Dissecting the Social Interactions of Yeast-Lactic Acid Bacteria Consortia

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Project Goals:

Microbial social interactions are a major driving force that regulates the organization and functioning of microbial communities. Here we experimentally investigate cellular interactions in various yeast—lactic acid bacteria (LAB) consortia and determine how these interactions contribute to corresponding ecosystem dynamics.

Abstract

Engineered microbial consortia must be able to generate desired population behaviors for reliable and efficient industrial bioprocessing. One promising way to develop such ecosystems is through the design and construction of specific cellular social interactions. Here, we experimentally uncover microbial interactions in various yeast—lactic acid bacteria (LAB) consortia and determine how these interactions contribute to corresponding ecosystem dynamics. In a glucose-supplemented, chemically defined medium which supports only the growth of yeast, we found that co-culturing *S. cerevisiae* S90 with LAB, including *Lactococcus lactis*, *Lactobacillus brevis*, *Lactobacillus plantarum* and *Lactobacillus acidophilus*, promotes their growth while being minorly inhibited. In a lactose-supplemented, defined medium that supports LAB only, LAB are able to grow normally but *S. cerevisiae* S90 fail when they are co-cultured. One exception is the *Lb. brevis—S. cerevisiae* S90 co-culture where the both grow better than their monocultures, suggesting that *S. cerevisiae* S90 and *Lb. brevis* can form a mutualistic interaction. To create the same symbiotic interaction between yeast and Lactococcus species, we engineered a lactose-positive and galactose-negative *L. lactis* strain, MG2, using direct evolution and genetic engineering. Our subsequent co-culture experiment confirmed that *S. cerevisiae* S90 and MG2 indeed form a mutualism consortia. Together, our experiments show different modes of social

interactions in yeast-LAB consortia and their corresponding community dynamics, which provides insights into the organization of yeast-LAB consortia and future applications of these ecosystems for metabolic engineering purposes.

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