



Rice University

George R. Brown School of Engineering
Department of Chemical and
Biomolecular Engineering

Presents

Dr. Nathan Crook

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Development of Tools Enabling Tunable, In Situ Delivery of Therapeutics Using Probiotics

The human large intestine houses trillions of microorganisms which collectively form the highly diverse microbial community known as the gut microbiota. The gut microbiota performs many functions critical to the maintenance of health, including extraction of nutrients from food, production of vitamins, and defense against pathogens. Like an organ, disturbances to the structure of the gut microbiota can have significant negative impacts to the human host, including obesity, malnutrition, and cancer. However, the gut microbiota is currently unique among organs in that it is highly engineerable, enabling improvement of function by substituting beneficial microbes for less desirable ones. These exogenous beneficial microbes are termed “probiotics” and their close contact with both their human host, as well as other gut bacteria, raises exciting therapeutic prospects, including the provision of additional metabolic functions, modulation of the host immune response, or competitive exclusion of pathogens. However, these applications remain out of reach due to insufficient metabolic activities of engineered strains, as well as the low residence time of most probiotics within the gut. In this talk, I will first describe a high-throughput method which accelerates gene and pathway evolutionary engineering through an in vivo, continuous process. Then, I will show exciting data from a culture-independent bioprospecting approach for increasing the residence time and altering the biogeography of probiotic strains within the gut. Taken together, this work has the potential to significantly improve our understanding and use of probiotics while providing a framework for developing robust chassis strains for future synthetic biology efforts in the human gut microbiota.

About the Speaker

Nathan Crook is a postdoctoral researcher in the Department of Pathology & Immunology at Washington University School of Medicine in the laboratory of Prof. Gautam Dantas, where he is applying functional metagenomics and next-generation sequencing to improve control over colonization and gene expression in probiotic bacteria. Nathan received his B.S. in Chemical Engineering from the California Institute of Technology in 2009, and his PhD in Chemical Engineering from the University of Texas at Austin in 2014. During his graduate work in the Alper Lab, Nathan developed several high-throughput computational and experimental methods which accelerate the engineering of new industrial phenotypes in *S. cerevisiae*. In the future, Nathan aims to engineer probiotics for in situ synthesis and delivery of therapeutics. Nathan has published 10 papers relating to his work, in addition to 2 book chapters and 3 review articles. He has mentored 2 high school students, 6 undergraduates, and 4 graduate students in experimental synthetic biology research. Nathan received the National Science Foundation's Graduate Research Fellowship in 2010.