

BIOACTIVE FOODS IN PROMOTING HEALTH

FRUITS AND VEGETABLES



RONALD ROSS WATSON VICTOR R. PREEDY



BIOACTIVE FOODS IN PROMOTING HEALTH: FRUITS AND VEGETABLES

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Academic Press is an imprint of Elsevier

32 Jamestown Road, London NW1 7BY, UK 30 Corporate Drive, Suite 400, Burlington, MA 01803, USA 525 B Street, Suite 1900, San Diego, CA 92101-4495, USA

First edition 2010

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British Library Cataloguing-in-Publication Data

A catalogue record for this book is available from the British Library

Library of Congress Cataloging-in-Publication Data

A catalog record for this book is available from the Library of Congress

ISBN: 978-0-12-374628-3

For information on all Academic Press publications visit our website at www.elsevierdirect.com

Typeset by Macmillan Publishing Solutions www.macmillansolutions.com

Printed and bound in United States of America

10 11 12 13 10 9 8 7 6 5 4 3 2 1

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Preface

Diet and nutrition are vital keys to controlling or promoting morbidity and mortality from chronic diseases. The multitude of biomolecules in dietary fruits and vegetables play a crucial role in health maintenance. They may, therefore, be more effective and certainly could have different actions beyond nutrients.

The U.S. National Cancer Institute reports that only 18% of adults meet the recommended intake of vegetables. Increasingly, Americans, Japanese, and Europeans are turning to the use of dietary vegetables, medicinal herbs, and their extracts or components to prevent or treat disease and cancer. It has been known for decades that those populations with high vegetable consumption have reduced risks of cancer. However, which vegetables or fruits, how much of them, and which extracts or components are best to prevent disease and promote health?

This book brings together experts working on the different aspects of supplementation, foods, and plant extracts, in health promotion and disease prevention. Their expertise and experience provide the most current knowledge to promote future research. Dietary habits need to be altered, for most people. Therefore, the conclusions and recommendations from the various chapters will provide a basis for change.

The basic outline of the book has three sections: (A) Fruit and Vegetables in Health Promotion, (B) Effects of Individual Vegetables on Health, and (C) Actions of Individual Fruits in Disease and Cancer Prevention and Treatment.

Constituents with anticancer activities in the prevention phytochemicals, are described.

Bioavailability of important constituents of fruit and vegetables plays a key role in their effectiveness. Their roles as well as that of whole vegetables in gastrointestinal disease, heart disease, and old age are defined. Each vegetable contains thousands of different biomolecules, some with the potential to promote health or retard disease and cancer. By use of vegetable extracts as well as increased consumption of whole plants, people can dramatically expand their exposure to protective chemicals and thus readily reduce their risk of multiple diseases. Specific foods, individual fruits or vegetables and their byproducts are biomedicines with expanded understanding and use. For decades, it has been appreciated that oxidative pathways can lead to tissue damage and contribute to pathology. Fortunately, nature has provided us the mechanisms found predominately in plants to defend against such injury. Antioxidant nutritional agents have consequently attracted major attention and rightfully deserve to be studied carefully for possible beneficial roles. One of the main reasons for the interest in antioxidant agents in dietary vegetables, and their products, is their virtually complete lack of harmful side effects. This stands in stark contrast to many drugs that are promoted and studied for possible disease-preventive activity.

Plant extracts as dietary supplements are now a multi-billion dollar business, built upon extremely little research data. For example, the U.S. Food and Drug Administration are pushing this industry, with the support of Congress, to base its claims and products on scientific research. Since common dietary vegetables and over-the-counter extracts are readily

X PREFACE

available, this book will be useful to laypersons who apply it to modify their lifestyles, as well as to the growing nutrition, food science, and natural product community. This book focuses on the growing body of knowledge on the role of various dietary plants in reducing disease.

Expert reviews will define and support the actions of bioflavonoids, antioxidants, and similar materials that are part of dietary vegetables, dietary supplements, and nutraceuticals. As nonvitamin minerals with health-promoting activities, nutraceuticals are an increasing body of materials and extracts that may have biological activity. Therefore, their role is a major emphasis, along with discussions of which agents may be the active components.

The overall goal is to provide the most current, concise, scientific appraisal of the efficacy of key foods and constituents medicines in dietary plants in preventing disease and improving the quality of life. While vegetables have traditionally been seen to be good sources of vitamins, the roles of other constituents have only recently become more widely recognized. This book reviews and often presents new hypotheses and conclusions on the effects of different bioactive components of the diet, derived particularly from vegetables, to prevent disease and improve the health of various populations.

Ronald Ross Watson Victor R. Preedy

Acknowledgments

Special appreciation is extended to the Natural Health Research Institute (non-profit) http://www.naturalhealthresearch.org. Its goal is to educate scientists, government regulators, and the lay public about the role of nutrition, bioactive foods and dietary supplements in health and wellness. The NHRI stimulated this book which was approved by its board and advisory panel. Their contribution to the book

is sincerely acknowledged. In addition, the NHRI supported the book's production by providing partial support for Bethany L. Stevens, the project's editorial assistant who was critical to the book's success. Her excellent work with the authors, editors and publisher greatly supported the work. The editors also greatly appreciate her assistance without which the book would not have been possible.

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xiv Contributors

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xvi CONTRIBUTORS

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Contents

Preface ix

Acknowledgments xi

Contributors xiii

Section A

FRUIT AND VEGETABLES IN HEALTH PROMOTION 1

- Botanical Diversity in Vegetable and Fruit Intake: Potential Health Benefits 3 MATTHEW D. THOMPSON AND HENRY J. THOMPSON
- 2. Vegetable and Fruit Intake and the Development of Cancer: A Brief Review and Analysis 19
 HENRY J. THOMPSON
 - 3. Fruit and Vegetable Antioxidants in Health 37

MANUELA BLASA, LORENZO GENNARI, DONATO ANGELINO, AND PAOLINO NINFALI

- 4. Medicinal Activities of Essential Oils: Role in Disease Prevention 59

 ALFREDA WEI AND TAKAYUKI SHIBAMOTO
- 5. Emerging Knowledge of the Bioactivity of Foods in the Diets of Indigenous North

 Americans 71

 ALEXANDER G. SCHAUSS
- 6. Barriers and Facilitating Factors Affecting Fruit and Vegetable Consumption 85 MING-CHIN YEH, JANEL OBENCHAIN, AND ANAHI VILADRICH

- 7. Healthy Eating: What Is the Role of the Economic Situation? 99

 TEA LALLUKKA, MIKKO LAAKSONEN, AND OSSI RAHKONEN
- 8. Trends in US Adult Fruit and Vegetable
 Consumption 111
 SARAH STARK CASAGRANDE AND TIFFANY L. GARY-WEBB
 - 9. Fruit and Vegetables in the Optimized
 Mixed Diet 131
 UTE ALEXY AND MATHILDE KERSTING
 - 10. The Antibacterial Properties of Dietary Fruit 141

 RACHEL O'MAHONY
 - 11. Fruit and Vegetable Intake of Mothers in Europe: Risks/Benefits 161
 ALEXANDRA WOLF AND IBRAHIM ELMADFA
- 12. Fruit, Vegetables, and Bone Health 173
 YU MING CHEN AND SUZANNE C. HO
- 13. Socioeconomic Inequalities in Fruit and Vegetable Intakes 195

 KYLIE BALL AND DAVID CRAWFORD
 - 14. Working with Industry for the Promotion of Fruit and Vegetable
 Consumption 205
 CHRISTINA M. POLLARD AND CHRIS ROWLEY

Section B

EFFECTS OF INDIVIDUAL VEGETABLES ON HEALTH 221

- Garlic and Aging: Current Knowledge and Future Considerations 223
 CARMIA BOREK
 - 16. Garlic and Heart Health 235
 KHALID RAHMAN
- 17. Fig, Carob, Pistachio, and Health 245 SOLIMAN KHATIB AND JACOB VAYA
 - 18. Poi History, Uses, and Role in Health 265 SALAM A. IBRAHIM AND DANFENG SONG
- 19. Increasing Children's Liking and Intake of Vegetables through Experiential Learning 273

 REMCO C. HAVERMANS
- 20. Bioactivity of Polyacetylenes in Food Plants 285 Lars P. Christensen
- 21. Nitrates and Nitrites in Vegetables: Occurrence and Health Risks 307 TERJE TAMME, MARI REINIK, AND MATI ROASTO
- 22. The Essentiality of Nutritional
 Supplementation in HIV Infection and AIDS:
 Review of Clinical Studies and Results
 from a Community Health Micronutrient
 Program 323

RAXIT J. JARIWALLA, ALEKSANDRA NIEDZWIECKI, AND MATTHIAS RATH

- 23. Tomatoes, Tomato Products, and Lycopene in Prevention and Therapy of Prostate Diseases Is There Evidence from Intervention Studies for Preventive and for Therapeutic Effects? 343

 SABINE ELLINGER
 - 24. Fruit, Vegetables, and Legumes
 Consumption: Role in Preventing and
 Treating Obesity 359
 ANA B. CRUJEIRAS, ESTIBALÍZ GOYENECHEA, AND
 I. ALFREDO MARTÍNEZ
- 25. Spinach and Carrots: Vitamin A and Health 381
 GUANGWEN TANG
- 26. Spinach and Health: Anticancer
 Effect 393
 NAOKI MAEDA, HIROMI YOSHIDA, AND YOSHIYUKI

MIZUSHINA

- 27. Potential Health Benefits of Rhubarb 407 ELISABETTA M. CLEMENTI AND FRANCESCO MISITI
- 28. Health Benefits of Fenugreek (*Trigonella foenum-graecum leguminosse*) 425
 TAPAN K. BASU AND ANCHALEE SRICHAMROEN
- 29. Weight Loss Due to Fruit and Vegetable
 Use 437
- ELENA RODRÍGUEZ-RODRÍGUEZ, ANA M. LÓPEZ-SOBALER, AND ROSA M. ORTEGA
- 30. Legumes and Cardiovascular Disease 449
 PETER M. CLIFTON

CONTENTS vii

Section C

ACTIONS OF INDIVIDUAL FRUITS IN DISEASE AND CANCER PREVENTION AND TREATMENT 457

31. Biological Effects of Pomegranate (*Punica granatum* L.), especially its Antibacterial Actions, Against Microorganisms Present in the Dental Plaque and Other Infectious Processes 459

GLAUCE S.B. VIANA, SILVANA MAGALHÃES SIQUEIRA MENEZES, LUCIANA N. CORDEIRO, AND F.J.A. MATOS

- 32. Açaí (*Euterpe oleracea* Mart.): A Macro and Nutrient Rich Palm Fruit from the Amazon Rain Forest with Demonstrated Bioactivities *In Vitro* and *In Vivo* 479

 ALEXANDER G. SCHAUSS
- 33. Beneficial uses of Breadfruit (*Artocarpus altilis*): Nutritional, Medicinal and Other
 Uses 491

 NEELA BADRIE AND JACKLYN BROOMES
 - 34. Bioactive Compounds in Mango (Mangifera indica L.) 507 Sônia machado rocha ribeiro and andreas schieber
 - Health Benefits of Bitter Melon (Momordica charantia) 525

EDRALIN A. LUCAS, GERARD G. DUMANCAS, BRENDA J. SMITH, STEPHEN L. CLARKE, AND BAHRAM H. ARJMANDI

36. Pomegranate in Human Health: An
Overview 551

ANA FARIA AND CONCEIÇÃO CALHAU

37. Kiwifruit and Health 565

DENISE C. HUNTER, MARGOT A. SKINNER, A. ROSS
FERGUSON, AND LESLEY M. STEVENSON

- 38. Bioactive Chemicals and Health Benefits of Grapevine Products 581

 MARCELLO IRITI AND FRANCO FAORO
- 39. Soursop (Annona muricata L.):
 Composition, Nutritional Value, Medicinal
 Uses, and Toxicology 621
 NEELA BADRIE AND ALEXANDER G. SCHAUSS
- 40. Carotenoids in Vegetables: Biosynthesis, Occurrence, Impacts on Human Health, and Potential for Manipulation 645

 DEAN A. KOPSELL AND DAVID E. KOPSELL

41. Apigenin and Cancer Chemoprevention 663 SANJEEV SHUKLA AND SANJAY GUPTA

- 42. Goitrogen in Food: Cyanogenic and Flavonoids Containing Plant Foods in the Development of Goiter 691

 AMAR K. CHANDRA
- 43. Nutritional and Health Benefits of Root Crops 717

TRINIDAD P. TRINIDAD, AIDA C. MALLILLIN, ANACLETA C. LOYOLA, ROSARIO R. ENCABO, AND ROSARIO S. SAGUM

Index 729

FRUIT AND VEGETABLES IN HEALTH PROMOTION

1

Botanical Diversity in Vegetable and Fruit Intake: Potential Health Benefits

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1. OVERVIEW

Dietary guidelines are evolving from a primary focus on providing adequate intake of essential nutrients in order to prevent nutritional deficiency to an emphasis on reducing the prevalence of chronic diseases including cardiovascular disease, cancer, type II diabetes, and obesity [1-3]. During this transition, there has been a movement to broaden nutritional terminology such that nutrients are divided into two categories: essential and nonessential [4]. Essential nutrients are those substances that cannot be made in the human body but that are required for normal cellular function. The absence of essential dietary nutrients results in defined disease syndromes. Nonessential nutrients are not required for life, but they promote health [5]. Many chemical constituents of plant-based foods, i.e. foods which are plants or are derived from plants, are termed nonessential nutrients since they positively impact health; such phytochemicals are also referred to as phytonutrients.

Current dietary recommendations attempt to meet these nutrient requirements and are based on grouping foods using culinary definitions and knowledge of essential nutrient content. Despite the recognition that literally thousands of chemicals exist in plant-based foods and that they are likely to exert a wide range of bioactivities in living systems, dietary guidelines continue to provide limited direction about the specific types of plant-based foods that should be combined to render maximal health benefits. This situation exists for many reasons including: 1) the lack of a systematic approach by which plant-based foods are nutritionally classified; 2) the limited information regarding the chemical profile of each type of plant-based food; 3) the lack of data on the biological activities of plant chemicals; and 4) the paucity of information about the impact of plant-based food combinations on health outcomes. However, technological advances in chromatographic separation and chemical identification of phytochemicals are occurring at a rapid rate [6] and this progress is providing a large amount of information regarding the chemical composition of plantbased foods. This situation has created an unprecedented opportunity to expand our approach to dietary guidelines and menu planning.

The objective of this chapter is to raise the awareness of health care professionals about opportunities to extend dietary guidance about plant-based food intake beyond meeting the recommended servings/day of cereal grains, vegetables, and fruit by incorporating information about the botanical families from which the plant-based foods are selected for menu planning. The approach also has the potential to identify food combinations that reduce chronic disease risk. The remainder of this chapter addresses three topics: Section 2 details the rationale underlying the proposed use of botanical families, Section 3 provides evidence of the potential usefulness of this approach in an effort to reduce chronic disease risk, and Section 4 considers how botanical families can be applied to meal planning.

2. RATIONALE FOR USING BOTANICAL FAMILIES

2.1 Categorizing Vegetables and Fruit

The focus of this chapter is on vegetables and fruit, yet a careful inspection of how these terms are defined and the manner in which they are used reveals a surprising amount of ambiguity about the foods placed in each category. While the term 'vegetable' generally refers to the edible parts of plants, the categorization of foods as vegetables is traditional rather than scientific, varying by cultural customs of food selection and preparation. Moreover, in the biomedical literature, some foods are not classified as vegetables because of their content of starch, e.g. potatoes [7,8], without consideration that these foods, as well

delivery of a wide array of small molecular weight compounds in addition to carbohydrate. The categorization of foods as fruits is no less ambiguous. Strictly, a fruit is the ripened ovary of a plant and its contents. More loosely, the term is extended to the ripened ovary and seeds together with any structure with which they are combined. The botanical definitions for fruit are not uniformly applied in nutrition and dietetics; rather, cultural customs tend to determine what differentiates a fruit from vegetables and grains. Examples include: 1) the apple, a pome, in which the true fruit (core) is surrounded by flesh derived from the floral receptacle; 2) wheat, a fertilized ovule is comprised of an outer coat (testa) that encloses a food store and embryo; seeds of wheat, rice, and oats, which are botanically the fruits of the plant, are classified in food terms as cereal grains, i.e. they are neither vegetable nor fruit; 3) tomato is classified as a vegetable, though it is the ovary of the plant; and 4) legumes, which could be botanically classified as fruits, are sometimes considered vegetables, but if they are consumed as a staple crop, they are categorized in the meat food group. Together, these examples demonstrate the need to acknowledge how we classify plant categorizing and in them, bias ourselves to thinking certain foods are either more or less related, more or less diverse, or more or less likely to provide health benefit. To overcome this bias, we need to acknowledge the different ways we categorize plant-based foods, e.g. scientific and cultural perspectives. The remainder of this discussion is as inclusive as possible, as almost all the plant-based foods we eat could be classified as a fruit or vegetable depending on the organizational scheme. Inclusion allows us to consider what advantages might be gained from using a scientifically-derived botanical and taxonomic scheme as an additional filter through which plant-based foods are categorized.

as other staple food crops, are vehicles for the