Spatial distribution of isobaric lipids using high-resolution ion mobility with the DESI XS

Imaging

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Desorption electrospray ionization (DESI) can be used for direct imaging of lipids from mammalian tissue sections. However, without robust chromatography separation, the specificity and identification of the imaged lipids are confounded due to many potential isobaric lipid species present, given the enormous structural diversity of lipids. Ion mobility separation can separate isobaric lipid ions with the same m/z values but does not have the resolution to resolve many isomeric ions. In this study, our objective was to utilize multipass high-resolution ion mobility separation to improve the specificity of lipid imaging by DESI imaging MS. Imaging MS data were acquired mouse brain tissue sections using a DESI- XS source (Waters Corporation) coupled with a quadrupole time-of-flight mass spectrometer with cyclic IMS (Waters Corporation). DESI images were acquired in positive ion mode with an acquisition rate of 1 scan/ second at 100 µm pixel size. DESI solvent (MeOH: water, 98:2, 0.1% formic acid) running at 2 µl/min was electrosprayed by holding capillary at 1.5 kV with nebulizing gas pressure set at 1.5 bar. Imaging MS data were mined using MassLynx V4.2, DrifSctope V2.9, Mobility Miner, and HDI 1.6 for image visualization. Initially, the survey image was collected using single pass DESI imaging with m/z 50-1,200, and multipass (8 passes) imaging was optimized on the lipid regions (m/z 750-850). Increased ion mobility separation enabled the separation of isobaric species with a different localization for each ion. For example, m/z 784.58 can be putatively identified based upon mass accuracy as PC (34:0), Na+ and PC (36:3), H+. In the single pass imaging, one peak was observed with a drift time of 28.71 ms showing ubiquitous localization throughout the brain tissue section. Two baseline-separated ion peaks were observed after the eight passes, at drift time 135.96 and 139.39 ms. The species with the 135.96 ms drift time had relatively ubiquitous distribution throughout the brain tissue section, but the species with 139.39 ms drift time was only localized in the grey matter within the cerebellum and hippocampus. In conclusion, multipass ion mobility separation was capable of high-resolution separation during the DESI imaging experiment.