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A lipidomic concept in infectious diseases

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ABSTRACT

Infectious diseases resemble a great threat to the human health according to World Health Organization where about 17% of all deaths (≈9.2 million deaths) in 2013 recorded are related to infectious diseases. The pathogenic microorganisms such as bacteria, viruses, fungi and parasites are the principle causes of infectious diseases. Ebola, AIDS, dengue, hepatitis, malaria, tuberculosis and schistosomiasis are among 216 infectious diseases found where the immunity represents the first line defense in infection. Lipidomic includes examination of different biological lipids in the biological cell. The lipidomic research covers all aspects of individual lipid molecule including its structure, function, connection with other cell constituents such as protein, lipid, and metabolite in both health and disease conditions. Details of cell biology obtained from different pathogens (viruses, bacteria, and parasites) provide a great data on molecular structure of host-pathogen relation and consequently on infection process. The lipids here play a very important role in many processes involved in host-pathogen relations. The role of lipid in host-pathogen link includes many processes in (1) structural host constituents, (2) host recognition, (3) intracellular transferring, and (4) energy and resource homeostasis during pathogen duplication. There are many lipid phosphatases, kinases, and lipases molecules that greatly involved in these processes and controlling pathogen expression and infection progress. The cell lipid metabolism depends on an adequate energy stores that push the infection to be accelerated and disease symptoms to be appeared. Consequently, future lipidomics studies are the basic for detecting the lipid role in host-pathogen relations which help in therapy advances and biomarkers development.

1. Introduction

Lipidomics was first detected by Han and Gross [1], through including the defined chemical properties in individual lipid molecules with a specific mass spectrometry technique. Lipidomics is identified as a study of different pathways of each individual cellular lipid inside specific biological systems [2–4]. The lipidomic research covers qualification and quantification of individual lipid molecules and their connections with other cell constituents such as proteins, lipids and metabolites. The lipidomic research includes different individual lipid structure, function and interaction with the changes that happened during pathophysiology of the cell biological system under investigation. The research concerning lipidomic technique comprises information dealing with lipid content and structure changes after invading of a cell through the change in cell physiological or pathological conditions. The data collected from these researches enable scientists to observe changes reported in the cell function. Consequently, lipidomic researches play a vital role in identification the biochemical mechanism condition of lipid-related disease progressions through categorizing the changes found in lipid metabolism and transfer inside the biological system. The lipidomic can combine with metabolomic to display anti-hyperlipidemic effect of grape seed extract where biliary acid, dicarboxylic fatty acid, and metabolites of cholesterol, purine, and eicosanoid were determined by mass spectrometry, multivariate analysis, mass spectrometry-mass spectrometry scan and mass database techniques [5]. Moreover, the lipidomic profiling and metabolomic profiling communicate together through using

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high performance liquid chromatography together with quadrupole mass spectrometry to examine different pathways of each individual amino acid metabolism and lipid metabolism [6].

The lipidomic research can be shown in a full and sharp picture through application of lipid metabolites and pathways plan as recommended by LIPID MAPS Consortium [7], and the fundamentals points are taken from the European Lipidomics Initiative program [8]. The lipidomic study is an innovative field that has been determined by the novel technologies used and these new applications include mass spectrometry, nuclear magnetic resonance technique, fluorescence spectroscopy, dual polarization interferometry and computational applications. The lipidomic study includes the identification of the lipid role in many metabolic diseases such as atherosclerosis, diabetes and obesity. The lipid research is a basic technique for the metabolomic study where lipidomic gave a full details data for different lipid occurred inside the biological system. The electrospray ionization tandem mass spectrometry is a new technique used in lipidomic research that provides quantitative data and is accurately adaptable to high analysis result [9]. A mass spectrometry technique is another new application used showed in details the alterations reported in each individual addition to proteomic study which focuses in detail on different protein structure and function changes to complete the pyramide shape which gives us all information about pathophysiological conditions metabolic pathways changes. Figure 1 reveals the general figure to explain the associations between lipidome to another one studies such as genome, transcriptome, proteome and metabolome techniques [11]. The lipids in another function adjust protein function changes and gene transcription induction and these conditions are responsible for pathophysiological state. In the infection case, the formation of biological system lipids needs more work to be understood while lipids formation decreased according to disappearance of many genes that incorporated in the process of lipid formation where the lipidomic study provides a great information about the lipid role in infection diseases and the lipid role in pathological condition-related to infection [2,3]. The lipidomic research investigates each individual lipid such as choline ether and ethanolamine lipids as well as seminolipids which are important for cell membrane function. For example, sperm (O-acyl)-ω-hydroxy-fatty acids are important for sperm quality, and function and seminal plasma phosphatidylethanolamines are very important lipids for sperm function [12].

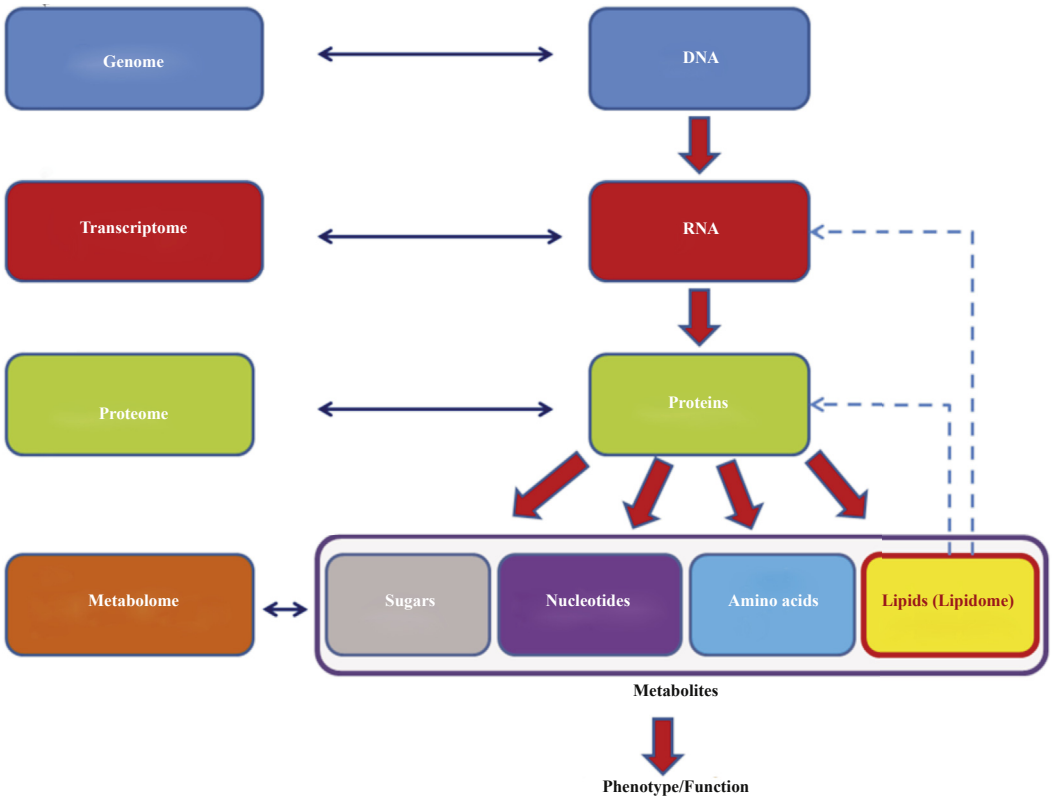

Figure 1. General schema showing the relationships of the lipidome to the genome, transcriptome, proteome and metabolome. Lipids as part of metabolomics. Lipids also regulate protein function and gene transcription as part of a dynamic interaction [11].

lipid profile in mice induced by endometriosis where the authors recognized many modified and structurally-changed lipids such as phosphatidylethanolamines, phosphatidylcholines, triglycerides and sphingomyelins [10].

To understand the metabolic pathways in a full consideration, the lipidomic research must communicate with genomic study which includes gene array application and genetic map in

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