

# PREFACE

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Among the major scientific research efforts of the recent period has been the recognition of the importance of the “essential fatty acids” (EFA). The profound effects of these special chemical entities, and equally profound effects of their deficit, are appreciated by a variety of disciplines, including (but not necessarily limited to) lipid biochemistry, physiology, nutrition, psychology, psychiatry, and, perhaps most intensely, by the neurosciences at large. Functions of the central nervous system, in particular, may be seriously compromised by deficits in the levels of these FA or the ratio (or balance) among major constituents. The role of the polyunsaturated fatty acids (PUFA)  $\alpha$ -linolenic acid (LNA; omega-3; n-3; 18:3n-3) and linoleic acid (LA; omega-6; n-6; 18:2n-6) and their metabolites has generated the most exciting findings. Health and medical implications related to these FA extend to visual development in infants, cognitive and emotional development, immunological responses, and cardiovascular health. Several foci of interest are worth noting at this point; foci that are represented in the chapters that follow and that mirror the directions in the field of FA research.

The experimental study of FA deficit has been characterized by investigations that utilize food deprivation or restrictions on nutritional intake, and by designs that have provided for dietary supplementation of the FA and/or their metabolites (especially DHA and its precursors EPA and LNA). Metabolic studies continue to address many of the unexplained complexities associated with the behavior performance observations in the laboratory. Among the questions of interest are: How do the EFAs get into the brain and other organs? What is the basis for the apparent selectivity of various organs, cells, and subcellular organelles for particular lipids and FA? Why is DHA (docosahexaenoic acid; 22:6n-3) concentrated in the brain? How can the adult brain maintain its DHA even when there is little support in the diet? How much can the metabolism of the precursors of DHA (e.g., LNA, EPA, etc.) support DHA composition in the brain in comparison to the incorporation of preformed DHA taken in the diet? In addition to their basic science value, these issues have practical implications for public health policy, such as the design of infant formulas.

The studies of supplementation have drawn attention to peripheral effects, such as the beneficial consequences of DHA in reducing cardiovascular mortality, reduction of immune and inflammatory responses, and influences in the management of diabetes. Supplementation effects also continue to be studied in order to better delineate complex behavioral patterns, with some critical insight on aggression, as but one example, in human studies.

Deprivation of n-3 in animal research has often been concentrated on the F2 offspring where demonstrable impairments in visual function and nonvisual cognitive behaviors have repeatedly been observed. Similar outcomes in human infants have been reported, with a pronounced increase in the frequency of randomized control trials being reported in the literature. Infant behavior appears to suffer quite seriously at the hands of nutritional deprivation, with some long-term followup studies suggesting that the early deficits appear to be maintained with functional loss in later years. The reader will soon discover that differences among outcome studies may be attributable, in part or in total, to variations in the test designs used to assess physiological or behavioral function. Often

the attempts to describe complex cognitive and emotional behaviors by use of learning and performance paradigms require a liberal interpretation of the results to support such assessments, which may be open to question or dispute.

Despite a number of known weaknesses, unexplained phenomena, and sorely needed pieces of information yet to be discovered, the present overview of activities in these areas allows one to justifiably conclude major advances in the chemistry and biochemistry of fatty acids have contributed to a considerable understanding about the metabolism and function of fatty acids and their impact on the physiology and behavior of whole organisms. The diversity of actions of fatty acids in many biological systems such as physiological, neurological, endocrinological, and immune begs for elucidation. The management of many chronic health issues will surely benefit from such knowledge in the near term. The purpose of *Fatty Acids: Physiological and Behavioral Functions* is to examine such a representative segment of the scientific aspects of this area, with topics ranging from molecular analyses to functional performance of physiological and cognitive behaviors. To assist the relative newcomer to the vocabulary of the field, we have provided a glossary at the end of the volume. Considerable additional helpful information is easily obtainable from many sources on the web, as even a brief search will indicate.

We hope that *Fatty Acids: Physiological and Behavioral Functions* will facilitate a consolidation of understanding among the separate disciplinary specialists, and will excite other investigators to enter this arena, so that even more dramatic advances and developments in chemistry, behavior, and health management will be forthcoming.

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