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Studies Of Population Genetics, Evolution Are An Exercise In Bad Taste

ScienceDaily (Feb. 19, 2007) — Scientific studies of why foods such as Brussels sprouts and stout beer are horribly bitter-tasting to some people but palatable to others are shedding light on a number of questions, from the mechanisms of natural selection to understanding how our genes affect our dietary habits.

Dr. Stephen Wooding, a population geneticist, studies how tiny variations in genes give rise to variations in traits among a given human population. Part of his research focuses on variations in human genes responsible for bitter-taste receptors on the tongue that intercept harsh-tasting chemicals from food. (Credit: UT Southwestern Medical Center)

Dr. Stephen Wooding, a population geneticist at UT Southwestern Medical Center in Dallas, studies how slight variations in genes give rise to variations in traits among a given human population.

Part of Dr. Wooding's research focuses on variations in the genes responsible for bitter-taste receptors, tiny receptacles on the tongue that intercept harsh-tasting chemicals from food. Each of these genes comes in several forms, and the forms you carry help determine how you perceive bitter-tasting compounds.

The ability to taste or not taste bitter foods might have played a role in human evolution and may today account for such health-related behaviors as smoking and vegetable consumption, Dr. Wooding said. He will present an overview of his research on the bitter-taste receptor today in San Francisco at the annual meeting of the American Association for the Advancement of Science. The title of his talk is "Evolution: A Study in Bad Taste?"

In the 1930s, scientists discovered differences in the ability of humans to taste a bitter synthetic compound called phenylthiocarbamide, or PTC, and they determined that the trait was controlled by genetics (the actual gene for PTC sensitivity was discovered in 2003). For PTC "tasters," even tiny concentrations of the compound are extremely bitter, while "nontasters" experience little or no taste to the same concentration of PTC.

"In some ways, bitter-taste sensitivity seems to be a trivial trait, but early geneticists recognized that this trait was special, for a variety of reasons," said Dr. Wooding, an assistant professor with UT Southwestern's Eugene McDermott Center for Human Growth and Development.

"Bitter-taste sensitivity is crucially important in protecting the human body from toxins in the environment. By enabling us to perceive noxious chemicals in potential foods -- especially toxins used by plants to defend themselves against herbivores -- bitter taste probably helped our early ancestors avoid poisoning," he said.

If that is the case, then why are both tasters and nontasters still present in the human population? Based on the rules of natural selection, shouldn't all of the nontasters have died off early in our evolution?

The answer is complex, Dr. Wooding said, noting that some things that taste bitter are used as medicine, such as compounds in certain tree barks that help protect against malaria.

He and his colleagues -- Drs. Dennis Drayna and Un-kyung Kim at the National Institutes of Health, along with Drs. Lynn Jorde and Michael Barnshad at the University of Utah -- analyzed the gene for PTC sensitivity for certain "signatures" of natural selection that would tell them how the gene has changed over time. They found very strong evidence that within humans, a process called "balancing natural selection" has taken place.

"This is a kind of natural selection that keeps two different forms of the same gene active in a population," Dr. Wooding said. "In this case they are the taster and the nontaster forms. In the absence of this type of natural selection, you would expect one form to dominate. That hasn't happened here because for some reason, there is not a strong advantage of one over the other. It's an unusual situation."

One hypothesis is that PTC nontasters can taste something that tasters can't.

"When we look at the nontaster form of the PTC receptor, it looks functional, so we think it probably responds to something," Dr. Wooding said. "One explanation could be that, long ago, it conferred some sort of protection from a different compound in these people."

Follow-up studies of variation in other bitter-taste receptor genes have revealed that different genes show different patterns of diversity. These might match up with other person-to-person differences in taste, Dr. Wooding said.

Regardless of the form of the PTC gene an individual carries, Dr. Wooding -- who genetically is a taster -- emphasized that taste preferences, upbringing and cultural issues clearly play very important roles in a person's diet.

"I personally like a little bit of bitter taste," he said.

Adapted from materials provided by UT Southwestern Medical Center.