Cheese source of dietary anticancer agent

A little more than four years ago, researchers at the University of Wisconsin-Madison reported finding a substance in cooked meat that inhibited the formation of several types of cancer in mice (SN: 12/22&29/84, p.390). Last year, they identified the mystery substance as slightly altered forms of linoleic acid — an essential polyunsaturated fatty acid (SN: 1/9/88, p.24). Now they report finding the altered fatty acids in a wide range of cheeses and milk, and — more important — clues to how they form and function.

Indeed, the new research suggests these compounds are unique among anticarcinogens. According to Michael W. Pariza, who directed the work, it appears they are the only known anticancer agents likely to become incorporated into the cells of those who eat them — thereby establishing a locked-in defense against cancer.

Fatty acids are long-chained, carbon-based molecules from which fats and oils form. Linoleic acid is an 18-carbon chain containing two double bonds. Its two pairs of double-bonded carbons are separated by a pair of single-bonded ones. In the rearranged forms of linoleic acid that Pariza's group is studying — known collectively as CLA — one single carbon bond now separates the pairs of double-bonded carbons.

Cheeses contain CLA at levels ranging from 550 to 8,810 parts per million (ppm) in fat, report Pariza and his co-workers in the January/February JOURNAL OF AGRICULTURAL AND FOOD CHEMISTRY. Both pasteurized and unpasteurized milk contain 700 to 825 ppm CLA in fat; raw and grilled ground beef contain concentrations of 2,050 and 9,290 ppm of the fat respectively.

Heating, free-radical-type oxidation and microbial enzymatic reactions in the forestomach of ruminant animals can all rearrange the placement of linoleic's double bonds, creating CLA. However, Pariza notes, even the temperatures involved in pasteurizing milk or grilling beef aren't high enough to explain the CLA levels he detected in these products. So his group began puzzling over how to initiate the CLA transformation without first oxidizing the fatty acid — a change that would preclude CLA formation.

A clue to what they now view as the most likely mechanism for the double-bond rearrangement came from Cheese Whiz — a processed food made from cheddar, mozzarella and whey concentrate. Cheeze Whiz had 6.5 times more CLA than cheddar alone, and indeed 4.5 times more than the next best cheese source tested — Parmesan. What really characterizes its difference from the other cheeses is its whey, rich in the proteins lactalbumin and lactoglobulin.

Work by others had suggested that when linoleic acid was oxidized in the presence of a protein like albumin, that protein donated a hydrogen atom, catalyzing the fatty acid's transformation to CLA. "We now think that certain proteins — and which ones we don't know for sure — may be able to donate hydrogen atoms to the system, causing a transient destabilization of these double bonds," Pariza told SCIENCE NEWS. Once the rearrangement is complete, the hydrogen would leave, yielding a stable CLA.

Last year, Canadian researchers showed that three polyunsaturated fatty acids (PUFAs) — including linoleic acid — can be extremely efficient cancer-cell killers, largely owing to their ability to generate free radicals (highly reactive oxygen molecules) and toxic secondary products, including singlet oxygen (SN: 5/21/88, p.332). Ironically, the Wisconsin team has discovered, their PUFA-derived cancer inhibitor appears to work by exactly the opposite mechanism. A potent antioxidant, in test-tube experiments CLA quenched damaging free radicals and singlet oxygens before they could damage healthy cells. Moreover, the Wisconsin data now show, since CLAs actually become part of tissue lipids (fats) — including cell membranes — they're likely planted along the front lines of a cell's defense against carcinogens.

Because CLA resides in a food's fat — itself a major risk factor in heart disease — Pariza cautions against megadosing on CLA-rich foods. But within a balanced diet, he believes, CLAs may confer some degree of protection against cancer — particularly when present in combination with other dietary anticancer agents, such as protease inhibitors found in many vegetables, including beans, rice and potatoes (SN: 3/28/87, p.206).

— J. Raloff

Solar-cycle peak threatens Max to the max

In Tucson, Ariz., this week, scientists installed an instrument in a 60-foot-high tower at Mt. Wilson Observatory to provide some of the most precise images yet to aid in mapping the sun's interior.

At the same time, researchers who had gathered at the NASA Goddard Space Flight Center in Greenbelt, Md., to discuss their work with the Solar Maximum Mission satellite heard NASA's current prediction of Solar Max's fate: Heating and expansion of Earth's upper atmosphere as the sun approaches the maximum activity in its 11-year cycle will make the device impossible to control by late September, so that a few months later it will burn up in the atmosphere.

Even before that, says Joan Schmelz of Applied Research Corp. in Landover, Md., "we expect to hit a period of intense solar activity, possibly causing [Solar Max] to fall kilometers at a time, like hitting a wall. The effects of the drag are already strong enough that we feel the effects on operations, and it often takes several minutes to reacquire the spacecraft [with commands sent from the ground]. The effects are only going to get worse."

Several researchers have hoped NASA would use the space shuttle to rescue Max, either by raising its orbit or by bringing it back to Earth for modifications and later relaunching. The agency, however, has declined, citing the lack of money and an available shuttle mission. "We have no manifest slot," Schmelz says, "and no 5 to 6 million dollars."

On the positive side, however, a group of Solar Max scientists has recently overlaid the images from one of the craft's instruments with those taken by the Soviet Phobos 1 satellite, providing new insights into the sun's energetic surface activities. Phobos 1 went dead in September due to an incorrect computer command from the ground, but its coronagraph made several images of the solar disk in July and August. Now Schmelz and her colleagues have succeeded in aligning the pictures from Phobos 1 with those from Solar Max's X-ray polychromator, which provides such details as studies of the dynamics of solar flares.

In fact, says Schmelz, "the Phobos 1 instrument saw an active region just coming over the east limb of the sun in the last couple of days in August. On Aug. 31, when the X-ray polychromator was turned on for the beginning of International Solar Month [SN: 8/27/88, p.134], it saw the same active region, which flared several times and grew to a huge area." The team plans to make a "movie" of its data, compressing about a week's observations into minutes.

At Mt. Wilson, David M. Rust of the Johns Hopkins University Applied Physics Laboratory in Laurel, Md., and his colleagues are readying a device called the Stable Solar Analyzer, a small telescope equipped with a "cell" of cesium-133 that allows it to make images of precisely measured emissions coming from the sun's extreme depths. The surface of the sun rotates fastest at its equator and slowest at the poles, says Rust, but it is unclear whether the interior rotates at a constant rate, like a solid planet, or with different speeds at different depths.

The study of the inner sun, known as helioseismology (SN: 7/2/88, p.8), has measured its rotation rate about 80 percent of the way to the center, Rust says, and the Analyzer might add another 10 percent. "The number of published papers," he says, "has been doubling every three years."

— J. Eberhart