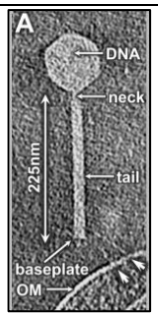

The Genomic and Phenotypic Characterization of Phage-like Plasmids and Their Ability to Horizontally Transfer Antibiotic and Heavy Metal Resistance Genes to Bacteria of Foodborne Importance

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Abstract

Each year, approximately 700,000 deaths worldwide are attributed to antibiotic resistance (AR), and this number is predicted to rise to 10 million by 2050. Antibiotic resistance genes (ARGs) can be found on mobile genetic elements (MGEs), including a novel MGE, termed phage-like plasmid (PLP), which is a phage/plasmid hybrid that exists extrachromosomally within bacterial cells. The objective of this study was to develop a better understanding of PLP genomic structure and biology, by focusing on two main objectives: First, the genomic characterization of PLPs to determine their taxonomic structure and the types of ARGs and HMR genes that they carry. Second, phenotypic analysis of the potential of PLPs to horizontally transfer ARGs and HMR genes by phage-mediated mechanisms, such as transduction, or plasmid-mediated mechanisms, such as transformation and conjugation, in order to determine whether they can confer resistance to antibiotics and heavy metals. Genomic analysis revealed that 29% of the PLPs carried ARGs that are known to confer AR resistance to β-lactams, carbapenems, colistin, and aminoglycosides, and that 10% of the PLPs carried genes that have been associated with resistance to either mercury or tellurite. HGT experiments demonstrated that PLPs AnCo1 harboring CTX-M-15, SJ1 harboring a mercury resistance operon and MA725 harboring tellurite resistance gene *terB* were successfully transferred by transduction to either *E. coli* or *Salmonella enterica* hosts, by transformation to *E. coli* DH10B and while the PLPs lack genes necessary for conjugation, AnCo1 and SJ1 were successfully conjugated to *E. coli* J53 in the presence of the helper plasmid pRK2013. Phenotypic characterization of the ability of the PLPs to confer antibiotic and heavy metal resistance was conducted through minimum inhibitory concentration (MIC) experiments and demonstrated that PLPs AnCo1 and SJ1 conferred 3 mg/ml of resistance to cefotaxime and 50 µg/ml to mercury chloride, respectively. Of note, it was demonstrated for the first time that *terB* harboured by PLP MA725 conferred 40 µg/ml of resistance to potassium tellurite and conferred cross-resistance (10 µg/ml) to colistin sulphate, which is of clinical significance, as colistin is considered to be an antibiotic of last resort. Collectively, the results of this study highlight the contribution of PLPs to the dissemination of AR within the agricultural and clinical environments.

About the Candidate

Anna Colavecchio, a Montréal native, hold a B.Sc. degree in Microbiology and Immunology at Université de Montréal. She obtained a M.Sc. degree in Food Safety at McGill University, which led her to pursue a PhD in Food Microbiology under the supervision of Dr. Lawrence Goodridge. Anna is a recipient of the Margaret A. Gilliam Fellowship in Global Food Security as well as the J.M Flaherty Research Scholarship, which allowed her to work in collaboration with Dr. Séamus Fanning at the University College Dublin (UCD) Centre for Food Safety in Dublin, Ireland. Anna is currently the Quality assurance, Compliance and Excellence Coordinator at Nu-B Inc.