SCIENCE NEWS of the week

Pectin Helps Fight Cancer's Spread

Home canners rely on pectins, plant-derived gelling agents, to set their jams and jellies. One day physicians may also rely on pectins – to jam certain receptors on the surface of cancer cells.

Blocking these receptors appears to prevent malignant cells circulating within the blood from seeding tissues with new tumors, called metastases, according to a study published this week. Because fewer people die from a primary tumor than from the growths they spawn, preventing metastasis remains one of oncology's leading targets.

For reasons scientists do not understand, most solid tumors eventually shed cells into the blood. Though the body kills most of these cells, any that escape the bloodstream can seed new cancers far from the initial tumor.

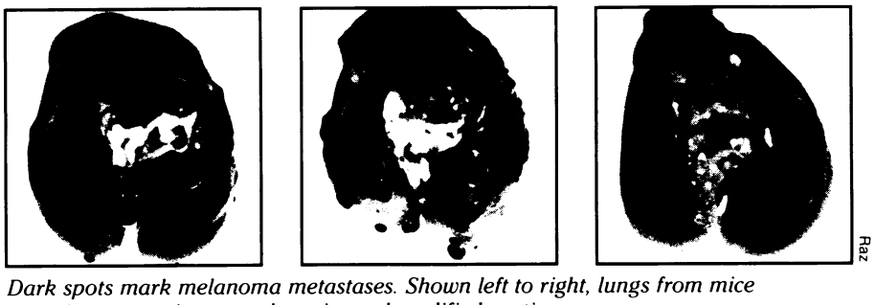
Certain cell-surface proteins, called lectins, help tumor cells clump. The larger the clump, the more likely it will lodge in some tissue as a metastasis, notes Avraham Raz of the Michigan Cancer Foundation (MCF) in Detroit.

Lectins that bind galactoside (a sugar-based molecule) play a role in the cell clumping of many cancers. Raz speculated that because pectin has numerous galactoside side chains, it may bind cancer cells (via their lectins) into clumps. By contrast, pectins possessing a single lectin-binding site might inhibit clumping. Together with David Platt, also at MCF, Raz created such pectin molecules by cleaving the normally branch-shaped citrus pectin into linear subunits with a single, free galactoside. In the March 18 JOURNAL OF THE NATIONAL CANCER INSTITUTE, the pair reports that in incubated melanoma cells, citrus pectin indeed increases cell clumping, whereas the modified pectin does not.

The most dramatic evidence of pectin's influence, however, appears in the lungs of mice autopsied 17 days after they had received injections of melanoma cells – with and without some form of pectin. Four times as many metastases peppered the lungs of mice receiving injections containing normal pectin as those injected with the tumor cells only. Animals receiving the modified pectin developed the fewest and smallest metastases (see photo).

"This is the first report ever describing the use of [nontoxic] plant products to try to prevent metastasis," Raz told SCIENCE NEWS.

Indeed, altering the implantation of circulating cancer cells with modified pectin "is a very clever idea," says Lance A. Liotta of the National Cancer Institute in Bethesda, Md. This promising approach also represents one of the few designed to stop metastases by means other than killing tumor cells, adds Hynda K. Kleinman of the National Institute of Dental Research, in Bethesda.



Raz

Dark spots mark melanoma metastases. Shown left to right, lungs from mice receiving no pectin, normal pectin, and modified pectin.

Kleinman notes, however, that the Michigan team's cell-culture experiments fall short of demonstrating how the modified pectin works in mice. It's a lesson she learned last year, when Japanese researchers published data demonstrating that a nontoxic, anti-metastasis drug her team was working on (SN: 4/15/89, p.228) operates through a mechanism totally different from the one suggested by several cell-culture tests.

– J. Raloff

Switching electrons from trickle to flood

Only a relatively small number of electrons leak across the narrow gap between a surface and the tip of a sharp needle in a scanning tunneling microscope. A similar flow of tunneling electrons can occur across the microscopic junction formed by two crossed wires separated by a helium layer only one atom thick.

Now a researcher has discovered that at temperatures near absolute zero, a strong interaction between the tunneling current and a magnetic impurity – possibly a single electron trapped somewhere in the crossed-wire junction – can greatly increase the electron flow across this junction. Moreover, squeezing the junction ever so slightly, which would presumably shunt a trapped electron aside, readily turns the magnetic effect off and brings the current down. Releasing the pressure restores the current to its previous, high level.

"It's a switch – if you like – whose properties are controlled by a single electron," says Stephen Gregory of Bellcore, in Red Bank, N.J., who described his discovery at an American Physical Society meeting held this week in Indianapolis. His findings will also appear in the March 30 PHYSICAL REVIEW LETTERS.

Gregory assembles his tunnel junction from a pair of fine tungsten wires about 10 microns in diameter. A layer of helium atoms between the crossed wires acts both as a barrier and as a "glue" to hold the microscopic junction together. When cooled to 1.5 kelvins, the device carries surprisingly large currents – as high as 1 microampere – that cross the junction through an area barely the size of an atom. Such currents are much greater than those commonly seen in scanning tunneling microscopy.

Gregory attributes this large current to a remarkable magnetic interaction, the Kondo effect, which in some way orchestrates and facilitates the passage of electrons across the junction. "The amazing thing is that all of the electrons essentially participate in this magnetic effect together," Gregory says.

The ease with which the effect can be turned on and off suggests that a single trapped electron provides the necessary magnetic influence. Squeezing the junction shifts the trapped electron slightly so that it no longer interacts magnetically with the tunneling electrons, thereby reducing the current through the junction from a flood to a mere trickle.

"My assumption is that, despite the fact that the wires are incredibly clean, there's always a possibility there may be a residual oxygen atom or a tungsten atom that isn't that well bonded to the surface, which is able to create a trap for an electron," Gregory says. "The gap [between the wires] is so small that the movement of an electron from one side of a trap to the other – as little as 0.1 angstrom – would be enough to do the job."

A tunnel junction magnetically controlled by one electron shows promise as a kind of quantum switch for novel electronic devices. It also provides a direct means of experimentally studying the Kondo effect itself, which plays a role in superconductivity and other solid-state phenomena.

– I. Peterson