Vitamin C protects blood from radicals

Ascorbate, better known as vitamin C, appears the premier blood agent responsible for disarming reactive chemicals called free radicals, according to new laboratory research. At levels typically found circulating in human blood plasma, the vitamin neutralized 100 percent of the free radicals produced in the study. No other plasma antioxidant, or free-radical "quencher," showed this capability.

Because other research has shown that free-radical damage of blood fats carried by low-density lipoproteins (LDLs) helps initiate artery-clogging plaque, the new findings also indicate that adequate vitamin C nutrition "might have the potential to protect against atherosclerosis," says biochemist Balz Frei of the University of California, Berkeley, who led the work.

"I was quite surprised at how much better a scavenger of free radicals and oxidants ascorbate was, especially when compared with vitamin E," says Frei. Scientists generally view tocopherol, or vitamin E, as the body's premier antioxidant. But tocopherol protected only about 70 percent of the LDL lipids from free radicals, whereas ascorbate protected them all, Frei notes. "And that 30 percent [of blood fats] tocopherol does not protect means that you risk considerable pathologically relevant damage," he says.

Frei and his co-workers isolated plasma from human blood, incubated it at body temperature and added a chemical that initiates free radicals as it decomposes at such temperatures.

In addition to ascorbate, plasma contains three other water-soluble antioxidants — protein thiols, bilirubin and urate—but when ascorbate was present, it alone disarmed the radicals, conserving the other antioxidants, the researchers report in the August PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES (Vol.86, No.16). And even though tocopherol — a fat-soluble antioxidant — resides in LDLs, when Frei's team allowed free radicals to overwhelm the ascorbate and use it up, the radicals succeeded in oxidizing nearly a third of the LDL lipids.

These observations suggest that while other plasma antioxidants can slow lipid oxidation, "only ascorbate can completely prevent it," Frei says. He and his colleagues think their data argue for increasing the recommended daily allowance for vitamin C — a level presently based only on the vitamin's role in preventing scurvy. — *J. Raloff*

Rearranging oxygen for superconductivity

The superconducting ceramic yttrium-barium-copper oxide behaves like an oxygen sponge, readily sopping up or releasing oxygen atoms. A team of researchers has taken a close, careful look at how oxygen content and arrangement influence the temperature at which a material starts to lose its resistance to electrical current. The findings, reported in the Aug. 24 NATURE, overturn certain commonly held views about the effect of oxygen arrangements on the superconducting transition temperature.

Researchers often refer to yttrium-barium-copper oxide as the 1-2-3 compound because those numbers represent the relative number of yttrium, barium and copper atoms in the material. Its corresponding oxygen proportion can vary from 6.4 to 7. For certain ranges of oxygen content, its superconducting transition temperature stays relatively constant: about 90 kelvins (-183°C) for the range from 6.8 to 7, and 60 kelvins between 6.6 and 6.7. When plotted on a graph of transition temperature versus oxygen content, those regions where the graph levels off appear as plateaus. Many scientists assume these two plateaus correspond to two different arrangements of oxygen atoms within the ceramic.

To check this idea, Robert B. Beyers of the IBM Almaden Research Center in San Jose, Calif., and his colleagues developed a special apparatus allowing them to control exactly how much oxygen gets into their samples. They used electron diffraction techniques to study the crystal structures of the resulting materials.

"We see a progression of ordered structures," Beyers says. "The only places where we see more than one type of electron diffraction pattern are right in the middle of the plateaus." That's the opposite of what many researchers had expected. Each plateau seems to represent not a single phase, or type of crystalline arrangement, but a mixture of two phases differing only slightly in oxygen content. At the same time, the researchers find no evidence for mixtures of phases that have very different oxygen contents.

"This is the kind of scientific underpinning you need for the development of any consistent, reproducible technology," says Robert A. Huggins of Stanford University. "The oxygen [content] is a critical feature of the properties of these materials. It may even turn out to be what determines who ends up getting the basic patents on the 1-2-3 compounds."

— *I. Peterson*

Crown-of-thorns no Johnny-come-lately

The crown-of-thorns starfish made a big splash in the mid-1960s — and another in the early 1980s — when unusually large numbers of the species devastated live coral on Australia's Great Barrier Reef. Because scientists had detected no starfish scourges in Australia before 1962, some blamed pollution, dredging or harvesting of starfish predators. But new evidence indicates the crown-of-thorns and its population surges may go back to the reef's beginning.

Australian and U.S. researchers have turned up spines of *Acanthaster planci* in ancient reef sediment and dated them to 8,000 years ago, near the time the reef began to form. Moreover, the variable abundance of spines in old sediment suggests a long history of population booms and busts, says A.J. Timothy Jull of the University of Arizona in Tucson. "The current increase in the starfish population isn't necessarily due to some man-made event," he says.

Jull used radioactive carbon-14 dating to determine the age of bits of starfish skeleton. His co-workers at the James Cook University of North Queensland in Townsville and the Australian National University in Canberra used a different carbon-14 dating method to correlate reef-sediment depth with its age.

Surface sand at sites of *A. planci* outbreaks contains abundant starfish spines and skeletal elements called ossicles. At a reef spared of starfish invasions, sand contains virtually no ossicles or spines.

Spines and ossicles also abound in deeper, older sediments, revealing the crown-of-thorns as a longtime resident, the team reports in the Aug. 25 SCIENCE. Jull says the fluctuating numbers of spines and ossicles found in dated sediments indicate crown-of-thorns populations have periodically surged throughout most of the reef's existence.

But sediment mixing by burrowing animals and the possibility that spines "float" upward in sediment lead geochemist Ellen R.M. Druffel of Woods Hole (Mass.) Oceanographic Institution to question the suggestion of ancient outbreaks. While Druffel says "the major premise is probably correct, that in the past these *Acanthaster* were abundant," she argues that the periodic waxing and waning has yet to be proved.

Jull remains confident of both assertions. "We dated the bits of starfish themselves," he says, "so even if the sediment is totally churned up, you still have bits of starfish going back 8,000 years, showing that these starfish have always been there." And the ages of individual spines found in undisturbed sediments, he says, closely match the dates of those sediments. — *S. Hart*