

Metabolomics and systems biology approaches to study health and disease

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Metabolomics is a discipline dedicated to the global study of small molecules (i.e., metabolites), their dynamics, composition, interactions, and responses to interventions or to changes in their environment, in cells, tissues, and biofluids. It has been proven and known for several decades from Metabolic Control Theory that small changes in the activities of individual enzymes can lead to large changes in metabolite concentrations. Concentration changes of specific groups of metabolites may thus be sensitive to pathogenically relevant factors such as genetic variation, diet, age, or gut microbiota, and their study may therefore be a powerful tool for characterization of complex phenotypes as well as for development of biomarkers for specific physiological responses.

My research team is investigating (1) how are the genetic and environmental factors imprinted in the metabolome; (2) the mechanisms by which alterations of metabolome lead to (patho)physiological changes at the systems level; and (3) discovery and functional characterization of metabolic markers for multiple diseases or responses to interventions and environmental challenges. We are relying on metabolomics techniques to characterize the metabolome, combined with systems biology strategies to investigate, e.g., how changes in gene expression, gut microbial composition or immune/inflammatory status alter the metabolic phenotypes. Current biomedical interests include metabolic and autoimmune diseases. We are part of the recently granted Academy of Finland Centre of Excellence in Molecular Systems Immunology and Physiology Research (2012-2017; directed by Prof. Matej Orešič).