Food Science

How monounsaturates may save arteries

For years, heart researchers have touted the relative merits of fats high in monounsaturated fatty acids, such as olive and canola oils. Consuming monounsaturates doesn't raise serum cholesterol levels, as saturated fats can, nor tend to lower levels of high-density lipoproteins (HDLs) – believed responsible for clearing cholesterol from the blood – as can fats high in polyunsaturates, such as corn oil. Now University of California, San Diego (UCSD) researchers report a more direct mechanism by which monounsaturates may slow heart disease.

Artery-clogging atherosclerosis begins when "foam" cells accumulate along artery walls. Low-density lipoproteins (LDLs) – the so-called "bad" lipoproteins – can foster this by providing the lipids (fats) that swell and transform macrophages, cells that scavenge unwanted materials from the body, into these foam cells. Previous work by UCSD's Daniel Steinberg and his co-workers showed, however, that it's not normal LDLs, but oxidized ones, that convert macrophages into foam cells. In the May Proceedings of the National Academy of Sciences, (Vol. 87, No. 10), Steinberg's team now reports finding that LDLs rich in oleic acid are "remarkably resistant" to oxidation – alteration by reactive oxygen molecules.

They incubated LDLs from rabbit blood with oxidants for 14 hours. One third of the LDLs came from animals fed standard rabbit chow, rich in the polyunsaturate linoleic acid. The other rabbits ate chow-based diets containing 10 percent sunflower oil. Half of these rabbits received conventional sunflower oil – containing 20 percent of the monounsaturate oleic acid and 67 percent linoleic acid – the other animals a version containing 83 percent oleic acid. Compared to LDLs from animals fed regular sunflower oil, those from animals on the monounsaturates-rich diet showed only one-third to one-quarter the oxidation – and were engulfed by macrophages (a gauge of foam-cell-development risk) at only one-tenth the rate.

As "there is no evidence that monounsaturated fat-rich diets are anything but safe," the La Jolla team writes, these data offer "exciting implications" – that using oleic acid as a primary dietary fat "may slow the progression of atherosclerosis." To beef up the range of monounsaturated-rich offerings available, Texas A&M University scientists in College Station have experimentally fed livestock high-oleic sunflower oil (HOSO). This boosts the proportion of monounsaturates in pork products by roughly one third, new data by Ki Soon Rhee shows. In the May/June Journal of Food Science, she also reports developing low-fat HOSO-supplemented hot dogs. Up to 70 percent of their fat is monounsaturated – well above the usual 40 to 45 percent.

Another reason to eat your broccoli raw

Last year, Canadian researchers reported that some of the most potent natural anticancer agents present in broccoli and related cruciferous veggies, such as cabbage and cauliflower, predominate only in the raw produce (SN: 11/25/89, p.351). Now Agricultural Research Service scientists in Beltsville, Md., find that cooking broccoli, and its cruciferous brethren, also takes its toll on an important nutrient – one some suspect may help protect against atherosclerosis.

Four ounces of raw broccoli contains twice the vitamin C in an equivalent amount of reconstituted frozen orange juice – about 100 milligrams. If the broccoli is especially fresh – evidenced by a bluish-green hue – it can contain up to 40 percent more of this vitamin. Because vitamin C is the premier antioxidant in blood (SN: 8/26/89, p.133), some researchers suggest diets high in this nutrient may help protect against the development of atherosclerotic deposits. But freezing, boiling, blanching, steaming or otherwise cooking broccoli roughly halves its vitamin C, Joseph T. Vanderslice now reports.

Materials Science

Making a small superconducting bar

To date, the ability of high temperature superconductors to carry high currents has waned as the physical dimensions of the samples waxed. In the May 24 Nature, physicist Paul Chu and his colleagues at the University of Houston report processing the ceramic yttrium-barium-copper oxide into a small superconducting bar (5.2 centimeter x .5cm x .3cm) that maintains encouraging current-carrying capacity. The process appears adaptable for continuous manufacturing of superconducting plates, rods, wires, ribbons and thick coatings.

Although researchers have processed the same superconducting ceramic into tiny single crystals or extremely thin films that carry enough current for specialty electronic devices and detectors, no one has made bulkier samples that carry enough current for larger-scale uses. Random alignment of the samples' crystalline grains, poor electrical contact between these grains and meandering regions of resistance-creating magnetic flux have frustrated attempts.

By using a tubular furnace with different temperatures at different locations within its interior, and by controlling the speed at which a bar of sintered precursor yttrium-barium copper oxide powder moves through the furnace, the scientists have made superconducting bars with fewer of these defects. Pieces of one bar carried currents as high as 30,000 amps/cm2, but the presence of magnetic fields reduces the pieces' capacity. Though preliminary tests seem promising, the researchers have yet to determine exactly how much current an intact bar can carry, notes Ruling L. Meng, a materials scientist working in the group. The work "brings practical applications for high-temperature superconductors closer to realization," notes Neil Alford of ICI Advanced Materials in Runcorn, England, in an accompanying commentary.

Layers of clues to superconductivity

While many scientists seek the material and processing keys to new and improved high-temperature superconductors, others are turning "failed" attempts into insights about the theoretical basis for the high-temperature superconducting phenomena. In the May 24 Nature, Angelica M. Stacy at the University of California, Berkeley, and her colleagues report discovering a class of lithium-niobium-oxide superconductors that superconduct only when cooled to within 6 degrees of absolute zero. The older copper-oxide series of high temperature superconductors, one of which superconducts at temperatures soaring to 122 kelvins, remains the most studied series and holds the most technological promise.

Both the niobium- and copper-oxide superconductors have layered structures, yet only the copper-oxides superconduct at the higher temperatures. Careful comparisons of their molecular properties "will help clarify the mechanisms of superconductivity in layered oxides," the Berkeley scientists surmise in their paper.

OTA praises and laments U.S. research

The quality of U.S. and Japanese high-temperature superconductivity research and overall federal and industrial spending for it are at par in the two countries, says a report from the congressional Office of Technology Assessment. But the more long-term approach to materials development by Japanese companies, who patiently foot larger R&D bills than their U.S. counterparts, places Japan at an advantage for commercializing high temperature superconductors, it asserts. To regain a foothold in the increasingly competitive commercial world, the U.S. government needs to realign its fiscal policies to provide an adequate supply of "patient capital to U.S. industry." This will require tradeoffs among military, economic and social goals, the report says.