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Bitterness, a line of defense against nasal infections

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Translated from Le Journal de Montréal, April 17, 2017

Recent studies indicate that receptors for bitter taste are also present in the nose and that they trigger an antibacterial response which reduces infections.

PROTECTIVE RECEPTORS

The detection of **taste** in foods relies on a sophisticated system of receptors which are responsive to five major types of distinct tastes, i.e. sweet, salty, sour (acid), umami (proteins) and bitter. The principal function of these receptors is to inform the brain about the nutritional value or the potential toxicity of the foods present in the mouth. For example, the detection of sugar by the sweet receptors signals to the brain the presence of a food which contains good caloric value and which could thus lead to survival. Inversely, some toxic substances of plant origin (such as the alkaloids) are very bitter and the presence of receptors capable of recognizing these molecules, even when they are present in very low quantities, enables the mouth to alert the brain of danger. This detection of bitterness must be very important since there are at least 50 distinct receptors which detect bitterness, and they operate at least 1,000 times more sensitively than do the sweet receptors!

NOT ONLY IN THE MOUTH

One of the most surprising things about the receptors for bitterness is their presence in several organs which are not in contact with food, most notably the nose. Several research studies performed over the past few years indicate that this localization is very important, because it plays a crucial role in the defense against bacteria present in the air[1]. The mechanisms used are of considerable elegance:

- When infecting the nose, some particularly dangerous bacteria (Gram negative group) release a particular class of molecules called acyl-homoserine lactones. These molecules are immediately detected by a class of bitterness receptors (T2R38) located on the surface of the nasal mucosa, which trigger the release of a gas (nitric oxide) which diffuses around the bacteria and kills them.
- In parallel, the bacteria also produce substances which interact with the bitterness receptors present in the solitary chemosensory cells, a subtype of nasal cells specialized in the detection of irritants. In response, these cells signal their neighbours to produce defensins, a group of very powerful antibacterial proteins capable of overcoming bacteria as dangerous as the *Staphylococcus aureus* which is resistant to methicillin.

Overall, one must thus consider the bitterness receptors to be like the leaders and organizers in a front-line system of defense for the respiratory system, capable of responding very quickly (within a couple of minutes if needed) to bacterial invasion. This system is all the more important because we breathe about 10,000 litres of air each day, primarily through the nose, which puts us into contact with very important quantities of microorganisms.

SUPER-TASTERS

Within the population there exist slight differences (polymorphisms) in the sequence of the gene encoding the bitterness receptor T2R38 and these variations have a considerable influence on perception of the bitter taste. For some people (20% of the population), the type of receptors present make them hypersensitive to certain bitter substances and these individuals are called “super-tasters”. Inversely, in other people (about 30% of the population), the receptors are less sensitive to bitterness and these individuals are called “non-tasters” (the remaining 50% of the population falls between these two extremes).

These differences influence not only the detection of bitterness by the tongue but also the resistance mounted in the face of bacterial invasion. Scientists have found that the nasal cells of super-tasters produce much more nitric oxide than do those of non-tasters, which indicates that they are better killers of bacteria. It seems that this difference could contribute to the sensitivity of certain people who are afflicted by nasal infections such as rhinosinusitis (chronic sinusitis); these studies have shown that the super-tasters, who have two copies of the hypersensitive T2R38 gene, have a lower risk of being affected by rhinosinusitis than have the non-tasters. Moreover, studies performed by the group of Dr. Martin Desrosiers at CHUM have shown that the non-taster individuals are more commonly detected in patients affected by chronic rhinosinusitis than in those have never been affected by this disease[2]. The discovery of substances capable of activating the bitterness receptors present in the nasal mucosa could thus provide a promising path for the treatment of the two million Canadians affected by chronic rhinosinusitis.

(1) Lee RL and Cohen N. L’amertume, sentinelle du système immunitaire. Pour la Science No. 473 (March 2017), 48-55.

(2) Mfuna Endam L et al. Genetic variations in taste receptors are associated with chronic rhinosinusitis: a replication study. Int. Forum Allergy Rhinol. 2014;4:200-206.

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