



# MAKING SENSE OF TASTE

TASTE IS A COMPLEX BLEND OF BIOLOGY AND PSYCHOLOGY, WHERE EXPECTATIONS AND COMMUNICATION ALL PLAY A ROLE. UNDERSTANDING THE SCIENCE IS CRITICAL BOTH TO GOOD EATING AND GOOD HEALTH.



nature  
café  
nature.asia/naturecafe

**Experts from the world of taste and flavour science**, nutrition and science communication met at the Nature Café on 11 December in London, UK, to discuss their findings and present new insights. Michelle Grayson, Senior Editor, Nature Research, moderated a panel discussion where the speakers explored the topics. The event was supported by Ajinomoto Co., Inc.

Taste receptors are found throughout the body, from the brain, gut and respiratory system to the testes and spermatozoa. They are most obviously found in the tongue where different receptors and combinations detect the five primary tastes of sweet, sour, bitter, salty and umami.

“As far as we can tell from mouse studies, there are no more than five tastes. Fat and capsaicin have also been suggested, but both are sensations rather than taste,” said

Dr Nicholas Ryba of the National Institute of Dental and Craniofacial Research in the US.

The best understood and most closely related are umami, which respond to glutamate (a combination of the T1R1 and T1R3 receptors); sweet, which respond to sugars and sugar substitutes (T1R2 and T1R3 receptors); and bitter, which respond to a variety of bitter flavours (T2R receptors).

“Salt flavour detection is much more complicated, and we understand sour the least. Sour tastes are triggered by acids, but carbonated water and high concentrations of salt will also trigger a sour response. It may turn out that it is a combination of different sensory inputs,” said Ryba.

Once the taste receptor is triggered, a message is sent through a rapid but complex pathway to the brain, which then drives the

makes identification faster and more accurate. It all adds up to ‘this tastes good’”

People learn from past experience with foods and form expectations, for example that oranges will be both sweet and bitter, and chicken will be savoury.

“The correspondence between expectation and taste influences the pleasantness — for example, if we expect bratwurst to be hot and savoury and it is sweet and cold, it won’t be as pleasant,” said Ohla. “We like most what we know best, which is why it can be hard to change eating patterns.”

Labelling can influence expectation and flavour perception. For example, a salmon dish labelled ‘ice cream’ can be perceived as less pleasant and more bitter than an identical one labelled ‘savory mousse’. A product labelled low-salt may be perceived as needing salt even if salt levels are the same or higher. Without checking the actual salt levels, people may add salt leading to an increased salt intake. This makes labelling challenging, as different people will have individual motives for their food choices; while a low-fat label might attract someone who wants to lose weight, it may put off someone who is looking for a pleasurable experience.

Because information, learning and experience all contribute to flavour perception and food palatability, they can be managed to support healthy choices, or to improve the pleasure of eating for older people, whose intensity of taste is sometimes reduced.

## THE ORIGIN OF FLAVOUR PREFERENCE

Taste has evolved to allow animals to make food decisions based on attraction or aversion, and its detection depends on the animal and its environment. Humans respond to all of the five known taste groups, whereas cats do not respond to sweet tastes, pandas can’t taste umami, and hummingbirds do not have a sweet taste receptor, but can detect sugar via a converted umami receptor.

The ability to detect tastes develops before birth, and picking up flavours from the mother’s diet in the amniotic fluid begins to shape a child’s flavour preferences. Breastmilk includes umami and sweet tastes, and also reflects the mother’s diet.

“The mother provides a bridge to the environment, with the flavours of the amniotic

fluid and breastmilk reflecting the family and cultural environment,” said Dr Julie Mennella of the Monell Chemical Senses Center. “This modifies their food acceptances at weaning and beyond.

Within hours of birth, babies will prefer sweet tastes, indicated by an increased sucking response, facial expressions, rate of intake, and heart rate. They will dislike bitter tastes, which protects them against toxins and poisons. The preference for sweetness continues through to adolescence, when tastes will begin to change.

**“MSG IS FAMILIAR AS UMAMI TASTE FROM THE TIME HUMANS ARE BORN, REGARDLESS OF WHETHER THEY COME FROM THE EAST OR THE WEST. CULTURALLY, IT HAS NEVER BEEN A FOREIGN SUBSTANCE.”**

“Children prefer much higher levels of sweetness than adults or adolescents, and this can be linked with periods of growth,” said Mennella. “In babies and children, sweetness will also blunt pain and mask bitterness.”

This biology, however, makes children vulnerable to unhealthy food preferences, and once these are established it can be hard to break them. “Biology isn’t destiny, and experiences can shape and modify flavour and food preferences, especially in the first two or three years,” said Mennella. “You have to taste broccoli, not just look at it, to learn to like it.”

Influencing a child’s food and flavour preferences includes repeated exposures to foods, as many as eight or ten times, and building on foods that are already familiar. Children used to a variety of foods are likely to be more accepting of new foods, and the diets of parents and peers will also have an influence.

“It’s much easier to change food preferences below the age of two. The senses are also changing around college age, and this can include food preference. This could be another



Professor Lord John Krebs examines the communication of persistent myths versus scientific reality.

opportunity to establish better eating habits,” said Mennella emphasizing that taste education from infant to school-aged children is of vital importance.

### FOOD FACTS, FICTION AND COMMUNICATION

Food safety and nutrition is a contentious issue, with many different perspectives, not all of which are science-based. Professor Lord John Krebs, University of Oxford, UK, and the first chair of the UK Food Standards Agency, raised the question of whether what we eat is safe, healthy and sustainable.

“We will all eat around a thousand meals a year – and we have our own opinions. We are bombarded with information and advice every day, and we need to understand how to navigate the competing claims,” said Krebs.

One of the biggest challenges for food science, and for health, is the epidemic of obesity. Obesity levels have risen around ten-fold in 40 years, and there are a lot of confused

messages around about the causes. The suggestions that sugar is worse than fat in terms of obesity, and that artificial sweeteners make people put on weight, have both been proven false after analysis.

An important starting point is to understand, and then communicate clearly, the nature of the evidence behind food research which is often based on retrospective or prospective epidemiological studies, or on small randomised controlled trials, Krebs said. Risk often isn’t communicated in a clear way. As an example, the media reported that eating processed meat such as bacon increased pancreatic cancer risk by 20%.

“Around five in 400 people will get pancreatic cancer in their lifetime. Looking at the study in more detail, if everyone ate 50g of processed meat every day, a 20% increase would mean just one extra case of pancreatic cancer.”

Professor Krebs urged better ways to communicate risk, for example

by parcelling life expectancy as 48 ‘microlives’ per day. Different behaviours would increase or decrease expenditure of microlives, for example eating five portions of fruit and vegetables per day would save four microlives, but smoking 15-24 cigarettes per day would ‘spend’ an additional 10 microlives each day.

### UMAMI & MSG: THE HISTORICAL PERSPECTIVE

Umami, through breastmilk, is one of the first flavours that babies learn. Umami, which means ‘savouriness’ in Japanese, has been present in food throughout history, in the ancient Greek and Roman fermented fish sauces, and in mushrooms, tomatoes, cured meats and aged meat and cheese. However, umami, in the form of glutamate, was only identified as one of the primary tastes in 1908, by Kikunae Ikeda, of Tokyo Imperial University, as a component in Japanese soup stock (konbu dashi), which is high in the amino acids glutamate and aspartate.

Ikeda discovered the method to manufacture the umami ingredient monosodium glutamate, under the brand name AJI-NO-MOTO®, and this began the industrial production of the umami taste in Japan. Other sources of umami, such as Maggi® seasonings, Bovril®, Marmite and Vegemite®, Oxo® stock cubes, ketchup, and Worcestershire sauce became available around the world.

Ikeda had spent time in Leipzig, Germany, under Wilhelm Ostwald, and realised that the German students were all much taller and better nourished, Dr Takeshi Kimura, corporate vice president at Ajinomoto Co., Inc. explained. This drove Ikeda to want to promote better nutrition in Japan. Since then, Ajinomoto Co., Inc. has supported nutrition programs in Japan, using taste and flavour to improve the diet of children and adults, together with chefs and dieticians. This has now expanded into Ghana and Vietnam.

Monosodium glutamate as an ingredient has faced negative press. In the 1960s, reports claimed that MSG made mice obese, and triggered the formation of lesions in the brain. This finding, however, was based on injections of high doses of MSG into post-natal mice whose blood-brain barrier was immature. The applicability of this result to humans remains distant. There were also anecdotal reports of dizziness and palpitations, which flared up again in the 1990s with a rash of books that blamed MSG for all

ills. Despite being thoroughly debunked, the myth still circulates, which Krebs puts down to our love of narrative.

“Conspiracy theories make for a good story, and MSG provides this, with illness, and the idea of a cover up. The story is proving hard to overcome. One approach would be to use a different angle, such as tying in with healthy eating,” said Krebs.

Research is finding benefits of MSG and umami in the diet, which may be used as a response.

“There are studies that show that umami can enhance appetite but also increase the feeling of fullness in combination with protein, and there is a trend towards lower body mass index in countries with a higher MSG intake,” said Kimura. “The use of dashi and umami can reduce the use of salt and other ingredients, and may even reduce fat preference.”

### TASTE: THE WAY FORWARD

MSG is familiar as umami taste from the time humans are born, regardless of whether they come from the East or the West. Culturally, it has never been a foreign substance. In a wide-ranging Q&A session, chaired by Grayson, the panel discussed the potential for using taste in improving eating patterns, the benefits of meals being a family event, and the vital role of a healthy eating narrative, and breaking down food myths such as those that still remain around MSG. ‘Emotional nutrition’, the feeling of satisfaction associated with good food, and an increased appreciation food by focusing all the senses was also discussed as a way to help people develop healthier eating patterns.

The science of taste is complex, from the physiology of the taste receptors, to the cultural, environmental and sociological discussions of what, how and why people choose to eat. This complexity can lead to findings that don’t always appear clear-cut. Because of this, communication has to be clear, and narrative as well as evidence used to beat myths and promote healthy eating across the whole population.



**MICHELLE GRAYSON**  
Senior Editor,  
Nature Research



**DR NICHOLAS RYBA**  
Principal Investigator,  
The National Institute of Dental and Craniofacial Research, US



**DR KATHRIN OHLA**  
Group Leader,  
The German Institute of Human Nutrition, Germany



**DR JULIE MENNELLA**  
Member,  
The Monell Chemical Senses Center, USA



**PROFESSOR LORD JOHN KREBS**  
Emeritus Professor of Zoology, University of Oxford, UK



**DR TAKESHI KIMURA**  
Corporate Vice President,  
Ajinomoto Co., Inc.



**DAISUKE HAYASHI**  
Executive Chef,  
Tokimeite, London  
Japan Culinary Academy UK



Mr. Hayashi prepares dashi