The Bitter Truth

Do some people inherit a distaste for broccoli?

By KATHLEEN FACKELMANN

ormer President George Bush got a lot of flack for his dislike of broccoli. Is it possible that he, as well as many others, has an inherited aversion to this bitter-tasting cruciferous vegetable?

Yes. At least, that's the conclusion of some scientists who say that 25 percent of the U.S. population are supertasters, people with a genetically determined dislike of bitter compounds found in many vegetables and fruits.

A trivial matter? Not to the parent of a picky eater. Nor to the purveyors of public health, who know that many cancers could be prevented if diners would load their plates with fruits and vegetables. Indeed, the National Cancer Institute recommends that people eat at least five servings of fruits and vegetables each day.

Lack of attention to this inherited yuck factor could derail NCI's effort to lower the country's cancer rate, says Adam Drewnowski, director of the nutrition program at the University of Michigan in Ann Arbor. His research suggests that supertasters indeed shun certain foods containing bitter-tasting compounds that scientists think may ward off cancer.

his story starts in the thirties with a fabulous accident in the lab of a chemist," says Linda M. Bartoshuk, a taste researcher at the Yale University School of Medicine.

In 1931, Arthur L. Fox of E. I. du Pont de Nemours and Company in Wilmington, Del., was synthesizing a compound called phenylthiocarbamide (PTC), when some of it blew into the air. A colleague who inhaled the PTC dust commented on the terrible taste. Fox tasted nothing. He went on to test a variety of his colleagues and discovered that some experienced PTC as intensely bitter, while others said the compound "has no more taste than sand" (SN: 4/18/31, p. 249). This early research indicated that people could be divided into two groups: tasters and nontasters.

Fox then provided PTC to other researchers, who conducted family studies. They soon found that the ability to taste PTC is an inherited trait.

In the 1970s, Bartoshuk's team began

to do research on a similar chemical, called 6-n-propylthiouracil, or PROP. After years of use, researchers had learned that PTC has some toxic effects, so they relied on PROP, a thyroid medication, to test people for sensitivity to bitter flavors.

At first, the research produced results similar to those for PTC. Some people experienced PROP as incredibly acrid, while others couldn't tell the difference between a solution containing PROP and water. Like PTC tasting, reactions to PROP were inherited. The scientists thought that the two tests reveal the same trait.

As time went on, Bartoshuk began to notice that "tasters weren't all alike." The research began to reveal a subset of people who seemed unusually attuned to the bitter taste of PROP. She called such people supertasters. Subsequent studies by Bartoshuk and other groups have shown that about 25 percent of the U.S. population are supertasters, 50 percent are regular tasters, and 25 percent are nontasters.

The researchers were curious as to whether supertasters let their acute sensitivity influence their choice of food. Drewnowski and his colleagues focused on naringin, a substance responsible for the bitter flavor of grapefruit juice. Naringin is also thought to fight cancer in several ways.

Drewnowski's team tested 123 women and found that 28 percent were supertasters, 40 percent were regular tasters, and 32 percent were nontasters. The researchers then had each woman rate several solutions of naringin and sugar water. Supertasters disliked the bitter naringin more than regular tasters and nontasters did, the team found.

In addition, when the scientists asked



A supertaster reacts dramatically to the bitter taste of PROP.

the volunteers to rate different foods, they discovered that the supertasters were most likely to report an aversion to grapefruit juice. There was no difference in the acceptability of orange juice, which does not contain naringin. These results are slated to appear in the August American Journal of Clinical Nutrition.

The researchers haven't finished analyzing the other food preference data from their study, but they have found that the supertasters are more likely than the others to reject broccoli. This vegetable contains another bitter compound that is also a powerful anticancer agent. If purchased from a chemical supplier, this substance contains a warning because it is so corrosive. "It's mean stuff," Drewnowski says.

In an as-yet-unpublished study of 53 women, Drewnowski's group has found that supertasters are more likely than other women to reject green tea and soy products. When they do drink soy milk, supertasters prefer vanilla soy milk, which is sweeter than the regular variety. Both green tea and soy products are popular in Japan, which has a low cancer rate. Ironically, supertasters are more common among Asians than in other populations tested.

Previous research has shown that a bitter substance in soy called genistein may act against breast cancer (SN: 5/12/90, p. 296). Genistein resembles the female sex hormone estrogen, which fuels the growth of breast cancers. Researchers believe genistein may block the breast cell's estrogen receptor, thus impeding cancer's growth.

amily studies have revealed a pattern in the inheritance of tasting and supertasting abilities. The researchers propose that people with one copy of the supertasting gene or genes become regular tasters and experience some of PROP's bitter flavor. People who inherit two copies become supertasters, grimacing and gagging in response to a solution of PROP. So far, the exact location of the gene or genes that influence whether people taste these bitter substances remains unknown.

In the course of human evolution, supertasters may have derived some advantage from their finicky taste. For example, says Drewnowski, people living in remote jungle areas must judge whether a particular plant or berry is poisonous. "Not being able to reject bitter poisons really places you in danger if you live in [such an] environment," he says.

For people living in a city, regular taster or nontaster status might prove beneficial, Bartoshuk says. Such people would be more likely to eat a broad range of items—foods they pick out at the grocery store, where poisons should not be a problem.

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In addition, the supertasting ability may have helped women avoid certain foods during pregnancy. Scientists have found that more women than men can detect the bitter taste of PROP. In addition, many of the compounds found to be harmful to a fetus, but not to an adult, are bitter. That may be why pregnant women can suddenly become choosy eaters.

Valerie B. Duffy of the University of Connecticut School of Allied Health in Storrs decided to check out that folk wisdom. She analyzed the food preferences of 50 pregnant women and found that the women were most likely to reject bittertasting foods in the first trimester, when the fetus is especially vulnerable to damaging compounds. Duffy presented her findings this week at the International Symposium on Olfaction and Taste held in San Diego.

Bartoshuk's team has also found that the number of supertasting women drops after menopause. In a study of 60 women age 65 and older, Laurie A. Lucchina, also at Yale, showed that about 7 percent were supertasters. Bartoshuk speculates that the supertaster gene becomes less active after the childbearing years, perhaps because it's no longer necessary to protect a developing child.

Supertasters may prove more sensitive to tastes and food sensations in general. According to Bartoshuk's research, they experience sweet foods as more sugary, fat foods as more slippery, and hot foods as more spicy than regular tasters or nontasters. "So you can imagine that the supertaster is living in quite a different world of food," Bartoshuk says. "We're just beginning to explore that."

A simple physical difference may explain their sensitivity. "Supertasters have very different tongues," Bartoshuk says. Her research has shown that, compared to regular tasters and nontasters, supertasters have more of the round structures on the tongue called fungiform papillae, so named because they resemble button mushrooms. These structures contain the taste buds, which send perceptions of flavor to the brain.

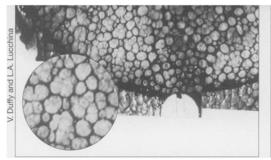
ho cares if you shun broccoli in favor of cake?

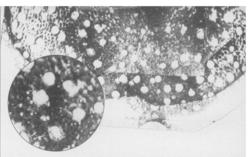
The National Cancer Institute, for one.

"The evidence supporting the role of fruits and vegetables in preventing cancer is fairly considerable," says Gloria Stables, director of NCl's 5-A-Day program. For example, reviews of more than 150 epidemiological studies show that people who eat about five servings of fruits and vegetables halve their risk of certain cancers, compared to those who eat less than that amount.

The American Heart Association, for another.

The AHA's nutrition committee recom-





A supertaster's tongue (left) contains more fungiform papillae than a nontaster's tongue (right). To find out your supertaster status, get some blue food coloring from the grocery store, swab it onto your tongue, and count the round structures that appear in a circle the size of a notebook paper reinforcer. If you're a supertaster, the circle will hold 25 or more papillae; if you're a nontaster, the area will contain only a few (see detail).

mends eating a wide variety of fruits and vegetables. Such a diet may help reduce the concentration of cholesterol in the bloodstream, the panel says in the June 3 CIRCULATION. Many fruits and vegetables contain natural chemicals, such as flavonoids, that inhibit cholesterol absorption. Thus, a diet rich in fruits and veggies may not only fight cancer but ward off a heart attack as well.

With all these benefits, why do many people continue to shun broccoli, brussels sprouts, spinach, grapefruit, melon, kale, tofu, and other healthful items found on the supermarket shelves? In the most recent U.S. Department of Agriculture survey, just one in three U.S. adults ate the recommended five servings of fruits and vegetables per day.

Drewnowski blames the supertaster gene, in part, for the vegetable-poor diet consumed in the United States. "There may be genetic reasons why you gag on broccoli," Drewnowski says.

Stables cautions that researchers have yet to prove that supertasters reject certain health-promoting foods. If there is a genetic component to taste, "it's a very small factor," adds Ritva Butrum of the American Institute for Cancer Research in Washington, D.C. "A much bigger factor is the way foods have been introduced early in life," she says.

Drewnowski agrees that his findings must be tested. Even if genes do play some role in food selection, their influence certainly wouldn't override experience, he says. He believes public health officials should take into account the fact that some people can't abide the taste of certain foods. Food campaigns could then work around a distaste for bittertasting vegetables and fruit.

"I think a supertaster can learn to like brussels sprouts," Drewnowski says.

Supertasters who want to include more such veggies in their diet might start gradually, using some adaptations to take the bitter edge off. He points out that cooking vegetables, rather than eating them raw, helps tone down the bitter flavor.

It may be that such research will lead to the development of additives specially designed to filter the bitter taste of fruits and vegetables. A study in the June 5 NATURE suggests that salt is a natural bitter blocker (see sidebar).

In the end, health officials may have to target children. "For whatever reason, some kids have a hard time eating some of the stronger-flavored vegetables," Stables says, noting that kids lag behind adults in adherence to the 5-A-Day program.

Children who are supertasters may resist all efforts to tempt them, Drewnowski notes. "If they don't want to eat cabbage, you can't make them."

Will public health officials fare any better at getting Johnny to eat his vegetables? That's the job. It won't be easy.

The sweet side of salt

As any aficionado of chocolate-dipped pretzels will tell you, the salt is an integral part of the package. That pretzel lover can't tell you why, but researchers in Philadelphia probably can.

Their study suggests that salt blocks the bitter flavor of foods. That filter allows more desirable flavors, such as sweetness, to shine through, says Paul A.S. Breslin of the Monell Chemical Senses Center in Philadelphia. Breslin and Monell director Gary K. Beauchamp report their findings in the June 5 NATURE.

Salt seems to do two things, Breslin says. First, it imparts a desirable salty flavor. Second, it "changes the charac-

ter of foods so that some of the bitterness is suppressed," he says. For example, chocolate, which has a slightly bitter edge to it, tastes sweeter with salt. "In many cultures, it's common to salt fruit," Breslin says, adding that the practice may be a way of enhancing the sweet side of some fruits.

Would salt help supertasters learn to love a side dish of broccoli? Breslin and Beauchamp don't know whether salt suppresses the particular bitter flavors that affect supertasters, but it may serve as nature's way of getting people to eat their fruits and vegetables. Not to mention chocolate-covered pretzels.

—K.F.