INDIVIDUAL DIFFERENCES IN TASTE PERCEPTION DIRECTLY RELATED TO GENETICALLY-DETERMINED VARIATION IN TASTE RECEPTORS

Differing forms of taste genes mean that we all live in our own unique taste world

Philadelphia, PA (February 21, 2005) -- Why do brussels sprouts taste bitterly repellent to one person and bland - or even delicious - to the next?

A study published in the February 22 issue of Current Biology confirms the influential role of genetics in determining the wide range of human sensitivity to taste, ultimately impacting how we each perceive the world in a slightly different way.

“Each human carries their own distinctive set of taste receptors which gives them a unique perception of how foods and medicines taste,” explains Monell Chemical Senses Center psychophysicist Paul Breslin, PhD, who shares first authorship and is a corresponding contributor for the study. “This paper shows that a single gene codes for multiple forms of a taste receptor, with each form having a differing sensitivity to taste compounds. Further, a person’s perceptual sensitivity to these bitter tasting compounds corresponds strikingly well with their genetically-determined receptor sensitivity.”

In the paper, researchers at the Monell Center and collaborating institutions related individual perception of the bitter-tasting compounds PTC and PROP to variation in a bitter taste receptor gene known as h*TAS2R38*.

The researchers cloned two forms (haplotypes) of the h*TAS2R38* gene and expressed the corresponding receptors in a cell culture. The two haplotypes, known as PAV and AVI, vary with respect to amino acid substitutions encoded at certain positions on the taste receptor protein.

In the cell culture experiments, small amounts of the bitter compounds activated cells expressing the PAV form of the receptor, whereas cells expressing the AVI form were unresponsive to the same compounds. Cells expressing other haplotypes (eg PVI, AAI or AAV) had intermediate sensitivity to the bitter compounds.

Other experiments examined bitterness perception in human subjects. People with the PAV form of the h*TAS2R38* gene were most sensitive to the bitter taste of PROP and PTC. Subjects homozygous for the AVI haplotype were 100 to 1000 times less sensitive to bitter taste of the two compounds, confirming the lack of response in the cell culture experiment. These data implicate the responsive PAV haplotype as a major determinant of sensitivity to the bitter taste of PROP and PTC in humans.

“These data answer a long-standing question about why humans differ in their ability to taste some bitter compounds,” explains study co-author Danielle Reed, PhD, a Monell geneticist. “Now we can expand our use of this procedure to understand why people are sensitive to other types or tastes, such as sweet or umami, or other types of bitter compounds. We would then be able to test people for their innate ability or inability to taste a variety of flavors and foods.” Such knowledge may someday be used to help patients consume beneficial bitter-tasting compounds, such as pharmaceuticals and health-promoting bitter-tasting plants.

The studies demonstrate that variations in a single bitter receptor gene can code for different taste receptors, each sensitive to distinct bitter taste compounds. Thus, while each human may have 25 or so bitter receptor taste genes, because each gene can code for multiple receptors with differing sensitivities, there may be hundreds of different bitter taste receptors in the human population as a whole, leading to wide individual variation in perception of bitterness.

The existence of both bitter “tasters” and “non-tasters” has the scientists curious for more answers. Breslin comments, “From a human evolutionary perspective, we want to understand how and why both tasters and non-tasters evolved and were maintained in the gene pool.” Reed continues, “Usually when we see a trait like this, there is a biological advantage to maintaining the variation. We’re wondering what that could be.”

Sharing first authorship of the paper with Breslin is Bernd Bufe from the German Institute of Human Nutrition (DIFE). Also contributing to the studies were Wolfgang Meyerhof and Christina Kuhn at the German Institute of Human Nutrition; Un-Kyung Kim and Dennis Drayna from the National Institute on Deafness and Other Communication Disorders at the National Institutes of Health; Jay P. Slack from the Givuadan Flavors Corporation; and Christopher D. Tharp of Monell.

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The Monell Chemical Senses Center is a nonprofit basic research institute based in Philadelphia, Pennsylvania. For 35 years, Monell has been the nation’s leading research center focused on understanding the senses of smell, taste and chemical irritation: how they function and affect lives from before birth through old age. Using a multidisciplinary approach, scientists collaborate in the areas of: sensation and perception, neuroscience and molecular biology, environmental and occupational health, nutrition and appetite, health and well being, and chemical ecology and communication. For more information about Monell, please visit www.monell.org.

CITATION: Bufe, B., Breslin, P.A.S., Kuhn, C., Reed, D.R., Tharp, C.D., Slack, J. P., Kim, U-K, Drayna, D., and Meyerhof, W. *The Molecular Basis of Individual*

Differences in Phenylthiocarbamide and Propylthiouracil Bitterness Perception. Current Biology, 2005, 15, 1-6.

FUNDING: German Science Foundation and the National Institute on Deafness and Other Communication Disorders.

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