LS12-001 - Nutrition and the intestinal microbiota-host symbiosis: A holistic stable isotope-labeling approach to decipher key microbial players and quantitatively link single cell activity to system function

Abstract

The symbiotic intestinal microbiota is a fundamental part of the animal and human body, with manifold implications for host nutrition, health, and disease. The composition and metabolic capacity of an individual's intestinal microbiota has a significant impact on the nutritional value of food and the amount of extractable energy through provision of short chain fatty acids to the intestinal epithelial cells. Genomic and postgenomic studies have revealed exciting insights into the diet-mediated metabolic potential of intestinal microorganisms in animals and humans. However, the physiological network of cooperation and competition among the various members of the diverse intestinal microbiota that determine the amounts of individual short chain fatty acids available to host cells are far from being completely understood. This project aims at closing this gap by establishing a novel approach to decipher the metabolic interplay between microbial and host cells in the harvest of dietary energy. This approach will be applied to mice subjected to different diet regimes, but is conceptually transferable to humans. The carbon-driven intestinal food chain will be elucidated with high-resolution by integrating experiments with mice harboring a natural, full-complexity microbiota or defined, low-complexity assemblages of known microorganisms in their intestinal tracts, in vitro and in vivo isotope-labeling, molecular biology methods, and cutting-edge single cells analyses. A deeper understanding of the intestinal microbial ecology of dietary carbon degradation will be gained by unraveling (i) key microorganisms that modify intestinal function in vivo, (ii) the physiological heterogeneity among individual cells of target populations, and (iii) the synergistic and antagonistic metabolic relationships between microbial and host cells.

Keywords:
intestinal microbiota, nutrition, single cell, stable isotope labeling, NanoSIMS,Raman microspectroscopy, FISH

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Further links to the persons involved and to the project can be found under
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