Omega-3 event focuses on functional changes

About 300 people attended the Second International Conference on the Health Effects of ω-3 Polyunsaturated Fatty Acids in Seafoods, sponsored by several U.S. government health organizations and fishing industry interests from Norway, Iceland, Denmark, the United Kingdom, and the United States. The meeting was organized by Stuart Barlow, of the International Association of Fish Meal Manufacturers; Robert Kifer, of the National Marine Fisheries Service (U.S. Department of Commerce); Roy Martin, of the National Fisheries Institute; and Artemis P. Simopoulos, of the American Association for World Health. The conference opened with remarks by representatives from the Food and Agriculture Organization of the United Nations and the World Health Organization. Simopoulos gave an overview of research advances in the field since the last conference on the health effects of polyunsaturated fatty acids in seafoods, held in 1985. Prior to the 1985 international conference, she said, research focused on the modification of the eicosanoid system by dietary ω-3 fatty acids. Current research emphasizes the functional changes in the cell as a result of ω-3 fatty acid contributions to membrane phospholipid composition.

At a news conference, Simopoulos criticized the National Institutes of Health for cutting back on research into the health effects of ω-3 fatty acids since 1987, noting that the National Heart, Lung and Blood Institute was virtually alone among the NIH institutes in declining to serve as a conference cosponsor. She accused the institute of placing disproportionate emphasis on serum cholesterol, which she called a secondary factor for the disease.

Essentiality of omega-3 fatty acids

Panel A: Growth and Development in Infants. Co-chairpersons: Susan E. Carlson, University of Tennessee, Memphis, Tennessee, USA; and Norman Salem, Jr., National Institute of Alcohol Abuse and Alcoholism, Bethesda, Maryland, USA. Speakers: Carlson; Manuela Martinez, Hospital Infantil Vall D’Hebron, Barcelona, Spain; Jean-Marie Bourre, INSERM, Hospital Fernand Widal, Paris, France.

Research over the past two decades has established docosahexanoic acid (DHA), one of the major fatty acids found in fish oil, as a major component of neural and retinal membrane phospholipids; DHA-deficient diets fed to experimental animals lead to learning and visual deficits and abnormal electroretinograms. Carlson said that infant formulas, particularly those for preterm infants, should contain DHA. She cautioned, however, that supplementation of infant formulas with fish oil should be evaluated in relation to its effect on arachidonic acid, especially since preterm infants tend to have low levels of red blood cell and plasma phospholipid arachidonic acid.

Martinez has also recommended ω-3 fatty acid supplementation for children with Zellweger syndrome (ZS), a peroxisomal disease that can cause severe mental retardation and blindness. These children have very low brain levels of several long chain fatty acids, including DHA.

Bourre showed that animals fed on a low α-linolenic acid (or a high linoleic acid) diet incorporate 22:5n-6 (docosapentanoic acid), rather than the physiologically normal 22:6n-3 (docosahexanoic acid), into brain cell, organelle and various organ membranes. He also noted that the speed of recuperation from these anomalies is extremely slow for brain cells, organelles and microvessels, in contrast with other organs.

Panel B: Requirements of Adults and Elderly. Speakers: William E. Connor, Oregon Health Sciences University, Portland, OR, USA; Kristian S. Bjerve, The University of Trondheim, Regional Hospital, Trondheim, Norway; Daniel Rudman, Clement J. Zablocki Veterans Administration Medical Center, Milwaukee, WI, USA; and Jan I. Pedersen, Institute of Nutrition Research, University of Oslo, Norway.

Based on long-term ω-3 fatty acid deficiency studies in monkeys, Connor concluded that ω-3 fatty acids must supply certain nutrients at certain developmental stages, and recommended the ratio of ω-6 to ω-3 fatty acids should range from 4:1 to 10:1.

Bjerve presented data on ω-3 fatty acid deficiency in ten humans on long-term parenteral or gastric tube-feeding regimens, and urged manufacturers of preparations used in such regimens to include adequate amounts of ω-3 fatty acids. When assessing the RDAs of ω-3 fatty acids, he said, the following criteria should be addressed: the minimal dietary intake necessary to avoid frank disease; the optimal dietary intake ensuring health, cell function and optimal protection against disease and stress; and the therapeutic dietary intake to be recommended in diseases beneficially affected.

Rudman suggested that ω-6 and ω-3 fatty acid consumption throughout life could influence several signposts of aging, in particular those affecting brain and photoreceptor cells.

Pedersen proposed that a conference should be convened to propose RDAs to be used in official dietary recommendations. Based on published data, Pedersen proposed that linoleic acid should provide 5% and linolenic acid, 1%, of the total energy intake. Alternatively, he said, recommendations could be made in absolute amounts, such as milligrams per kilogram body weight.

Michael Crawford, of the Zoological Society of London and chairman of the session, urged scientists to think differently about lipids in nutrition. He noted that there are fairly tight dietary requirements for proteins, and that, in turn, there is a large degree of conformity in amino acid composition of protein among several species. In contrast, there is a wide range of fatty acid consumption and utilization within which animals can function. He suggested that lipids might play a role in the evolution of species. He also suggested that different Recommended Daily Allowances (RDA) for lipids may be needed for various stages of the development.
lifespan. Noting the “sophistication and complexity of membrane lipids,” Crawford said that “physical growth is not the parameter for a species as complicated as Homo sapiens.”

Biochemistry and physiology
Chairman: Rodolfo Paoletti. Panel C: Advances in Mechanisms of ω-3 Fatty acids. Co-chairmen: William E.M. Lands, University of Illinois, Chicago, Illinois, USA and Howard Sprecher, Ohio State University, Columbus, Ohio, USA. Speakers: Sprecher; Lands; Harumi Okuyama, Nagoya City University, Nagoya, Japan; and Therese A. Dolecek, The Bowman Gray School of Medicine, Winston-Salem, North Carolina, USA.

Heart myocytes, neutrophils and platelets are examples of cells, Sprecher said, which do not synthesize polyunsaturated fatty acids, although the fatty acid composition of their lipids differs. Sprecher said that these differences are due to specificities for fatty acid uptake and processing.

Lands reviewed evidence suggesting that the dose-response range for dietary 18:2n-6 as a precursor for eicosanoids may be much lower than has been previously discussed, and that competitive interactions between ω-3 and ω-6 dietary fats can be demonstrated and interpreted if the dietary polyunsaturated fatty acids are in the responsive ranges.

Okuyama presented evidence from his laboratory showing that the mechanisms that keep ω-3/ω-6 ratios of tissue lipids within limited ranges and a relatively smaller pool size for ω-3 fatty acids in the body lead to a faster turnover of excess ω-3 fatty acids.

Dolecek summarized results from the Multiple Risk Factor Intervention Trial (MRFIT), a randomized clinical trial in the primary prevention of coronary heart disease. Dolecek concluded that the composition and balance of polyunsaturated acids in the diet may influence cardiovascular disease and possibly various forms of cancer, and that ω-3 fatty acids confer significant protection against cardiovascular disease.

Lands, summarizing session II, said that the flow of dietary fats to the nonesterified fatty acid pool and on to leukotrienes, prostaglandins and other mediators, merits future research. In particular, he urged further research on the cloning and isolation of the enzymes involved in fatty acid desaturation and elongation. Lands also emphasized the need to incorporate ω-3 fatty acids into different parts of the food chain, and thereby giving people dietary alternatives to fish.

Effects on diseases I
Panel D: Cardiovascular I—Cell-Vessel Wall Interactions. Co-Chairmen: Alexander Leaf, Massachusetts General Hospital, Boston, Massachusetts, USA; and Peter C. Weber, University of Munich, Munich, Federal Republic of Germany. Speakers: Weber; Paul M. Vanhoutte, Baylor College of Medicine, Houston, Texas, USA; Marc Fisher, University of Massachusetts Medical School, Worcester, Massachusetts, USA; Haifa Hallaq, Massachusetts General Hospital, Boston, Massachusetts, USA; and Paul L. Fox, Cleveland Clinics Research Institute, Cleveland, Ohio, USA.

Vanhoutte presented data showing that ω-3 fatty acids stimulate the release of endothelium-derived relaxing substances which relax vascular smooth muscle and inhibit platelet adhesion and aggregation. This action may, Vanhoutte suggested, help explain the antithrombotic and antiatherosclerotic effects of fish oil.

Fisher presented data from his laboratory showing that dietary fish oil supplementation significantly reduced free radical generation, and therefore the inflammatory capabilities of stimulated human immune cells that have been implicated in the pathogenesis of atherosclerosis and autoimmune diseases.

Hallaq has shown that EPA may stabilize the contractility and rhythm of cardiac cells by preventing excessive levels of calcium influx in the cells following exposure to a toxic substance or, perhaps, injury.

Fox showed that fish oil inhibits the production of platelet-derived growth factor (PDGF, which has been implicated in the atherogenic process) by endothelial cells. Furthermore, the inhibitory action of fish oil is oxygen-dependent, an interesting observation since fish oils are so easily oxidized, he said.

(Continued on next page)
Panel E: Cardiovascular II—Heart. Co-chairs: Paul J. Nestel, CSIRO Division of Human Nutrition, Adelaide, Australia, and Arne Nordøy, University of Tromsø, Tromsø, Norway. Speakers: Nestel; John S. Charnock, CSIRO Division of Human Nutrition, O’Halloran Hill, Australia; Sigmundur Gudbjarnason, University of Iceland, Science Institute, Reykjavik, Iceland; and Michael L. Burr, MRC Epidemiology Unit (South Wales), Cardiff, United Kingdom.

Nestel gave an overview of research on ω-3 fatty acids, cardiac function and cardiac survival. He stressed the need to think carefully about the appropriate human models to study. An unanswered question, he said, is how much of the reduced mortality due to increased fish oil consumption reflects lower cardiovascular risk, and how much from direct protection of the heart?

According to a recent survey of 200 food editors and writers, the single most important factor in making the American diet healthier:

Reducing saturated fat
Reducing cholesterol
Reducing sodium
Reducing calories

... hottest foods of the 90s:

Low-fat foods
Convenience foods
Guilt-free foods
Healthy snack foods

Traditional foods


Charnock presented data showing that giving rats or monkeys a fish oil supplement for several months greatly improves cardiac function and reduces the vulnerability of the heart to develop cardiac arrhythmia when subjected to ischemic stress. Cardiac arrhythmia and severe ventricular fibrillation are frequently the cause of sudden cardiac death. Charnock was able to elicit this effect even in older animals previously exposed to high saturated fat intake for the first half of their normal life span.

Gudbjarnason outlined epidemiological data showing that cardiovascular disease mortality in older age groups in Nordic countries is inversely related to fish consumption in these countries, but positively correlated to the arachidonic acid level in plasma phospholipids in the normal population. He concluded by saying that the balance between ω-3 and ω-6 fatty acids in cardiac phospholipids plays an important role in stress adaptation and development of coronary heart disease.

Burr reported that 2,000 middle-aged heart attack victims advised to eat fatty fish once or twice a week suffered nearly 30% fewer fatal heart attacks than their nonfish-eating counterparts. He noted, however, that there is little or no advantage in eating large amounts in comparison with a moderate intake.

Nordøy concluded that, while we can do no harm and will probably do good by encouraging increased consumption of fish oils, we must also examine the effect of ω-3 fatty acids in relationship to risk factors. Fish oils, he said, provide us with a new way of looking at triglycerides as a bridge between thrombosis and atherosclerosis.


Singer reviewed studies which show that subjects with normal blood pressure taking fish oil supplements show minimal changes in blood pressure, whereas those with mild to more severe hypertension usually have significant lowering in blood pressure. He noted that antihypertensive drugs taken in conjunction with fish oil supplements enhance the hypotensive effects, while preventing drug-induced lipid alterations (notably HDL cholesterol).

Mills noted that supplementation with certain ω-3 (20:5) and ω-6 (18:3) fatty acids attenuates cardiovascular responses to pressor stimuli in animals and possibly humans. He concluded that borage oil (22% 18:3ω-6) improved the maintenance of systemic arterial pressure during a simulated hemorrhage, whereas fish oil increased resting peripheral blood flow.

Sanders noted that EPA and DHA can markedly lower plasma triglycerides and VLDL concentrations in a strongly dose-responsive manner. This change is accompanied by a marked increase in the proportion of EPA and DHA in plasma and blood cell phospholipids, mainly at the expense of linoleic and arachidonic acids.
Alexander Leaf, in summarizing the session, said that it is now evident that we can prevent further progress in secondary disease by making changes in dietary lipids. He said that our expectations for therapeutic approaches to chronic diseases may have been raised too high by the dramatic success of antibiotics. Chronic diseases, unlike bacterial infections, arise from a physiologic imbalance, and the goal should be to nudge the body back to physiological balance, he said. He urged scientists to limit advice to the public until the science was really sound.

**Effects on diseases II**

**Panel G: Rheumatoid Arthritis and Inflammatory Mediators.** Co-chairmen: Joel M. Kremer, Albany Medical College, Albany, New York, USA; and Dwight R. Robinson, Massachusetts General Hospital, Boston, Massachusetts, USA. Speakers: Kremer; Fred Snyder, Oak Ridge Associated Universities, Oak Ridge, Tennessee, USA; Richard Sperling, Brigham and Women's Hospital, Harvard Medical School, Boston, Massachusetts, USA; and Charles Dinarello, Tufts University School of Medicine, Boston, Massachusetts, USA.

Kremer gave an overview of clinical studies examining the use of fish oil as a supplement to medication in patients with rheumatoid arthritis. He noted that patients do, in general, respond positively to fish oil supplements; this response is associated with a decrease in the level of interleukin-1 (IL-1, a potent inflammatory cytokine) production. Kremer had a couple of suggestions for study design: since the beneficial effects of fish oil supplementation last long after a normal "wash-out" period, a cross-over design is unsuitable for fish oil studies; he also recommended paraffin, rather than olive oil, as a placebo. Kremer said the unresolved questions are: Who gets fish oil? Can fish oil supplements ever replace nonsteroidal anti-inflammatory drugs? Is there disease-modifying potential in fish-oil supplementation?

Snyder presented his research showing that the ω-3 fatty acids are selectively enriched into the pool of ether-linked phospholipids, important storage reservoirs of polyunsaturated fatty acids. It is from this pool, Snyder said, that, like arachidonic acid, ω-3 fatty acids may also be used to produce platelet activating factor, a substance with many immunological activities.

Sperling showed that EPA has several effects on leukocyte function and arachidonic acid metabolism. He noted that the predominant effects may be different in patients with an active inflammatory disease and treated with background medications, as compared with healthy individuals.

Dinarello reviewed the wide array of immunological activities mediated by the cytokines tumor necrosis factor (TNF) and interleukin-1 (IL-1), which are synthesized primarily in association with disease states or host perturbation. He presented data showing that ω-3 fatty acids induce a reversible reduction in the synthesis of IL-1 and TNF, whereas subjects taking continuous, low doses of aspirin produce more IL-1 and TNF. He discussed the pathways through which these various mediators might act, and the
clinical implications for control of IL-1 and TNF production.


Cardiovascular disease is the major cause of death in non-insulin-dependent diabetes mellitus (NIDDM), according to Vessby. He reported that fish oil supplements or a diet rich in fatty fish, while lowering plasma triglycerides, tend to impair blood glucose control in these patients, and says that the use of high doses of ω-3 fatty acids is more controversial in NIDDM than in insulin-dependent diabetes mellitus.

Jensen, on the other hand, has studied the effects of ω-3 fatty acids on patients with insulin-dependent diabetes (IDDM), especially the subgroup of patients that develop clinical nephropathy. This subgroup (40% of those with IDDM) is at extremely high risk for dying from cardiovascular disease. Jensen found that these patients had reduced blood pressure, a slight improvement in plasma lipoproteins, and partial normalization of the elevated microvascular permeability after receiving fish oil supplements. Although recommending further studies, Jensen said that the use of fish oil supplements appears quite attractive in the delay or prevention of cardiovascular disease in this subgroup.

Panel J: Psoriasis. Chairman: Vincent A. Ziboh, University of California, Davis, California, USA. Speaker: B.R. Allen, University Hospital, Queen's Medical Centre, Nottingham, United Kingdom.

Psoriasis is a disease characterized by a sustained inflammatory reaction in the skin. Ziboh showed that patients with psoriasis receiving ω-3 fatty acid supplementation had an overall favorable response, which correlated with an inhibition of production of a potent inflammatory mediator found in the skin of these patients.

Allen reviewed the use of fish oil therapy in combination with other therapies. The use of fish oil in conjunction with cyclosporin was one such promising therapy, he said, as fish oil may reduce the nephrotoxicity of the drug.

Panel J: Cancer. Co-chairpersons: Ritva Butram, National Cancer Institute, National Institutes of Health, Bethesda, Maryland, USA; and Claudio Galli, Università di Milano, Istituto Scienze Farmacologiche, Milan, Italy. Speakers: William T. Cave, Jr., St. Mary's Hospital, Rochester, New York, USA; George L. Blackburn, New England Deaconess Hospital, Boston, Massachusetts, USA; and Gabriel Fernandes, The University of Texas Health Science Center, San Antonio, Texas, USA.

Galli gave an overview of research on ω-3 fatty acids and cancer. Some of the mechanisms whereby fatty acids may modulate tumor development are: changes in immune function, prostaglandin production, free radical formation, membrane fluidity, intracellular transport systems, caloric utilization and hormone secretion.

Cave reviewed animal studies on the effect of ω-3 fatty acids on breast, colon, pancreas and prostate cancer. Collectively, the studies indicate that qualitative differences in the fatty acid composition of dietary lipids can modify tumor lipid metabolism, and that diets with high proportions of ω-3 fatty acids can prevent or delay the expression of certain tumors.

Blackburn described his efforts to develop diets and dietary supplements that effectively enrich selected phospholipid fatty acids, ω-3 fatty acids in particular. Since competition exists between ω-3 and ω-6 fatty acids for many enzymatic processes, Blackburn said, the proposed diet may modulate the precursor for thromboxanes and prostaglandins, two physiological mediators that may be involved in tumor promotion and growth.

Fernandes has been studying the growth of a human breast cancer cell line in nude mice fed diets rich in saturated fats (butter), polyunsaturated fats (corn oil) and ω-3 fatty acids (menhaden oil). He found that the fish oil diet reduced some prostaglandin and endocrine hormone production, which in turn may reduce the expression of oncogenes in tumor cells.

Butram, in summarizing the panel, said that the following issues need to be addressed: the optimum ω-6/ω-3 ratio at varying levels of total fat intake; the effect of saturated fats on ω-6 and ω-3 fatty acid utilization; species differences in fatty acid utilization; and careful attention to protocols. On the issue of protocols, Butram emphasized the need to include sufficient essential fatty acids in the experimental diets and to monitor oxidation of the fish oil.

Peter Weber, in summarizing the session, said that there is a need to consider the potential interaction between ω-3 (or ω-6) fatty acids and ion channels in the cell membrane, and their effects on gene expression, in addition to more traditional thinking about metabolites of these fatty acids. In the future, he said, we should see more use of ω-3 fatty acid supplementation in combination with other therapies. Future research should combine our knowledge of molecular and cell biology with that of the functional activities of fatty acids.

Jorn Dyerberg, Medi-Lab a.s., Copenhagen, Denmark, summarized the conference, saying that ω-3 fatty acids should be a regular part of the diet, and tube-feeding preparations and formulas devoid of ω-3 fatty acids should be abandoned. The borderline between essentiality, pharmacology, and toxicology is still not well established, he said, and recommended that a conference should be convened to issue recommendations on ω-3 consumption.

During the conference banquet, four researchers, three of whom are AOCs members, were honored for their pioneering work on ω-3 fatty acids. They are: Ralph Holman, the University of Minnesota's Hormel Institute at Austin, MN, USA; Hugh Sinclair, of the International Nutrition Foundation, Abingdon, United Kingdom; and Maurice Stansby, of the National Marine Fisheries Service in Seattle, Washington. The fourth person honored was H.O. Bang, from Denmark.

(For a report on the one-day symposium, Dietary Aspects of Fats and Oils, held during March under sponsorship of the AOCs North Central Section, see the "Inside AOCs" section in this issue of INFORM.)

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Canadians told to limit fat intake

The present level of total fat, and particularly of saturated fat, in the Canadian diet constitutes a risk factor for cardiovascular disease and possibly for certain other diseases including some forms of cancer. This is one of the conclusions from the recent Nutrition Recommendations for Canadians, prepared by Health and Welfare Canada’s Scientific Review Committee. The 204-page report, which was released in March 1990, contains a section each on dietary lipids and dietary cholesterol. The report recommends that the fat content of the diet be reduced to 30% of total energy, with the intake of saturated fat not to exceed 10% of total energy. U.S. and Canadian citizens generally are regarded as obtaining 35% to 40% of their calories from fats.

The ω-6 fatty acids should provide at least 3% of energy, and the ω-3 fatty acids at least 0.5% of energy, with a ω-6/ω-3 ratio in the range of 4:1 to 10:1, the report said. When the diet of infants contains no ω-3 C20 and C22 fatty acids, 1% energy should be provided by ω-3 linoleic acid. It was stressed that recommendations to reduce dietary fat do not apply to children under 2 years of age.

The report also recommended that “the cholesterol intake of the Canadian population be reduced. This should apply to all age groups. In infants and children, caution should be taken to ensure that the dietary changes this recommendation entails do not result in an unbalanced diet, deficient in energy and essential nutrients.”

Copies of the report, in French or English, may be obtained for $18.95 (Canada) or US$22.75 (outside Canada), from the Canadian Government Publishing Centre, Ottawa, Canada, K1A 0S9; telephone 819-956-4802, fax 819-994-1498, telex 053-4296.

NCEP endorses plan to cut cholesterol

The National Cholesterol Education Program (NCEP) Coordinating Committee unanimously approved the Population-Based Panel report, which outlines a dietary strategy for lowering average blood cholesterol levels in the United States by at least 10%.

The report recommended diets designed to lower average fat intake to 30% or less of total calories, saturated fat to less than 10% of calories, and cholesterol intake to less than 300 mg daily. On the controversial issue of low-fat diets for children, the report urged “prudent movement to the recommended eating pattern” as children begin eating the same foods as other family members, usually after age two. Noting that the U.S. Department of Agriculture (USDA) is represented on the committee, Richard Carleton, panel chairman and director of the Pawtucket (R.I.) Heart Health Program, called the USDA’s National School Lunch Program a “suitable target” for reform. He added, “I’d be quite surprised if USDA didn’t agree to modify the school lunch program” in the direction of low-fat menus.

NCEP is seeking an appropriate journal in which to reprint the report, perhaps as a supplement, which will be printed by the National Heart, Lung and Blood Institute in limited quantities.

Worldwide data sought on diet surveys

Technical Assessment Systems Inc. (TAS) is working with the U.S. National Cancer Institute (NCI) on a three-year project to collect international food consumption data.

The goal is to develop a personal computer system containing data on food consumption surveys conducted throughout the world. TAS will also evaluate the quality and usefulness of individual surveys for investigating diet-disease relationships, and food consumption and nutrient content source data from selected surveys.

TAS encourages food consumption experts to participate. Contributors will be reimbursed for expenses and will receive a copy of the full database when the project is completed. Contact: Barbara Petersen, Judith Douglass or Kathryn Fleming at Technical Assessment Systems Inc., The Flour Mill, Suite 102; 1000 Potomac St. NW; Washington, D.C. 20007; phone 202-337-2625, fax 202-337-1744.
Research notes

(This new section is being introduced to provide readers with a brief summary of major research results and projects as reflected in published reports from the U.S. and overseas.)

Rats fed a diet containing soybeans developed an average of half as many tumors as those on a soybean-free diet in an experiment conducted by Stephen Barnes, associate professor of pharmacology and biochemistry at the University of Alabama at Birmingham. Barnes presented his research at an American Cancer Society seminar in March.

Two separate studies have shown that chickens and cattle fed menhaden oil directly in their feed can "significantly" increase the tissue levels of polyunsaturated fatty acids (PUFA), including ω-3 eicosapentaenoic (EPA) and docosahexanoic (DHA) acids. Kenneth Hall, University of Connecticut, found that the amounts of saturated, monounsaturated and polyunsaturated fatty acids in each tissue were related to the amounts received in the diets. A.W. Young, Southern Illinois University, developed a system using a corn protein and ethanol to coat small fish oil droplets with a protein shield to protect them from being saturated in the cattle rumen. Young reported that the cattle fed fish oil had "highly significant" increases in tissue PUFA as well as lower tissue cholesterol levels.

A research group, headed by David H. Blankenhorn at the University of Southern California in Los Angeles, reported that even modest changes in the diet can slow or stop the clogging of the arteries. The new study, published in the March 21, 1990, issue of the Journal of the American Medical Association, shows that among a group of men who had proven coronary heart disease, those who substituted lean meats and low-fat dairy products for fatty meats and high-fat dairy products were far less likely to develop new fatty deposits in their coronary arteries than men who stuck to their old eating habits.

NEWS

Producers Cotton Oil Co. closes oil operations

Producers Cotton Oil Co. has closed its oil mill operations in Fresno, California, after 60 years in oilseed processing. The company, currently owned by Dunavant Enterprises of Memphis, Tennessee, will continue its cotton ginning businesses.

Company officials said cottonseed meal and oil prices have been inadequate to justify further operation of the oil mill. The company said it has no plans to sell the facility; the mill, which crushed cottonseed and safflower, is to be mothballed for possible reopening.

Dunavant Enterprises, which purchased Producers Cotton Oil in 1987, spent approximately $2 million to modernize the oil mill. However, increased use of whole cottonseed for feed by the dairy cattle industry in central California stunted demand for cottonseed meal.

Producers Cotton Oil was established in 1930. It began focusing on its ginning operations several years ago as the market for cottonseed oil and meal began to decline. The mill, which includes a miscella refinery and a solvent extraction plant, began crushing safflower in the off-season in the early 1980s.

Oilseeds International Ltd. of San Francisco, California, which had served as Producer Cotton Oil Co.'s exclusive broker for safflower oil sales, now has agreed to represent C. Itoh, a large Tokyo trading company, in the marketing of safflower and oleic safflower products.

Two other California cottonseed mill operations have shut down in recent years: Ranchers Cotton Oil's mill in Fresno and a small expeller mill at Kingsburg owned by Kingsburg Cotton Oil Co. of California. Two other California oil milling operations are operating: Western Cotton Services' oil mill and refinery at Chowchilla and J.C. Boswell Company's integrated operations in Corcoran.

Unilever buys Mexican refinery

Unilever Group has announced that its Unilever Mexico unit has purchased the Industrias Consapex edible oil refinery and pasta manufacturing facility in Tultitlan, Mexico.

Unilever Mexico bought the facility, which produces vegetable oils, vegetable shortenings and pastas for