Biomedicine

From a meeting in San Francisco of the Federation of American Societies for Experimental Biology

Antioxidants preserve lung function

Several studies have shown that diets rich in antioxidants—chemicals that defuse free radicals and other biologically damaging molecular fragments in the body—appear to protect the heart (SN: 7/6/96, p. 6). A new study suggests that they also shield the lungs from damage. The difference in lung function between people who consume above-average amounts of four major antioxidants and those who consume lower-than-average amounts "is approximately equivalent to the difference between nonsmokers and people who have smoked a pack [of cigarettes] a day for 10 years," explains Patricia A. Cassano of Cornell University, an author of the report.

Cassano and Guizhou Hu, also of Cornell, worked with newly released federal data collected as part of the third National Health and Nutrition Examination Survey. Using this representative cross-section of the U.S. population, which includes more than 18,000 people, they correlated each person's dietary consumption of antioxidants with the volume of air he or she could forcefully expel in 1 second. This test of lung function serves as an indicator of pulmonary health, reflecting problems such as asthma, emphysema, and chronic bronchitis.

A few other studies, including some conducted in China by Cassano's group, had turned up hints that diets high in various antioxidants might protect lung function. However, none of the studies had looked at the individual and combined effects of the most common dietary antioxidants: vitamin C and beta carotene, which are present in fruits and vegetables; vitamin E, found in plant-derived oils; and selenium, present in whole grains, meats, and nuts.

The new study's biggest surprise, Cassano says, "was a finding that benefits of individual antioxidants were somewhat different in smokers." For instance, while smokers derived more protection from selenium, nonsmokers benefited most from beta carotene. Indeed, she notes, among heavy smokers, "we see little or no effect [of beta carotene]."

Some recent studies have found that smokers who take beta carotene supplements appear to face an elevated risk of lung cancer—suggesting that a biological difference affects their response to the antioxidant, Hu says. "Our study confirms this, that there must be some biological interaction between beta carotene and smoking." —*J.R.*

Need a fever? Turn up the heat

Elderly people have trouble generating fevers. This presents a problem because "fevers are not just an annoying side effect of being sick, they can help fight infection," observes Maria Florez-Duquet of the University of Delaware in Newark.

She's found a trick that turns up the body's internal thermostat. Heating a room to 100°F works like a charm—at least for geriatric rats, which also resist developing fevers. Florez-Duquet borrowed the idea from a colleague who found that hot rooms helped newborn rabbits mount beneficial fevers.

A couple of weeks after implanting temperature sensors into groups of young and old rats, Florez-Duquet injected a fever-producing bacterial agent into each animal. When housed at 72°F, young rodents mounted a fever, but old ones merely shivered and began to lose body heat. When Florez-Duquet released the treated animals into a narrow chamber that varied along its length from about 50°F to 104°F, the elderly rats quickly sought out the 100°F zone and stayed there. Soon, their body temperature zoomed to a moderately feverish 102°F.

Because untreated rats of any age maintain a healthy body temperature of 98.6°F when caged in a 100°F room, she says, it's clear that rats use a hot environment to induce fevers only when they're needed. If subsequent studies show that people respond similarly, she says, then cranking up Grandma's thermostat may help her fight off flu and other infections. —*J.R.*

Physics

From a meeting in Columbus, Ohio, of the American Physical Society

Probing a deuteron's structure

To understand the interactions that determine the size and shape of an atomic nucleus, it helps to have a detailed picture of the simplest possible combination: a proton bound to a neutron. Known as a deuteron, this simple nucleus has roughly the same dumbbell structure as a molecule consisting of two atoms. The protons and the neutrons are themselves made up of quarks, however, and the strong force that binds one quark to another is carried by particles known as gluons. The relatively weak attractive force that holds together the deuteron—or any other atomic nucleus—arises from residual interactions between quarks in individual protons and neutrons.

In recent years, physicists have studied the characteristics of the nuclear binding force by firing electrons at nuclei. Increasing the electron energy enables them to probe deeper into these nuclear systems. At a sufficiently high energy, theorists predict, signs of the strong, gluon-mediated binding between quarks should become apparent. In the case of the deuteron, one might expect it to look more like six quarks than two nucleons.

An international team of about 60 researchers has completed an experiment at the Thomas Jefferson National Accelerator Facility in Newport News, Va., in which an intense, high-energy electron beam interacted with deuterons in a liquid deuterium target. The electron energy was high enough to resolve details as small as one-fifth the proton's diameter. Experiments elsewhere had probed features just half the proton's size.

Preliminary results indicate that even at the small scale now accessible—and contrary to some theoretical predictions—the deuteron can be adequately described as consisting of two particles loosely bound together. "We don't have to worry about the quarks and gluons," notes team member Elizabeth Beise of the University of Maryland at College Park. The findings have already stimulated new theoretical work to produce improved models of nuclear behavior. —*I.P.*

Rare fission processes

In nuclear fission, the splitting of an unstable atomic nucleus typically produces two moderate-size fragments and a number of neutrons. Akunuri V. Ramayya of Vanderbilt University in Nashville and his collaborators have discovered that, in addition to normal spontaneous fission, the isotope californium-252 occasionally splits in two in such a way that no neutrons are released. Measurements taken with the Gammasphere detector at the Lawrence Berkeley (Calif.) National Laboratory indicate that this rare process, known as neutronless binary fission, occurs only 1 to 10 times per 10,000 fission events.

Ramayya and his coworkers have also found that californium-252 sometimes breaks into three fragments—two of moderate size and one as small as a helium nucleus (or alpha particle). These findings provide significant insights into fission processes, Ramayya says. Theorists are now trying to formulate explanations of the newly observed phenomena. —*I.P.*

Antiproton path to nuclear suburbs

One way to study the distribution of neutrons and protons at the periphery of an atomic nucleus is by shooting antiprotons into a target made up of a single isotope such as nickel-58. A nickel nucleus could then capture an antiproton, which would go into orbit around the nucleus. At some point, an orbiting antiproton may approach a neutron or proton from the nucleus closely enough for the particles to annihilate each other. Annihilation of a neutron produces nickel-57, whereas destruction of a proton creates cobalt-57. Recent experiments determining which isotope prevails, says F. Joachim Hartmann of the Technical University of Munich, have shown that there are more neutrons than protons at the fringes of the nucleus. —*I.P.*