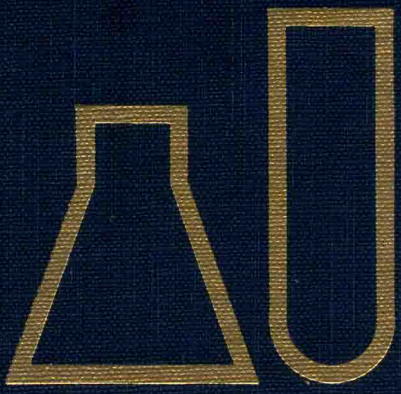

NUTRITIONAL EVALUATION OF FOOD PROCESSING

THIRD EDITION

NUTRITIONAL EVALUATION OF FOOD PROCESSING

Third Edition

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Robert Samuel Harris

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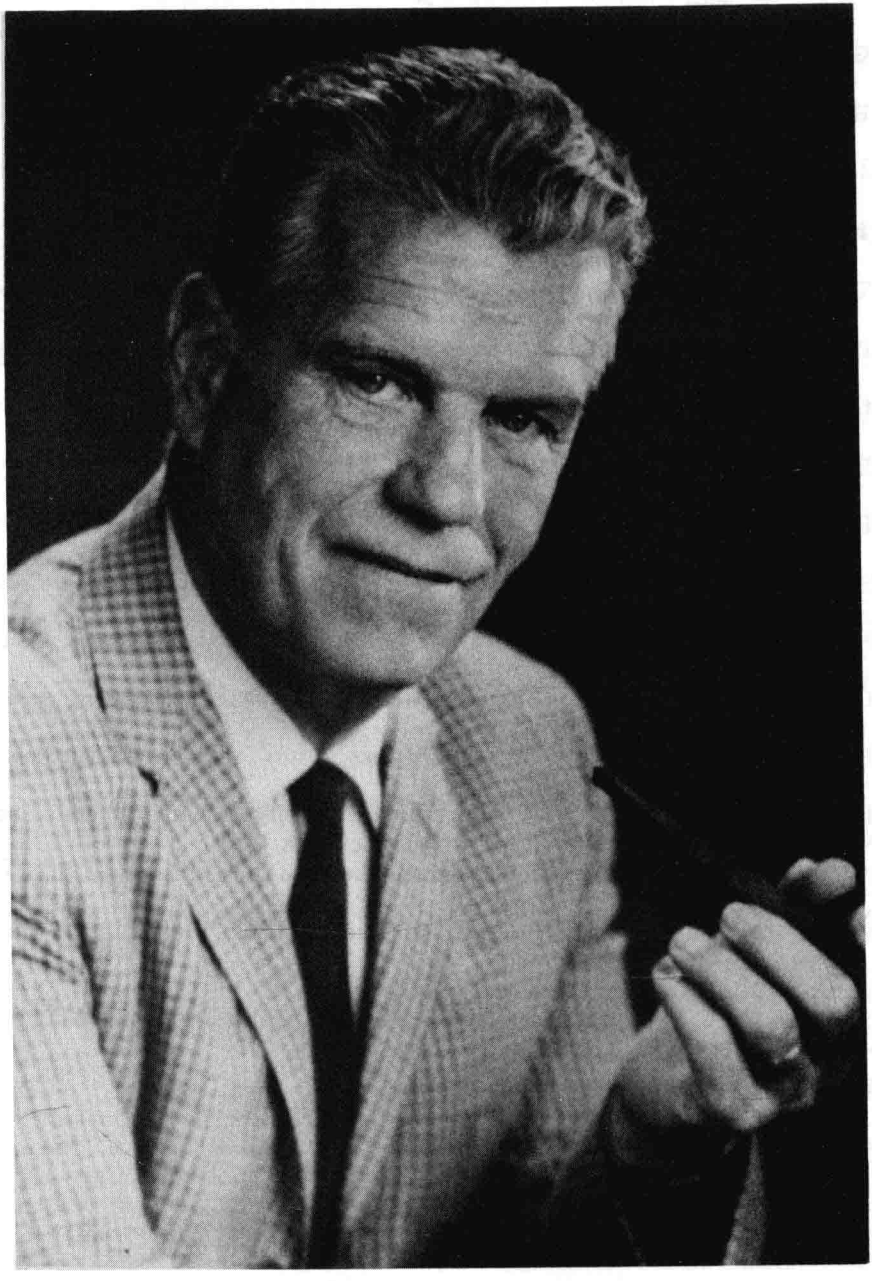

Robert Samuel Harris
May 10, 1904–December 24, 1983

Preface

Dramatic changes in the attitudes toward human nutrition have taken place during the past decade. Food-related and medical professionals as well as consumers are now, more than ever before, aware of and concerned about diet, nutrition, and the beneficial and deleterious effects of food processing upon nutrients. The old saying "We are what we eat" is still relevant. Nutritious food will contribute greatly to consumers' good health and ultimately reduce medical bills.

Food processing is essential to maintaining our food reserves from one harvest to another, thus letting us serve our daily meals regularly. If food processing is defined as including all treatments of foodstuffs from harvest to consumption, then more than 95% of our food may be considered as processed. In most cases, food processing and storage cause some reduction in the nutritional value of foods. Advances in food science and food technology have resulted in an increase in nutrient retention after processing. In addition, today's consumer better understands how to avoid excessive nutrient losses during food preparation.

The information presented in this completely revised reference and textbook will help the reader to understand better the relationship between food processing and nutrient retention. The authors' scholarly contributions are greatly appreciated.

With the publication of the first edition of *Nutritional Evaluation of Food Processing*, Dr. Harris was the very first scientist in the world who compiled, systematized, and presented data on the effects of food processing on the nutrient composition of foods. I must state with deep sorrow that Dr. Harris passed away while the third edition was in preparation.

I remember the first time I met Dr. Harris. He invited me to collaborate on the second edition. At first I was reluctant to accept his invitation and suggested several names of renowned nutritionists, who, in my opinion, were much more qualified for the task. Dr. Harris replied, "I am a nutritionist! I need a food technologist, who already has experience in publishing books, to help me!" I accepted his invitation, and from that moment on, a close collaboration and friendship developed between us. The second edition and the present edition, the third, are the two last additions to Dr. Harris's nearly 300 scientific publications.

Perhaps one of the saddest moments in Dr. Harris's life occurred when he had to tell me that his illness prevented him from further helping me with this edition. At this tragic point, his battle with an incurable disease had already progressed too far. I will always remember, with great gratitude, my association with Dr. Harris who was a competent and distinguished scientist, a compassionate and generous man, and a committed and true friend!

ENDEL KARMAS

Contents

Part 1

Introduction

1

General Discussion on the Stability of Nutrients

Robert S. Harris

Nutrients are destroyed when foods are processed largely because they are sensitive to the pH of the solvent, to oxygen, light and heat, or combinations of these. Trace elements, especially copper and iron, and enzymes may catalyze these effects.

The relative stabilities of the vitamins and amino acids under these various conditions are tabulated in Table 1.1. Vitamin A is stable under an inert atmosphere, but rapidly loses activity when heated in the presence of oxygen, especially at higher temperatures. It is completely destroyed when oxidized or dehydrogenated. It is more sensitive to ultraviolet light than to other wavelengths of light.

Ascorbic acid is fairly stable in acid solution and decomposes in light. This decomposition is greatly accelerated by the presence of alkalies, oxygen, copper, and iron.

A 50% loss in biotin occurs when it is boiled for 6 hr in 30% hydrochloric acid or for 17 hr in 1 *N* potassium hydroxide, yet it is relatively stable in air and oxygen or when exposed to ultraviolet light. It is inactivated by agents which oxidize the sulfur atom, and by strong acids and alkalies.

Essential fatty acids isomerize when heated in alkali and are sensitive to light, temperature, and oxygen. When oxidized, they become inactive biologically and may even be toxic.

The stability of vitamin D is influenced by the solvent in which it is dissolved, but it is stable when crystals are stored in amber glass bottles. Generally, it is stable to heat, acids, and oxygen. It is slowly destroyed in foods and feeds which are slightly alkaline, especially in the presence of air and light.

The folic acid group is stable during boiling at pH 8 for 30 min, yet large losses occur during autoclaving in acids and alkalies. This destruction is accelerated by oxygen and light.

Inositol is stable during refluxing in strong hydrochloric acid or potassium hydroxide. It occurs in plants mainly in the form of phytic acid salts and as plant and animal phosphoinositides. These complexes are broken down by phosphatases and similar enzymes. The free inositol has the highest biological value.