Preface

Over the past several years we have noted a substantial increase in the amount and novelty of research involving omega fatty acids in health promotion and disease prevention. Therefore we felt it was appropriate to bring together experts involved in the research and its analysis with the focus on human health improvements and actions that should now be taken. Our goals included:

- **First** brain and heart disorders resulting from long-chain omega-3 (EPA+DHA) deficiency. They are one of the biggest challenges to the future human health. Such health costs are devastating health care and threatening economic instability.
- **Second** assessment of status is critical for public health. Thus professional need to modulate the relative tissue concentration of long-chain omega 3 to long-chain omega 6, in the population over a lifetime, a daunting challenge. Assessment of tissue status in an easy and economic method is needed.
- **Third**, for the many people consuming Western-type diet reaching a balance of omega 3 and omega 6 fatty acids in tissues fall far short of basic needs for health. Thus how to improve intake including via supplementation is a focus of the book and should be for health professionals.

On the Science behind the economics of the omega-6/3 fatty acids, William Lands states “we must not think that thunders cause rain” in an attempt to help rescue health care professionals addressing symptoms rather than causes of diseases. The potential saving is enormous and so is the current disaster in terms of spending. The change is at anyone’s reach. Lands’ chapter is conducive to the launch of his new “gadget” developed with the purpose in mind to help anyone reaching out with long-term health, i.e., prevention of diseases. Quoting him on the launch: “Finally, we have an ‘app’ to help you learn and teach others about the balance of Omega-3 and Omega-6 nutrients in the foods that you eat.” Clemens von Schacky reviews medical progress to date with the highly standardized Omega-3 Index and identifies a possible 8–11% ideal target range for future ill-health prevention at large and for immediate application in preventive cardiology, pregnancy and lactation, and depression. Claudio Galli emphasizes the very individual nature of the fatty acid status in humans with variables extending from age to physiological (mind ↔ body) conditions to lifestyle including diet/matrix, to geographical situation including circadian rhythm (chronobiology). Ram Bahadur Singh et al. look at the molecular relevance of omega-3 fatty acids in genetic expression (nutrigenetics); noncommunicable diseases are multifactorial and polygenic in nature—feeding genes the evolutionary dietary ratio of essential fatty acids (omega-6/3~1) may well be the determinant factor in silencing polymorphisms and phenotype expression on noncommunicable diseases. Jeffrey Anshel’s introduction, “the eye is not simply a window
to the soul, but actually is a mirror of the body” reflects on the essentiality as well as the urgency, to consider mind ↔ body approaches to preventing noncommunicable diseases including dry eyes and age-related macular degeneration. DHA—the information receptor—and EPA—the anti-inflammatory eicosanoid fatty acid—obviously are center to the theme here. Jan-Philipp Schuchardt and Andreas Hahn report in detail on the accumulating literature testing for a potential relationship between cognitive and mental development and dietary omega-6/3 fatty acids in pregnant and lactating mothers as well as in newborns and young infants. No wonder that current evidence no matter how encouraging suffers from the current inability of Western medicine to approach inception and development from a more holistic mind ↔ body angle, leaving mind-related confounding factors in the darkness. Nilufar Mossaheb et al. entertain us on psychotic disorders and the plausible disease-fatty acid (EPA and DHA) structure/function relationship. Their in-depth review of the subject identifies benefits in prevention rather than treatment of psychoses. Lena Burri and Kjetil Berge presents evidence in favor of marine phospholipids associated with astaxanthin as vector for omega-3 fatty acids in supporting cardiovascular and brain health; the identification of the endocannabinoid system and its modulation by omega-3 phospholipids opens doors to therapeutic potential. Asim Duttaroy, and Sanjay Basak reviews the critical aspects of the control of angiogenesis and discusses the peculiar properties of DHA to stimulating it in first trimester placental cells via increased synthesis of VEGF (whereas other fatty acids do not affect its expression) and, from there, the critical importance of DHA in (pre)pregnancy. Eric Lien gathers accumulating evidence in favor of health benefits (vision, resistance to respiratory diseases) associated with the non-discontinuation of dietary supplementation of DHA after the first 6 months of life. Olaf Christophersen questions the reason for the presence of high proportions of DHA in testes, retina, and brain, and extends on the critical importance of the omega-6/3 ratio in keeping germline cell mutation rates under control.

On the Market behind the economics of the omega-6/3 fatty acids, Jack Winkler starts with an appropriate definition of sustainability: “securing regular supplies of LC-Omega-3 sufficient to meet the nutritional needs of the global population.” He goes on estimating the nutrition gap from reviewing sourcing and from there perceives an urgent need for rationing and incrementing, pragmatically. Simeon Hill reveals current lack of knowledge—and therefore area of uncertainty—in how natural state of ecosystems does or may respond to exploitation. Taking Antarctic krill fishery as an example, he identifies the need for precautionary measures and responsible governance to serve sustainability. Jesse Trushenski and John Bowzer add promising perspectives in terms of harnessing the biosynthetic capacity of cultured fish to produce/deposit LC-PUFA in their tissue and, in that respect, the positive influence of noncompeting dietary saturated fats versus linoleic acid. Thomas Balle tells us about the capacity of the industry to enzymatically process omega-3 oil to highly concentrate forms, hence keeping pace with the growing markets of dietary supplements. Peter Lembke has a similar endgame objective with non-enzyme-based processes, i.e., supercritical fluid extraction and molecular distillation, resulting in outstandingly pure omega-3 oils. Kirsten Kramer and coworkers elaborate on current and developing technologies to accurately measure EPA and DHA in omega-3 oils. Clearly, the highly standardized GC remains gold, but
a high-throughput IR methodology is well on its way to cope with the growing demand for analyses. Michael Schneider rebounds on marine phospholipids as new generation of omega-3 fatty acids with high potential of market development for they outperform marine triglycerides in terms of their natural content of omega-3, their stability versus oxidation, their diet-to-tissue transfer, and their therapeutic potential. Wayne Coates reviews plant sources of alpha-linolenic acid and their contribution to the pool of LC-Omega-3 in humans or more broadly speaking to the economics of omega-6/3. Finally, Nigel Baldwin looks at the regulatory and labeling challenges—health claims—for omega-3 oils and derived products. In summary the books focuses on four key principles from international meetings reviewed in Chap. 1:

Brain and heart disorders resulting from LC-Omega-3 (EPA+DHA) deficiency are the biggest challenges to the future of humanity. Their associated costs are currently bankrupting health care systems and threatening wider economic instability worldwide.

Tissue concentrations of LC-Omega-3 (relative to LC-Omega-6) are the key variable for health—not dietary intakes. Thus biomarkers need to be standardized and used as public health targets and omega-3 Index 8–11, Omega-3 in HUFA 50%+ would protect 98% of the population.

Dietary intake of >1,000 mg LC-Omega-3 needed if consuming Western-type diet (but this depends on dietary %LA vs. ALA and ARA) as most people fall far short of these basic needs.

Shorter-chain omega-3 (ALA, SDA and EPA) have poor conversion to DHA in humans.

In conclusion the chapters support international conference and experts recommendations for action as to make tissue targets feasible, we urgently need to:

- Reduce LA and increase ALA in human and animal diets.
- Increase the availability of LC-Omega-3 (especially DHA) for human consumption in a sustainable, environmentally responsible way.

Finally the book’s and authors’ key objective is to provide knowledge for the readers’ education, key to achieving these changes.
Omega-6/3 Fatty Acids
Functions, Sustainability Strategies and Perspectives
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