Scientists discuss dietary fatty acids

In the following article, J. Edward Hunter of The Procter & Gamble Co., Associate Editor for JAOCS *News for Health and Nutrition, summarizes highlights from a scientific conference on dietary fatty acids held in Washington, D.C., May 23-24, 1989.*

The Nutrition Committee and the Council on Thrombosis of the American Heart Association (AHA) sponsored a scientific conference in late May on the Effects of Dietary Fatty Acids on Serum Lipoproteins and Hemostasis. Cosponsoring organizations included the International Life Sciences Institute-Nutrition Foundation, the National Heart, Lung and Blood Institute, and the Institute of Shortening and Edible Oils Inc.

Objectives of the conference were: to review the "state of the art" relative to effects of dietary fatty acids on serum lipoproteins and hemostasis; to identify gaps in knowledge; and to make recommendations for research initiatives. Approximately 100 invited scientists attended. Chairing the conference were Robert J. Nicolosi of the University of Lowell and John C. LaRosa of George Washington University Medical Center.

Effects of dietary fatty acids on lipoproteins

The first session focused on effects of dietary fatty acids on lipoproteins and the basic mechanisms of lipoprotein action. A. Chait of the University of Washington, reviewing the metabolism and functions of various lipoproteins, noted that low-density lipoprotein (LDL) is involved in transport of cholesterol into cells and high-density lipoprotein (HDL) is concerned with transport away from cells and to the liver for excretion.

E. Schaefer of the U.S. Department of Agriculture's (USDA) Human Nutrition Research Center on Aging at Tufts University discussed the key human dietary intervention trials involving dietary fat and blood lipoproteins that have been conducted over the past 20 years and concluded that several have been successful in reducing coronary heart disease incidence. A crucial factor in the success of diet modification trials, according to Schaefer, has been continuous reinforcement provided to the subjects about necessary diet changes. F. Mattson, formerly with the University of California at San Diego and now retired, commented that although many of these intervention trials have shown favorable effects on heart disease risk factors, none has shown any benefits with respect to total mortality.

S. Grundy of the University of Texas Health Science Center at Dallas reviewed his recent clinical work indicating that a liquid formula diet high in monounsaturated and low in saturated fatty acids has the same potential for lowering LDL-cholesterol levels as either a high-polyunsaturated or a low-fat, high carbohydrate diet. In addition, it appears that a diet high in monounsaturated fatty acids also may conserve HDL, whereas the high-polyunsaturated and the low-fat, high carbohydrate diets did not. M. Katan and coworkers at the Agricultural University, The Netherlands, however, have found that feeding human subjects a conventional food diet with polyunsaturates at approximately the level recommended by the American Heart Association did not lower HDL levels. Furthermore, in agreement with Grundy's results, a high monounsaturated diet was as effective as the high polyunsaturated diet in lowering LDL levels.

H. Ginsberg of Columbia University similarly reported that the AHA Step 1 diet (30% of calories as fat; saturates = monounsaturates = polyunsaturates) was as effective as a higher fat (38% of calories) high-monounsaturated diet in reducing total cholesterol levels in healthy young male subjects. S. Eisenberg of Hadaffah University Hospital, Jerusalem, Israel, meanwhile, has found a high-monounsaturated

diet to be slightly more effective than a high-polyunsaturated diet in lowering total cholesterol levels of a free-living population in Jerusalem. The results of Ginsberg and Eisenberg were preliminary as part of multi-year trials (in progress) involving a variety of dietary treatments.

Discussing effects of omega-3 fatty acids from fish oils, W.E. Connor of Oregon Health Sciences University noted that a well-established effect of fish oil supplementation is reduction in blood triglyceride levels. The mechanism of this effect appears to be reduction in VLDL triglyceride synthesis. R. Illingworth, also of Oregon Health Sciences University,

Supplementation may reduce VLDL triglyceride synthesis

focused on effects of fish oils other than simply reducing triglycerides. He noted that low doses of fish oil (four to six grams/day) not only decrease triglyceride levels but also increase LDL-cholesterol levels, which may not be beneficial. On the other hand, high doses of fish oil (about 20 grams/day) lower LDL levels; however, this decrease is less extensive than that observed with omega-6 fatty acids.

Among the unresolved issues concerning omega-3 fatty acids, according to Illingworth, are uncertainty about the relative hypolipidemic effects of eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) in humans and the mechanism(s) responsible for decreasing LDL at high doses of omega-3 fatty acids.

R. Nicolosi of the University of Lowell reported that a diet high in coconut oil fed to cebus monkeys resulted in higher levels of total, HDL- , and LDL-cholesterol as well as higher levels of apo A-I (the apolipoprotein of HDL) and apo B (the apolipoprotein of LDL) than a diet high in corn oil. Addition of 0.1% cholesterol to either the coconut oil or corn oil diet had no further effect on these parameters. Consistent with these results, animals on the corn oil diet were able to degrade LDL at a much faster rate than animals on the coconut oil diet.

J. Dietschy of the University of Texas Health Science Center at Dallas reviewed his hamster studies on the mechanism of how inflow of dietary cholesterol into the liver affects the LDL level in plasma. Addition of cholesterol to a constant amount of dietary fat results in increased LDL levels due to increased LDL production and to decreased LDL receptor-dependent transport in the liver. At a constant level of dietary cholesterol, addition of saturated fat (hydrogenated coconut oil) to the diet increased LDL levels by increasing LDL production and decreasing LDL receptor number. Addition of polyunsaturated fat (safflower oil) did not change the LDL level because the resulting increases in both LDL production rate and LDL receptor number cancelled each other.

D. Spady, a coworker of Dietschy's, added that supplementing the diet with fish oil reduced LDL levels due to increased liver LDL receptor activity. Addition of a complex carbohydrate (corn starch) to the diet similarly reduced LDL but apparently by a different mechanism because, unlike the situation with added polyunsaturates, there was no change in receptor activity when complex carbohydrate was added to the diet.

In the area of *trans* fatty acids, E.A. Emken of USDA's Northern Regional Research Center noted that *trans* acids have no unique effect on total cholesterol or triglyceride levels, do not induce atherosclerosis in animals fed adequate essential fatty acids, do not accumulate abnormally in human tissue lipids, and should not be considered equivalent to saturated fatty acids with regard to blood cholesterol effects. In addition, *trans* fatty acids appear to have little, if any, effect on platelet aggregation. Emken indicated that while effects of *trans* acids on HDL and LDL levels in humans are uncertain, these fatty acids have not been found to affect HDL and LDL in animal species (swine and rats). In a recent study, Emken found no significant correlations between total *trans* or total positional isomers in human adipose tissue and various clinical parameters associated with coronary heart disease risk.

The scientific literature on *trans* fatty acids was extensively reviewed in a monograph (**Health Aspects of Dietary Trans Fatty Acids,** 1985) prepared by a special Federation of American Societies for Experimental Biology committee. This monograph reported no adverse effects of *trans* acids as presently consumed in the U.S. diet.

D.M. Hegsted, formerly at Harvard University and now retired, explained why he felt studies by himself and Keys 30 years ago found monounsaturates to have no effect on total blood cholesterol, whereas recent studies by Mattson and Grundy and others have indicated that monounsaturates lower LDL (and total) cholesterol. Hegsted attributed this difference in results to differences in experimental design. He agreed that high monounsaturated diets could be blood cholesterol-lowering if they were cholesterol-free (e.g., certain liquid diets) or low in saturates. However, his experience has indicated that feeding human subjects conventional food diets high in safflower oil plus added cholesterol consistently maintained total blood cholesterol levels below those seen with an olive oil-enriched diet plus added cholesterol.

Hegsted recommended that investigators consider doing more experiments in which monounsaturated or polyunsaturated fats are added to a constant level of saturated fat. Thus total dietary fat would be allowed to vary. He cited a study in which the addition of sunflower oil to a diet containing 50 grams of animal fat per day resulted in the lowering of total blood cholesterol.

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Effects of dietary fatty acids on hemostasis

W.E.M. Lands of the University of Chicago introduced this session by reviewing interrelationships between nonesterified fatty acids (derived from the diet) and eicosanoids which contribute to regulation of platelet activity. A key research need in this area, according to Lands, is identifying parameters that may be useful in predicting the tendency of an individual's platelets to aggregate (measuring clotting time is considered an unreliable indicator). Platelet aggregation leads to increased clotting tendency, and the blockage of a coronary artery by a clot is now widely believed to be the cause of most heart attacks.

S. Renaud of INSERM Unit in Bron, France, outlined a prospective eight-year study he and his colleagues are conducting in Cardiff, Wales, to investigate how various platelet tests may predict development of coronary heart disease. Data available so far (i.e., after six years) have indicated that subjects with a myocardial infarction have shown higher platelet aggregation to several agonists (thrombin, collagen and ADP) than those who have not had a myocardial infarction. Further work by Renaud involving human subjects indicates that a high-saturated fat diet, and particularly a diet high in stearic acid, correlates closely with increased platelet aggregation and reduced clotting time. Renaud said increased platelet aggregation and atherosclerosis may be independent risk factors for coronary heart disease. He also said he believes dietary long-chain saturated fatty acids can predispose individuals to thrombosis by increasing platelet reactivity. To date, Renaud has not determined whether fatty acid chain lengths longer than stearic acid (e.g., behenic acid) promote clotting tendency in humans.

S. Goodnight of the University of Oregon Medical School reviewed effects of omega-3 fatty acids on platelet function. Fish oil supplementation is known to increase the omega-3 fatty acid content and decrease the omega-6 fatty acid content of platelet phospholipids. These changes occur after several days of omega-3 fatty acid supplementation and result in decreased platelet aggregation (due to decreased synthesis of thromboxane by platelets). Recent studies have indicated that fish oil supplementation may decrease ventricular arrhythmias, which may be beneficial to certain coronary patients. Goodnight also indicated that dietary omega-6 fatty acids can reduce platelet aggregation but that the effect is much less marked than with omega-3 fatty acids.

G. Hornstra of Limburg University, Maastricht, The Netherlands, added that although dietary fish, fish oil or fish oil concentrates reduce platelet aggregation, they apparently have little or no effect on the actual blood coagulation process in which the soluble blood protein fibrinogen is converted to insoluble fibrin. Dietary fish or fish oil do not affect the level of circulating fibrinogen in humans or the levels of certain factors involved in the clotting process.

The possibility that fish oil supplementation may prevent restenosis, the reformation of blockages in

blood vessels following angioplasty, is inconclusive, according to G.A. FitzGerald of Vanderbilt University. Two of three studies addressing this question have indicated a beneficial effect of fish oil feeding, but one study showed no beneficial effect. All three studies had insufficient subjects for statistical validation. FitzGerald also reported that high doses of fish oil (50 ml/day for four weeks) can reduce blood pressure in men with hypertension. However, smaller more palatable levels of fish oil (10 ml/day for four weeks) had no effect on blood pressure.

A. Leaf of Harvard Medical School concluded the session by posing several questions warranting further study. Among them were the following:

- Considering that clinical trials have shown short-term benefits from using large amounts of omega-3 fatty acids, would smaller amounts given over a longer period of time show similar benefits?
- Would dietary α-linolenic acid provide adequate levels of EPA and DHA for optimum health?
- What effects, if any, do EPA and DHA have on cell membranes?

Conclusions and future considerations

The following are points of agreement or suggestions for future work expressed by participants:

- There appears to be almost universal agreement that intake of dietary saturated fatty acids should be reduced.
- Current evidence does not clearly favor monounsaturates over polyunsaturates (or vice versa) as substitutes for saturates in mixed diets consumed in the U.S. Although high levels of dietary polyunsaturates have been found to reduce HDL levels, this has not been observed at moderate realistic levels of polyunsaturates (around 10% of total calories).
- Some participants felt that AHA recommendations on polyunsaturates should recognize different effects of omega-6 and omega-3 polyunsaturates. However, there was no agreement on what the desirable balance between omega-6 and omega-3 fatty acids should be.
- *Trans* fatty acids at current levels in the U.S. diet do not pose any harm to humans consuming a balanced diet containing adequate essential fatty acids.
- Attention needs to be given to effects of dietary fatty acids on clotting as well as on blood lipoprotein levels. The validity of the methodology for measuring platelet aggregation was questioned by some participants.
- Diets high in stearic acid appear to be effective in lowering blood cholesterol in humans. On the other hand, stearic acid may promote increased clotting tendency. Additional work will be necessary to resolve whether these seemingly incompatible health-related effects of dietary stearic acid can be reconciled.
- It may be important to establish whether any relationships exist between clotting factors and blood lipoprotein levels.

The proceedings of the meeting are expected to be published as a supplement to *Arteriosclerosis.*

SURFACTANTS & DETERGENTS NEWS

Unilever buys English, German cosmetic firms

Unilever has completed a $120 million purchase of Rimmel International Ltd. of London and Chicogo GmbH of West Germany, two cosmetics-producing subsidiaries of Schering-Plough Corp.

Unilever United States Inc. has announced it will buy Minnetonka Corp. for $22.86 a share, then dismantle the company, retaining only Minnetonka's Calvin Klein cosmetic business. Minnetonka has agreed to sell its medical division and its fragrance marketing group to Tsumura & Co. of Tokyo; proceeds from that sale will go to Unilever, reducing its cost to acquire the Calvin Klein operation.

Unilever United States Inc. also announced it will buy the toiletries, cosmetics and fragrance businesses of Faberge and Elizabeth Arden for $1.55 billion. The transaction, subject to a number of technical conditions, was expected to be completed by mid-August. Earlier this year, Unilever terminated negotiations for the businesses because of "technical and structural differences." Unilever officials announced in July that those differences had been resolved. Faberge and Elizabeth Arden, owned by the Riklis Family Corp., have their headquarters in New York.

Coatings growth

The industrial coatings market in Western Europe is projected to grow 2% a year, according to a CHEMARK study entitled "The European Coatings Industry, 4th Edition."

The study says that conventional low solids, solvent-borne coatings are declining in favor of a myriad of "compliant technologies," those that readily conform to V.O.C. standards without expensive solvent reclamation. Meanwhile, the use of technologies such as radiation-curing or emulsions and latexes, however, is growing by 10% or more a year.

The report consists of three bound volumes. Vol. 1 is a review of the European Economic Community, including plans for a unified community by 1992, as it relates to the coatings industry. Vol. 2 is a review of 25 end-use markets for coatings in Europe. Vol. 3