Route to obesity passes through tongue

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Obesity gradually numbs the taste sensation of rats to sweet foods and drives them to consume larger and ever-sweeter meals, according to neuroscientists. Findings from the Penn State study could uncover a critical link between taste and body weight, and reveal how flab hooks the brain on sugary food.

"When you have a reduced sensitivity to palatable foods, you tend to consume it in higher amounts," said Andras Hajnal, associate professor of neural and behavioral sciences at Penn State College of Medicine. "It is a vicious circle."

Previous studies have suggested that obese persons are less sensitive to sweet taste and crave sweet foods more than lean people. However, little is known about the specific differences between obese and lean individuals in their sense of taste and the pleasure they derive from sweet foods.

Hajnal and his Penn State colleague Peter Kovacs, a post-doctoral fellow, investigated these differences by studying the taste responses of two strains -- OLETF and LETO rats.

Compared to the lean and healthy LETO rats, the taste responses in OLETF rats mirror those in obese humans. These rats have normal body weight at first, but they tend to chronically overeat due to a missing satiety signal, become obese and develop diabetes. The obese rats also show an increased preference for sweet foods and also are willing to work harder to obtain sweet solutions as a reward for their learning.

"When you have excess body weight, the brain is supposed to tell you not to eat more, or not choose high caloric meals" said Hajnal. "But this control apparently fails and thus the obesity epidemic is rising, and we want to find out how the sense of taste drives up food intake."

The researchers implanted electrodes in the rodents' brains to record the firing of nerve cells when the rats' tongues were exposed to various tastes -- salt, citric acid, plain water and six different concentrations of sucrose.

Hajnal and Kovacs specifically looked at differences in processing taste in the pontine parabrachial nucleus (PBN), a part of the brain that uses nerve cells to relay information from the surface of the tongue to the brain.

"We found that compared to the LETO rats, the OLETF rats had about 50 percent fewer neurons firing when their tongues were exposed to sucrose, suggesting that obese rats are overall less sensitive to sucrose," explained Hajnal, whose findings appeared in a recent issue of the Journal of Neurophysiology. The response to salt was the same for both strains.

However, when the obese rats were fed a stronger concentration of sucrose, their nerve cells fired more vigorously than in the lean rats. In other words, obese rats have a weaker response to weak concentrations and a stronger response to strong concentrations.

"These findings tell us that there is a difference in activation of neurons between lean and obese rats when they are exposed varying concentrations of sucrose," noted Hajnal. "If you sense sweetness less, you may be inclined to eat sweeter foods."

The Penn State researchers believe that the increased consumption of

sweet foods over time could be influencing the brain's reward center by relaying progressively weaker nerve signals, which affects the perception of taste of the meals through the PBN.

In obese humans, an increase in the weight-height ratio is usually accompanied by a decrease in dopamine, which is a neurotransmitter associated with the brain's pleasure system.

"In these obese rats, like in humans, the dopamine system is suppressed and it is very possible that the obese rats are seeking a hedonistic experience or reward by eating larger meals and when they have a chance they also eat more sweets," Hajnal added.

The findings linking taste responses and obesity could hold an important message for a condition that affects more than 60 percent of adult Americans.

For instance, Hajnal points to an ever-increasing amount of fat and sugar in processed foods. The enhanced taste of these foods, he says, stimulates our taste and food reward neurons on a chronic basis, making them less sensitive over time. And what do we do when this happens?

"Instead of eating less, we seek out higher palatability," Hajnal explained. "We simply start putting an extra spoonful of sugar in our coffee."

Source: Penn State