June 2006

"Preface" to *Selenium: Its Molecular Biology and Role in Human Health, Second Edition*

Dolph L. Hatfield
National Cancer Institute

Marla J. Berry
University of Hawaii

Vadim N. Gladyshev
University of Nebraska-Lincoln, vgladyshev@rics.bwh.harvard.edu

SELENIUM
Its Molecular Biology and Role in Human Health, Second Edition

Edited by

Dolph L. Hatfield
National Cancer Institute, USA

Marla J. Berry
University of Hawaii, USA

and

Vadim N. Gladyshev
University of Nebraska, USA

Springer

2006

Preface

Since the first edition of *Selenium: Its Molecular Biology and Role in Human Health* was published in 2001, many new insights into the biochemical, molecular, genetic and health aspects of this fascinating element have been elucidated. Several new human clinical trials have also been undertaken examining the role of selenium in protection against different cancers. For example, the National Cancer Institute initiated two new clinical trials involving selenium. One of these is called SELECT, **Se**lenium and vitamin **E** **C**ancer Prevention **T**rial, and it involves examining the role of selenium and vitamin E in protecting against prostate cancer, with a goal of enrolling over 35,000 males in the study. The other trial involves examining the role of selenium in protection against lung cancer, a study incorporating 1960 individuals. The commitment of hundreds of millions of dollars to these trials for examining the role of selenium in protecting humans against different forms of cancer illustrates how highly important this element is regarded by the medical and scientific communities in health issues. What is of such significance to elucidating the role of selenium in health in these human clinical trials is that not only will the effect of selenium on prostate and lung cancers be assessed, but these trials will shed light on the role of many additional aspects of selenium in health such as aging, heart disease, viral inhibition and other forms of cancer including colon, liver and brain malignancies.

Many exciting discoveries have occurred in the last five years which are described in the current edition. For example, the entire selenoprotein gene population, designated the selenoproteome, has been identified in humans and rodents. Furthermore, the various selenoproteins described in the last edition have been further characterized and their new features described. Numerous selenoprotein genes have been targeted for removal using standard or *loxP-Cre* technologies to further elucidate their functions in development and health. Selenoproteins have also been shown to be involved in different human genetic disorders. Many new and novel features have been uncovered on the biosynthesis of selenocysteine, the amino acid that contains selenium, and its incorporation into protein as the 21st amino acid in the genetic code. Further studies on the various components involved in the biosynthesis of selenocysteine and its insertion into protein have determined that much of this vast selenoprotein machinery exists in supramolecular complexes. Finally, several mouse models that were specifically generated for examining the role of selenium and selenoproteins in health and development have been devised. The rapid expansion and many new discoveries in the selenium field in the last five years are reflected by the addition of many new chapters and a much longer current edition.

The purpose of the new edition book is to inform the reader of these many new discoveries and to examine our present knowledge of the molecular biology of selenium, its incorporation into proteins as selenocysteine and the role that this element and selenium-containing proteins (selenoproteins) play in health. The book's emphasis is on our understanding of selenium metabolism in mammals and the role of this element in human health. The book begins with a brief history of selenium and how its face has changed through the years from one of a toxin and possible carcinogen to one of an essential micronutrient in the diets of humans and other animals. Indeed, selenium is now touted as an important cancer chemopreventative agent, as well as for its roles in inhibiting viral expression, delaying the progression of AIDS in HIV positive patients, preventing heart disease and other cardiovascular and muscle disorders, slowing the aging process, and having roles in development, male reproduction and immune function. As more of the molecular biology of selenium is unraveled, we are understanding the manner in which this element does indeed have direct roles in each of these health issues.

The present book, like the first edition, is divided into three parts with ten more chapters than the earlier edition. The chapters in Part I, which is entitled "Biosynthesis of selenocysteine and its incorporation into protein," define selenocysteine as the 21st naturally occurring amino acid in the genetic code and describe how this amino acid is incorporated into protein. Interestingly, the inclusion of selenocysteine to the genetic code as its 21st amino acid marks the first addition to the code since it was deciphered in the mid-1960s. Our current understanding of how selenoprotein expression is regulated and the nucleocytoplasmic shuttling of the selenocysteine biosynthesis and insertion machinery in eukaryotes is also discussed in Part I. Part II is entitled "Selenium-containing proteins" and it discusses our current understanding of selenoproteins, primarily in higher eukaryotes. Part III is entitled "Selenium and human health" and it covers our current understanding of the role of selenium in various diseases, including cancer and heart disease, in HIV infection and AIDS, in male reproduction, and as an antiviral agent. The role of small molecular weight, selenium-containing compounds (selenocompounds) in human health and the dietary selenium requirements for humans are also discussed.

In summary, this book provides an up-to-date review of much of the on-going research in the selenium field. It provides a resource for scientists working in the selenium field, as well as for physicians, other scientists and students who wish to learn more about this fascinating micronutrient.

Dolph L. Hatfield, Marla J. Berry and Vadim N. Gladyshev