British Journal of Nutrition (2012), **107**, S1–S2
doi:10.1017/S0007114512001420

British Journal of Nutrition

PREFACE

Systematic reviews of the role of omega-3 fatty acids in the prevention and treatment of disease

This issue of the BJN provides a series of up to date systematic reviews on the pleiotropic effects of omega-3 fatty acids in health promotion and disease prevention. It is not yet 100 years since the studies of George and Mildred Burr provided the first evidence for the essential nature of specific types of fats. This was only made possible by the earlier pioneering work of EV McColllum who demonstrated by controlled studies that certain substances were necessary in small but measurable quantities for normal health in rats. He named these substances 'fat-soluble A' and 'water-soluble B', thus initiating the alphabetical nomenclature for vitamins. His first thoughts were that there existed one fat-soluble A and one water-soluble B, but further work in his laboratory and elsewhere soon indicated that there were numerous chemical entities involved. The prevailing view at the time was that fat represented mainly a source of energy and that its hydrophobic nature allowed energy to be concentrated better than what was possible with starches. However, prominent nutritionists indicated that animals could make fat from carbohydrates provided energy supply was in excess and ridiculed those that postulated other potential roles for fats. George Burr worked with Evans at the time and contributed in establishing that the elusive vitamin E was in the unsaponifiable fraction. Thus for a period of time Burr was drawn away from considering fatty acids as a potential novel essential dietary factor. In the process, they established that animals fed on a fat-free diet composed of casein, sugar yeast, and the unsaponifiable fraction of wheat germ and cod liver oils developed deficiency symptoms. Evans was searching for a new vitamin that could explain the observed skin changes, while Burr decided to explore the saponifiable components. This was a turning point in his path to discovery of essential fatty acids. He left Evans' laboratory at Berkeley moving to Minnesota. Burr took two cages of Long Evans rats with him. He also took Mildred Lawson who was in charge of the rat colony. The rest is history: soon after they established a laboratory and a rat colony, they announced (in 1929) that unsaturated fat was essential, and in 1930 that linoleic acid, and possibly other fatty acids, were also active in reversing the skin changes and in restoring growth seen in rats fed fat-free diets. Work over the following 60 years conclusively determined the essential nature of both linoleic and α-linolenic acids. Yet few considered the importance of these nutrients for human health until the past decades where the full significance of dietary essential fatty acids has been realized considering their role in the synthesis of prostanoids and the myriad of pleiotropic functions that relate directly and indirectly to them. The prevailing belief was deeply rooted that fats were only a concentrated source of calories that were easily stored and served as carriers of fat-soluble vitamins.

This issue of the BJN provides a glimpse of how fast this field has moved and serves to underscore the recent realization in human nutrition that the quality of the fat supply in terms of the parent *n*-6 and *n*-3 essential fatty acids as well as their longer chain, more unsaturated derivatives arachidonic, eicosapentaenoic and docosahexaenoic acids plays a vital role in human health from conception through every stage of human development, maturation and aging. In terms of health and disease the essential fatty acids and their derivatives interact at multiple levels, including cell membrane composition, metabolism, signal transduction and amplification, and gene expression. Furthermore they influence cell growth and differentiation, tissue repair, apoptosis and cell death and many physiological and pathological processes including immunity and inflammation. The observations made lead to a conclusion that long chain polyunsaturated fatty acids (arachidonic, eicosapentaenoic and docosahexaenoic acids) are conditionally essential nutrients for adequate growth, development and function in humans. Despite the impressive documentation of EPA and DHA related health benefits, the cellular and molecular mechanisms for their action are still insufficiently understood.

The evidence systematically reviewed in this issue of the BJN indicates that the effects of DHA and EPA are mediated, not only by their known effects on membrane biophysical properties and the corresponding electrophysiological correlates, but also by effects on cell growth, differentiation and functional maturation, and by modulating gene expression during development and at all subsequent stages of human life. Every tissue and every cell type is influenced not only by the genetically coded DNA-proteome but also by the dietary supply of essential fatty acids that determines how tissues and animals adapt to changing environments. The plasticity given by essential fatty acids is key to biological adaptations of every type. What is also clear from the articles herein, however, is that there remain multiple unanswered questions, and specifically there is a lack of high-quality population-based effectiveness trials in many areas crucial to human development and health. With global population ageing continuing apace and a concomitant increase in the number of individuals suffering from chronic diseases

including declining cognitive health, we must not delay in our search for cost-effective solutions.

Angel Gil
Department of Biochemistry and Molecular Biology II Institute of Nutrition and Food Technology "José Mataix Biomedical Research Centre, University of Granada, Avda Conocimiento s/n 18100 Armilla, Granada, Spain

Luis Serra-Majem
Department of Clinical Sciences, Faculty of Medicine, University of Las Palmas de Gran Canaria, 35016 Las Palmas, Spain

Philip C. Calder
Human Development and Health Academic Unit Faculty of Medicine, University of Southampton, Southampton SO16 6YD, UK

Ricardo Uauy
Institute of Nutrition and Food Technology University of Chile, Santiago, Chile and Nutrition and Public Health Intervention Research Unit, London School of Hygiene and Tropical Medicine, London, UK

British Journal of Nutrition