Chemistry

From a meeting in Boston of the American Chemical Society

Fake fat promises to lower cholesterol

A new fat substitute made from crushed oats and barley could turn dessert into a healthful indulgence. The substance, a white powder called Nu-Trim, contains high concentrations of beta-glucans, soluble fibers that have been shown to lower cholesterol (SN: 5/26/90, p. 330). In cookies, muffins, and frozen treats, Nu-Trim can replace fat by mimicking its texture and mouth-feel.

Nu-Trim is a cousin of Oatrim, another fat replacer currently used in food products (SN: 5/26/90, p. 330). Both were created by George E. Inglett of the Department of Agriculture's Biopolymer Research Unit in Peoria, Ill. Oatrim is produced by breaking oats apart chemically, whereas heat and mechanical crushing produce Nu-Trim. The latter process, says Inglett, is "no different from cooking oatmeal and putting it through a sieve."

Wallace H. Yokoyama of the USDA's Western Regional Research Center in Albany, Calif., says that Nu-Trim has reduced cholesterol in hamsters by 27 percent, a greater decrease than has been achieved with unprocessed oats. The processing probably liberates the beta-glucans from the oat cell walls, he suggests, making them readily available to the body. —*C.W.*

Assembling an antidote to anthrax

Nations that illicitly produce biological weapons often favor spores of anthrax to pack the deadly punch. Unfortunately for potential targets, existing anthrax vaccines and antidotes don't work well, says Jennifer Maynard of the University of Texas at Austin. Her team is engineering molecules to fight the bacterium.

Maynard started with three antibodies that bind to the anthrax toxin and prevent it from invading cells. Guided by the three-dimensional structure of the toxin, she honed in on the parts of the antibodies that are important to the binding. Next, she plans to change selected amino acids in the proteins and test how well the new versions bind. The team will also screen thousands of molecules with random amino acid changes to find the ones that best block the toxin. —*C.W.*

Reheating can't make stale bread fresh

Many people love the smell of fresh-baked French bread, but sometimes it goes stale faster than they can eat it. Now, Gerhard Zehentbauer of the University of Minnesota in St. Paul has analyzed why French bread smells the way it does and why its aroma quickly turns old. Moreover, his study shows that reheating stale bread doesn't restore its fragrance to its former mouth-watering glory.

For his analysis, Zehentbauer baked French bread in his lab, using both a common industrial recipe and a traditional one. He then captured and identified the melange of volatile chemical components in the bread's aroma.

One hour after baking, the aroma of the industrial bread contained a higher concentration of 2-acetyl-1-pyrroline, a compound associated with a roasted smell, than the traditional bread did. The traditional bread, however, gave off higher concentrations of malty-smelling compounds called Strecker aldehydes than did the industrial bread.

Four hours after baking, the industrial bread had lost more than half of its malty-smelling components and increased its concentration of fatty substances—a combination that results in a stale odor. The traditional bread also had lost much of its maltiness, but it didn't smell as stale because it had more Strecker aldehydes to begin with. "If there's enough of a malty aroma, it can suppress the fatty aroma," Zehentbauer says.

He also reheated the bread after a day, let it sit for an hour, and tested to see if it had regained that fresh-baked fragrance. It hadn't. Nevertheless, he says, "reheating must have some benefit or else people wouldn't do it." He speculates that most people eat the bread 10 to 15 minutes after reheating, which might improve the flavor "within limits." —*C.W.*

Physics

Coarse treatment makes heat flow surge

When the going gets rough, the heat gets going.

Researchers measuring heat passage through turbulent water have found that they can cause a remarkable boost in the flow of energy simply by roughening surfaces in their test chambers.

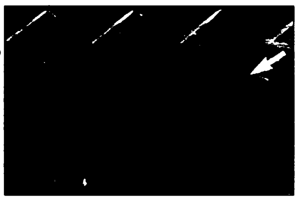
Experimenters at Oklahoma State University at Stillwater have worked with water-filled cylinders capped with brass stoppers that heat one end of the tube and cool the other end. A large temperature difference between the caps causes turbulent flow. When the researchers cut a grid of grooves into the caps, they observed a more than 76 percent jump in heat transmission for the same temperature drop.

"It was a surprise to see such a huge enhancement in heat transport," says Penger Tong, who along with Yi-Bing Du, reports the findings in the Aug. 3 Physical Review Letters.

The researchers propose that the roughening disturbs a thin layer of relatively tranquil liquid that usually hugs surfaces and slows down heat transport. The uneven surface causes swirls of comparatively cold or hot water to peel away from the caps, speeding heat exchange, they conclude. Their findings could prove useful in fields such as climatology and aerodynamics, where turbulent fluid flows are important, Tong says.

Although engineers who design heat exchangers already know that bumpy surfaces improve heat transfer, "we are the first ones to do a really systematic study," Tong says. —*P.W.*

Tong/OSU



A roughened surface (top) ejects plumes of cooler water (brown) into warmer flows (green and blue), causing swirls (arrow).

Electrons hang-ten on laser-made waves

Electrons have surfed the wake of a laser torpedo in the latest demonstration of laser-driven particle acceleration.

Theorists proposed the idea of laser "wakefield" acceleration 20 years ago as a scheme for replacing hulking, conventional accelerators with nimble, laser-driven, tabletop devices (SN: 2/10/96, p. 95). Experimental proof had to await major advances in lasers, but a 15-person team of French and British scientists now reports the first laboratory realization of the technique in the Aug. 3 Physical Review Letters. The wakefield technique is the most recent of three laser-based acceleration methods to make the leap from theory to experiment.

At the École Polytechnique in Palaiseau, France, researchers led by François Amiranoff fired a powerful laser pulse, lasting only 400 trillionths of a millisecond, into a chamber of helium gas. The intense pulse shattered gas molecules into a cloud of charged particles known as a plasma and created a wake of oscillating electrons that wriggled behind the pulse at nearly the speed of light. Simultaneously, the researchers shot a 3-million-electronvolt (MeV) electron beam into the wake. Bunches of injected electrons rode the speeding wake waves for roughly 2 millimeters, reaching a maximum energy of 4.6 MeV.

The energy gain was puny, compared to that produced by conventional accelerators, which routinely boost particles to billions and trillions of electronvolts. Nonetheless, the wakefield technique holds the most promise as an eventual challenger to today's vast machines because of its relative stability, the researchers assert.

In pursuit of higher energy with laser methods, the team is planning November tests to increase the accelerating length to a centimeter, says École Polytechnique's Victor Malka. One approach calls for using a long laser pulse to bore a channel in the plasma to guide a second, shorter pulse. —*P.W.*