

Smelling with your tongue

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Dr. Ozdener is a cell biologist at the Monell Center. Credit: Monell Center

Scientists from the Monell Center report that functional olfactory receptors, the sensors that detect odors in the nose, are also present in human taste cells found on the tongue. The findings suggest that interactions between the senses of smell and taste, the primary components of food flavor, may begin on the tongue and not in the brain, as previously thought.

"Our research may help explain how odor molecules modulate [taste perception](#)," said study senior author Mehmet Hakan Ozdener, MD, Ph.D., MPH, a [cell biologist](#) at Monell. "This may lead to the development of odor-based [taste](#) modifiers that can help combat the excess salt, sugar, and fat intake associated with diet-related diseases such as obesity and diabetes."

While many people equate flavor with taste, the distinctive flavor of most foods and drinks comes more from smell than it does from taste. Taste, which detects sweet, salty, sour, bitter, and umami (savory) molecules on the tongue, evolved as a gatekeeper to evaluate the nutrient value and potential toxicity of what we put in our mouths. Smell provides detailed information about the quality of food flavor, for example, is that banana, licorice, or cherry? The brain combines input from taste, smell, and other senses to create the multi-modal sensation of flavor.

Until now, taste and smell were considered to be independent sensory systems that did not interact until their respective information reached the brain. Ozdener was prompted to challenge this belief when his 12-year-old son asked him if snakes extend their tongues so they can smell.

In the study, published online ahead of print in *Chemical Senses*, Ozdener and colleagues used methods developed at Monell to maintain living human taste [cells](#) in culture. Using genetic and biochemical methods to

probe the taste cell cultures, the researchers found that the human taste cells contain many key molecules known to be present in [olfactory receptors](#).

They next used a method known as calcium imaging to show that the cultured taste cells respond to odor molecules in a manner similar to olfactory receptor cells.

Together, the findings provide the first demonstration of functional olfactory receptors in human taste cells, suggesting that olfactory receptors may play a role in the taste system by interacting with taste receptor cells on the tongue. Supporting this possibility, other experiments by the Monell scientists demonstrated that a single taste cell can contain both taste and olfactory receptors.

"The presence of olfactory receptors and taste receptors in the same cell will provide us with exciting opportunities to study interactions between [odor](#) and taste stimuli on the tongue," said Ozdener.

In addition to providing insight into the nature and mechanisms of smell and taste interactions, the findings also may provide a tool to increase understanding of how the olfactory system detects odors. Scientists still do not know what molecules activate the vast majority of the 400 different types of functional human olfactory receptors. Because the cultured taste cells respond to odors, they potentially could be used as screening assays to help identify which [molecules](#) bind to specific human olfactory receptors.

Moving forward, the scientists will seek to determine whether olfactory [receptors](#) are preferentially located on a specific taste cell type, for example, sweet- or salt-detecting cells. Other studies will explore how [odor molecules](#) modify taste cell responses and, ultimately, human taste perception.

Provided by Monell Chemical Senses Center

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