Study shows how human immune cells react to non-nutritive sweeteners

May 16 2023

Credit: Joseph Krpelan, Leibniz-LSB@TUM

Diet drinks often contain a mix of non-nutritive sweeteners that also enter the bloodstream after consumption. As a new pilot study shows, even dietary intake levels of saccharin, acesulfame-K and cyclamate are

enough to modulate the copy rate of various genes in white blood cells.

"Our data suggest that this modulation sensitizes immune cells to certain immune stimuli," says Dietmar Krautwurst of the Leibniz Institute for Food Systems Biology at the Technical University of Munich. He adds, "Likewise, they also suggest that taste receptors may act as sweetener sensors of the cellular immune system."

Non-nutritive sweeteners are sweeteners that have very high sweetening power but contribute little or nothing to energy intake. They play a major role not only in the U.S. but also in Germany—especially among people who love sweets but want to cut calories and sugar.

Sweeteners don't just affect taste buds

However, sweeteners do not only affect the taste buds in the mouth. Recent studies suggest that they also affect the human immune system, although the underlying molecular relationships are still poorly understood. In order to contribute to their clarification, Dietmar Krautwurst's team was involved in a pilot study with ten healthy test subjects as part of a cooperation with the ZIEL—Institute for Food & Health at the Technical University of Munich.

At the beginning of the study, the participants had to drink 10.7 ml of a sweetener solution per kg of their body weight. The solution contained a beverage-typical mix of approx. 76 mg saccharin, 228 mg cyclamate and 53 mg acesulfame-K per liter. Converted to a 70 kg person, this resulted in a drinking volume of approximately 0.75 liters. The amounts of saccharin, cyclamate and acesulfame K consumed corresponded to approximately 16%, 35%, and 6%, respectively, of the acceptable daily sweetener intake according to the to the European Food Safety Authority (EFSA).

Subsequent blood analysis showed that four hours after drinking the test solution, sweetener concentrations in the blood were at their highest. The team therefore investigated, on the one hand, how the maximum concentrations of the respective sweeteners determined act in vitro on white blood cells, which serve the bacterial defense. On the other hand, the team analyzed ex vivo immune cells taken from the blood of the test subjects before and after the intervention.

Sweeteners influence the transcription of various genes

Both in vitro and in vivo, sweetener administration increased the copy rate of genes containing the blueprint of taste receptors that also commonly respond to sweeteners in the mouth. In addition, the sweeteners modulated the copy profile of genes encoding regulatory proteins of the immune system. According to the team, this does not necessarily lead to altered cell functions. Nevertheless, further study results suggested that the modulated transcriptional profile shifts cells into a state that makes at least isolated immune cells more sensitive to a bacterial stimulus in the presence of the three sweeteners.

"Our results suggest that even an average non-nutritive sweetener intake can affect immune cells in the blood. Of course, we cannot say at this stage whether this is good or bad for health. Further research is needed on this. However, we can deduce from our results the hypothesis that taste receptors serve as sensors for food-related stimuli not only in the mouth, but also on immune cells," explains Dietmar Krautwurst. The Leibniz Institute in Freising will further investigate this assumption.

The paper is published in the journal *Nutrients*.

More information: Thomas Skurk et al, Sweetener System Intervention Shifted Neutrophils from Homeostasis to Priming, *Nutrients*

(2023). DOI: 10.3390/nu15051260