How antioxidants may fight cancer

Consumers often buy dietary supplements fortified with antioxidants—usually vitamins C and E—to defend themselves against the ravages of ozone and other biologically damaging free radicals. While such radicals have been linked to heart disease and a host of aging-related changes, they also may underlie types of DNA damage that can foster the development of cancer, two new studies indicate.

Seattle researchers offer evidence that a radical-induced DNA disorder may trigger the transformation that allows formerly self-contained human breast tumors to begin spreading throughout the body.

Not all cancer cells can invade neighboring tissue and colonize new sites. Those that have this ability usually exhibit a greater diversity of functional attributes than those that served as the foundation of the initial tumor.

Now, Donald C. Malins of the Pacific Northwest Research Foundation in Seattle and his coworkers find that DNA from breakaway cancer colonies has greater chemical and structural diversity than DNA from cells in a well-confined initial cancer. After analyzing breast cancer tissue from dozens of women, they report in the March 19 Proceedings of the National Academy of Sciences that DNA from invasive, spreading cancers contains twice as much radical damage as DNA from noninvasive tumors.

Tumors appear to inflict this damage on themselves, Malins says, by generating hydrogen peroxide—a chemical that cells readily transform to a hydroxyl radical, one of the most potent and damaging of the free radicals. Eventually, his data suggest, a tumor's hydroxyl-induced DNA alterations give rise to mutant cells that can invade and thrive where their parent cells could not.

Such hydroxyl-initiated DNA damage "is a threat to the integrity of genes"—especially tumor-suppressor genes, he says—and challenges the conventional view of DNA as a relatively immutable genetic blueprint. If confirmed, physicians might one day test cancer patients for radical-induced DNA disorders and, when they find one, prescribe a treatment that includes antioxidants.

Malins' "strong and novel" study should spur a search for antioxidants that can enter tumor cells in sufficient amounts to provide the needed "on-site defense" of DNA, says Russel J. Reiter of the University of Texas Health Science Center in San Antonio. Such a defense, he notes, "may require several antioxidants used in combination."

In the second recent study, 50 men—half of them smokers—received just such an antioxidant combo of vitamins C, E, and beta-carotene for more than 20 weeks. Susan J. Duthie and her coworkers at the Rowett Research Institute in Aberdeen, Scotland, then subjected white blood cells from each volunteer to hydroxyl radicals.

Treated cells were next incubated with an enzyme that initiates the repair of DNA by making a cut when it finds certain types of damage. Then the scientists separated the enzyme-snipped strands of DNA into comet-shaped structures that could be counted under a microscope. Duthie says that blood from both the smoking and nonsmoking men given antioxidants contained roughly two-thirds as many comets as blood from some 50 men receiving placebo pills.

This is the first study that has shown "a highly significant moderating effect of long-term antioxidant supplementation . . . on oxidative DNA damage," Duthie's team reports in the March 15 Cancer Research.

They say it also suggests that antioxidants may underlie much of the cancer protection afforded by diets high in fruits and vegetables. *—J. Raloff*

Thin-film mirror changes into a window

Mirror, mirror, on the wall, who're the cleverest of them all?

This week, the answer appears to be Ronald P. Griessen, a physicist at Free University in Amsterdam, and his colleagues. The group has devised a metallic thin film that can be switched from a reflective mirror to a transparent window.

Describing their switchable mirror in the March 21 Nature, the physicists explain that thin films of yttrium or lanthanum hydrides, when exposed to hydrogen, abruptly become insulators rather than metals. At the same moment, such a film loses its reflective metallic sheen and changes into a see-through sheet.

The process is fully reversible, they add.

The researchers made their discovery while working on an entirely different project, a study of superconductivity in hydrogen under extreme pressure and low temperature. "One day, while we were exposing yttrium hydride to hydrogen in the laboratory, the sample just disappeared," says Griessen. "It became almost invisible while the film was absorbing hydrogen."

After months of investigation, the team discovered they could reproduce the strange effect at room temperature and lower pressure. Their switchable mirror consists of a film of yttrium dihydride only 500 nanometers thick, coated with a 20 nm protective layer of palladium.

To see whether the thin film's change in appearance is linked to its electrical transition, the physicists measured various characteristics, including resistance, photoconductivity, and optical transmission. They found that the switch from reflectivity to transparency indeed correlates with the change in its electrical properties.

"We're not absolutely certain why this optical effect occurs," Griessen says. "There are several possible explanations, making this phenomenon interesting from a fundamental point of view."

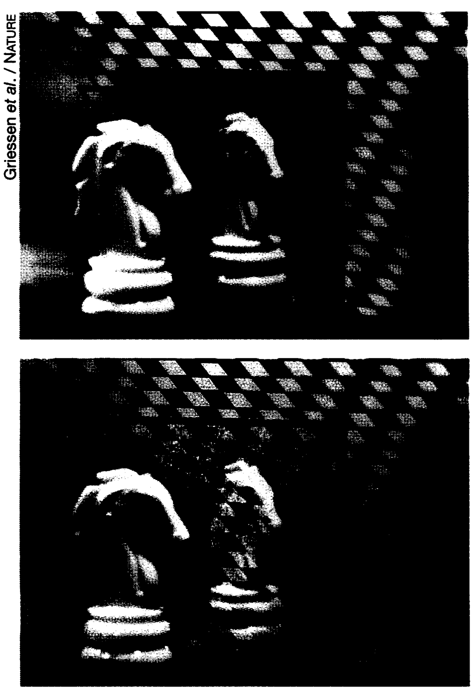
Louis Schlapbach, a physicist at the University of Fribourg in Switzerland, calls Griessen's original experiment "a clever idea, which proves that the [current] theory of metal-to-nonmetal transition in rare earth hydrides is correct."

According to J.J. Huub Eggen, a scientist at the Dutch national science foundation in Utrecht, the electronics manufacturing company Philips is seeking to patent the technique. Though applications remain years away, the material may ultimately prove useful for solar cells, electronic switches, optical sensors, and even windows in houses.

"This switchable mirror is a good example of an inadvertent spin-off from basic research," says Griessen. "We set out to do fundamental science and stumbled into this discovery, which may have great technical relevance.

"Sometimes, to discover something really new," says Griessen, "you just have to play around." *—R. Lipkin*

Griessen *et al.* / Nature



A thin film of yttrium dihydride changes from a metal mirror to a transparent window when exposed to hydrogen.