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Commentary

Study of Cellular Lipid Networks in Biological Systems

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DESCRIPTION

Lipids are the broad category of naturally occurring compounds comprises fats, waxes, sterols, monoglycerides, diglycerides, phospholipids, and fat-soluble vitamins (such as vitamins A, D, E, and K). Lipids have a variety of functions in the body, including energy storage, signalling, and functioning as structural components of cell membranes.

Small molecules that are hydrophobic or amphiphilic can be broadly referred to as lipids. Some lipids can form vesicles, multilamellar/unilamellar liposomes, or membranes in an aqueous environment due to their amphiphilic nature. Ketoacyl and isoprene groups, two different kinds of biochemical "building-blocks," and these are the fraction of biological lipids. This allows for the identification of lipids into eight different groups: Sterol lipids, prenol lipids, glycerolipids, sphingolipids, and polyketides (formed by condensation of ketoacyl subunits) (derived from condensation of isoprene subunits). The comprehensive study of cellular lipid networks and processes in biological systems is known as lipidomics. A subset of the "metabolome," which also contains the three other major groups of biological molecules proteins/amino-acids, carbohydrates, and nucleic acids is the term "lipidome," which refers to the entire lipid profile within a cell, tissue, organism, or ecosystem. With the rapid advancement of techniques like Mass Spectrometry (MS), Nuclear Magnetic Resonance (NMR) spectroscopy, fluorescence spectroscopy, dual polarisation interferometry, and computational methods, as well as the growing understanding of the role of lipids in a variety of metabolic diseases like obesity, atherosclerosis, stroke, hypertension, and diabetes, the field of lipidomics has emerged. The biology system, which is rapidly expanding, is a key contribution to the immense advancements in genomics and proteomics. Identification and quantification of the cellular lipid molecular species, in addition to their interactions with other lipids, proteins, and other metabolites, are crucial attributes of lipidomics. Lipidomics looked at the dynamics, correlations, and functionalities of cellular lipids in addition to the alterations that arise when the system is perturbed.

The field of lipidomics established by integrating through mass spectrometric technique with the distinct chemical characteristics present in lipid molecular species. Despite falling under broader category of "metabolomics," lipidomics distinguishes as a distinct topic because of the contrast and functional specialisation of lipids in comparison to other metabolites. After perturbing a cell by altering its physiological or pathological condition, lipidomics accumulates a significant quantity of data quantitatively detailing the spatial and temporal modifications in the content and composition of various lipid molecular species and these findings provide mechanistic insights into alterations in cellular activity. Therefore, by detecting changes in cellular lipid metabolism, transport, and homeostasis, lipidomic studies serve a crucial role in elucidating the molecular underpinnings underlying lipid-related disease processes.

The synthesis of different combinations of these building components originates in the enormous structural variety present in lipids. Glycerophospholipids are constituted of a glycerol backbone related to one of perhaps 10 potential head groups, two fatty acyl/alkyl chains, and potentially up to 30 distinct chemical configurations. Due to chain preferences that vary by cell type and detection restrictions, not all potential permutations are actually detected experimentally. Nevertheless, many hundred different glycerol phospholipid molecular species have been found in mammalian cells.

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