Asian Functional Foods

This third volume in the Nutraceutical Science and Technology Series covers a wide range of Asian functional foods that have healthy benefits. The book pays particular attention to regular Asian foods, with respect to sources, history, important components, properties, health benefits, possible mechanisms and some clinical and epidemiological information.

Healthy and healing foods have a long history in Asian cultures. For example, the Chinese and Indians have long known that food and medicine come from the same source, can prevent and treat ailments, and will help a person to live a healthy life. One of the most remarkable Asian contributions to civilization is the wealth of information collected on the uses of natural substances, plants, chemicals, and animals in treating illnesses. No doubt, tracing back to ancient time, both the interrelationship between food and medicine has been an important concept.

Today, Asian countries have a wide range of nutritional needs, with some countries wrestling with problems of undernourishment and others suffering more from health problems associated with over-nutrition. In fact, this trend extends outside Asia to many Western countries where problems of malnutrition and overnutrition coexist.

The result of these problems is that many affluent societies are now faced with new rises in many chronic diseases such as obesity, cancer, and heart problems while the cost of medical services continues to increase. Therefore, development of Asian functional foods not only has great business opportunities within Asian nations, but also exerts significant impact on the health and well-being of general populations around the world.

Asian Functional Foods consists of 21 chapters, authored and co-authored by as many as 41 well-known scientists across the continents. The subjects cover a range of functional foods, including Asian herbs and tea, seafoods, red meat, fruits and vegetables, seeds and nuts, garlic, onion, sugar cane, and even fermented soyfood. The discussions also explain a food’s developmental history and its local ethnic culture. From foods and beverages, supplements and new medicines, the book also includes information on market opportunities and emerging food technologies. There is even a chapter reporting research in applying Western-developed fat replacers to improve the functional and nutritive values of Asian foods.

This book is international in scope, broad and timely in subject coverage. It is fairly comprehensive at nearly 650 pages, and each chapter has an extensive list of references for additional learning. Therefore, the volume should serve as a good reference book and a valuable addition to a reader’s personal library.

Like many other new books, there are some aspects that could have been better treated during writing and editing. In this reviewer’s opinion, these problems include lack of cohesiveness and logical order in chapter arrangements, inconsistency in coverage and styles among the chapters, and lack of link words among chapters. For example, chapter 19 is about Japanese miso and chapter 20 about Korean doenjang. Although the two chapters cover the same group of food products—fermented soy paste that can be traced back to ancient Chinese jiang or chiang—each chapter is rather dependently described, and there are no linking words about each other in the text orpreface.

In terms of content, I found it problematic that there was no single chapter covering Asian functional foods derived from cereals and grains. The largest problem, however, was the lack of a general definition about Asian functional foods and suggested classification.

In spite of these problems, however, it is a good reference book. I have no hesitation in recommending this book to food scientists, food technologists, nutritionists, biochemists, engineers, and business developers in foods, beverages, pharmaceutical, and related fields. In fact, I would recommend it to anyone who wants to learn about Asian functional foods, their functional components and health benefits, regardless of whether he or she is a newcomer or longtime professional in the field.

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Improving the Fat Content of Foods

The book focuses on the health problems associated with saturated fats in food and the potential health benefits of increasing mono- and poly-unsaturated fat contents. Practical strategies are presented for improvement of the fat content of food products.

The text is divided into three distinct sections: Part I Dietary Fats and Health, Part II Reducing Saturated Fatty Acids in Food, and Part III Using Polynsaturated and Other Modified Fatty Acids in Food Products.

The topics covered in Part I include health problems associated with saturated fatty acid intake; dietary fatty acids, insulin resistance and diabetes; lipid–gene interactions, diet and health; health benefits of monounsaturated fatty acids; health benefits of polynsaturated fatty acids (PUFAs); dietary fat and obesity; specific fatty acids and structured lipids for weight control; and conjugated linoleic acids (CLAs) and health.

Part II considers the role of lipids in food quality; gaining consumer acceptance of low–fat foods; optimizing dairy milk fatty acid composition; optimizing goat milk and cheese fatty acid composition; reducing fats in raw meat; producing low-fat meat products; the use of fat replacers for weight loss and control; testing novel fat replacers for weight control.

Part III contains information on developing products with modified fats; using PUFAs as functional ingredients; new marine sources of PUFAs; production of PUFAs from plant sources; modifying hydrogenated fats; and novel fats for the future.
Fast fatty acid analysis

Sub-microgram quantity of vegetable oil dissolved in dimethyl carbonate (DMC) plus nanopowder titanium silicon oxide powder subjected to pyrolysis at 500°C for 10 s yielded solely fatty acid methyl esters (FAME). The pyrolysis was conducted with a resistively heated filament pyrolyser interfaced to a GC-MS apparatus to allow direct analysis of evolved FAME. Comparison of the procedure with that of classical boron trifluoride-methanol technology showed that the DMC method had lower precision and was biased toward lower levels of polyunsaturated fatty acids, but was more advantageous in terms of reduced sample treatment, waste generation and risk factors of employed chemicals.

Monitoring enzymatic interesterification

Blends and lipase-catalyzed interesterified fat samples in liquid form were measured by attenuated total reflectance based FT-IR and transmission mode based FT-NIR at 70°C. Calibrations of FT-IR and FT-NIR for conversion degrees (evaluated by triglyceride profile), solid fat contents (SFC) and dropping points of interesterified samples were carried out by using partial least-squares regression. High correlations were obtained from cross-validations of the data estimated by FT-IR, FT-NIR and the conventional analytical methods except for correlations between FT-IR and SFC profiles. FT-NIR spectroscopy coupled with transmission mode showed the highest correlations and may have a great potential for implementation as an on-line control for monitoring the enzymatic interesterification process.

Mechanism of base-catalyzed interesterification

The mechanism of base-catalyzed interesterification carried out at low (<100°C) temperatures has been re-examined with due regard to experimental observations. The proposed mechanism assumes that the reaction of a base with the oil will eventually lead to the abstraction of an α-hydrogen from a fatty acid moiety and that the enolate anion so formed will act as the catalytic intermediate. This enolate can then re-abstraction a proton from the hydroxyl group of a partial glyceride resulting in alcohoholate attack of the carboxyl group and leading to a new ester and a glycerol anion that then regenerates a new enolate anion. Reaction with water leads to catalyst inactivation due to conversion of the enolate anion to an unreactive fatty acid or soap and a partial glyceride. Thermal inactivation of the enolate intermediate is assumed to be through the formation of catalytically inactive β-keto esters. The accelerating role of acetone can be explained. Theoretical calculations on the enolate-alcohol system at PM3 level are also in agreement with the enolate mechanism.

Tocopherol stabilization of stripped vegetable oils

Pure tocopherols-α, β, γ, and δ- in their naturally occurring proportions in soybean and sunflower oils were added to the triacylglycerols of soybean and sunflower oils stripped of all minor constituents. The oils were subjected to accelerated autoxidation in the dark and accelerated photoxidation in the light. Oxidation levels of aged oils were measured by the formation of peroxides and volatile compounds and by flavor analysis. Results from substituting the tocopherol profile from one oil type to another varied depending on oxidation in either light or dark. Thus the tocopherol profile typical of soybean oil was found to be signficantly more effective in inhibiting autoxidation in the dark; that typical of sunflower oil inhibited light oxidation significantly more than the soybean tocopherol profile.

Nitratated unsaturated fatty acids in cell signaling

Mass spectrometric analysis of human plasma and urine revealed abundant nitrated derivatives of all major unsaturated fatty acids as well as their nitrohydroxy derivatives. Specific identification of 9- and 10-nitro-9-cis-octadecenoic acid (OA-NO₂) was made in plasma, red blood cells (RBC) and urine of healthy humans. Plasma and RBC free and esterified OA-NO₂ concentrations were determined. OA-NO₂ is a potent ligand for peroxisome proliferator activated receptors (PPARs) at physiological concentrations. A dose-dependent activation of all PPARs was found with PPARγ showing the greatest response at 100 nM. OA-NO₂ also induced PPARγ-dependent adipogenesis in 3T3-L1 preadipocytes. Nitrated fatty acids comprise a class of nitric oxide-derived, receptor-dependent, cell signaling mediators that act within physiological concentration ranges.

Diabetes impact on EFA status

Diabetic pregnant women and the infants they delivered were compared to controls. The type 1 diabetes group had lower plasma and red blood cell (RBC), choline phosphoglyceride (PG) docosa-hexaenoic acid (DHA) and RBC ethanolamine PG DHA than controls: type 2 diabetes subjects had lower choline PG DHA. Cord arachidonic acid (AA) and DHA were lower in plasma type 1 and RBC type 2 choline PG, and in cord RBC ethanolamine PG in both types of diabetes. Either type of diabetes compromises RBC DHA and cord plasma and RBC AA and DHA. The association of these two fatty acids with insulin sensitivity and results obtained may explain the higher incidence of insulin resistance and diabetes in the offspring of diabetic women.

Leptin blockade favors obesity
Activated STAT-3 (a transcription factor) in rat white adipose tissue (WAT) was found to be less on a 60% high fat diet than on 4% fat, despite a 10-fold higher plasma leptin level. mRNA of the postreceptor leptin inhibitor, suppressor of cytokine signaling-3, increased 22-fold in WAT, while leptin receptor mRNA gradually disappeared, suggestive of leptinergic blockade at both postreceptor and receptor levels. Activated STAT-3 and AMP-activated protein kinase, and the mRNA of lipooxidative enzymes, peroxisome proliferator-activated receptor-coactivator-1α, and uncoupling protein-1 and -2 were increased in WAT. Results suggest that the storage of surplus energy in WAT and the development of diet-induced obesity require the blockade of a latent leptin-stimulated caloric sump in white adipocytes.

Human milk trans fat


Milk fat from women in the United States as in Canada contains concentrations of trans fatty acids that exceed levels found in other countries. The mean total trans fatty acid concentration was determined to be 7.0 ± 2.3% of the total fatty acid component with 18:1 accounting for 5.1 ± 2.0%. The bulk of total 18:1 comprised, in decreasing order of concentration, the Δ9t, Δ11t, Δ9t, and Δ12t isomers. The origin of these acids is considered to be from partially hydrogenated vegetable oils and ruminant fat in the diet.

CD acids in CLA-treated muscle


Examination of the fatty acid composition of the total lipid content of conjugated linoleic acid (CLA) treated (dietary or in vitro) human vascular smooth muscle cells revealed a significant isomer-specific formation of conjugated dienoic (CD) metabolites of CLA. Studies were made with administered cis-9, trans-11 CLA, trans-10, cis-12 CLA and trans-9, trans-11 CLA. Different (CD)16:2/CLA ratios between various CLAs administered were found to be influenced by their configuration of the double bonds. The suggestion is that the effects of CLA in vascular cells may be mediated by CLA itself as well as by its conjugated CD metabolites. Availability of highly purified CD metabolites is needed to allow more definitive studies.

Arachidonic acid production in GM soybeans


Seed-specific expression of the genes encoding Δ6-desaturase, fatty acid elongase, and Δ5-desaturase from Mortierella alpina as well as the down-regulation of an endogenous gene for Δ15-desaturase in genetically modified (GM) soybean was achieved, and resulted in the seed accumulation of several fatty acids not normally produced in native soybean. These acids included γ-linolenic acid, eicos-8, 11-dienoic acid, δhomo-γ-linolenic acid and arachidonic acid, and accounted for up to 11.0% and 8.4% of the total fatty acids in GM histodifferentiated somatic embryos and GM mature seeds, respectively. The ability to synthesize these novel fatty acids was determined to be inheritable. The possible engineering of oilseed crops to produce very long-chain is considered to be feasible.

Lipoxygenase gene regulates multi traits


A hybrid procedure to map loci involved in complex traits is described that takes advantages of the strengths of forward and reverse genetic approaches. Genotypic and expression data in a segregating mouse population were integrated and revealed that clusters of expression quantitative trait loci (QTL) linking to regions of the genome accurately reflect the underlying perturbation to the transcriptional network induced by DNA variations in genes that control complex traits. Genes controlling clusters of expression and clinical QTL can be mapped directly by matching patterns of gene expression in a segregating population with expression responses induced by single-gene perturbation. Results show 5-lipoxygenase as underlying previously identified QTL in an F2 cross between strains and has pleiotropic effects on body fat, lipid levels and bone density.

DAGAT varying activity in plants


Incubation of microsomal fractions of olive an oil palm gave increased labeling of triacylglycerol at 30°C compared to 20°C that was accompanied by a buildup of diacylglycerol (DAG) radioactivity in olive, but not in oil palm. This observation was considered to indicate that the activity of DAG acyltransferase (DGAT1) was becoming limiting in olive. Specific inhibition of DAGAT with 2-bromooctanoate and examination by metabolic control analysis showed that the enzyme had a flux control coefficient under the test conditions of 0.74 in olive but only 0.12 in oil palm. Findings suggest important differences in the regulation of lipid biosynthesis in different plants and imply that changes in DAGAT activity are unlikely to affect oil accumulation in oil palm crops.

Event specific PCR detection of GM corn

Yang, L., S. Xu, A. Pan, C. Yin, K. Zhang, Z. Wang, Z. Zhou, and D. Zhang. Event Specific Qualitative and Quantitative Polymerase Chain Reaction Detection of Genetically Modified MON863 Maize Based on the 5’-Transgene Integration Sequence, J. Agric. Food Chem. 53:9312-9318, 2005. The 5’-integration junction sequence between the host plant DNA and the integrated gene construct of the genetically modified (GM) corn MON863 was determined by means of thermal asymmetric interlaced-polymerase chain reaction (PCR); the specific PCR primers and TaqMan probe were designed based upon the revealed 5’-integration junction sequence. Using these primers and probes, conventional qualitative PCR gave a limit of detection (LOD) at 0.1% in 100 ng of corn genomic DNA; quantitative TaqMan real-time PCR assay gave the LOD and limit of quantification as 8 and 80 haploid genome copies, respectively. Results indicated that the event specific real-time PCR detection systems were reliable, sensitive and accurate.