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アプリケーションノート

Demonstrating Vion IMS QTof Linear Dynamic Range for Lipid Profiling

Adam King, Chris Hughes

日本ウォーターズ株式会社

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This is an Application Brief and does not contain a detailed Experimental section.

Abstract

This application brief highlights the achievable dynamic range of the Vion IMS QTof Mass Spectrometer for lipid quantification in human plasma.

Benefits

The demonstration of linear dynamic range of Vion IMS QTof for the UPLC-MS profiling of the plasma lipidome for biomedical research.

Introduction

The term lipid covers a broad range of compounds which can be classed as “fatty acids”, derivatives of fatty acids and biosynthetically related compounds derived from acetyl-CoA metabolism. These molecules play many important biological roles including e.g. acting as structural components of cell membranes, energy storage and intra and inter cell signaling.

Lipids can be segmented into categories or classes based upon their biochemical building blocks: fatty acids (FA), glycerolipids (GL), glycerophospholipids (GP), sphingolipids (SP), saccharolipids (SL), polyketides (PK), sterol lipids (ST), and prenol lipids (PR). These lipids differ in the hydrophobic nature of the molecule, the fatty acid chain length, degree of unsaturation and addition of polar groups such as phosphates.

LC-MS-based lipid profiling (lipidomics) has become a popular tool in biomedical research to understand disease biology and health. Successful lipidomics requires the identification and quantification of lipid species in complex mixtures such as biological fluids, tissues, food stuffs and fats. To perform accurate quantification, the instrument measurements of any LC-MS system should show a linear response over the concentration range of the samples being measured. Here we demonstrate the linear dynamic range of the Vion IMS QTof Mass Spectrometer for the analysis of lipids in human plasma.

Results and Discussion

The linear dynamic range of Vion IMS QTof was evaluated by the spiking of the Avanti SPLASH LipidoMix

standard kit, containing 14 deuterated lipids from multiple lipid classes, into pooled human plasma at class specific concentration ranges covering seven orders of magnitude. The plasma samples were prepared by protein precipitation lipid extraction with isopropanol. The resulting solutions were analyzed using reversed-phase chromatography on a 2.1 x 100 mm ACQUITY UPLC CSH C_{18} Column (p/n 186005297) over a 20 min. gradient. The mobile phases consisted of 10 mM ammonium formate and formic acid in 40:60 water: acetonitrile (mobile phase A) and 90:10 isopropanol: acetonitrile (mobile phase B). The column effluent was monitored using Vion IMS QTof in $HDMS^E$ positive and negative ion mode using a collision energy ramp from 25–35 eV and a mass acquisition range of *m/z* 50–1000 with a scan time of 0.1s.

A typical extracted ion chromatogram obtained for the Avanti splash mix lipids LPC (d7), LPE (d7), SM (d7), and PC (d7) in plasma is shown in Figure 1.

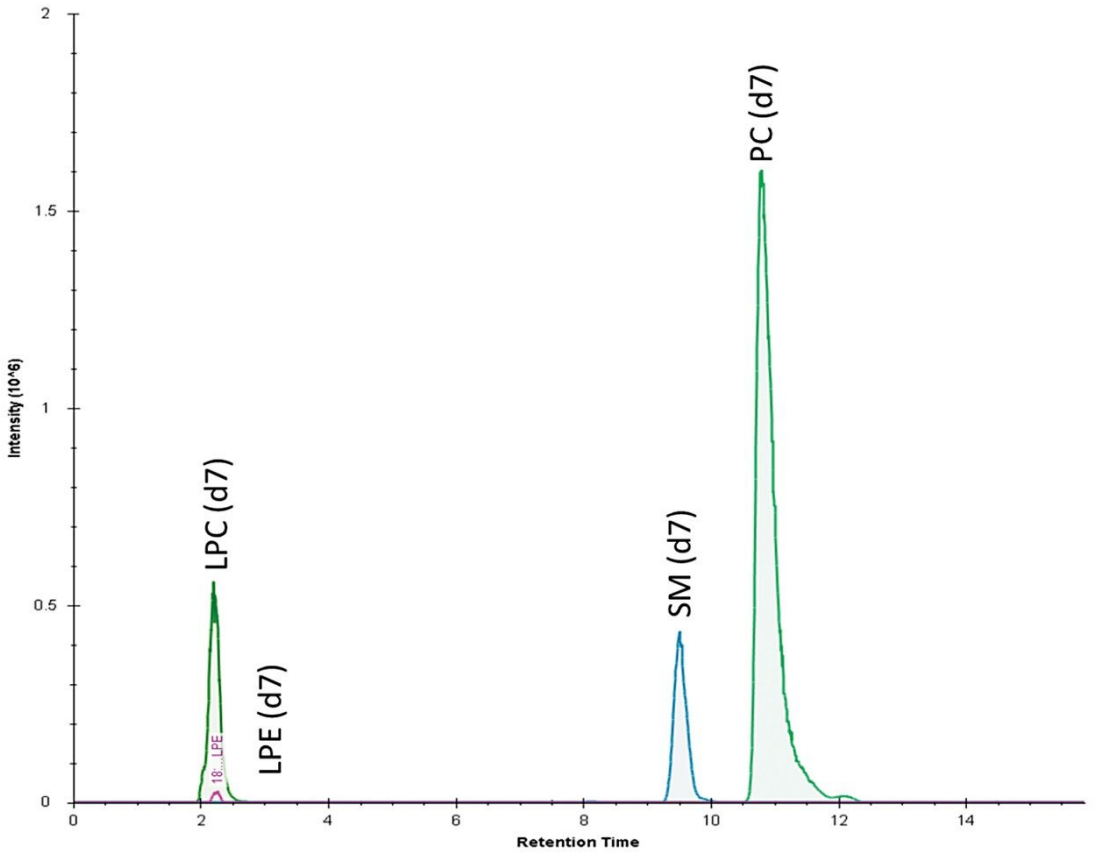

Figure 1. Extracted ion chromatogram of stable labelled isotope spiked into human plasma.

The Vion IMS QTof showed a linear response of 3 orders of magnitude for the lipids standards spiked into plasma. A typical calibration obtained for 18:1 (d7) SM and 15:0 18:1 (d7) PC are shown in Figure 2. The data shows that the 18:1 (d7) SM gave a linear response over the range of 37.5–7500 ng/mL and the 15:0 18:1 (d7)

PC gave a linear response over the range of 200–40000 ng/mL.

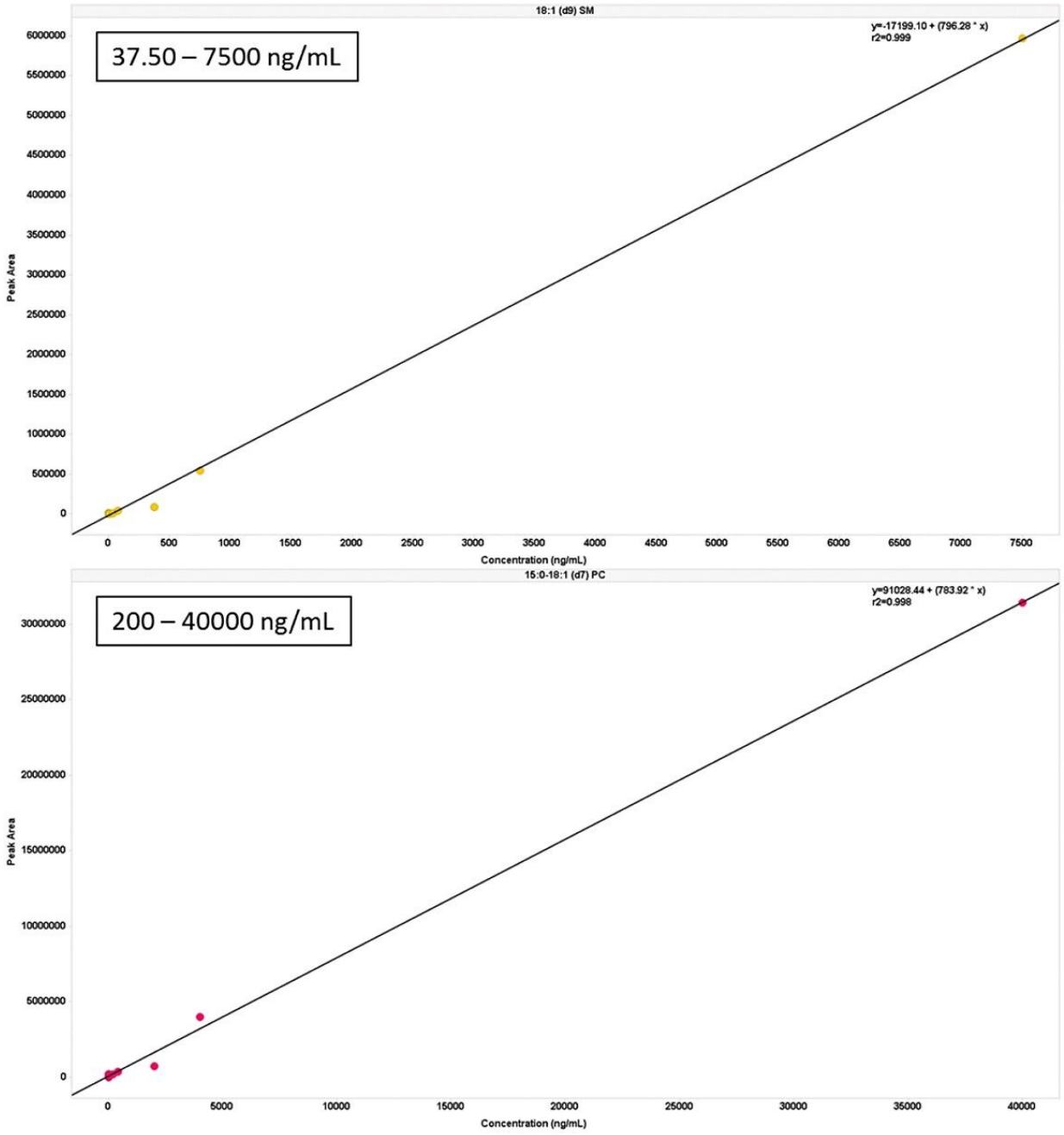

Figure 2. Example calibration curves for SM (d7) and PC (d7).

Conclusion

Lipidomics is a rapidly expanding field of science for biomedical and food nutrition research. The analysis of lipids in biological fluids requires a system which is accurate as well as specific enabling the identification and quantification of these lipids at biologically relevant levels. The Vion IMS QTof delivers sensitivity with linear concentration response, and structural elucidation capabilities using ion mobility and accurate mass MS/MS.

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