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Review

Acyltransferases and transacylases that determine the fatty acid composition of glycerolipids and the metabolism of bioactive lipid mediators in mammalian cells and model organisms

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ABSTRACT

Over one hundred different phospholipid molecular species are known to be present in mammalian cells and tissues. Fatty acid remodeling systems for phospholipids including acyl-CoA:lysophospholipid acyltransferases, CoA-dependent and CoA-independent transacylation systems, are involved in the biosynthesis of these molecular species. Acyl-CoA:lysophospholipid acyltransferase system is involved in the synthesis of phospholipid molecular species containing *sn*-1 saturated and *sn*-2 unsaturated fatty acids. The CoA-dependent transacylation system catalyzes the transfer of fatty acids esterified in phospholipids to lysophospholipids in the presence of CoA without the generation of free fatty acids. The CoA-dependent transacylation reaction in the rat liver exhibits strict fatty acid specificity, i.e., three types of fatty acids (20:4, 18:2 and 18:0) are transferred. On the other hand, CoA-independent transacylase catalyzes the transfer of C20 and C22 polyunsaturated fatty acids from diacyl phospholipids to various lysophospholipids, especially ether-containing lysophospholipids, in the absence of any cofactors. CoA-independent transacylase is assumed to be involved in the accumulation of PUFA in ether-containing phospholipids. These enzymes are involved in not only the remodeling of fatty acids, but also the synthesis and degradation of some bioactive lipids and their precursors. In this review, recent progresses in acyltransferase research including the identification of the enzyme's genes are described.

Contents

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1. Introduction

Fatty acids are the most important and common constituent of lipids [1–13]. Most fatty acids are present as not only free forms, but also esterified forms in phospholipids, triacylglycerols (TAGs), and cholesterol esters (CEs). Phospholipids are the major constituents of biomembranes including plasma or organelle membranes. In contrast, TAGs and CEs are involved in the storage and transport of fuels in lipid droplets and lipoproteins. Various kinds of fatty acids are distributed in phospholipids and TAGs in a number of mammalian tissues [3–13]. The main theme of this review is the molecular mechanism of fatty acid distribution in phospholipids, TAGs, and CEs.

Acyltransferases and transacylases are enzymes that catalyze fatty acid transfer between an acyl donor and acceptor [8–13]. These enzymes are involved in lipid biosynthesis, in particular, the incorporation of fatty acid into various lipids such as phospholipids, TAGs, and CEs. Most acyltransferases employ activated fatty acids such as acyl-coenzyme A (CoA) as an acyl donor. However, transacylases employ esterified fatty acids with lipids including phospholipids, and transfer these to the acceptor lipids.