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Do cells in the blood, heart and lungs smell the food we eat?

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In a discovery suggesting that odors may have a far more important role in life than previously believed, scientists have found that heart, blood, lung and other cells in the body have the same receptors for sensing odors that exist in the nose. It opens the door to questions about whether the heart, for instance, "smells" that fresh-brewed cup of coffee or cinnamon bun, according to the research leader, who spoke here today at the 245th National Meeting & Exposition of the American Chemical Society.

Peter Schieberle, Ph.D., an international authority on food chemistry and technology, explained that scientists thought that the nose had a monopoly on olfactory receptors. Located on special cells in the mucus-covered olfactory epithelium in the back of the nose, olfactory receptors are docking ports for the airborne chemical compounds responsible for the smell of food and other substances. Those molecules connect with the receptors, triggering a chain of biochemical events that register in the brain as specific odors. But discovery of olfactory receptors on other, non-olfactory cells came as a surprise.

"Our team recently discovered that blood cells—not only cells in the nose—have odorant receptors," said Schieberle. "In the nose, these so-called receptors sense substances called odorants and translate them into an aroma that we interpret as pleasing or not pleasing in the brain. But surprisingly, there is growing evidence that also the heart, the lungs and many other non-olfactory organs have these receptors. And once a food is eaten, its components move from the stomach into the bloodstream.

But does this mean that, for instance, the heart 'smells' the steak you just ate? We don't know the answer to that question."

His team recently found that primary blood cells isolated from human blood samples are attracted to the odorant molecules responsible for producing a certain aroma. Schieberle described one experiment in which scientists put an attractant odorant compound on one side of a partitioned multi-well chamber, and blood cells on the other side. The blood cells moved toward the odor.

"Once odor components are inside the body, however, it is unclear whether they are functioning in the same way as they do in the nose," he stated. "But we would like to find out."

Schieberle's group and colleagues at the Technical University of Munich work in a field termed "sensomics," which focuses on understanding exactly how the mouth and the nose sense key aroma, taste and texture compounds in foods, especially comfort foods like chocolate and roasted coffee.

For example, baked beans and beans in foods like chili provide a "full," rich mouth-feel. Adding the component of beans responsible for this texture to another food could give it the same sensation in the mouth, he explained. Natural components also can interact with substances in foods to create new sensations.

The researchers use sensomics to better understand why foods taste, feel and smell appetizing or unappetizing. They use laboratory instruments to pick apart the chemical components. They then put those components together in different combinations and give these versions to human taste-testers who evaluate the foods. In this way, they discovered that although coffee contains 1,000 potential odor components, only 25 actually interact with an odor receptor in the nose and are smelled.

"Receptors help us sense flavors and aromas in the mouth and nose," said Schieberle. "These receptors are called G-protein-coupled receptors, and they were the topic of the Nobel Prize in Chemistry in 2012. They translate these sensations into a perception in the brain telling us about the qualities of a food." Odorant receptors and the organization of the olfactory system also were the topic of the 2004 Nobel Prize in Medicine.

Of the total of around 1,000 receptors in the human body, about 800 of these are G-protein-coupled receptors, he said. Half of these G-protein-coupled receptors sense and translate aromas. But only 27 taste receptors exist. And although much research in the food industry has gone into identifying food components, little effort has focused on the tying those components to flavor perceptions until now, he said.

More information: Abstract

During eating, a distinct set of food constituents induces a pattern of neural activity in the human olfactory and gustatory systems. However, we all know by experience that the complex neural patterns generated at the receptor sites on the tongue and in the nose are finally "translated" by our brain into a simple perception telling us the overall flavor quality of a food. However, although thousands of food constituents have already been identified, only a few studies have attempted to clarify the chemical background of food flavor perception. The concept of Sensomics, developed by our group, allows one to decode the blueprint of those genuine key flavor compounds able to interact with the odorant receptors during food consumption. This interaction with the peripheral receptors renders bioactivity to odorants as well as to tastants. However, interestingly, for certain food constituents, besides flavor properties, other "bioactivities" have been reported, such as effects on behavior, mood, satiety and also, human health.

Using comfort foods as examples, in the first part of the lecture, methods how to unravel complex food flavors by breaking down the overall flavor sensation into single, "chemical" responses will be presented, followed by approaches how to use this knowledge in chemistry to improve the quality of the respective food. In the second part of the talk, recent results are discussed with special emphasis on compounds displaying flavor activity as well as postprandial bioactivity in the human body. The talk will, thus, include data on the fate of aroma compounds in the human body as well as on "flavor perception" in other human tissues.

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