

Unlike Solomon, however, Brasseur also found substantial ozone depletions—on the order of 6 to 8 percent—in the mid-latitudes during *summer*, when ultraviolet levels reach their yearly maximum. Sasha Madronich of NCAR calculates that such thinning would allow summertime levels of ultraviolet radiation to reach 18 percent higher than normal in the northern mid-latitudes, which includes much of the United States, Europe and the Soviet Union. The boost in radiation would increase skin cancer risk and could generate several thousand additional cases of melanoma in the United States alone over the next few decades, estimates Madronich.

Other atmospheric chemists, however, say discussions of health problems are premature because scientists remain unsure whether the eruption will spur *any* significant ozone decrease. "We don't really have the models or the measurements that would allow us to confidently make such predictions," says Michael J. Prather, an atmospheric chemist at NASA's Goddard Institute for Space

Studies in New York City. According to Prather, only about half of the atmospheric-research community is currently betting the volcano will significantly decrease ozone levels.

The answer should become clearer this winter, after the aerosols spread toward the North Pole. Long before the eruption, scientists began planning a major research campaign to probe the fate of ozone in the stratosphere over the northern mid-latitudes and polar regions. They want to understand why wintertime ozone levels have declined by 6 to 8 percent over the mid-latitudes during the last decade. The planned measurements should also detect effects of the volcanic aerosols, providing the data needed to make better predictions of the possible summertime ozone thinning, Prather says.

The same veil of sulfuric acid aerosols that threatens ozone also reflects sunlight back toward space, slightly dimming light reaching the Earth's surface. Climate experts say the Pinatubo aerosols will lower average world tempera-

tures during the next several years, temporarily reversing the warming trend of the last two decades.

Global temperatures may not fall significantly in 1991 and 1992, because an El Niño developing in the Pacific will help warm the Earth, slightly offsetting the aerosol cooling. But when the El Niño wanes in about a year, Pinatubo aerosols could chill the Earth by about 0.5°C, says James Hansen of NASA's Goddard Institute.

Before the eruption, Hansen and others had predicted that the behavior of global temperatures during the 1990s would provide a good test for theories forecasting a global warming from greenhouse-gas pollution. Because Pinatubo's cooling should temporarily mask any long-term warming trend, the eruption will make the climate record more complex and difficult to interpret. But even with several years of cooling, the 1990s should still turn out warmer than the 1980s if the greenhouse warming is currently underway, Hansen says.

— R. Monastersky

## Tea-totaling mice gain cancer protection

Green tea helps shield mice against tumors of the liver, lung, skin and digestive tract, and may do the same for people, U.S. and Japanese researchers reported this week at the Fourth Chemical Congress of North America, held in New York City.

"This green tea cannot prevent every cancer, but it's the cheapest and most practical method for cancer prevention available to the general public," asserts Hirota Fujiki, a chemist at the National Cancer Center Research Institute in Tokyo.

In 1987, preliminary evidence that the popular Asian beverage provides anticancer benefits led Fujiki to pinpoint (-)-epigallocatechin gallate (EGCG) as the key protective ingredient. He and others speculate that this antioxidant may protect against tumor development by destroying highly reactive atoms or molecules, called free radicals, that could otherwise attack DNA and disrupt normal cell processes.

Alternatively, EGCG may prevent the activation of certain carcinogens so that the free radicals never form, suggests Fung-Lung Chung, a chemist at the American Health Foundation in Valhalla, N.Y.

Fujiki now reports that EGCG, given orally in concentrations equivalent to those consumed daily by tea drinkers in Japan, reduced the number of liver tumors—sometimes preventing them altogether—in mice specially bred to develop liver cancer. And in mice given a carcinogen that affects the digestive tract, 20 percent of the animals treated

with EGCG developed intestinal cancer, compared with 63 percent of mice that did not get EGCG.

Researchers at Rutgers University in Piscataway, N.J., describe similarly encouraging effects on skin cancer rates in female hairless mice. The team exposed some mice to ultraviolet light only, and others to ultraviolet light plus a compound known to induce skin tumors. Mice that drank green tea instead of plain water for about 10 days before and then during the exposure period proved less susceptible to skin damage from the light alone, they report. Mice exposed to both the light and the carcinogen developed up to 87 percent fewer skin tumors, with an average of 50 percent fewer tumors, says Rutgers biochemist Mou-Tuan Huang.

"These broad effects of the green tea are quite interesting," says study director Allan H. Conney. "There aren't that many things that have as broad a spectrum [as green tea]."

Even so, he hesitates to advise people to drink more green tea. "The results are encouraging, but I think it would be premature to extrapolate these studies to humans," Conney says. "We're using the same concentration [in mouse experiments] as what people are drinking, but for mice, it's their sole source of drinking water. Any kind of chemical or material that is ingested in large amounts has potential risks."

To obtain protective benefits, it seems a person would need to drink about 10 small teacups of the beverage per day, says Fujiki, who notes that

many Japanese routinely consume that amount.

Green tea may also help explain why cigarette smokers in Japan have a lower rate of lung cancer than smokers in the United States, Chung says. He investigated the protective potential of green tea and its components against the nitrosamine NNK, a powerful carcinogen in cigarette smoke. Chung's group exposed mice to the tobacco nitrosamine three times a week for 10 weeks, for a dosage equivalent to the inhalations of a typical smoker over six years. Mice that drank only tea during that time developed 12 to 16 lung tumors per mouse, while mice that drank plain water wound up with an average of 22 tumors. "What this shows is that drinking green tea might be beneficial to protect the smoker from getting lung cancer," Chung says.

Taking a different tack, chemist Chi-Tang Ho of Rutgers measured the amount of EGCG in green tea, oolong tea (popular in China) and black tea (the type most commonly consumed in the United States). To bring out black tea's strong flavor, manufacturers allow the leaves to ferment almost completely. Oolong tea undergoes partial fermentation. As a result, oolong retains about 40 percent of the EGCG in green tea, while black tea retains only 10 percent. "In black tea, you can almost not find it," Ho reports. However, black tea contains other compounds with antioxidant potential that may also offer some protection against cancer, he says. Manufacturers might be able to develop a way to bring out the taste without destroying the EGCG, Ho suggests. — E. Pennisi