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Abstract

Probiotic Engineering: Resolving How Fermentable Sugars Affect Aggregation, Adhesion, and Aggression in Lactobacillaceae †

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Abstract: Lactobacillaceae are Gram-positive and lactic acid-positive (LAB) bacteria that frequently serve as probiotics. LAB strains vary in their responses to different carbohydrates as free-living and biofilm communities. We previously found that fermentable sugars triggered an altered carrying capacity with strain specificity during planktonic growth, calling for adding a buffering system during the formulation of probiotics. In addition, a heterogeneous response to fermentable sugars was manifested in microbial aggregation (measured by image-stream flow cytometry), colony development, and attachment to mucin. Of all the probiotic strains, *L. rhamnosus GG* (LGG), a prevalent probiotic species, manifested an enhanced survival of self-imposed acid stress, consistent with the enhanced cell wall modulation observed by transmitting electron microscopy and proteomic analysis. A comprehensive proteomic and metabolomic study revealed that the formation of biofilms and aggregation capacity is a specific response to glucose independent of self-imposed acid stress. In contrast, the increased competitiveness and aggression of LGG and other LAB strains towards enteric pathogens were a synergistic outcome of a change in organic acid production, glucose-dependent bacteriocin production, and fermentation-specific volatile production. Our improved resolution into the cellular circuits (metabolome, proteome, and volatilome) of probiotic strains and their interactions can lead to developing novel therapeutic approaches to combat GI tract infections.

Keywords: probiotics; microbiome; metabolome; bacteriocins

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