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Foreword

The cells of our bodies require oxygen for energy generation, but the same process that results in ATP production for this needed function may result in generation of highly reactive oxygen free radicals. These radicals are toxic byproducts that damage DNA, lipids and proteins and have been associated with a number of different disease states. These disease states include cardiovascular diseases, diabetes, cancer and various neurological disorders. These diseases constitute the most significant threats to public health today. The aging process itself has been shown to be related to oxidative damage in cells. Although still somewhat controversial, antioxidants found in the foods we eat or in vitamin supplements have been suggested as being capable of reducing damage due to oxidative stress. Exercise has also been suggested as a way to increase the levels of antioxidants in circulation and therefore reduce the impact of oxidative damage due to reactive oxygen species. In contrast, life style choices, such as tobacco and alcohol use have been shown to positively affect the levels of free radicals and thus increase oxidative stress. Other free radical sources have been attributed to environmental or workplace exposure to hazardous materials. In short, the careful assessment of the oxidative stress status on an individual is possibly the best reflection of their overall health and their propensity to develop disease in the future.

This special issue on *Analysis of Antioxidants and Biomarkers of Oxidative Stress* was conceived through a consideration of the immense importance this topic has gained as disease processes have been related to the an imbalance in the generation of reactive oxygen species and their removal by antioxidants and other mechanisms. A simple literature search yields almost 11,000 papers related to oxidative stress and almost 13,500 on antioxidants in the last 2 years alone. Nearly 3000 of these papers deal with both oxidative stress and antioxidants and more than one third of these deal with analysis in some way.

Oxygen free radicals are very difficult to measure directly because of their highly reactive nature and their very short half-life. Various byproducts of these free radicals reactions include a number of protein modifications, lipid peroxidation products and altered DNA bases. These byproducts as well as some related enzymes have therefore been used as biomarkers to reflect the degree of oxidative damage which may be related to a particular disease state.

Potent antioxidants include among other things, organic compounds, such as Vitamin C, Vitamin E and beta carotene as well as trace metals, such as selenium. These nutrients cannot be manufactured by the body and must be ingested through food or supplement intake. In addition to various enzyme systems, these nutrients are essential to removal (scavenging) of reactive oxygen species from the body to prevent their harmful effects. When the antioxidant capacity of a biological system is overwhelmed by the presence of excess free radical reactive species, or the concentrations of antioxidants are not sufficient to protect against oxidation, oxidative damage to cells is enhanced and the disease processes are accelerated. It is therefore important to be able to measure not only the level of oxidative stress biomarker but to also view this in the context of the levels of antioxidants.

There has been no shortage of controversy over the role that antioxidants play in oxidative stress and whether or not antioxidant supplements should be used. The argument as to which reactive species byproduct provides the most reliable biomarker for a particular disease is ongoing. Further study is therefore essential considering the importance of this area of research and analytical innovation is critical to provide the tools needed to advance the science. Analytical separation science oriented approaches for biomarkers of oxidative damage and related antioxidants have dominated in the literature and include high performance liquid chromatography, gas chromatography, and capillary electrophoresis; as well as a number of immunoassays. Innovation is needed to enhance sensitivity for achieving detection of the relevant concentrations of biomarkers and antioxidants. Improving sample preparation procedures and measurement selectivity is also needed to improve reliability and efficiency so analytical procedures can become more widely available.

This special issue is dedicated to the pursuit of these analytical innovations and the biological applications that result, to the end of promoting a better understanding of oxidative stress. Fifty-five of the most active analytical researchers in this field were invited to contribute articles to this special issue. Thirty-two of these were able to accept the invitation resulting

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in 29 submissions and the final complement of papers included herewith. They represent a broad cross-section of the research being conducted in the analysis of biomarkers of oxidative stress and antioxidants. I trust the readers of J. Chromatogr. B will benefit not only form the analytical innovation presented but from the application of these innovations to biological problems.

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