Three-dimensional imaging of cholesterol and sphingolipids within a Madin-Darby Canine Kidney Cell

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ABSTRACT

Metabolic stable isotope incorporation and secondary ion mass spectrometry (SIMS) depth profiling performed on a Cameca NanoSIMS 50 were used to image the ^{18}O-cholesterol and ^{15}N-sphingolipid distributions within a portion of a Madin-Darby Canine Kidney Cell (MDCK) cell. Three-dimensional (3D) representations of the component-specific isotope distributions show clearly defined regions of ^{18}O-cholesterol and ^{15}N-sphingolipid enrichment that seem to be separate subcellular compartments. The low levels of nitrogen-containing secondary ions detected at the ^{18}O-enriched regions suggests that these ^{18}O-cholesterol-rich structures may be lipid droplets, which have a core consisting of cholesterol esters and triacylglycerides.

I. INTRODUCTION

Lipids and cholesterol comprise the cellular plasma membrane and also play important roles in signal transduction[1,2] and intracellular trafficking.[3,4] Alterations in the distributions of various lipid species within subcellular compartments are linked to a variety of pathologies, the most well-known being Niemann-Pick disease.[5] Direct imaging of the lipid and cholesterol composition of various subcellular compartments without the use of fluorophores that may alter organization and intracellular trafficking[6] would provide a valuable alternative perspective on native cell structure, and ultimately, function. Furthermore, three-dimensional imaging would enable organelles and intracellular processes to be resolved.