Metabolomics in biomedical research – The influence of ω-3 fatty acids on the brain metabolome during systemic inflammation

R. Verena Taudte[1], Fabian Pflieger[2], Alexander Karabatsiakis[3], Christoph D. Rummel[2]
[1]Core Facility für Metabolomics, Philipps-Universität Marburg
[2]Institut für Veterinär-Physiologie und -Biochemie, Justus-Liebig-Universität Gießen
[3]Fachbereich Klinische Psychologie II, Universität Innsbruck

Omics fields such as genomics, transcriptomics, proteomics and metabolomics have revolutionized the study of biological systems. The corresponding holistic analyses of genes, RNA, proteins or metabolites enable a comprehensive understanding of biological systems and help to elucidate pathological mechanisms. Among the omics family, genomics, transcriptomics and proteomics are well-established, while metabolomics is a relatively young, however, rapidly growing technology. In metabolomics, small molecules that reflect the phenotype of a biological system as well as the interaction of an organism with its environment are studied.
Since the metabolome is highly dynamic, it changes considerably depending on different factors, for instance altered functions or concentrations of enzymes and associated product concentrations.
Lipid mediators play an essential role in systemic inflammations. Among these, ω-3 fatty acids have demonstrated to exert anti-inflammatory actions and moved into the focus of various research areas. In many animals, a ω-3 fatty acids desaturase enzyme converting ω-6 to ω-3 fatty acids is missing. Genetically altered FAT-1 mice however express this enzyme. Thus, these mice have increased ω-3 fatty acid concentrations and provide a valuable model to study the functions of these important mediators.
To further resolve the function of ω-3 fatty acids during systemic inflammation in the brain, we performed untargeted metabolomics via liquid chromatography high-resolution mass spectrometry on tissue samples taken from hypothalamus areas of FAT-1 and WT mice treated with LPS and controls. After normalization and comprehensive data processing, we identified significant metabolite differences between brain samples taken from FAT-1 and WT mice associated with higher or lower ω-3 fatty acid concentrations. In conclusion, untargeted metabolomics assisted in the characterization of brain tissue from FAT-1 and WT and allowed for a better understanding of the function of ω-3 fatty acids during systemic inflammation.