682
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MSI MALDI-MS for Direct Lipid Profiling of Intact Tissues

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Matrix-Assisted Laser Desorption/Ionization coupled with Mass Spectrometry (MALDI-MS) has become the method of choice for mass spectrometry based imaging (MSI) of lipids directly from tissue sections.[1] Molecular ion identification and localization with a 20-50 μm spatial and nanomolar sensitivity can be achieved over a wide mass range (typically, 400- 2 kDa).

Current challenges are in the sample preparation method and matrix deposition to improve analysis reproducibility. For MALDI experiments, matrix choice is strongly dependent on the chemical class of interest. Lipids account for up to 50% of the dried weight of brain tissue sections compared to other chemical classes and are vital brain function regulators. Lipidomic analysis of brain tissues has significantly increased in relation to better understanding the role of lipids in the development of debilitating neurodegenerative disease states, particularly Alzheimer's Disease in the aging population.

Our work focuses on the applications of MALDI-MS for direct lipid mapping in model systems as a function of a biological question (e.g., disease vs. non disease, low vs. high fatty acid diet, etc.). Comparison between positive and negative MS mode shows that molecular ion emission can be directly correlated to the surface concentration, the ionization probability and lipid classification. Two distinct lipid distributions were observed and can be attributed to the difference in the charge carriers (lipid head groups) for the different lipid classes.

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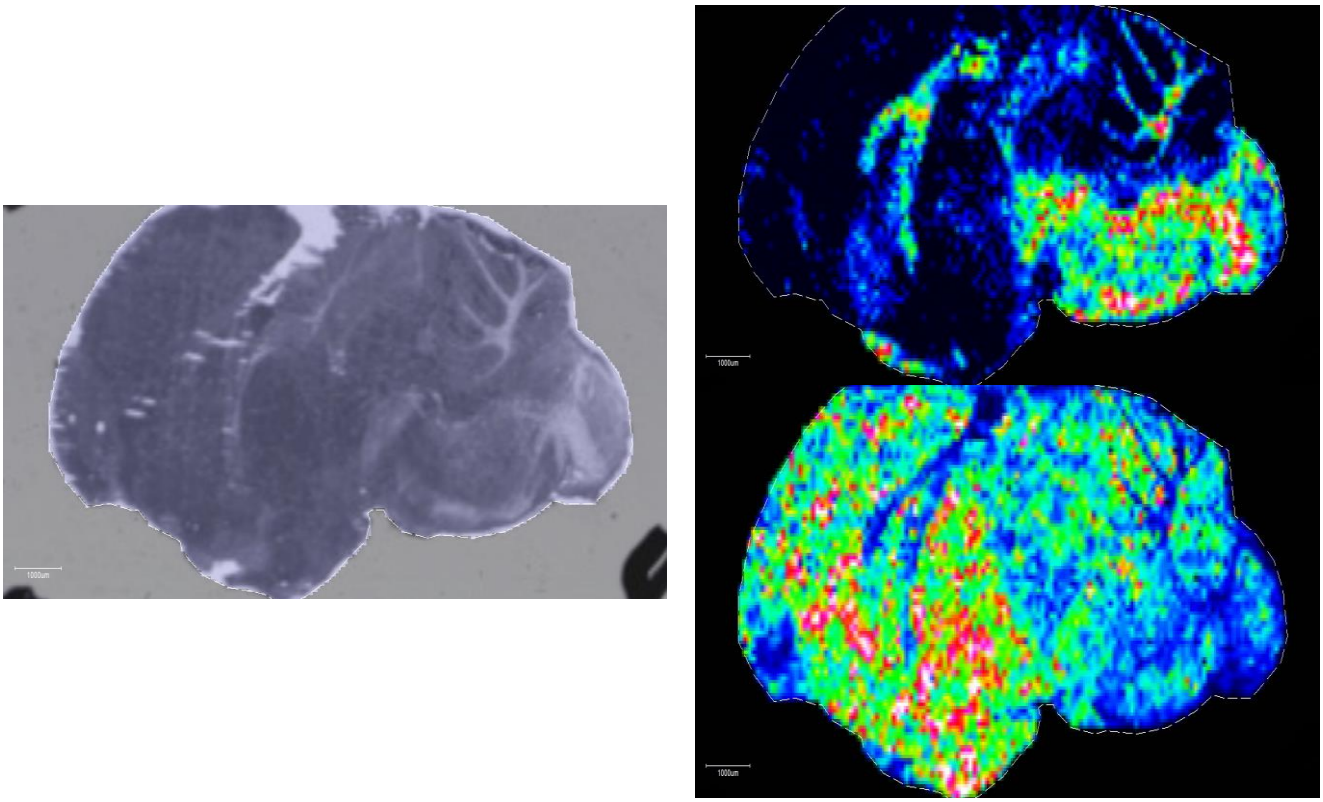

Figure 1. left) Optical image of the Bat Brain section; top right) Phosphoserine PS (38:1) molecular ion distribution; and bottom right) Phosphoinositol PI (38:4) molecular ion distribution.

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