Modern Dietary Fat Intakes in Disease Promotion

Nutrition and Health

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Modern Dietary Fat Intakes in Disease Promotion

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Series Preface

The *Nutrition and Health* series of books have had great success because each volume has the consistent overriding mission of providing health professionals with texts that are 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, inter-chapter referrals, (8) suggestions of areas for future research, and (9) balanced, data-driven answers to patient as well as health professionals questions which are based upon 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 the potential to examine a chosen area with a broad perspective, both in subject matter and in the choice of chapter authors. The editor(s), whose training(s) is (are) both research and practice oriented, has(ve) the opportunity to develop a primary objective for their book, define the scope and focus, and then invite the leading authorities 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.

Modern Dietary Fat Intakes in Disease Promotion, edited by Fabien De Meester, Sherma Zibadi, and Ronald Ross Watson, clearly exemplifies the goals of the *Nutrition and Health* series. The editors are leaders in their fields of expertise. Fabien De Meester, Ph.D., was until recently President and CEO of BNLfood. He recently decided to step down from his position at BNLfood to establish a new and innovative international platform of DMF (Development & Management Frontiers) companies focused on educational aspects of the Columbus Concept as the new standard in lipid nutrition. Dr. De Meester and Dr. Watson have published a recent volume for Humana Press entitled *Wild-Type Food in Health Promotion and Disease Prevention: the Columbus Concept*. Dr. De Meester has published over 50 research articles, patents, and communications on topics related to organic chemistry, enzymology, biochemistry, molecular biology, food science, and business, and has organized a series of international workshops on the Columbus Concept. Dr. Sherma Zibadi, M.D., Ph.D., has completed postgraduate training in medicine and has concentrated on metabolic diseases. Dr. Watson is a well-known editor of more than 65 volumes on a wide range of biomedically related nutrition topics over the past 25 years and has published over 250 peer-reviewed research articles. He is professor of Public Health at the University of Arizona and the director of the NIH-funded Alcohol Research Center.

The book chapters are logically organized to provide the reader with a basic understanding of the interactions between behavioral aspects of eating and the critical importance of what we

eat with specific emphasis on the types and qualities of the fats that are consumed. The volume is divided into five sections including the section on the behavioral aspects of eating; a second section on dietary fats; the third section examines the clinical relevance of fats and cardiovascular disease. The fourth section contains novel chapters on the potential for contaminants in fats and oils to increase risk of illnesses. The fifth section looks at dietary and pharmaceutical approaches to modify fat-induced disease and ill-health. Each section contains chapters that address treatment options as well as prevention strategies. This logical sequence of chapters provides the latest information on the current standards of practice for clinicians, related health professionals including the dietician, nurse, pharmacist, physical therapist, behaviorist, psychologist, and others involved in the team effort required for successful treatment of lipid disorders, cardiac and cerebrovascular diseases as well as conditions that adversely affect normal metabolic processes. This comprehensive volume also has great value for academicians involved in the education of graduate students and post-doctoral fellows, medical students and allied health professionals who plan to interact with patients with lipid disorders as well as those who are overweight or obese.

Cutting edge discussions of the roles of growth factors, hormones, cellular and nuclear receptors, adipose tissue, and all of the cells directly involved in fat metabolism are included in well-organized chapters that put the molecular aspects into clinical perspective. Of great importance, the editor and authors have provided chapters that balance the most technical information with discussions of its importance for clients and patients as well as graduate and medical students, health professionals, and academicians.

There are numerous chapters that are devoted to the treatment of obesity and its related comorbidities. These include an overview of current treatment options as well as a discussion of future treatments that are already in development. Critical to any weight reduction program is exercise, and there is a comprehensive chapter on the role of physical activity, exercise, and nutrition in weight control. The importance of a team approach to the treatment of obesity as a chronic disease is extensively discussed in chapters on social interactions, lifestyles as well as behavioral modification in the treatment of obesity. Unique to this volume are chapters that examine the development of obesity in Asian populations including an examination of factors including social class and genetics. Specific treatment modalities are reviewed in separate chapters on pharmacotherapies, combination therapies, potential for behavioral interventions, and the effects of different fat types on feelings of hunger and satiety. Each of these chapters presents an objective evaluation of the treatment and identifies the positives and negatives that have been seen during clinical studies as well as cumulative data derived from clinical practice.

There is a clear, data-driven message throughout the volume that there are important debates that are ongoing between researchers concerning the value of weight reduction, statins, fish consumption, consumption of meats, and the use of feedlots versus free-range feeding of domesticated animals. There are also thought-provoking chapters that examine whether all saturated fats are “bad” and whether there are sufficient studies to warrant a recommendation of consumption of conjugated linoleic acid; there are two novel chapters on the effects of modifying milk fats and/or other dairy constituents.

Of particular interest to the consumer and the patient are answers to their questions about food contaminants. Chapters examine the health effects of inadequate storage, processing, and/or cooking of foods including those with potentially oxidizable fats. Another chapter reviews the complex area of mycotoxins that have been in the human food supply since the beginning of civilization. Women of child-bearing potential are anxious to know about the benefits and/or

risks of eating fish that are rich in long-chain polyunsaturated fats, yet may also contain contaminants from the sea. Two in-depth chapters provide guidance to the reader in the value of fish consumption.

Detailed tables and figures assist the reader in comprehending the complexities of the chemistry of fats and their effects on eating behaviors. Modulators of eating responses and the role of Western diets in the development of the diseases associated with overconsumption of total calories, total fats, specific fats, and other dietary constituents are covered in the last section that also includes discussions of chronic fatigue syndrome, attention-deficit hyperactivity, insulin resistance and type 2 diabetes, micronutrients including selenium, folic acid, and vitamins B12 and B6; chapters include discussions of the relevance of bioactive compounds such as polyphenols, resveratrol, tocotrienols, phytosterols, soy, sulfur compounds from cruciferous vegetables, and other relevant plant constituents. Thus, this volume is focused on answering questions commonly asked by clients and patients about why some diets do not work and why some "professional" sources advocate certain products that are available over the counter but may not "work." The over-riding goal of this volume is to provide the health professional with balanced documentation and awareness that their clients'/patients' metabolic conditions are complex states that transcend the simplistic view of just losing a few pounds.

Hallmarks of the 29 chapters include bulleted key points at the beginning of each chapter, complete definitions of terms with the abbreviations fully defined for the reader, and consistent use of terms between chapters. There are more than 75 relevant tables, graphs, and figures as well as over 2,200 up-to-date references; all chapters include a conclusion section that provides the highlights of major findings. The volume contains a highly annotated index and within chapters, readers are referred to relevant information in other chapters.

This important text provides practical, data-driven resources based upon the totality of the evidence to help the reader understand the basics, treatments, and preventive strategies that are involved in balancing the fats in one's diet as well as within one's body. The overarching goal of the editors is to provide fully referenced information to health professionals so that they may have a balanced perspective on the value of various treatment options that are available today as well as in the foreseeable future.

In conclusion, *Modern Dietary Fat Intake in Disease Promotion*, edited by Fabien De Meester, Sherma Zibadi, and Ronald Ross Watson, 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 identifying and treating as well as providing strategies to prevent the development of chronic, serious metabolic diseases. 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.

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Preface

Modern Dietary Fat Intakes in Disease Promotion is the follow-up book to the original one published in 2008 under the running title *Wild-Type Food in Health Promotion and Disease Prevention: The Columbus Concept*, 2008 Humana Press Inc, ISBN 978-1-58829-668-9, E-ISBN 978-1-59745-330-1. It shifts focus from examining the beneficial effects of dietary fat intake to targeting the disease-promoting aspects of fat in the human diet.

A review of both disease promotion and disease prevention reveals many diet–health relationships and paradoxes reported regularly in the scientific literature. Perhaps the most frequently neglected family of *essential* nutrients in contemporary diets is polyunsaturated fatty acids or PUFAs. Their two subgroups omega-6 and omega-3 compete against each other for substrates, intermediaries, and end products in many biological pathways involved in physiological inflammatory processes. A consensus is growing in the modern scientific community about their public health burden through the promotion of chronic degenerative diseases whose incidences and severity continue to increase. Recent attempts at increasing dietary omega-3 fatty acids in foods to reduce disease have met with limited enthusiasm and acceptance by producers, retailers, and consumers—essentially due to the oxidative instability of these acids. Simultaneously, there is a return to plant and animal foods that reflect the wild standard—in other words, which include healthy omega-6/3 fatty acids with an ω6:ω3 PUFA ratio of 1:1 and/or a 25% proportion of ω6 highly unsaturated fatty acids (HUFAs). The goal is to have more balance in blood serum/plasma total lipids in association with a balanced mixture of naturally occurring antioxidant vitamins and minerals. This is the basis of the Columbus Concept, referred to as a new standard in lipid nutrition; it implies a reduction in the relative contribution of omega-6 fatty acids and favors an absolute increase in the contribution of omega-3 fatty acids to the modern dietary pattern.

Modern Dietary Fat Intakes in Disease Promotion was a challenging but critical book to edit and publish, as the twentieth century has seen food become readily available due to remarkable advances in agricultural and food-processing technologies. There are both benefits and adverse health consequences to removing cholesterol and omega-3 fats from natural foods, hydrogenating PUFAs from vegetable and fish oils/fats by chemical means, designing high-fat/carbohydrate empty-calorie diets, and spreading around non-biodegradable agrochemicals and pesticides. Such practices today appear to belong to a regrettable era of (1) free-market excitement, probably fueled by a lack of humility in recognizing the historical importance of humanity's adjustment to wild-type foods, and (2) over-confidence in scientific knowledge. Now, at the beginning of the twenty-first century, we have learned from the *cholesterol craze* that nature-designed foods may not need to be altered to improve their beneficial health effects, save perhaps in subgroups of the world population that are genetically predisposed to specific diseases and for whom a

nutrigenetic/genomic approach is more appropriate. Therefore, the twenty-first century appears to be focusing on nutritional sciences based on wisdom and the following basic principles:

1. Appropriate balanced intake of *essential* nutrients.
2. Energy intake = energy expenditure.
3. Whole foods and/or least-processed foods including the following:
   a. Non-chemically hydrogenated saturated and mono-unsaturated fats for cooking.
   b. Cold-pressed, non-refined, antioxidant-rich polyunsaturated oils for dressing.
   c. Extracted, refined, antioxidant-rich highly unsaturated oils for supplementing.

Modern Dietary Fat Intakes in Disease Promotion calls for a three-level grasp of the feed–food–fork value chain that includes the following reviewed critical aspects:

1. Behavior: social, cultural, economic, and educational aspects.
2. Composition: fat/protein, triglycerides/phospholipids, and omega-6/-3 ratios.
3. Contamination: peroxides, agrochemicals, and microorganisms.

Volume Contents

The first chapters include discussions of the behavioral aspects of eating. Wilczyńska-Kwiatek, De Meester, Singh, and Łapiński review nutrition as modified by behavior on brain function. They point out that the high-carbohydrate diets promoted by Western food guidelines are associated with clinical manifestations of affective disorders leading to depression. This disease is ranked by WHO as the leading degenerative disease in developed countries. A parallel is made between the increased intake of carbohydrate-rich, refined, grain-based fast foods and lower proportional intake of essential nutrients including omega-3 fats, antioxidant vitamins, and minerals. This observation led the authors to review the effects of dietary essential nutrients, primarily omega-3 fatty acids, on psychological function and mental health. The authors found strong evidence that EPA (eicosapentaenoic acid, C20:5ω3) is a promising dietary supplement for the prevention of mental decay in *healthy* individuals. Puri adds two papers on the potential role of modern lifestyles in myalgic encephalomyelitis and attention-deficit hyperactivity disorder. He shows how a deficiency of and/or imbalance between omega-6 and omega-3 at the tissue level—caused by Western diets and environmental (viral infection, organophosphate) factors—could lead to the rising prevalence of neuron-degenerative diseases in the Western world. Puri concludes that a change in diet should be considered by physicians prior to prescribing a synthetic drug to children and adults newly diagnosed with such disorders. Going and Hingle review data that correlate the health effects of diet and exercise. They define the beneficial influences of regular-to-moderate physical activity and moderate energy-dense, nutrient-rich diets to help control weight and regulate metabolism. O'Hara and Gregg emphasize that focusing health recommendations *only* on body weight (the weight-centered health paradigm) may not be health promoting. First, it is ineffective as a means to improving health or controlling body weight, and second, the attitudes, behaviors, and practices arising from such a paradigm are harmful to health and well-being. In particular, this paradigm is associated with dissatisfaction, dieting,

discrimination, and death. Dokken and Boucher test the hypothesis that excessive caloric intake of any kind versus any specific dietary components, including fats, explains the strong relationship between obesity associated with insulin resistance and type 2 diabetes. Dube and Stanton report on the social context of dietary behavior. They suggest that a multi-faceted approach targeting the home-cooking role model, increasing the availability of fruits and vegetables, and decreasing the availability of snacks is necessary to encourage lifetime healthy dietary practices in children and adults, lower the burden on health-care systems, and to reduce health disparities. Bartholomew and Jowers review strategies for modifying school-based foods and conclude that restricting access to calorie-dense foods by manipulating the price structures of their healthy counterparts (i.e., salad bars versus snack foods) has great potential for success. Singh, Rastogi, Goyal, Vajpayee, Fedacko, Pella, and De Meester review data suggesting that populations of developing countries are more sensitive to modern chronic diseases of affluence than are those of developed countries, suggesting a maladaptive process in the latter. They cite data showing that southeast Asians suffer more diabetes and coronary artery disease than do Caucasians, especially at younger ages, whereas their fat intake is less than 25% and obtained from plant rather than animal food. Vaghefi, Watkins, and Brown define how modern Western low-cost and time-saving diets are finding their ways throughout the planet through economic development and technological progress. The high fat content and the low nutritional value of such diets are discussed from the standpoint of their contribution to promoting diseases globally.

There are important chapters that review the composition of fats, oils, and other constituents in the diet. Vituru and Gormley explain how the oil-seed industry resulted from the ability to hydrogenate oil produced by extraction from seeds. This generalized processing of plant fats thereafter led to the appearance of *trans*-unsaturated fats and the disappearance of ω3 fats in the twentieth-century diet, a double trend that mirrors the dramatic global increase in modern degenerative diseases. Crawford, Lehane, and Ghebremeskel revisit health effects as modified by dietary animal fat. Feeding intensively reared, domesticated animals with growth-promoting oil grains has facilitated artificially fat animals presenting high fat/protein and increased omega-6/3 and triglyceride/phospholipid ratios in their carcasses. Using such animals as food has little in common with using wild animals or game historically as food—and is a possible modulator of human physiology from an evolutionary standpoint. Surai, Pappas, Karadas, Papazyan, and Fisinin point out that modern, land-based agriculture has washed essential micronutrients away from the food supply. Their review focuses on the removal of selenium as a striking example of a lost essential mineral in plants due to low soil pH and high concentrations of sulfur and phosphorus from the massive use of fertilizer. Enrichment of chickens, cattle, and pig feed with selenomethionine appears to be a sustainable transitory solution to the problem until soil composition can be restored, which is appropriate to animal/man feeding requirements. Sabetisoofyani, Larson, and Watson address the primary role of homocysteine in the inception and progression of endothelial dysfunction with accelerated atherosclerosis from both a dietary perspective (a deficiency in essential B vitamins) and a genomic perspective (mutations in cystathione β-synthase or 5,10-methylenetetrahydrofolate reductase). Ravnskov's review summarizes much of his lifetime effort at re-establishing the facts behind lipid nutrition. He concludes that cholesterol and saturated fats are not primary risk factors of cardiovascular disease, claiming that both the market place and limited understanding of research on fats and cholesterol have helped encourage previous misconceptions about cholesterol and heart disease. Ravnskov calls for an urgent revision of modern dietary guidelines based on a more educated approach to dietary lipids.

Jahreis and Hengst provide evidence that dietary fats do not represent a health issue per se. They suggest that fats obtained from ruminants fed grass-type, omega-3-rich fodder promote positive effects on established risk factors of CVD. Jacques, Leblanc, and Bergeron review the different options available to the dairy industry for increasing the understanding of both scientists and the lay public about the health roles of certain fats, particularly in terms of the many misconceptions about cholesterol and saturated fats. Modifications of milk-fat composition through cow feeding, enzymatic inter-esterification, and physical fractionation appear to be among the most promising options. De Lorgeril corroborates Ravnskov's review by summarizing recent cholesterol-lowering (absorption, synthesis) trials. He concludes with a similar recommendation that medical (in addition to food) guidelines should be carefully re-examined. He describes how reducing blood cholesterol increases atherosclerotic progression as measured by changes in carotid intima-media thickness. Sharma, Singh, and Katz explain the role of statins in modern and modernizing societies where blood cholesterol and triglyceride lowering has become a health-care priority, notwithstanding the potential side effects of such a preventive approach in what they refer to as *cardiovascular incapability*. Careful selection as to statin types and dosage appears to minimize their side effects on hepatic and renal functions, muscular impairments, and other physical properties while providing sought-after preventive benefits. Vasanthi, Kartal-Özer, Azzi, and Das summarize the recent literature on the efficacy and mechanisms of popular cholesterol-lowering dietary supplements. Zibadi, Larson, and Watson explore how obesity induces *maladaptive remodeling* of the cardiac muscle through alterations in myocyte shape and number and the extracellular matrix, resulting in cardiac hypertrophy and fibrosis. Leptin, an adipokine overproduced in obesity, appears to play a major role in the remodeling process and therefore to provide an avenue of treating obesity and other hyperleptinemic-related cardiac dysfunctions. Cordova et al. present the genetically modified rodent animal models that are developed to test the *maladaptive remodeling* hypothesis in the human obesity, cardiac structural, and functional changes relationship. Togni presents the *non-deficiency malnutrition syndrome* that results from the characteristic load of empty calories in advanced Western diets. In this context, he shows that plant extracts including polyphenols may be recommended as dietary supplements. Kelley, Hubbard, and Erickson review the currently available literature on the influence of conjugated linoleic acid (CLA) isomers on human body composition and tumorigenesis. They conclude that at present it is too early for CLA to be labeled as a health-promoting dietary supplement. Vemuri and Kelley warn that t10,c12-CLA may cause lipodystrophy, insulin resistance, non-alcoholic fatty liver disease, fat mass, and increased body weight in animals and humans.

A unique feature of this volume is the extensive information pertaining to major sources of food contaminants. Surai and Fisinin describe how food processing can affect dietary lipids and eventually promote ill-health effects when not protected from peroxidation. They emphasize the need for improving the conditions of food processing, storage, and cooking at a time when fat hydrogenation is increasingly perceived as detrimental to foods. Surai, Mezes, Fotina, and Denev report on the global endemic contamination of the feed–food–fork chain by fungal metabolites: mycotoxins. These food contaminants have detrimental biological effects on both animal and human health through their organ toxicity, including immunomodulation, neurotoxicity, mutagenicity, carcinogenicity, and teratogenicity. As 25% of the current world crop production is potentially contaminated, it is essential to find sustainable solutions to this fungal-persistent presence in the animal and human food chain. Sioen, De Henauw, and Van Camp review a conflict of interest in establishing dietary recommendations for fish as a source of long-chain, ω3 fatty acids. Modern agro-food and environmental practices translate into loading oceans with all kinds

of persistent and potentially toxic residues that accumulate in fish, in particular fish fats. Their statistical evaluation proposes a balance that can be approached in terms of nutritional benefits versus toxicological aspects of fish consumption. Covaci and Dirtu extend this discussion to naturally produced, organo-brominated compounds from marine micro-organisms present in fish and fish fats. Their review presents evidence that refined fish-oil dietary supplements might be a suitable alternative to fish consumption.

The Columbus Concept, defined by this book and the previous one, still has a long way to go to establish itself in the market place. The way lipid standards are taught and implemented in dietary and medical practices within culinary and medical schools, agro-food and pharmaceutical industries, and legislatures has to be changed. In the balance, the burden and cost of chronic diseases on both modern and modernizing societies is exploding, and currently there is no single critical environmental factor identified other than a dietary omega-6/3 PUFA imbalance.

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Acknowledgments

Modern Dietary Fat Intakes in Disease Promotion is positioned as a complementary rationale to the previously published *Wild-Type Food in Health Promotion and Disease Prevention: The Columbus Concept*. As with the previous volume, this book is the result of long-term, committed teamwork aimed at translating an ever more robust new standard in lipid nutrition into a market reality. In 2008, the Sixth International Congress on the Columbus Concept (ICCC) coincided with the Second Congress of the International Society of Nutrigenetics & Nutrigenomics (ISNN) in Geneva, Switzerland, where a satellite session on dietary PUFAs and cholesterol was organized and sponsored by the Columbus Paradigm Institute (www.columbus-concept.com), a BNLfood company. A special note of thanks should be extended to Artemis P Simopoulos from the Center for Genetics, Nutrition, and Health (CGNH, Washington DC) for her continuous support for the development of the Columbus Concept.

Dr. De Meester extends his most sincere gratitude to all contributors of this second tome on the Columbus Concept and confirms his uncompromised support to taking it to market for the health benefits of human societies at large. In this respect, he wishes to emphasize the outstanding contributions of Michael Crawford, Michel de Lorgeril, Ram B. Singh, Peter Surai, Basant Puri, Uffe Ravnskov, and Ronald Ross Watson to the Columbus venture so far.

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