TASTE MODIFIERS – DRIVING THE TRENDS

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Contributing Editor at Flavour Horizons
‘Regulation 1334/2008 on flavourings and certain food ingredients with flavouring properties for use in and on foods.’

Flavour categories;
(ii) made or consisting of the following categories:

- Flavouring substances
- Flavouring preparations
- Thermal process flavours
- Smoke flavourings
- Flavour precursors
- Other flavourings or mixtures thereof

**Article 3 (2) (a)** ‘flavourings shall mean products: (i) not intended to be consumed as such, which are added to food in order to impart or modify odour and/or taste’.
What is the difference between a flavour modifier and a flavour enhancer?

**Guidelines published by EFFA defining the difference earlier this year**

A flavour modifier is a flavouring substance with modifying properties that changes individual organoleptic characteristics of a food product but does not produce an overall enhancement of all the sensorial properties.

A flavour enhancer is a material that influences all the attributes equally keeping the same overall profile.

A flavour enhancer is covered by the Food Additives Regulation 1333/2008 and requires an E number.

A flavour modifier is covered by 1334/2008 and is on the Union List and does not require an E number and is labelled ‘flavouring’.
THE UNION LIST

The objective - to establish a list of flavouring substances ‘the use of which is authorised to the exclusion of all others’.

The Union List of Flavouring Substances entered into force on 22\textsuperscript{nd} October 2012 and applied as of 22\textsuperscript{nd} April 2013.

\textit{Full compliance to the flavouring substances on the Union List by industry - 22\textsuperscript{nd} October 2014}

There are 2511 flavouring substances on the Union List. 2258 have been evaluated by EFSA. Evaluation continues on 253 substances.

\textit{The USA has the FEMA GRAS List}
Categories of flavour patent published by flavour companies in 2015

- Flavour delivery: 6%
- Enzyme synthesis: 2%
- Fermentation: 2%
- Flavour emulsions: 4%
- Flavour encapsulation: 3%
- Reaction flavours: 6%
- Salt reduction: 3%
- Sweeteners: 13%
- Bitter taste maskers: 7%
- Flavour modifiers: 11%
- Flavour enhancers: 8%
- Kokumi flavours: 2%
- Seasonings: 15%
- Flavouring substances: 13%

Source: M. Brown, Flavour Horizons, Issue 17, March 2016
SWEETNESS MODIFIERS
PAMs

PAMs = Positive Allosteric Modulators. These are compounds that induce an amplification of a taste sensation – in this case sweetness.

These are small molecules that enhance receptor activity and sweetness perception and are very effective at potentiating the sweetness of sweet compounds.

The driving force behind the development of PAMs is the US research company Senomyx who have filed a number of patents and four of the many compounds detailed in these patents have received clearance in the US and are now on the FEMA GRAS list and two are listed as newly notified substances in the EUs Union List.
**PAMs**

4-amino-5,6-dimethyl thieno(2,3-d)pyrimidin-2(1H)-one (and its hydrochloride salt)

![Chemical Structure](image)

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<td>JECFA No: 2117 (HCL salt)</td>
<td>EFSA evaluation: No safety concern.</td>
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*Enhances the sweet taste of sucralose. At a level of 6-22ppm halves the amount of sucralose required to produce an equivalent sweetness.*
PAMs

3-(4-Amino-1H-benzo[c][1,2,6]thiadiazin-5-yloxy)-2,2-dimethyl-N-propylpropanamide-2,2-dioxide

FEMA 4701 (GRAS 25)  
JECFA No: 2082  
EU Flavis number: 16.126  
EFSA evaluation: No safety concern.  
Senomyx product: SucroGem™

‘Used at ppm levels as part of a flavour system to restore the desired taste profile of products in which sucrose (table sugar) has been reduced.’
Enhances the sweet taste of sucrose. Examples in the patent demonstrate that use of the compound at a level of 26μM (10ppm) halves the amount of sucrose required to produce an equivalent sweetness.
Enhances the sweet taste of sucrose and fructose. The use of the compound at a level of 10ppm halves the amount of sucrose required to produce an equivalent sweetness. 10ppm also reduces the level of high fructose corn syrup by one third.
COMMERCIALISATION OF PAMs

PepsiCo invested $30 million in a four year deal with Senomyx and are reported to be developing a soft drink that will halve the level of sugar targeting health conscious consumers. A further investment of $32 million is reported to have been made taking the collaboration to 2016.

Firmenich has also entered into a product discovery and development collaboration with Senomyx and has exclusive rights for marketing S617 in food and alcoholic drinks. PepsiCo has a parallel deal in place for non-alcoholic beverages.

Firmenich market the PAM that enhances the sweetness of sucralose as SucralGem™ and the EU approved PAM that enhances sucrose as SucroGem™
Flavonone found in grapefruit, orange, lemons and apples. Can reduce the content of sugars such as sucrose, lactose, fructose and glucose by between 5 and 60% in the presence of around 100ppm hesperetin.

Cholesterol lowering properties. Protective against colon and other cancers.
BITTERNESS MASKING
Neohesperidin dihydrochalcone (NHDC)

A high intensity sweetener 1500-1800 times sweeter than sugar. Neohesperidin is extracted from bitter oranges then treated to produce NHDC. Used as a bitterness blocker at levels below 5ppm where it is classified as a flavour modifier and the E number is not declared. Used widely in dairy products where it reduces bitterness and improves creaminess and in pharmaceutical products to block bitter notes.
A Glycoside Dihydrochalcone isolated from the leaves of *Lithocarpus litseiffolius* used as a sweet tea in Yunnan Province, China. Used as a sweetener but also has bitter masking properties at levels of 3-200ppm. Masks bitterness of cocoa, coffee and caffeine containing energy drinks. Masks potassium chloride and is useful in salt reduction formulations.
Homoeridictyol sodium salt

Bitter masking flavanone from Yerba Santa, a plant native to North America. Also found in lemons and rose hips. Blocks the bitter notes and off-notes of high intensity artificial and natural sweeteners. Also reduces the bitter character of tea, caffeine and pharmaceutical products. Masks potassium chloride and is useful in salt reduction formulations.
4-(2,2,3-trimethylcyclopentyl) butanoic acid

![Chemical structure](image)

| FEMA 4529 GRAS 24 (June 2009) | EU Flavis number: Fl 08.135 | Givaudan 3727 Patent: filed 2008 |

Specifically targets and inhibits a handful of human bitter taste receptors. Blocks the bitter notes and off-notes of high intensity artificial and natural sweeteners. Also bitter and off-notes in cocoa, coffee caffeine and pharmaceutical products.
TASTE: UMAMI AND KOKUMI
‘UMAMI’ – THE FIFTH TASTE SENSE

• In 1908 Professor Ikeda discovers Monosodium Glutamate in kombu. He founded a new company called ‘Essence of Taste or Aji-no-moto.

• Glutamate is found in all savoury foods:
  - Kelp (kombu) 2240mg/100g
  - Parmesan cheese 1400mg/100g
  - Tomato 250mg/100g
  - Walnuts 650mg/100g
  - Green Tea 670mg/100g
  - Potato 180mg/100g
  - Mackerel 36g/100g
  - Broccoli 115mg/100g

• University of Miami, Nature 2000 – publication of the discovery of a receptor on the human tongue that specifically responds to the glutamate ion.
In 1913 a student of Professor Ikeda, Shintaro Kodama, discovers Inosine 5’ monophosphate (IMP) in bonito flakes.

The third element of umami, Guanosine 5’ monophosphate (GMP) was found in dried shitake mushroom in 1960 by Akira Kuninaka.
# SYNERGY

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Source: Ajinomoto publications
THE AMPLIFICATION OF THE DELICIOUSNESS
OF FOOD

In Japanese cuisine they have learnt combine foods and ingredients that contain the elements of Umami.

The glutamate element of some foods and the ribonucleotide element of other foods produce synergy and enhance the flavour of a dish.

It is common knowledge in Japan that the combination of kombu (seaweed - glutamate) with bonito (ribonucleotides) makes a tastier soup.
What is Kokumi?

THE EMPEROR’S NEW CLOTHES?

Hans Christian Andersen
What is Kokumi?

Kokumi is a well recognised taste phenomena in Japan

According to Ajinomoto the word ‘kokumi’ is difficult to translate but contributes to the deliciousness of a food. ‘Koku’ means body and fullness and ‘Mi’ means taste.
BUT – WHAT ARE THE CHEMICAL COMPOUNDS THAT INITIATE THE ‘KOKUMI SENSATION?

Glutamic Acid

Alpha Glu-Gly

Gamma Glu-Gly
KOKUMI TASTE PERCEPTION

Kokumi taste perception has been linked to the calcium sensing receptor (CaSR). This receptor is a class C, G-protein receptor located in taste buds and interestingly in the parathyroid glands, the kidneys, and in many other tissues such as the liver, heart, lungs, alimentary canal, and pancreas.

Ajinomoto demonstrated that γ-glutamyl peptides are recognised by the CaSR in taste cells and produce the desirable kokumi taste sensation in humans. enhancing all three kokumi taste characteristics (thickness, continuity and mouthfeel) at a concentration as low as 0.002%.
Gamma-glutamyl-valyl-glycine

Reported in scallops in 2012. Occurs also in fish sauce. High kokumi intensity.
At 0.01-0.1% in the presence of glutamate and ribonucleotides it enhances the whole
taste profile.
It also improves the sweet profile of sweet substances such as sucralose, aspartame
and acesulfame K by activating the calcium receptor on the tongue suppressing the
bitter aftertaste.
A VERY UGLY SWAN INDEED

Hans Christian Andersen