

BEVERAGES IN NUTRITION AND HEALTH

NUTRITION ♦ AND ♦ HEALTH

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BEVERAGES IN NUTRITION AND HEALTH

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DEDICATION

In a stream we fish for trout, but in nutrition we fish for the truth. These chapters are the flies we use to fish for healthier lives. Let our wisdom guide our understanding of how to use this information appropriately. Special thanks to my father for indirectly helping me understand this on the Big Horn River in Montana and my mom.

—Ted

To Alf and Esther, thanks for the genes and the dreams.

—Norman

SERIES INTRODUCTION

The *Nutrition and Health* series of books has an overriding mission to provide health professionals with texts that are considered essential because each includes: (1) a synthesis of the state of the science; (2) timely, in-depth reviews by the leading researchers in their respective fields; (3) extensive, up-to-date, fully annotated reference lists; (4) a detailed index; (5) relevant tables and figures; (6) identification of paradigm shifts and the consequences; (7) virtually no overlap of information between chapters, but targeted, interchapter referrals; (8) suggestions of areas for future research; and (9) balanced, data-driven answers to patient/health professionals' questions that are based on the totality of evidence rather than the findings of any single study.

The series volumes are not the outcome of a symposium. Rather, each editor has been asked to examine a chosen area with a broad perspective, both in subject matter as well as in the choice of chapter authors. The international perspective, especially with regard to public health initiatives, is emphasized where appropriate. The editors, whose trainings are both research and practice oriented, have the opportunity to develop a primary objective for their book, define the scope and focus, and then invite the leading authorities from around the world to be part of their initiative. The authors are encouraged to provide an overview of the field, discuss their own research, and relate the research findings to potential human health consequences. Because each book is developed *de novo*, the chapters are coordinated so that the resulting volume imparts greater knowledge than the sum of the information contained in the individual chapters.

Beverages in Nutrition and Health, edited by Ted Wilson and Norman J. Temple clearly exemplifies the goals of the *Nutrition and Health* series. In fact, this is the most unique topic currently in the *Nutrition and Health* series. Containing 28 comprehensive chapters that examine beverages such as water, both tap and bottled; alcoholic beverages; teas, such as green, black, and herbal; juices, including orange, grapefruit, tomato, and cranberry; milks, both animal and plant-based, with and without probiotics; chocolate drinks; sodas; oral rehydration and nutritional support drinks, this volume is clearly the most comprehensive treatise available concerning the role of beverages in human health. As the editors and chapter authors remind the reader, beverage consumption is essential for life, and the care that is given to assure the safety of the water supply is extensively reviewed. Regulation of beverages on a global perspective is also included, with a most informative chapter on the beverage categories in Japan. This important text provides practical, data-driven resources in well-organized tables and figures that assist the reader in evaluating the nutritive value of the beverages discussed as well as the up-to-date science on the potential for beverages, especially in at-risk populations, to optimize health and prevent disease. The overarching goal of the editors is to provide fully referenced information to health professionals so they may have a balanced perspective on the value, or lack thereof, of many beverages that are routinely consumed.

Wilson and Temple, who have edited many important volumes in the past, have organized the volume into 10 areas of focus that reflect the beverages that are reviewed in this text. Unique areas of focus include regulatory and ethical aspects of beverage labeling and distribution. Certain of these chapters are controversial in their position; however, these are supported by extensive references to the published literature and national epidemiological surveys. Other chapters present the scientific arguments for or against the use of beverages such as probiotic-containing milks, herbal teas, bottled water, and soda. Each chapter includes a discussion of the chemical composition of the actives contained in the beverage, the physiology of the response to the beverage, the effects in populations that could benefit and/or be at risk with consumption, pertinent drug–beverage interactions, especially with grapefruit juice, coffee, alcohol, and other relevant drinks. At the end of each chapter there is a summary entitled Main Points for Primary and Clinical Review, which readers will find exceptionally helpful.

Beverages in Nutrition and Health sets the benchmark for providing the most critical data on the health role of the myriad of beverages available for human consumption. This important information is provided in extensive, well-organized tables and figures that are captured in the extensive index. The editors have taken special care to use the same terms and abbreviations between chapters, and provide clear reference to relevant material between chapters.

Understanding the complexities of the beverage industry, water treatment standards, and the regulations that are in place to assure the safety of the public certainly is not simple and the standards used can often seem daunting. However, the editors and authors have focused on assisting those who are unfamiliar with this field in understanding the critical issues and important new research findings that can impact their fields of interest. Drs. Wilson and Temple have carefully chosen the very best researchers from around the world who can communicate the relevance of specific beverages to nutrition's role in health. The authors have worked hard to make their information accessible to health professionals interested in public health, geriatrics, nursing, pharmacy, psychology, as well as nutrition-related health professionals. The well-referenced tables and figures, as well as the detailed references, add great value to this text. Many of the tables provide health professionals with guides to assessment of the nutritional content of the beverages, and also are helpful in assessing the potential for problems when regulations are not followed carefully. Several chapters include unique tables of information that were not available previously, such as the three-page table on the medical claims that have been made for chocolate. Discussions of the metabolic fate of the active constituents of several juices are included, and the epidemiological as well as clinical study literature is reviewed in each chapter.

In conclusion, *Beverages in Nutrition and Health* provides health professionals in many areas of research and practice with the most up-to-date, well-referenced, and easy-to-understand volume on the importance of beverages for optimal health. This volume will serve the reader as the most authoritative resource in the field to date and is a very welcome addition to the *Nutrition and Health* series.

Adrienne Bendich, PhD, FACN, Series Editor

FOREWORD

Most people, certainly including myself, do not read technical books from cover to cover. Thanks to a welcome invitation from the editors to write this foreword, however, I have done exactly that: read *Beverages in Nutrition and Health* from cover to cover. I have found it to be a rewarding, informative, and enriching experience. What makes a body of information of real value is when it reaches a wider audience. This is perhaps the real value of edited books such as this one. The authors have read, digested, and analyzed a vast number of studies and have synthesized the findings into a collection of reviews that are accessible to a broader audience of such people as health professionals, academics, and food scientists, the very people who are in most need of this information. Reading groups of related chapters for specific information will also be useful for readers with narrower interests, for example, those writing articles about topics covered in this book, or as part of a class, or in product development and marketing. The reference lists alone are a treasure trove.

Why a comprehensive book about the nutrition of beverages? There are, after all, plenty of academic nutrition books and plenty of books about the nutrition of foods generally. But there is a difference between eating and drinking, hunger and thirst. The need for water is distinct from the need for energy- and nutrient-bearing foods. Hydration and consumption of nutrients can be thought of as distinct aspects of nutrition. I can be hungry, but not thirsty, or I can be thirsty, but not hungry. Liquid vs solid form of the consumable is nearly, but not exactly, the key here: drinking a milkshake (liquid form) will satisfy hunger, while eating an apple (solid form) will reduce thirst at least somewhat. The same amount of sugar appears to have different effects on satiation in a soft drink vs a sweet solid dessert. Therefore, the question of beverages and health is not entirely subsumed under the question of food and health. This book is unique in that it constitutes a comprehensive review of an underappreciated nutritional subfield, namely the nutrition of beverages.

I list several categories of beverages, with different implications for interpretation. First are beverages that are extracts of whole foods. These extracts might contain less nutritional value than the whole food, but they also might extract just what is nutritionally important. Second are foods that arise only as beverages, including most importantly water itself. Also included here are extracts such as coffee, wherein the whole bean is rarely eaten, and a fermentation product: alcohol. Third are designer beverages, in which I include beverages for rehydration of the elderly or ill and those for rehydration and enhanced performance in sport and other activities demanding high-energy expenditure. In this category falls also soft drinks or liquid sugar. Besides comments on these three categories of beverages, the book offers one chapter on the sociology of drinking beverages and pieces of several chapters that comment on issues surrounding labeling and marketing of various beverages.

The book covers a wide variety of topics. It demonstrates the role that beverages have played historically in the evolution of modern day society. It goes on to highlight positive and negative effects of alcohol generally and of wine consumption more particularly. The health effects of cranberry, orange, and tomato juices are characterized. Cautionary notes are presented concerning the shelf life of orange juice. Interesting interactions are noted of grapefruit juice with some medications, either facilitating uptake or allowing lower dose for the same medical effect. Tea, coffee, cocoa, and herbal drinks are widely consumed and therefore have great potential to affect health. This potential is extensively reviewed with an emphasis on their phytochemical content and potential health benefits.

Especially enlightening is the examination of milk from cow, human, and soy sources, with a further consideration of probiotic organisms that are often added to cow's milk. The point is made by Friel that human milk has many characteristics associated with a "tissue," in that it is responsive to the biological needs of the infant. An interesting aspect of cow's milk is therefore that it must contain myriad substances aimed at the health of the calf. Vegetable milk substitute formulations, particularly soy milk, are interesting in that they avoid some of the potentially deleterious aspects of animal products (e.g., saturated fat and cholesterol), but with a possible tradeoff of more limited biological versatility.

Consideration of beverage impact on weight control, nutritional support, optimal physical performance, and rehydration is important in light of the explosion of products marketed for these purposes. A comprehensive review of potential effects of tap and mineral waters is included, wherein bottled water has also been the subject of much recent marketing effort. The discussion of the important role of marketing is carried forward in chapters by Jacobson and by Balay-Karperien, Temple, and Nestle. Marketing has played a major role in the explosion of soft drink consumption. Finally, the interaction of marketing, health claims, and health is decisively reviewed in chapters on the legalities of presentation of beverage content and labeling claims in the United States and Japan. In the light of nutritional and financial forces on beverage consumption, a final summary chapter asks whether it is possible to have a society in which beverages promote both a healthy economy and a healthy population.

A strength of this book is that most sections contain several chapters that provide complementary views on each topic. In several cases, there are chapters with different perspectives from a group or author in academia and another in industry. Although some chapters might be interpreted to paint an overly rosy picture, and some an overly glum picture, this strategy provides balance, providing competing views and interpretations, and therefore pushes scientific discourse forward. Despite extreme efforts by all authors for scientific objectivity, in the end scientific inference is an art; there are always unknown facts. This art proceeds by discourse. In my view, the essence of scientific discourse is putting facts, interpretations and opinions on the table; then discussing them. *Beverages in Nutrition and Health* is a step forward in scientific discourse.

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PREFACE

In this high-tech era of molecular biology and designer drug therapies, it remains a basic fact that good nutrition is the single most cost-effective way to improve the health and well-being of the greatest number of individuals on our planet (1,2). *Beverages in Nutrition and Health* is the first book dedicated to helping us discover how different beverages impact our basic nutrition and the risk of disease. This book also helps explain the potential value of these beverages for the promotion of optimal human health and well-being. In addition, it discusses developments in the formulation of beverages and the likely implications on human health.

During the last century, we have vastly improved the palatability and variety of beverage choices available to a population that is expanding in size, demands, and affluence. We have also seen many changes in the state of our health, sometimes for the better and sometimes for the worse. It has only been in the last 100 years that the Western diseases have become prominent in the cultures that have embraced the new diet of affluence (3), and beverages are very much a part of that diet of affluence.

Beverages have been an integral part of life since animals left the sea and moved onto dry land. The first period of human life occurs bathed in a sea of fluids; indeed as a fetus we begin to drink even before birth has occurred. Beverage consumption starts for most of us immediately after we are born with breast milk. For the rest of our lives, we will continue to require approx 1.2 mL of water per dietary calorie spent per day.

Until modern times, our choices of beverages were fairly limited and included water, alcoholic drinks, milk, and a few fermented milk products. The history of the human use of these drinks is discussed in Chapter 1 by Grivetti and Wilson. However, in recent years, there has been an explosion in the number of beverage choices available for acquiring our daily fluid requirements. This has been made possible by using such industrial processes as carbonation, processing to add ingredients, such as high-fructose corn syrup, vitamins, and minerals, and the development of new processing and preservation methods. But what has the impact of these changes been on our ability to obtain proper nutrition and maintain health? These impacts are the focus of *Beverages in Nutrition and Health*.

Alcohol has been a part of our diet for thousands of years. In recent years, we have come to a new understanding of how alcohol affects our health, and how the amounts and types of alcoholic beverages that increase or decrease mortality rates. This is discussed in Chapter 2 by Rimm and Temple. Research has revealed mechanisms by which substances in wine may have specific health benefits, a topic reviewed in Chapter 3 by Walzem and German.

Recent advances in ideas and methods for investigation available to researchers in the food sciences and medicine have provided new insights into how fruit and vegetable juices affect disease outcomes in both beneficial and potentially deleterious ways. Wilson, in Chapter 4, discusses how cranberry juice has been clinically determined to prevent

urinary tract infections and possibly other diseases. McGill, Wilson, and Papanikolaou, in Chapter 5, review how citrus juice consumption affords protection against various diseases, whereas Johnston, in Chapter 6, discusses how processing methods and storage may actually limit the availability of vitamin C and flavonoids from these same juices. The observation that some citrus juices may actually create harmful interactions with prescription drugs is another possibly important ancillary issue and is discussed in Chapter 7 by Kane. In addition, the intriguing associative link between tomato juice consumption and reduced risks of prostate and other cancers is explored by Hadley, Schwartz, and Clinton in Chapter 8.

How do coffee and tea and the caffeine and other substances they contain affect our health? The health effects of green and black teas are discussed in Chapter 10 by Afaq, Adhami, Ahmad, and Mukhtar. In Chapter 9, Tavani and La Vecchia discuss the general lack of associations between coffee intake and cancer. They also discuss the complex relation between coffee and heart disease. Chocolate was originally consumed in the form of a drink and its consumption in a liquid form remains popular. In Chapter 11, Schmitz, Kelm, and Hammerstone investigate this topic from a historical and health-related point of view. In Chapter 12, Weinberg and Bealer discuss the health effects of the caffeine that is a ubiquitous component of these and numerous other beverages. Finally, in Chapter 13, Craig discusses the health risks and some of the benefits that may be obtained from the increasing number of herbal teas that are available.

A variety of milks and milk products have been in the diet of many human cultures for millenia. Chapter 14 by McBean, Miller, and Heaney provides an optimistic view of how cow's milk can provide some degree of protection against osteoporosis, obesity, and heart disease, and discuss some of the claims and counterclaims that have emerged in regard to milk consumption. The potential of probiotic organisms in dairy and fermented dairy products to impact the health qualities of beverages is discussed by Heller in Chapter 17. Finally, because many persons avoid dairy products for health or religious reasons, substitutes are needed and Woodside and Morton, in Chapter 15, discuss the health qualities of the most commonly consumed substitute, soy milk.

Different beverages become more important as we pass from neonate to adult to elderly adult. Friel reviews the current state of affairs in the heated and continuing breast milk vs neonate/infant formula debate, fueled on one side by our traditional habits and on the other by commercial forces. As we enter middle age, weight management becomes a problem for many of us and Chapter 18 by Stubbs and Whybrow discusses how particular beverages can contribute to weight problems, whereas others may become part of the solution. Finally, Johnson and Glassman, in Chapter 19, look at what happens when an elderly person's diet is unable to meet his or her nutrient needs. They describe the often overrated value of nutritional support beverages for helping us achieve our required intake of vitamins and minerals.

Beverages have also evolved to meet specific physiological functions and needs for simple hydration. The topic of sports beverage content and effectiveness is reviewed in Chapter 20 by Maughan. Ramakrishna considers the factors that have helped oral electrolyte-carbohydrate rehydration therapies save more lives on our planet every year than any other medical treatment. In Chapter 21, our transition to living in an urbanized, and sometimes affluent, culture has created new opportunities for safe water and at the same

time created potential exposure to new water-borne pathogens, a topic discussed in Chapter 23 by Chauret. Our affluence and concern about water safety has led many to consume bottled water. In Chapter 20, Jamal and Eisenberg discuss some surprising facts regarding the quality and content of these products.

The consumption of soft drinks has recently been linked to a wide range of health problems, especially for children and young adults. This problem is discussed in Chapter 24 by Jacobson from the watchdog organization the Center for Science in the Public Interest. In that chapter, as well as in Chapter 25 by Balay-Karperien, Temple, and Nestle, the authors discuss marketing practices used to promote the consumption of these products.

Regulation of beverage content and marketing practice has been a part of American life for nearly a century since the establishment of the US Food and Drug Administration and the original “Snake Oil Laws” of the 1920s. These laws sought to limit the use of bogus health claims that manufacturers used to market their products. The fast growing popularity of “functional foods” (including beverages) has created a resurgence of concern and interest in the area of regulation. Chapter 27 by Krasny provides a current update of the status of these laws and regulations with regards to how beverages can be marketed in the United States. Other nations have similar laws, and in Chapter 26, Ohki, Nakamura, and Takano provide a review of the status of the recreational and tonic beverage industry in Japan and how the laws of Japan regulate beverage-health claims on products sold there.

In recent decades, researchers have made considerable progress in our understanding of possible associations between beverages and the Western diseases. This book provides an overview of the field. In that respect it continues from our previous books (2,3). Every one of us will undoubtedly (unless we want to die) continue to consume beverages and experience potentially beneficial or possibly detrimental effects related to our choices. Readers of this book will have a better understanding of how to optimize their beverage consumption for optimizing health. *Beverages in Nutrition and Health* is also intended to help the reader understand how current and probable future innovations in the beverage industry have the potential to affect our health in both positive and negative ways. At the risk of stating the obvious, beverage nutrition research is very much an ongoing activity. As a result, there are many contrasting views on aspects of the field, and the significance of some of these contrasts is discussed in the final chapter (28) by Jacobs, Temple, and Wilson. An important means of resolving these contentious areas is by debate. To some extent this debate can be found on the pages of this book. Accordingly, the editors make no apology if the reader finds that statements in one chapter may contradict those in another.

Ted Wilson, PhD
Norman J. Temple, PhD

REFERENCES

1. Wilson T. What types of nutrition research give the best results? *Nutrition* 2002;18:352.
2. Wilson T, Temple NJ, eds. *Nutritional health: Strategies for Disease Prevention*. Humana Press, Totowa, NJ, 2002.
3. Temple NJ, Burkitt DP, eds. *Western Diseases: Their Dietary Prevention and Reversibility*. Humana Press, Totowa, NJ, 1994.

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