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Editorial

Methods of lipid oxidation product identification and quantification

Lipid oxidation, both enzymatic and non-enzymatic, is involved in physiological and pathological alteration of cell function. This special issue of Free Radical Biology & Medicine is devoted to the methods that can be used to identify and quantify the vast array of products of lipid oxidation. The issue however, begins with a review by Fritz and Petersen [1] on the generation and chemical reactivity of lipid-derived aldehydes, one important class of lipid oxidation products. Generation of these electrophilic molecules trigger cell signaling through modification of proteins critical for cellular homeostasis.

Most of the articles here describe methods for measurement of oxidation products of polyunsaturated fatty acids. In the article by Levison, et al. [2], methods for detection of specific oxidized fatty acids containing a single or multiple combinations of epoxide, hydroxyl, ketone and hydroperoxide moieties are described. Using addition of synthetic internal standards, base hydrolysis and liquid-liquid phase sample extraction species can be identified and accurately quantified using stable isotope dilution and multiple reaction monitoring and coupled multiplexed high performance liquid chromatography - mass spectrometry. Milne, et al. [3], provides a method for the measurement of F_2-isoprostanes and isofurans. The protocol described is used to quantify F_2-IsoPs and IsoFs using gas chromatography/mass spectrometry (GC/MS) in a variety of biological fluids including urine, plasma, tissues, cerebral spinal fluid, exhaled breath condensate, and amniotic fluid. Massey and Nicolaou [4] provide lipidomic methods for analysis of oxidized polyunsaturated fatty acids formed by the action of cyclooxygenases, lipoxygenases, and cytochrome P450 monooxygenases. The method describes how liquid chromatography coupled to electrospray mass spectrometry can be used as a sensitive and accurate quantitative approach for the analysis of these bioactive lipids. In Grintzalis, et al. [5], the authors describe a method for the simultaneous determination of free/protein malondialdehyde and lipid/protein hydroperoxides. The procedure described how, after initial fractionation: free malondialdehyde, protein-bound malondialdehyde, total hydroperoxides, and protein hydroperoxides can be measured fluorometrically in human plasma.

The article by Cummins, et al. [6], provides how fluorescent probes can be used for the quantification and identification of subcellular proteomes and biological processes regulated by lipid peroxidation products. Methods for identification of subcellular protein targets of lipid oxidation and for linking protein modifications with biological responses such as autophagy are described in detail.

In the article by Wacker, et al. [7], methods for analysis of chlorinated lipids in biological systems produced in tissues by the action of myeloperoxidase on plasmalogens are provided. The direct product and metabolites can be quantified using thin layer chromatography and other chromatographic separation techniques combined with mass spectrometry.

The article by Woodcock et al. [8], concerns two approaches for the study of nitrated fatty acids. Multiple methods for synthesis of nitrated fatty acid are provided. Sample extraction from complex biological matrices along with qualitative and quantitative detection of nitrated fatty acids by liquid chromatography–mass spectrometry are also described in detail.

Griffiths, et al. [9], describe a method for the analysis of cholesterol metabolites, particularly the oxysterols and cholestenoic acids. The method described is an enzyme-assisted derivatization for sterol analysis (EADSA) in combination with liquid chromatography–electrospray ionization–mass spectrometry.

The issue concludes with an article by Stafforini and McIntyre [10] describing a radiometric assay of platelet-activating factor acetylhydrolase. This enzyme is also called lipoprotein-associated phospholipase A_2 and phospholipase A_2 group 7A. The required instrumentation, including a liquid scintillation counter, is standard.

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