MNF Interview

with Thomas Hofmann,
University of Münster

The discovery of alapyridaine, a new multimodal flavor enhancer

Food chemist Thomas Hofmann, University of Münster in Germany, and his team have identified a multimodal taste enhancer called alapyridaine. The compound, which is tasteless on its own, intensifies the human perception of sweet, salty and umami tastes. Alapyridaine is the first compound known to heighten more than one type of flavor, and the discovery is expected to lead to the production of new foods with reduced levels of salt, sugar and monosodium glutamate (MSG).

MNF:
Prof. Hofmann, how did you come up with the idea that the heating of hexoses and L-alanine would form a new type of flavor enhancer?

Hofmann:
We were interested in taste and taste modifying compounds in beef broth. As hexoses and L-alanine are present in beef in rather high concentrations, we wanted to evaluate the precursor potential of glucose and L-alanine in generating sensorially active non-volatiles.

MNF:
What was your first thought when you isolated this unique compound with its multimodal flavor enhancing properties?

Hofmann:
First, we detected the sweetness modifying properties of alapyridaine. Later on, we discovered by taste recombination experiments that this compound does not only influence sweet perception, but also salty and umami tastes, whereas sour and bitter tastes were unaffected.

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MNF:
You have now performed a systematic study on the structure and physiological activity of alapyridaine (see this issue pages 270–281). What are the basic results of this study?

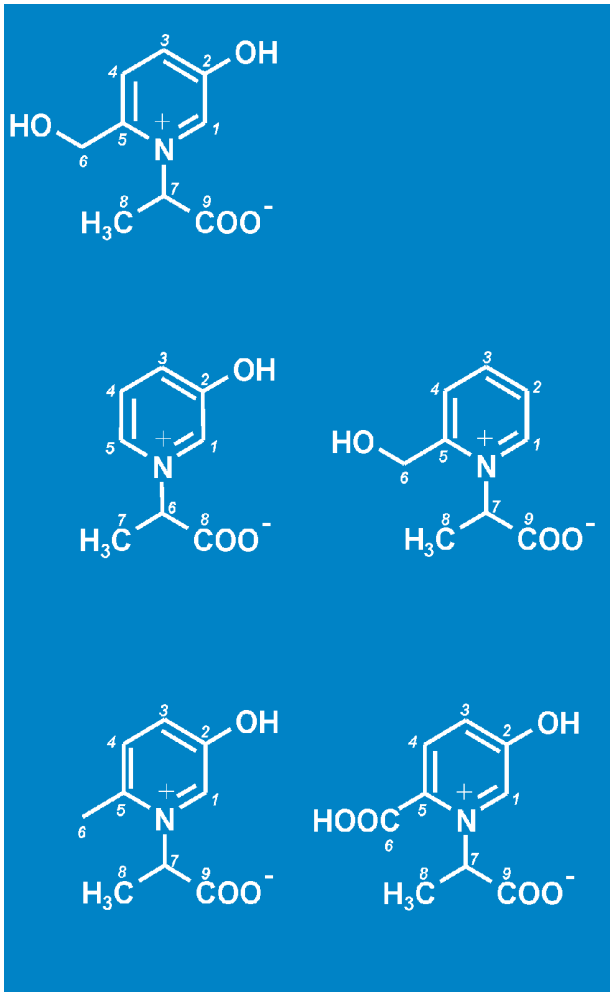
Hofmann:
We have found that the 2-(hydroxymethyl)-5-hydroxypyridinium moiety in alapyridaine is an essential structural element for taste enhancement. Regarding the amino substituent, the (*S*)-configuration as well as the carboxy function are required for taste enhancement, but substitution of the methyl group in the alanine moiety by a benzyl group yielded a compound showing similar taste enhancing activities as found for alapyridaine. Interestingly, substitution of the alanine moiety in alapyridaine by an arginine moiety revealed a one-dimensional taste enhancer exclusively increasing the human sensitivity for salty taste.

MNF:
Do you expect that researchers will be able to identify other similar multimodal taste enhancers? How about heating experiments with other sugars (e.g. pentoses) and other amino acids?

Hofmann:
As the Maillard reaction between reducing carbohydrates and amino acids is known to produce a multiplicity of reaction products, I would expect that there are some additional sensory active non-volatiles either having interesting taste properties on their own, or modifying the human perception of sweet, salty, bitter, sour and umami tastes.

MNF:
Humans have five types of taste-receptors on the tongue. What is the explanation that alapyridaine can enhance several tastes?

Hofmann:
Very recent molecular-biological investigations nicely demonstrated that human T1R1/T1R3 heterodimeric receptors responded to the umami taste stimulus L-glutamate, whereas T1R2/T1R3 dimers recognized diverse natural and synthetic sweeteners. This implicates the T1Rs in playing a key role in umami as well as sweet taste perception, and suggest that sweet and umami taste receptors share a common unit. This common unit might be the clue to explain how alapyridaine is operating on a biomolecular level. The finding that alapyridaine also enhances salty perception suggests the existence of an additional mechanism by which this taste enhancer operates in taste cells. Whereas sweet and umami tastes are mediated by G-protein-coupled receptors, salt detection in the oral space is believed to operate through independent mechanisms. As ion channels are commonly thought to play a key role in the transport of Na^+ ions, such ion channels or downstream signaling elements might be targeted by alapyridaine.



MNF:
How much is known about how taste enhancers act?

Hofmann:
Recent molecular-biological investigations succeeded in confirming the synergistic effect of purine-5′-ribonucleotides on the umami taste of MSG at the taste receptor level. Human T1R1/T1R3 heterodimeric receptors, made up of C-family G protein-coupled receptor T1R1 coexpressed with the related taste specific receptor T1R3, were demonstrated to respond to the umami-type taste stimulus L-glutamate. Although 5′-IMP and 5′-GMP, two hallmarks of taste enhancement, did not alone activate human T1R1/T1R3, these 5′-ribonucleotides strongly potentiated the L-glutamate induced T1R1/T1R3 receptor response. In contrast, cytidine-5′-monophosphate, which does not enhance human umami-type taste perception, showed no effect on human T1R1/T1R3 receptors.

MNF:
Alapyridaine is very promising for the production of foods with reduced levels of salt, sugar and monosodium glutamate. Thus, this new flavor enhancer holds much potential to reduce the level of many human diseases including high blood pressure and obesity. What quantity of alapyridaine is required to maintain taste in foods while significantly lowering the amounts of salt, sugar and MSG?

Hofmann:
So far, the activities of alapyridaine have been demonstrated using aqueous solution models for taste molecules. To answer your question, systematic sensory experiments will have to be done with food products spiked with different amounts of alapyridaine. Such studies are currently under way.

MNF:
What about the toxicity of alapyridaine in this concentration range?

Hofmann:
Toxicological studies are currently being performed, but there are no data available so far.

MNF:
Professor Hofmann, thank you very much for this interview.

Interview by Hans-Ulrich Humpf

