Perception and preference may have genetic link to obesity

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About five years ago, animal studies first revealed the presence of entirely novel types of oral fat sensors or receptors on the tongue. Prior to this time, it was believed that fats were perceived only by flavor and texture cues. With this new information, "everything that we thought we knew about fat perception got turned on its head," said Beverly Tepper, a professor in the Department of Food Science at Rutgers School of Environmental and Biological Sciences.

Tepper has been studying consumer preferences for high-fat versus low-fat foods, and has been intrigued by the questions: "Why are some people more sensitive and others less sensitive to fat?" "Is this a personal trait?" "And do genes contribute to these differences?"

Those new discoveries suggest that fats are perceived on the tongue as a "taste" sensation by binding to specialized receptors on taste buds. More specifically, Tepper explained, "fats are broken down in the mouth to fatty acids, and it's the fatty acids that bind to these receptors."

One oral fat receptor that has attracted a great deal of recent attention is CD36, a carrier protein that helps fatty acids traverse cell membranes in many tissues of the body. This is necessary for fats to participate in many different metabolic functions. Recent studies show that CD36 is also located on the surface of taste buds and may send signals to the brain about the presence of fat in the mouth.

But how is CD36 related to consumer fat preferences and the possible genetic differences that Tepper and colleagues are so keen on understanding?

The answer lies in a new study published in the journal *Obesity* by Tepper, in conjunction with her former student Kathleen Keller, who received her Ph.D. in 2002 from Rutgers' graduate program in nutritional sciences. Keller, an assistant professor of nutritional sciences at The Pennsylvania State University and lead author on the article, studied an overweight population of African-American adults and found those who had a specific change or variation in the CD36 gene perceived the creaminess and fattiness of salad dressings quite well, but they were less able to differentiate the high-fat from the low-fat versions.

Despite this insensitivity, these same individuals reported by questionnaire that they liked added fats such as salad dressings, spreads, butter and margarine more than those who did not have this variation in their CD36 gene. "This is the first time that a gene involved in fat taste has been linked to fat preference in humans," said Tepper.

A Genetic Marker for Fat Texture

This latest finding came out of years of research on PROP-tasting, a different genetic trait that seems to be an index of general food preferences, including liking of fat. PROP (short for propylthiouracil) is a bitter-tasting compound that is strong-tasting to some people and tasteless to others. The ability to taste PROP is controlled by a gene called TAS2R38. People who are taste-blind to PROP are called "non-tasters" and those who perceive PROP to be strongly bitter are called "super-tasters." Those in the middle of the pack, not surprisingly, are called "medium tasters."

"Several things became very clear from our studies and those from other labs," says Tepper. "Non-tasters were insensitive to a wide range of oral sensations such as bitterness, sweetness, chili pepper heat and the texture of fats, and they avidly consumed foods with these characteristics." At the other end of the spectrum were "super-tasters, who disliked strong tasting foods because they were too intense for them."

One area Tepper began focusing on was the perception and preference of fat since this has obvious implications for obesity development, a fact that is highlighted in her recent review in The Scientist magazine. In a series of studies, she asked participants to use their own words to describe dairy products that varied in fat content such as ice cream, sour cream, whole milk and skim milk. Super-tasters used a rich and varied vocabulary to describe these foods, whereas non-tasters used very few, simple words.

However, said Tepper, "even though the non-tasters had difficulty describing the foods, they knew what they liked, and they preferred the higher-fat products."

Until recently, it was unclear why a genetic trait that controls the ability to taste bitterness plays a role in fat perception. Why should these two behaviors be related at all?

According to Tepper, "the key linking these two factors together is differences in tongue anatomy." Super-tasters have more taste buds and more nerve fibers that carry signals to the brain about oral texture; non-tasters have fewer taste buds and nerve fibers. Since the perception of fat is due mostly to its texture—flavor being the second component—differences in the ability to sense the texture of fats seem to distinguish non-tasters from super-tasters.

Designer Fats and Personalized Diets

The ability to taste fatty acids provides important signals about the type of fat being consumed and the implications of this could be far reaching, suggested Tepper. "We could use this information to design more healthful fats that also give foods the high sensory appeal that consumers want."

"Using these two genetic markers (CD36 and PROP), we could identify those who are insensitive to oral fat and who may be more susceptible to high-fat diets and obesity," said Tepper. "We could devise more personalized diet strategies to address this specific dietary issue," she added.

"CD36 is only the beginning," said Tepper. "There is at least one additional fatty acid receptor that is known to exist in humans, and probably others that have yet to be identified."

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