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International Conference on the Return of ω3 Fatty Acids into the Food Supply
I. Land-Based Animal Food Products. Bethesda, Md., September 18–19, 1997

The Return of ω3 Fatty Acids into the Food Supply
I. Land-Based Animal Food Products and Their Health Effects

Volume Editor
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The Center for Genetics, Nutrition and Health, Washington, D.C.

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Preface

Studies on the evolutionary aspects of diet suggest that major changes have taken place in our food supply since the agricultural revolution 10,000 years ago. The change in animal feeds that came along with the domestication of animals changed the composition of meats, particularly the content of essential fatty acids ($\omega_6$ and $\omega_3$ fatty acids). The meat of animals in the wild has less total fat, less saturated fat and more polyunsaturated fat with a ratio of $\omega_6$ to $\omega_3$ fatty acids of less than 2/1. The change became even greater with the advent of modern agricultural practices and agribusiness. Using grains to feed cattle instead of grazing and eating grass has led to increases in the $\omega_6$ fatty acids and decreases in the $\omega_3$ fatty acid content of meat. Similar changes have occurred in the composition of eggs, poultry, and in fish from aquaculture. Because wild plants have a ratio of linoleic acid to $\alpha$-linolenic acid of less than 1, the overall ratio of $\omega_6$ to $\omega_3$ was less than 2/1 prior to the agricultural revolution.

These changes have been widely reported in the scientific literature. Industry has recognized the need to alter animal feeds in order to reverse this change. Today one can find products consistent with the evolutionary aspects of diet in the American market, such as $\omega_3$-enriched eggs with the $\omega_6/\omega_3$ ratio closer to eggs under completely natural conditions. The $\omega_3$ enrichment was accomplished by adding to chicken feed $\omega_3$ fatty acids in the form of fish meal, or flaxseed or docosahexaenoic acid (DHA) produced from algae. This change is not limited to the US market. $\omega_3$-enriched eggs can be found in various parts of the world, in Canada, Brazil, Australia, Israel, Greece, Germany, and other European countries.

As a result of the above developments, and the recognition of the important role of $\omega_3$ fatty acids in growth and development and in health and disease, it was thought timely to hold the 1st International Conference on the Return of $\omega_3$ Fatty Acids into the Food Supply: I. Land-Based Animal Food
Products and Their Health Effects, at the Natcher Conference Center, National Institutes of Health in Bethesda, Md., Sept 18–19, 1997.

The conference, organized by the Center for Genetics, Nutrition and Health, was sponsored by the Center for Genetics, Nutrition and Health, the National Institute on Alcohol Abuse and Alcoholism-NIH, the National Institute on Child Health and Human Development-NIH, Designer Egg Producers’ Association International, ENRECO, Inc. (Essential Nutrient Research Company), F. Hoffmann-La Roche AG, Flax Council of Canada, Martek Biosciences Corporation, OmegaTech, Inc., Pilgrim’s Pride – Eggs Plus, Roche Vitamins Inc., the Iams Company, and the NutraSweet Kelco Company.

The conference, limited to 100 persons, was attended by scientists from Argentina, Australia, Belgium, Canada, France, Greece, Israel, Mexico and the US.

The first session was on the relationship of ω3 fatty acids in health and selected disease states. It began with presentations on the evolutionary aspects of diet with emphasis on the ω3 fatty acids. Dr. Simopoulos gave an overview of the evolutionary aspects of diet and pointed out that the ω3 fatty acids are found in every meal of the traditional Greek diet, as it was during the Paleolithic period when our genetic profile was established, which may account for the lowest rates of cardiovascular disease and cancer in the Greek population as noted in the Seven Countries Study. Dr. Eaton reviewed the evidence and the need to take into consideration the findings of the Paleolithic diet in the development of dietary recommendations. Dr. Leaf presented a thorough review of the role of ω3 fatty acids in cardiovascular disease, and Dr. Bruce Watkins presented rather provocative but persuasive data on the effects of polyunsaturated fatty acids on bone modeling and cartilage function. His work has important implications in the prevention of osteoporosis since ω6 fatty acids increase the production of prostaglandin E2 which in turn increases osteoclastic activity. A number of diseases are due to inborn errors of essential fatty acid metabolism. Retinitis pigmentosa is such a genetic disorder. Dr. Hoffman reviewed the data and described the ongoing intervention trials with DHA.

The second session consisted of presentations on the development of ω3-enriched products and the sources of ω3 fatty acids for animal feeds. Dr. Barclay discussed the production of DHA from microalgae and pointed out its beneficial use in animal feeds. He was followed by Dr. Abril who described the production of DHA-enriched poultry eggs and meat using the algae-based feed ingredient. Dr. Sim reviewed his studies in which poultry products are enriched in ω3 fatty acids by using flaxseed. Dr. Sim gave an extensive presentation of his clinical studies with ω3-enriched eggs and their beneficial effects.
in human subjects. This theme was continued by Dr. Van Elswyk who spoke on poultry-based alternatives for enhancing the \( \omega-3 \) fatty acid content of American diets. Dr. Kyle reviewed his experience with the production of DHA from single cell oil sources of DHA and the clinical studies with DHA-enriched infant formula.

Dr. Howe reviewed his data on \( \omega-3 \)-enriched pork and emphasized the need to balance \( \omega-3 \) enrichment without adversely affecting the taste of pork. He presented data indicating that feeds containing \( \omega-3 \) fatty acids can be withdrawn 4 weeks prior to slaughter without compromising the \( \omega-3 \) enrichment, yet preventing alterations in the taste of pork or its physical characteristics.

Dr. Mandel discussed the studies leading to the enrichment of beef with \( \omega-3 \) fatty acids, and Dr. Holub spoke on the natural enrichment of cow’s milk with DHA. This session ended with a presentation by Mr. Born, who discussed the issues involved in \( \omega-3 \)-enriched products as they move from research to retail.

\( \omega-3 \) fatty acid-enriched products are not limited to human consumption. Therefore, two papers discussed the status of \( \omega-3 \)-enriched products in companion animal nutrition. Dr. Hayek presented studies with \( \omega-3 \)-enriched products showing improvement in various disease states, and Mr. Stitt presented data on the rapid absorption and elongation of \( \alpha \)-linolenic acid in dogs.

The fourth session was on the Scientific and Policy Aspects. Mr. Newton gave an overview on the status of Global Food Fortification Perspectives of Long Chain \( \omega-3 \) Fatty Acids. Dr. Holub discussed the \( \omega-3 \) fatty acid status in Canada. Canada has specific recommendations for \( \omega-3 \) fatty acids. Dr. Howe discussed the situation in Australia and Dr. Lee discussed the situation in the US. The US does not have dietary recommendations for \( \omega-3 \) fatty acids and the nutrition label does not separately list the \( \omega-6 \) and \( \omega-3 \) polyunsaturated fatty acids.

There was an extensive discussion on these issues. Particularly the need to include \( \omega-3 \) fatty acids in infant formula.

Dr. Simopoulos addressed two issues: (1) dietary recommendations and genetic variation, and (2) the need to redefine food safety to include food composition. Dr. Simopoulos spoke on the need to redefine the dietary reference values by taking into consideration not only the evolutionary aspects of diet, but also genetic variation. She used as an example the folate data. The dietary reference values for folate, as for other nutrients, are targeted to the general and supposedly normal population, and do not take into consideration consumers with special needs, such as those with genetic abnormalities or diseases. In the case of folate, 5–15% of the general population are homozygous for a thermolabile variant of 5,10-methylenetetrahydrofolate reductase.
(C677T) which causes mild hyperhomocysteinemia and is positively associated with the development of vascular disease and the risk of neural tube defects. Individuals with C677T have lower red cell folate concentrations and the current reference daily intake is not adequate since they have increased needs. It is possible that other genetic variants interact with particular nutrients, which casts doubt on the validity of assuming ‘normality’ for nutrient requirements in any population.

There is a need to redefine food safety. Food safety should not be limited to avoiding contamination with bacteria, viruses, protozoa, and toxins. Food safety must take into consideration changes in food composition. This principle is even more important when we have a food supply, such as the current Western diet, that has an imbalance in the ω6 and ω3 essential fatty acids and is high in trans fatty acids, increasing the risk for chronic diseases. Furthermore, when new nutrients are introduced into the food supply whose structure has been altered, i.e. trans fatty acids, or the ratio of essential nutrients has changed as is currently the case with the ω6 and ω3 fatty acid imbalance, the short- and long-term effects and safety need to be established.

The adverse effects of trans fatty acids on lipid metabolism and the lack of ω3 fatty acids in infant formulas highlight the importance of taking into consideration nutritional effects on both growth and neurological development and on chronic disease processes when designing new food products. Just as we are required to develop Environmental Impact Statements whenever environmental changes are contemplated, we should be required to develop Nutritional Impact Statements for novel foods relative to their safety in growth and development and in health and disease, particularly chronic diseases.

This conference was the first to bring together scientists from academia, government and industry to discuss the return of ω3 fatty acids into the food supply. The published proceedings cannot capture the thoughtful discussions and the excitement of active participation that took place within the scientific sessions and during the social events, but the interested reader will find the papers stimulating, groundbreaking, and useful.

These proceedings should be of interest to physicians, veterinarians, nutritionists, dieticians, food technologists, agriculturalists, food policy-makers, consumer advocates, lawyers and entrepreneurs.

Artemis P. Simopoulos