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David A. Bender

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## **Nutritional Biochemistry of the Vitamins**

SECOND EDITION

The vitamins are a chemically disparate group of compounds whose only common feature is that they are dietary essentials that are required in small amounts for the normal functioning of the body and maintenance of metabolic integrity. Metabolically, they have diverse functions, such as coenzymes, hormones, antioxidants, mediators of cell signaling, and regulators of cell and tissue growth and differentiation. This book explores the known biochemical functions of the vitamins, the extent to which we can explain the effects of deficiency or excess, and the scientific basis for reference intakes for the prevention of deficiency and promotion of optimum health and well-being. It also highlights areas in which our knowledge is lacking and further research is required. This book provides a compact and authoritative reference volume of value to students and specialists alike in the field of nutritional biochemistry, and indeed all who are concerned with vitamin nutrition, deficiency, and metabolism.

David Bender is a Senior Lecturer in Biochemistry at University College London. He has written seventeen books, as well as numerous chapters and reviews, on various aspects of nutrition and nutritional biochemistry. His research has focused on the interactions between vitamin B<sub>6</sub> and estrogens, which has led to the elucidation of the role of vitamin B<sub>6</sub> in terminating the actions of steroid hormones. He is currently the Editor-in-Chief of *Nutrition Research Reviews*.

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**DAVID A. BENDER**

University College London



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## Preface

In the preface to the first edition of this book, I wrote that one stimulus to write it had been teaching a course on nutritional biochemistry, in which my students had raised questions for which I had to search for answers. In the intervening decade, they have continued to stimulate me to try to answer what are often extremely searching questions. I hope that the extent to which helping them through the often conflicting literature has clarified my thoughts is apparent to future students who will use this book and that they will continue to raise questions for which we all have to search for answers.

The other stimulus to write the first edition of this book was my membership of United Kingdom and European Union expert committees on reference intakes of nutrients, which reported in 1991 and 1993, respectively. Since these two committees completed their work, new reference intakes have been published for use in the United States and Canada (from 1997 to 2001) and by the United Nations Food and Agriculture Organization/World Health Organization (in 2001). A decade ago, the concern of those compiling tables of reference intakes was on determining intakes to prevent deficiency. Since then, the emphasis has changed from prevention of deficiency to the promotion of optimum health, and there has been a considerable amount of research to identify biomarkers of optimum, rather than minimally adequate, vitamin status. Epidemiological studies have identified a number of nutrients that appear to provide protection against cancer, cardiovascular, and other degenerative diseases. Large-scale intervention trials with supplements of individual nutrients have, in general, yielded disappointing results, but these have typically been relatively short-term (typically 5–10 years); the obvious experiments would require lifetime studies, which are not technically feasible.

The purpose of this book is to review what we know of the biochemistry of the vitamins, and to explain the extent to which this knowledge explains

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the clinical signs of deficiency, the possible benefits of higher intakes than are obtained from average diets, and the adverse effects of excessive intakes.

In the decade since the first edition was published, there have been considerable advances in our knowledge: novel functions of several of the vitamins have been elucidated; and the nutritional biochemist today has to interact with structural biochemists, molecular, cell, and developmental biologists and geneticists, as well as the traditional metabolic biochemist. Despite the advances, there are still major unanswered questions. We still cannot explain why deficiency of three vitamins required as coenzymes in energy-yielding metabolism results in diseases as diverse as fatal neuritis and heart disease of thiamin deficiency, painful cracking of the tongue and lips of riboflavin deficiency, or photosensitive dermatitis, depressive psychosis, and death associated with niacin deficiency.

This book is dedicated in gratitude to those whose painstaking work over almost 100 years since the discovery of the first accessory food factor in 1906 has established the basis of our knowledge, and in hope to those who will attempt to answer the many outstanding questions in the years to come.

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David A. Bender

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