are at the interface of environmental microbiology with engineering, genomics and computational biology. The overarching goal of his research is to broaden our understanding of the genetic and metabolic diversity of the smallest organisms on the planet, the bacteria and archaea and the role of this diversity for ecosystem function and resilience to natural as well as anthropogenic perturbations. He is also interested in the biotechnological applications of microbial diversity in the bioremediation of environmental pollutants and the assessment of water quality.

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