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Impact of Genetic Modification on Bacterial Surface Properties and Transport

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Abstract Text:

Genes control the hereditary traits of cells. Current genetic technologies have made it possible to change microbial cell functions by means of manipulating the genetic materials. As genetic modification affects microbial interactions with the surrounding environment, dissemination of genetically engineered microbes can thus be enhanced or retarded as compared to parent strains. For this research, we investigated the impact luminescence-based genetic marker on bacterial surface properties and their transport. Typical gram-positive strains of Lactobacillus casei, Streptococcus mitis, and Micrococcus luteus were used as model bacterial strains in this research. We manipulated gene transfer to observe the impact of genetic transformation on bacteria surface properties based on contact angle measurements and conducted column experiments to study the transport of genetically engineered bacteria. After genetic modification, bacterial interactions with the porous media increased, demonstrating stronger attachment potentials with the porous media. Accordingly, mobility of daughter strains decreased. Genetic modification also resulted in an increase of bacterial dispersion and equilibrium adsorption on the porous media. Bacterial deposition coefficient was found to correspond to the free energy of interactions between bacteria and the porous media.

Impact Statement:

This project advances our knowledge in pathogenic bacterial mobilization and transport in the subsurface soil at pore scales. Based on this proposed research, we can recommend necessary pre-treatment of the animal waste and reclaimed wastewater to maximize pathogenic bacteria retention in the subsurface soil. This research also provides a framework for the assessment or evaluation of maximum pathogenic bacteria daily load directly related to agricultural fields. Results of this proposed research are invaluably useful for long-term animal waste and reclaimed wastewater field applications --- a powerful means of water conservation and nutrient recycling.