EAT FISH! Nutrition Studies Zero In on Health

FLORIDA DEPARTMENT OF AGRICULTURE & CONSUMER SERVICES

Seafood can be a source of DHA and EPA, omega-3 fatty acids that are essential for good health. ARS scientists are determining more about the health-promoting roles of these compounds.

Like salmon?

Find that anchovies are one of your "must have" pizza toppings?

If you're a fan of such fish, your body is probably thanking you right now.

These and some other fish, including mackerel, herring, albacore tuna, and more, are rich in healthful natural compounds known as "omega-3 fatty acids." Ongoing studies by chemist Darshan S. Kelley and his Agricultural Research Service and university coinvestigators are helping uncover new details about how these fish-oil components help protect us from chronic diseases.

Kelley is based at the ARS Western Human Nutrition Research Center at the University of California-Davis.

Trio of Fatty Acids Studied

In an early study with laboratory mice, Kelley and colleagues took a closer look at the interplay of three different fatty acids, commonly referred to by their abbreviations: CLA, DHA, and EPA.

The type of CLA, or conjugated linoleic acid, that the team investigated is known as "trans-10, cis-12 CLA" and is found in partially hydrogenated vegetable oils and some dietary supplements. Its interactions with DHA and EPA, from fish oils, are of interest to nutrition scientists in the United States and abroad.

Why the interest in CLA, DHA, and EPA?

Results from a handful of studies, conducted by researchers elsewhere, indicate that feeding fish-oil supplements—in conjunction with CLA supplements—to lab animals prevents certain harmful side effects attributed to CLA. Those side effects include insulin resistance and fatty liver.

Those studies, however, have not conclusively determined whether it was fish oils' DHA, EPA, or both that provided the protection.

DHA (docosahexaenoic acid), and EPA (eicosapentaenoic acid) occur in different amounts and ratios in fatty or oily fish like those mentioned earlier, as well as in some mollusks, crustaceans, and other seafood; and, of course, in fish-oil supplements.

Insulin Resistance and Fatty Liver Monitored

The insulin resistance that Kelley and colleagues monitored is a condition in which the body isn't able to efficiently use its own insulin, a hormone, to remove glucose (sugar) from the bloodstream. If left untreated, insulin resistance can lead to diabetes and harmful buildup of glucose in the bloodstream.

An estimated 26 million to 57 million Americans are insulin resistant.

The liver condition that the team tracked is known as "non-alcoholic fatty liver disease." It results from accumulation of excess fat in the liver. Causes include diabetes and obesity. Afflicted liver tissue may harden and scar, sometimes resulting in cirrhosis of the liver or liver cancer.

Kelley's 8-week test with 50 laboratory mice indicates that DHA protected against both CLA-induced insulin resistance and

CLA-induced non-alcoholic fatty-liver disease. In contrast, EPA offered partial protection against CLA-induced fatty liver disease and no protection against insulin resistance.

Four Different Rations Used

The mice were fed one of four different kinds of rations: one that contained no CLA, DHA, or EPA; another with CLA amounting to 0.5 percent of the total weight of the feed; a third feed with CLA as 0.5 percent plus 1.5 percent DHA; or, in a fourth ration, 0.5 percent CLA plus 1.5 percent EPA.

"We chose these amounts of DHA and EPA because they are in line with amounts in the fish oils that were used in several previous animal studies," says Kelley. "That gave us a better basis for comparison."

Kelley published the study findings in a 2007 issue of *Metabolic Syndrome and Related Disorders* with colleagues Madhuri Vemuri, the senior author and former graduate student in Kelley's lab; Giovanni Bartolini of the Davis team; and Reuven Rasooly and Bruce E. Mackey, with ARS in Albany, California.

The study was the first to demonstrate that DHA provided protection against CLA-induced insulin resistance and non-alcoholic fatty liver disease.

Now, as a followup to the mouse investigation, Kelley would like to work with adult human volunteers who are prediabetic.

The intent?

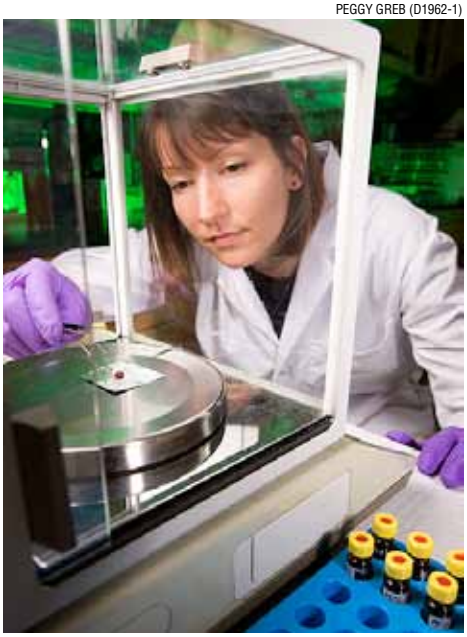
To determine whether DHA can improve the volunteers' ability to use insulin efficiently and thus help delay onset of diabetes.

"We're particularly interested in the mechanisms that DHA and EPA use and the sites upon which they act," Kelley says. "We're also interested in the genes that control these mechanisms." This information could help shape larger studies and, eventually, may lead to new dietary recommendations.

Adiponectin: A Hormone From Fat Cells

One mechanism of interest is DHA's interaction with a recently discovered hormone known as "adiponectin." Scientists already know some of the basics: Adiponectin is produced by fat cells in adipose tissue; low levels of adiponectin have been associated with insulin resistance; CLA depletes the adipose tissue in which adiponectin is made; and DHA can restore adipose tissue, thus indirectly increasing adiponectin levels.

PEGGY GREB (D1962-1)



Graduate student Dawn Fedor weighs liver tissue before analyzing it for lipid content.

Kelley and coinvestigators noted that laboratory mice fed the CLA-plus-DHA feed had higher levels of adiponectin than did the mice that were given the feed that contained CLA but not DHA. Thus, "increasing adiponectin levels may be an important mechanism by which DHA protects against insulin resistance," says Kelley. "But we need to know more."

According to Kelley, several dozen studies with human volunteers have been conducted in the past decade to determine the effect of EPA and DHA mixtures—from fish or fish-oil supplements—on insulin resistance. With coresearcher Dawn Fedor, a University of California-Davis graduate student, Kelley reviewed 3 years' worth of these investigations in an article published in 2009 in *Current Opinions in Clinical Nutrition and Metabolic Care.*

In general, and for many different reasons, study results are inconsistent. The review underscores the need for new investigations, with larger numbers of volunteers, to more clearly define the precise relation of DHA and EPA to insulin resistance.—By **Marcia Wood,** ARS.

This research is part of Human Nutrition, an ARS national program (#107) described at www.nps.ars.usda.gov.

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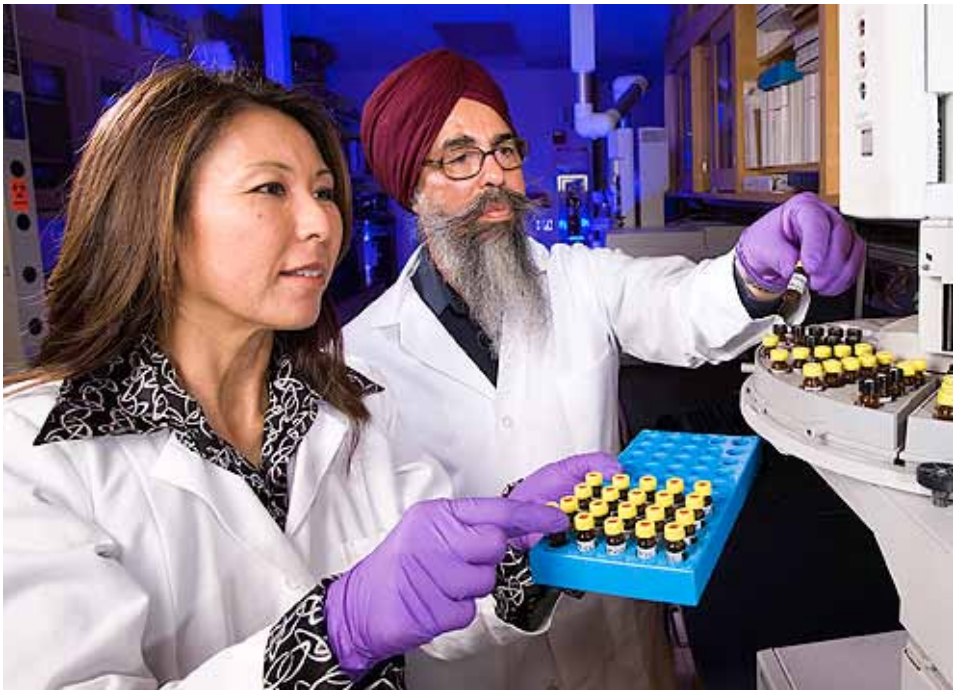

Molecular biologist Yuriko Adkins (left) and chemist Darshan Kelley load lipid samples extracted from tissue for analysis of fatty acids by gas chromatography/mass spectroscopy.