海外特別講演

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Research summary

The human gut microbiome plays key roles in health and disease. Although diet is a major driver of the microbiota physiology, the gut microbiota-mediated mechanisms that link diet to intestinal disorders, enteric infections and allergy sensitization are poorly understood. The research work in Desai lab is focused on discerning these mechanisms and underlying eco-immunological processes via interactions of the gut microbiome with the colonic mucus barrier. Since the modern diet of developed nations includes significantly reduced dietary fiber, the lab seeks to understand how a fiber-deprived gut microbiota impacts our health and contributes to disorders such as inflammatory bowel disease and colon cancer, and how dietary therapeutics targeting the gut microbiome could be employed to improve health.

Education

2005–2008 Graduate Student, International Max Planck Research School, Marburg, Germany

Professional positions

2018–present Honorary Associate Professor, University of Southern Denmark, Odense, Denmark
2017–present Visiting Scientist, RIKEN Center for Integrative Medical Sciences, Yokohama, Japan
2015–present Principal Investigator, Luxembourg Institute of Health
2012–2015 Visiting Scientist and Research Associate, University of Michigan Medical School, Ann Arbor, USA
2012–2015 Research Associate, Luxembourg Centre for Systems Biomedicine, Luxembourg
2010–2012 Postdoctoral Associate, University of Göttingen, Göttingen, Germany
2009–2010 Postdoctoral Fellow, Max Planck Institute for Terrestrial Microbiology, Marburg, Germany

Honors & Awards

2017 Luxembourg National Research Fund award for outstanding scientific publication
2016 Best oral presentation award, Irish Society for Immunology
2016 Landmark oral presentation, International Human Microbiome Consortium
2008–2014 Scholarships/travel awards from: National Institutes of Health, USA; American Society for Microbiology; European Molecular Biology Laboratory; German Academic Exchange Service; Society for General Microbiology, UK; Society for Experimental Biology, UK; International Society for Microbial Ecology; Marine Biological Laboratory, USA; and International Max Planck Research School, Germany

Dietary fiber, the gut microbiota and the colonic mucus barrier: implications for health and disease

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The functional interactions between the human gut microbiota with its host are largely driven by the diet, yet the underlying mechanisms have remained poorly understood. By employing a gnotobiotic mouse model containing a synthetic human gut microbiota composed of 14 commensals (SM14), we recently published that a dietary fiber-deprived microbiota degrades the colonic mucus barrier and enhances susceptibility to the enteric pathogen *Citrobacter rodentium* (Desai et al. *Cell* 2016, 167, 1339–1353). Based on these results, we further hypothesize that the increased pathogen susceptibility is directly linked to the enhanced mucus degradation. To test our current hypothesis, we manipulated our synthetic microbiota by omitting all 4 mucus-degrading species from the SM14 community, in order to obtain a gnotobiotic model with 10 species (SM10). Next, we fed the mice either a Fiber-rich (FR) or a Fiber-free (FF) diet, followed by infection with *C. rodentium*. Our results – based on body weights, pathogen load, bacterial community abundance, mucus layer thickness, fecal lipocalin (LCN 2) and histological disease scoring – show that in the absence of mucus-degrading microbes, colitis caused by the enteric pathogen was significantly reduced, even in the mice fed a fiber-deficient diet. To further test the link between commensal microbial mucus foraging and the enhanced pathogen activity, we added back only a single mucus degrader, *Bacteroides caccae*, to the SM10 community that otherwise lacks the metabolic capacity of mucus foraging. The presence of a single mucus degrader in the SM10 community restored the severe colitis in the mice fed the FF diet, but not in the FR mice. In the face of changing Western diets, our results suggest that dietary therapeutics, including next-generation prebiotics, could be utilized to modulate the the gut barrier alterations and to reduce the incidence of colitis.