U M A M I



UMAMI
INFORMATION CENTER

A Message from the Umami Information Center

In pursuit of even more flavorful, healthy cooking, chefs the world over are turning their attention to umami.

Once there were thought to be four basic—or primary—tastes: sweet, sour, salty and bitter. Until that is, Japanese scientist Dr. Kikunae Ikeda noted the presence of another savory taste unexplainable solely by these four. In 1908 Ikeda attributed this fifth taste to the amino acid glutamate found in large quantities in kombu seaweed, and dubbed it "umami." Then in 1913 Shintaro Kodama found inosinate to be the umami component in dried bonito flakes (katsuobushi), and in 1957, Dr. Akira Kuninaka discovered umami in guanylate, later identifying guanylate as the umami component in dried shiitake mushrooms.

Glutamate, inosinate and guanylate are the three dominant umami substances, and are found not only in kombu and katsuobushi, but other foods as well. Glutamate is a component of vegetables such as tomatoes, and of fermented foods such as cheese, miso or soy sauce. Inosinate is found in meat and fish, and guanylate in dried mushrooms. Umami substances, though discovered by Japanese scientists, are present in a wide variety of foods found all over the world. It may have been the straightforward umami of Japanese cuisine, unmasked by complex flavors or aromas, that led to umami's discovery in Japan first.

In 1982, researchers in fields encompassing the physiology of taste, physiology of the oral cavity, nutritional science, and food chemistry established a study group to promote research on umami. International symposiums on the topic of umami were held in Japan and elsewhere, facilitating the exchange of scientific information on umami, including the work of overseas researchers. As a result, umami was internationally recognized as the fifth taste, joining the existing four basic tastes, and in 2002, the presence of umami receptors in the taste buds on the tongue was revealed: further scientific proof cementing umami's status as a primary taste.

In December 2013 "Washoku, traditional dietary cultures of the Japanese" was accorded Intangible Cultural Heritage status by UNESCO. Japanese cuisine is currently enjoying a burgeoning international profile thanks to the growing awareness of healthy eating choices. One characteristic of Japanese food is the skillful use of umami to create tasty, healthy dishes without animal fats. Umami—a Japanese word now internationally recognized—is a key element in palatability or "deliciousness," and a focus of intense interest among people involved in food, from taste researchers to nutritionists, food journalists and chefs the world over. It is also now receiving extensive exposure in the non-Japanese media, and on the internet.

The Umami Information Center is engaged in a range of promotional and educational activities designed to further understanding of umami. These include organizing lectures and symposiums both in Japan and elsewhere, running websites (Japanese: www.umamiinfo.jp, English: www.umamiinfo.com), and publishing books and leaflets.

We hope this leaflet will help you to learn more about umami.

March 2015
Takashi Yamamoto
Chairman
Umami Information Center
D.M.D.

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Heston Blumenthal's photo by Alisa Connan: p.20

Umami: critical to delicious cooking

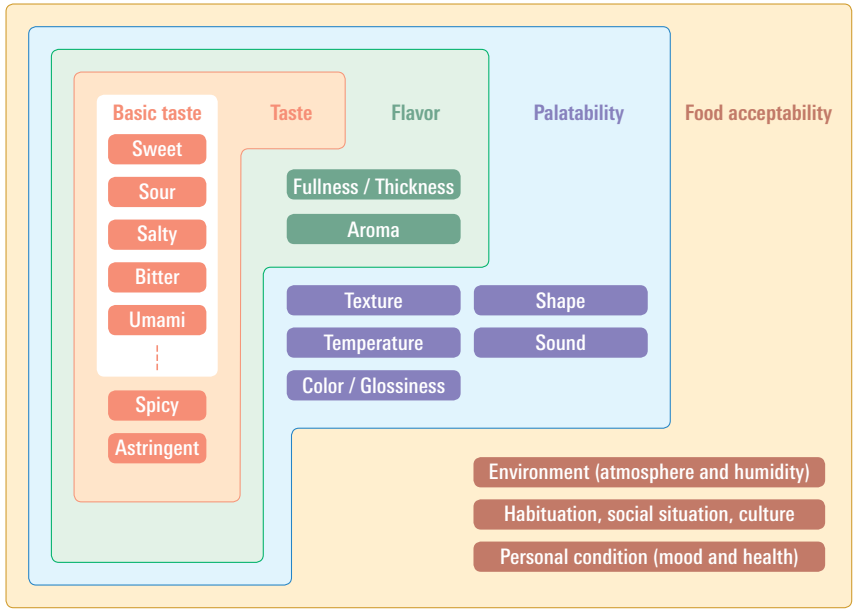
It has been over a century since umami was discovered in Japan, but umami is just now attracting global attention, primarily from chefs and others with a strong interest in food.

Umami is the fifth taste, joining sweet, sour, salty and bitter. These are unique tastes that cannot be created by mixing other tastes, and are known as the basic, or primary tastes. Umami is a general term used mainly for substances combining the amino acid glutamate, and/or the nucleotides inosinate and guanylate, with minerals such as sodium and potassium.*

Umami and "deliciousness"

Since the word "umami" is originally Japanese and the Japanese expressions "to have *umami*" and "*umai*" can mean "tastiness" or "deliciousness," "umami" is often confused with "deliciousness." Whether something tastes good or not is a comprehensive yet subjective evaluation determined by elements such as taste, aroma, texture and temperature, besides other factors such as appearance, color and shape, as well as one's physical condition, surrounding environment, cultural background, and previous experiences. Of these various elements, umami in balance with the other basic tastes (sweet, sour, salty, and bitter) plays an important role in determining the deliciousness of a dish.

How humans experience their food



* In scientific terms, umami is defined as the taste of salts combining glutamate, inosinate or guanylate with the likes of sodium ions, such as monosodium glutamate, or potassium ions, but for the purposes of this pamphlet, except for sections requiring scientific precision, we describe umami as the taste of glutamate, inosinate and guanylate.

Salts of the amino acid aspartate and the nucleotide adenylate are also types of umami substance, weaker than glutamate. Succinic acid, which gives shellfish their distinctive taste, has also been identified as another possible umami substance.

The basic tastes and common corresponding foods/components

For human beings, being able to distinguish the five basic tastes is an indispensable survival skill, because it allows us to avoid risky foods and obtain nutrients safely.

By detecting the sour taste of organic acids in unripe fruit or rotting food, or the bitterness of alkaloids, for example, our tongue enables us to avoid danger. In contrast, when we detect the sweetness of sugars that serve as our energy source, or the saltiness of minerals necessary to maintain the balance of body fluids, we actively consume them.

Umami meanwhile serves as a signal to the body that we have consumed protein. Sensing umami triggers the secretion of saliva and digestive juices, facilitating the smooth digestion of protein.

Common examples of foods/taste substances for each of the basic tastes

Taste	Taste substance	Common foods
Sweet	Sucrose Fructose Glucose	Sugar  Honey  Candy 
Sour	Acetic acid Citric acid Lactic acid	Vinegar  Lemons  Limes  Yogurt 
Salty	Sodium chloride	Salt 
Bitter	Caffeine Alkaloids Momordicin	Coffee  Bitter melon  Chocolate (90% cacao mass) 
Umami	Glutamate Inosinate Guanylate	Tomatoes  Cheese  Meat  Fish  Dried shiitake mushrooms 

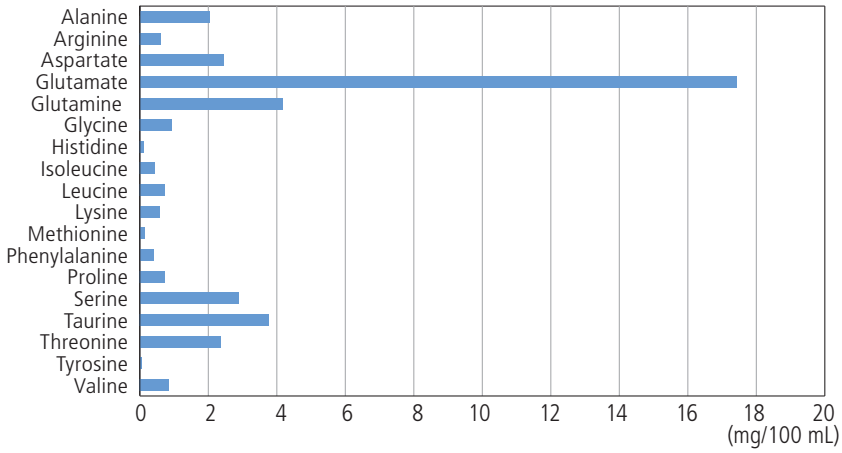
Umami and babies

Umami is an important taste for newborn babies. Breast milk is rich in the umami component glutamate. It is also contained in amniotic fluid, making umami a familiar taste even before birth.

For babies too, the basic tastes are a vital signal that tells them whether what they have consumed is nutritious or harmful. When sour and bitter solutions were placed in the mouths of six-month-old infants transitioning to solid food, their facial responses indicated rejection of the tastes. On the other hand, when offered a sweet liquid, they appeared calm and happy.

When then given vegetable soup, the infants screwed up their faces slightly, but when given vegetable soup with umami added, they exhibited the same degree of satisfaction as when given the sweet liquid.

Amino acids in mother's milk 7 days after birth



(Carlo Agostini et al., 2000)

Infant taste responses

Sweet

Sour

Bitter

Vegetable soup only

Vegetable soup with added umami

*This experiment was conducted under expert supervision and in accordance with the method of Dr. J. E. Steiner. Because infants are less sensitive to saltiness than adults, and out of concern for any possible health effects, no experiments were undertaken with salty tastes. (J. E. Steiner et al., 1987)

Umami and our bodies

Where do we sense umami?

Dotted over the tongue are patches of tissue called papillae, which contain bud-shaped organs that detect taste. These taste buds, as they are commonly known, consist of dozens of taste cells clumped together. The taste cells in turn contain receptors for sweet, sour, salty, bitter and umami substances. From these receptors, information is transmitted to the brain, and we perceive the taste of the food.

Umami substances function as the keys and their receptors as the keyholes. When the receptors in taste cells receive the umami substance glutamate, that information is swiftly passed on to the brain via taste nerves, and umami is recognized.

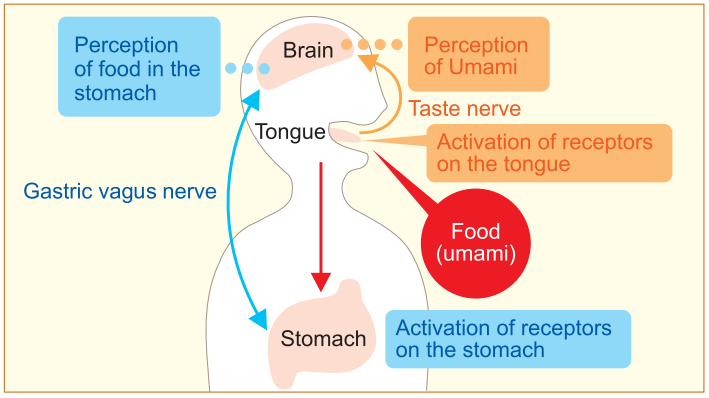
A signal for protein

Each of the basic tastes acts as a signal for nutrients or harmful substances. Umami is the taste of amino acids and nucleotides, and tells us when a food contains protein, a nutrient essential to survival.

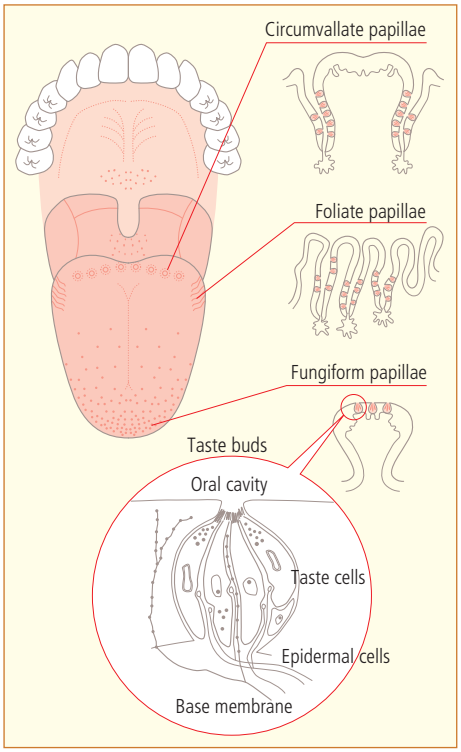
The role of glutamate

Recent studies have revealed the presence of umami receptors not only on the tongue, but also in the stomach. When food enters the stomach, and receptors in the stomach detect an umami substance (glutamate), the umami information is conveyed to the brain via the vagus nerve. The brain in turn transmits a message to the stomach that triggers the digestion and absorption of protein. Thus umami is closely involved in protein digestion and absorption, giving it a vital role in our bodies. No doubt the future will bring further discoveries about glutamate's role in digestion and absorption.

Intake of Umami-Rich Food



The Perception of Taste



(T. Yamamoto, 1996)

The discovery of umami

Umami and the history of seasonings

Throughout history, human beings have created various seasonings and condiments to improve the palatability of food. Salt has been a familiar flavor-enhancer for thousands of years. Foods such as sugar and vinegar have also been known since ancient times. This is why we can all readily imagine sweet, sour and salty tastes.

Umami too is contained in a variety of foodstuffs, and is familiar to us from the taste of traditional foods such as soy sauce, miso and cheese. However, it is only around a century ago that umami was discovered as a basic taste, and monosodium glutamate invented and launched as an umami seasoning.

A Japanese discovery

There were long thought to be just four basic tastes: sweet, sour, salty and bitter. Then a scientist in Japan—Professor Kikunae Ikeda of Tokyo Imperial University (now the University of Tokyo)—noticed the presence of a taste that did not fit into any of these categories. Professor Ikeda discovered the main taste component in kombu dashi (broth or stock) to be glutamate, and dubbing it "umami," penned an academic paper explaining the existence of umami as one of the basic tastes.

Following in Professor Ikeda's footsteps, other Japanese scientists discovered the umami substances inosinate and guanylate.

Professor Kikunae Ikeda

Glutamate extracted from kombu by Professor Ikeda

12 kilograms of kombu yielded 30 grams of glutamate

1908	Professor Kikunae Ikeda identifies the "fifth taste" component as glutamate, an amino acid found in large quantities in kombu seaweed, and dubs this taste "umami."
1913	Shintaro Kodama, Professor Ikeda's leading disciple, identifies the nucleotide inosinate as the umami component of katsuobushi (dried bonito flakes).
1957	Dr. Akira Kuninaka of the Yamasa Shoyu Research Laboratories identifies the nucleotide guanylate as an umami component, and later confirms it to be the umami component in dried shiitake mushrooms.

What umami tastes like: three properties

A delicate taste. A mild, subtle taste. A taste that spreads across the tongue, coating it completely. A persistent, lingering taste. A mouthwatering sensation. This is how chefs who have experienced and recognized umami describe its characteristics.
Let us take a look at three properties of umami.

Spreading across the tongue

Umami is frequently described as a taste that "spreads across the tongue, coating it." Experiments on the tongue's areas of taste receptivity have shown that sweet and salty tastes are sensed more intensely on the tip of the tongue, while umami is sensed all across it.

Persistence

One study had participants separately take solutions of the umami substances glutamate and inosinate, table salt, and tartaric acid (the acid component of wine) into their mouths, then spit the solutions out and compare the intensity of taste left in their mouth. While the salty and sour tastes of table salt and tartaric acid soon faded, umami was found to linger for several minutes. This suggests that even among the basic tastes, umami has a major impact on the aftertaste of foods.

Promotes salivation

Sour or acid taste is widely known to promote salivation, but in fact it has been revealed that umami triggers the sustained secretion of saliva for a longer period.

Furthermore, the saliva produced with sour tastes has a lighter quality, whereas the saliva produced with umami is more viscous, and this seems to moisten more the inside of the mouth.

Without saliva we are unable to sense taste or swallow food smoothly. Umami holds the key to these functions.

Experiencing umami for yourself

Tomatoes are rich in the umami substance glutamate. Here they are used in a simple method for tasting umami.

1 **Remove the stalk from a cherry tomato and place the tomato in your mouth.**

2 **Chew about 30 times without swallowing, and try to slowly sense the change in taste on your tongue.**

3 **After chewing 30 or so times, see if you can feel the taste that lingers in your mouth long after the tartness, sweetness and distinctive tomato flavor have dissipated. This taste is umami. You will probably also notice that your mouth waters continuously as you chew, since umami promotes salivation.**

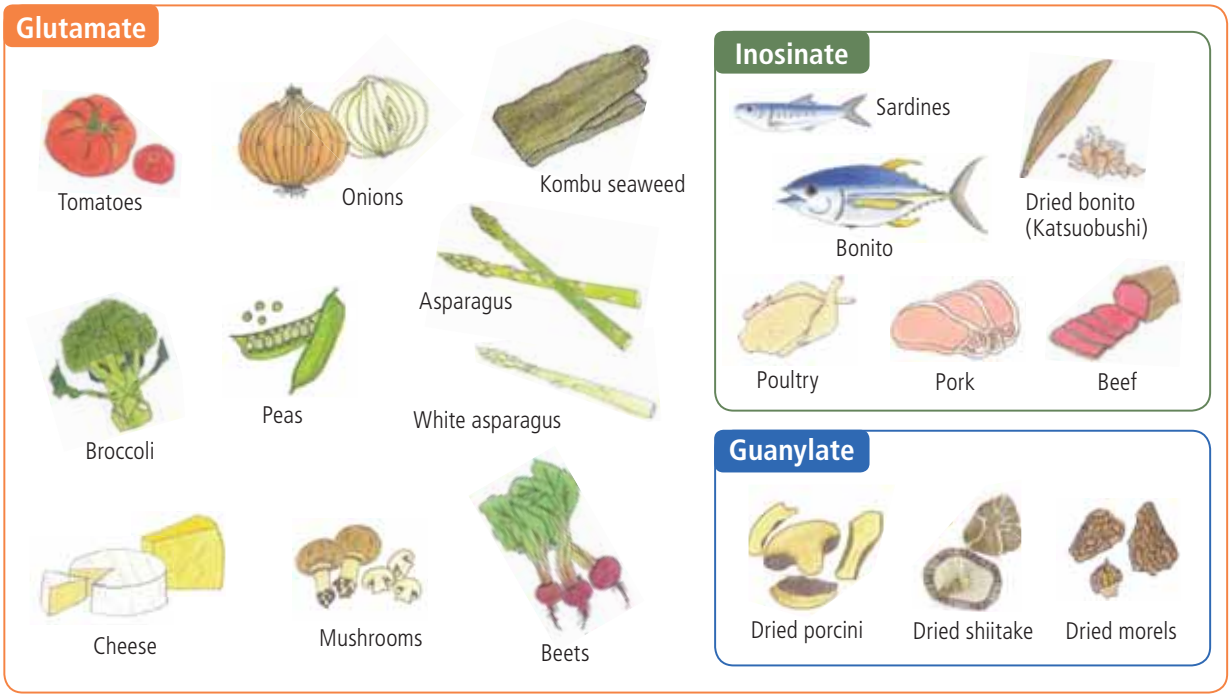
*Various other methods of experiencing umami can be found on the Umami Information Center website at www.umamiinfo.com/2013/02/tasting-umami.php.

Where can we find umami?

The main components of umami are glutamate, inosinate and guanylate. Glutamate is found in a variety of foods including meat, fish and vegetables. Inosinate is found in generous quantities in animal-based foods such as meat and fish, while large amounts of guanylate can be found in dried mushroom products such as dried shiitake.

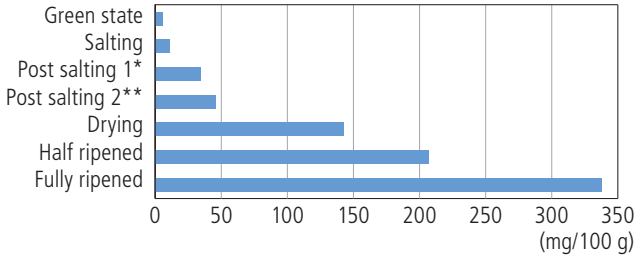
We also know that the umami component of food increases as a result of processing such as ripening and fermentation. Many traditional foodstuffs from around the world, such as soy sauce and other fermented condiments made from grain, fish sauces such as Thailand's *nam pla* and *nuoc mam* from Vietnam, and cheeses are excellent sources of umami.

Umami-rich foods



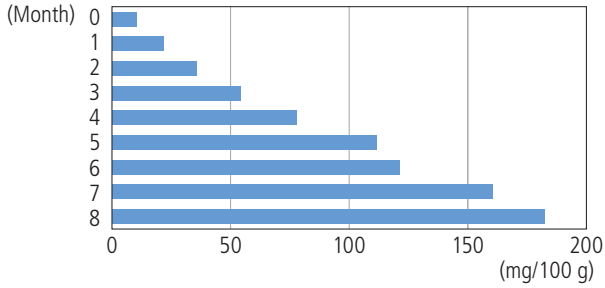
Umami and aging/fermentation

Changes in glutamate content during cured ham ripening



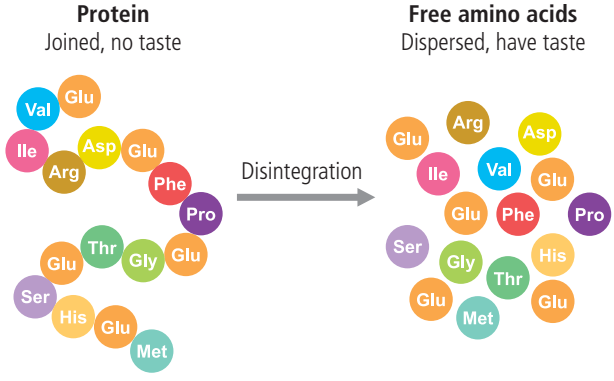
* cool temperature, high humidity, 2 months (winter)
**higher temperature, lower humidity, about 1½ months (spring)

Glutamate levels of cheddar cheese aging



(K. Ninomiya, 1998)

Connection between protein and free amino acids



Umami
Asp Aspartate
Glu Glutamate

Sweet
Ala Alanine
Ser Serine
Gly Glycine
Thr Threonine
Pro Proline

Bitter
Arg Arginine
Leu Leucine
Phe Phenylalanine
His Histidine
Lys Lysine
Val Valine
Ile Isoleucine
Met Methionine

Meat generally undergoes a certain period of aging prior to being sent to the market. The main component of meat is protein, which is made up of a long chain of 20 amino acids. Glutamate constitutes the largest proportion of these amino acids, around 15 percent.

Protein itself has no taste. Taste is only perceived when protein breaks down and the amino acid chain disintegrates. These scattered amino acids are known as free amino acids, and are usually referred in this pamphlet as amino acids. This is why instead of "free glutamate," we simply use "glutamate." As well as the likes of free glutamate and free aspartate containing umami, free amino acids can impart a sweet taste (from glycine or alanine) and bitterness (from leucine or valine).

The flavor peculiar to meat emerges when the protein in the meat breaks down during the aging process, and the umami-carrying free glutamate increases.

A similar phenomenon occurs in foods such as cheese, cured ham, miso and soy sauce. In the case of cured ham a leg of pork is salted, allowed to develop mold, dried and carefully aged. During this process the volume of glutamate is boosted by around a factor of fifty. In cheese, the longer the aging process, the higher the glutamate.

Traditional foods around the world and umami

Many different traditional seasonings and foodstuffs can be found around the world. Most have been processed in some way to preserve them, either by fermentation, drying or salting. These processes boost umami substances such as glutamate, creating food rich in umami.

Here is a selection of umami foods that continue to be regional favorites.

- Foods made by fermenting legumes or cereals
  Used in paste or liquid form
- Foods made by fermenting seafood
  Used in paste or liquid form
- Other foods
- Regions where tomatoes are used as a staple in cooking

Umami Q&A

Q What is that white powder on the surface of kombu?

A Dried kombu may be covered in a fine white powder. Though occasionally mistaken for glutamate, this powder is in fact a type of mildly sweet sugar known as mannitol, another taste element of kombu.

Q What are the white crystals visible on long-ripened cheeses such as Parmigiano reggiano?

A As cheese ages its amino acid content rises and water content declines. These white crystals are mainly clumps of amino acids not readily soluble in water, such as leucine, isoleucine, and valine. Glutamate is only found in very small amounts inside the white crystals.

Q Is inosinate the umami component in cured ham?

A The umami in cured ham is not inosinate, but glutamate.

Although, like katsuobushi (dried bonito flakes), ham is an animal product, it contains almost no inosinate. Inosinate is produced when ATP (adenosine triphosphate), the energy source in animal muscles, is broken down posthumously by enzyme action. If this disintegration becomes too advanced, inosinate will turn into another, different substance, from which umami is absent. This means that inosinate content first rises after death, then falls.

Raw pork is rich in inosinate, but cured ham is pork that has been salted then aged over a long period of one to two years. During that time the inosinate content declines, reaching almost zero by the time the ham is ready for consumption. Meanwhile, glutamate increases during aging, and is concentrated by the drying process. This compensates for the drop in inosinate and makes cured ham a food with umami to spare.

Q Is the umami component of foods like katsuobushi and niboshi (dried anchovies) inosinate?

A Inosinate does indeed account for most of the umami in foods such as katsuobushi and niboshi.

The process used to manufacture katsuobushi and niboshi differs from the usual processing of dried fish, in that the fish is heated to almost 100°C. This heating deactivates the enzyme that breaks down inosinate into a different non-umami substance, thus preserving the inosinate content.

Katsuobushi and niboshi are also rich in glutamate.

Q Is guanylate the umami component in fresh mushrooms?

A Fresh mushrooms contain almost no guanylate.

Guanylate is a nucleotide, one of the components of RNA (ribonucleic acid). In fresh mushrooms, a pre-guanylate substance is preserved within the cells. When fresh mushrooms are dried or frozen, for example, the cell wall disintegrates, and enzyme action converts that substance into guanylate.

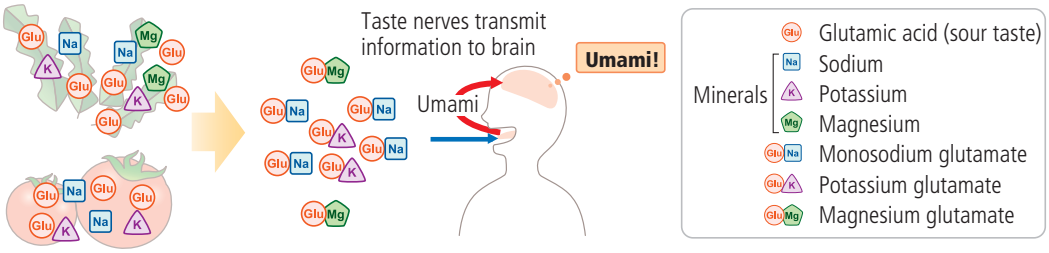
Fresh mushrooms do contain a lot of glutamate.

Q What is the difference between the glutamate in seasonings/condiments and glutamate found in the likes of tomatoes and kombu?

A The glutamate in foods such as tomatoes and kombu is the same substance as the glutamate in seasonings and condiments.

Most foods contain minerals such as sodium, potassium and magnesium. This means that the glutamate in tomatoes and kombu, like the glutamate used as a seasoning, is actually present as a glutamic acid salt such as monosodium glutamate or potassium glutamate.

Glutamate in foods and the process by which we sense umami



Umami synergy

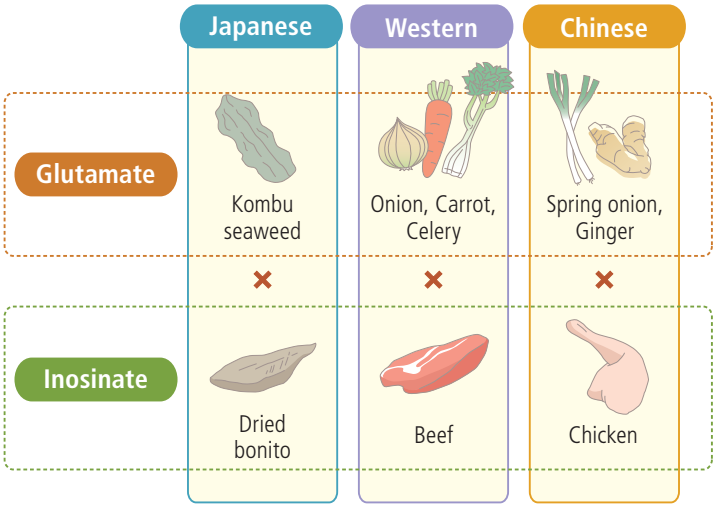
The main umami substances are glutamate, inosinate and guanylate, and it has been scientifically proven that umami is sensed far more strongly when these are present not individually, but when glutamate is combined with inosinate or guanylate. This is referred to as umami synergy.

Yet people have been capitalizing on umami synergy for centuries, long before this effect was scientifically proven. All over the world, in dishes from soups combining glutamate-rich vegetables and inosinate-rich meat and fish, to the *tang* of Chinese cuisine extracted from chicken or pork bones and green onions, to Japanese dashi made from kombu (high in glutamate) and katsuobushi (high in inosinate), people have acquired an empirical understanding of umami synergy and applied that knowledge to cooking.

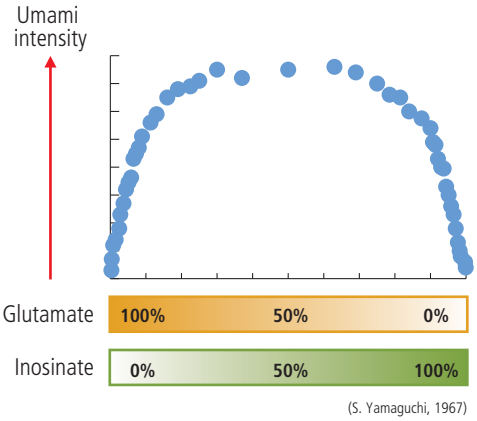
The strength of the umami synergy between glutamate and inosinate varies according to the ratios of each. When solutions containing slightly varying proportions of glutamate and inosinate were used to perform a sensory evaluation, umami was found to be most powerful with a glutamate to inosinate ratio of exactly 1:1. This proportion was deemed 7 to 8 times the intensity of tasting either glutamate or inosinate in isolation.

An analysis of the *ichiban* (primary) dashi used at one venerable Japanese restaurant revealed the glutamate/inosinate ratio to be exactly 1:1, suggesting that top restaurants know from experience the optimal proportions for greatest umami.

Synergistic effect in various cooking



Umami intensity by Glutamate/Inosinate ratio



(S. Yamaguchi, 1967)

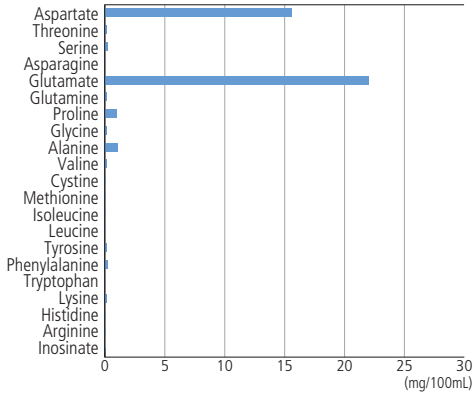
*Proportions of glutamate and inosinate were adjusted to maintain a fixed total concentration (0.05g/100ml) of umami substance.

Comparing soups the world over

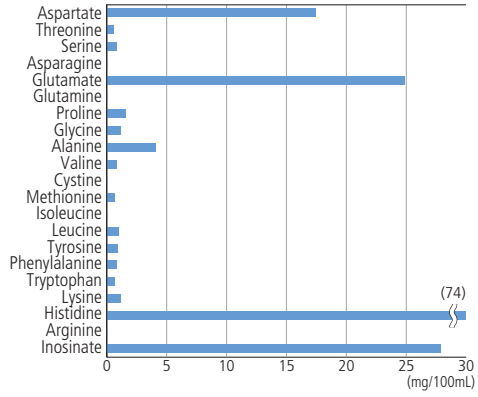
The dashi of Japan, *bouillon* from France, Chinese *tang*—ingredients and uses may differ, but all are indispensable to their respective cuisines. Analysis of their content reveals all to be rich in the umami substances glutamate and inosinate, and all are striking in their intense taste. Both east and west make clever use of umami.

Japanese dashi is simple, composed mainly of glutamate, inosinate, and the weaker umami substance aspartate. In contrast, *bouillon* and *tang* have high levels of amino acids that are not umami substances, and consequently have more complex tastes.

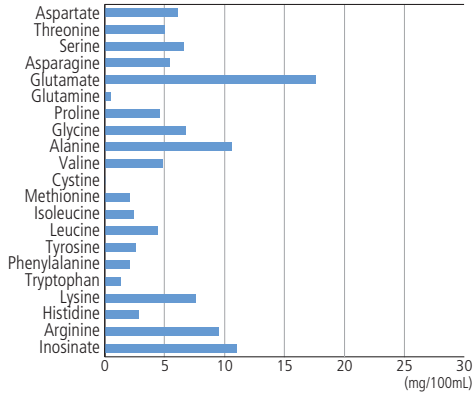
Kombu dashi



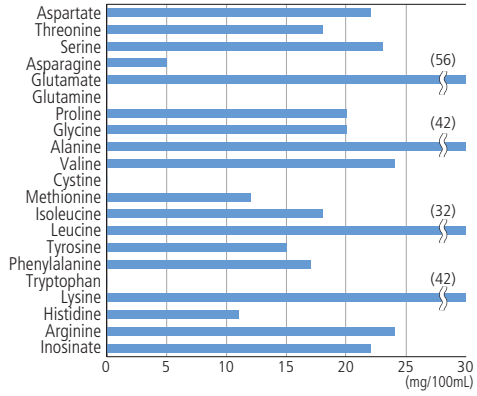
Ichiban dashi*



Chicken bouillon



Shang tang



* Ichiban dashi is high in a weak sour amino acid by the name of histidine, found in katsuobushi.

Analysis courtesy of: AJINOMOTO Co., Inc.

The growing use of umami

The functions of umami are attracting growing interest not only in the world of cooking, but from medical and nutrition professionals as well.

Healthy Japanese cuisine in the global spotlight

Recent years have seen a growing shift in the developed world toward fewer calories and animal fats, as people look to prevent lifestyle diseases and maintain good health. As part of this dietary trend, Japanese cuisine has enjoyed burgeoning popularity, thanks to its health properties.

Rather than relying on animal fats, Japanese cooking uses the umami of dashi to highlight the intrinsic flavors of ingredients, and chefs from all over the world have started visiting Japan to study these cooking techniques. Learning how to make Japanese dashi, they master the use of umami as an alternative to animal fats before going on to develop their own approaches to umami-oriented cooking.

For instance, a *kaiseki*-style bento box made by one traditional Japanese restaurant uses over 40 different ingredients, yet contains fewer than 500 calories. The secret is the Japanese cooking technique of using the umami of dashi to enhance flavors.

Bento box high in variety yet low in calories

This *kaiseki*-style bento box uses over 40 ingredients, but contains fewer than 500 calories, by using the umami of dashi to highlight individual flavors.

Courtesy of: Yoshihiro Murata (Kyoto, Kikunoi)

Umami allows for less salt

Umami also helps to reduce salt content in cooking. Numerous studies and statistics link excessive salt intake to many different lifestyle diseases. Yet food does require a certain amount of salt to taste good. Drastically reducing salt content renders food tasteless, and while we know that cutting down on salt is good for our bodies, a low-salt diet is difficult to maintain.

It has been demonstrated that making use of umami allows salt content to be reduced without compromising palatability. In an experiment comparing egg-drop soup prepared according to a standard recipe with a soup made with extra umami, it was found that salt could be reduced in the umami-boosted soup by around 30 percent with no loss of palatability. In a similar manner, some Japanese restaurants are experimenting with serving healthy *kaiseki* food able to be savored equally by those on a salt-reduced diet, by focusing on boosting umami in food preparation.

Incorporating umami skillfully into our daily diet allows us to enjoy tasty meals, even with less salt.

Improving quality of life for the elderly

Umami is mouthwatering, literally. Recent advances in taste physiology confirm that the umami substance glutamate promotes salivation. Salivation is further encouraged by the addition of inosinate.

Taste impairment among older people is deemed primarily due to a decline in salivation, and with some reports suggesting that such impaired taste sense can be ameliorated using umami to promote salivation, moves are underway to use umami as a means of improving quality of life for the elderly. In the UK, for example, chefs and scientists are working together to develop umami-rich meals for this purpose.

Umami foods for delicious, low-fat French cuisine

By reducing cream and butter content, boosting the boullion component and using umami-rich ingredients, this potage is made with only one-third the calories of a more conventional recipe. Enhancing umami allows more intense flavor with fewer calories.

Courtesy of: Koji Shimomura (Tokyo, Edition Koji Shimomura)

Healthy *kaiseki* cooking using the umami of dashi

Kaiseki restaurants can serve equally enjoyable low-calorie or salt-reduced diets, by using umami of dashi. One example is preparing simmered dishes with more umami-rich dashi. This can be achieved by increasing the quantities of dashi ingredients.

Courtesy of: Takashi Tamura (Tokyo, Tsukiji Tamura)

Chefs and researchers give their views on umami

Michael Anthony
Chef, Gramercy Tavern (USA)

Umami is a way to make dishes compelling yet keep them restrained. Discovering umami gives us a chance to create dishes that are irresistible even with just a few ingredients, because it brings the natural deliciousness of those ingredients to the fore.

Gary Beauchamp
Distinguished Member Emeritus Director and President, Monell Chemical Senses Center(USA)

Human breast milk is rich in umami. The high glutamate content of breast milk is the same for all humans, regardless of race.

From a young age, we have all been exposed to umami, and honed our taste for it. Even if we are unaware of it, umami is a taste familiar to us all from birth.

Heston Blumenthal
Owner chef The Fat Duck (UK)

I deliberately and intentionally created a dish that I called "umami broth" (2001) which was absolutely full of many umami tastes. I included a lot of different umami ingredients such as kombu, soy sauce, white saury, dried shiitake mushrooms, lightly poached mackerel and of course tomatoes, amongst other things.

Mauro Colagreco
Owner chef, Mirazur (France)

I don't think that umami is something uniquely Japanese that Japan has transmitted to the rest of the world. It's true that perhaps the West was not conscious of the umami taste, but I think that now recognition for umami is widening, and it's being used in cuisine to a great extent.

Regis Cursan
Pastry chef Nobu London (UK)

The first time I ate tamarillo I could feel something was different from other fruits. I later realized that thing was umami. Maybe I was the first one to discover umami in the tamarillo! Out of that discovery came the idea for a new dessert.

Toru Fushiki
Professor, Graduate School of Agriculture, Kyoto University (Japan)

In Japanese the word *umami* can mean either the fifth taste umami, or "deliciousness," and right now the former is becoming an internationally-recognized term.

Umami is not just about providing delicious food to the world community: I think it's got more potential than that. By having our children learn about and experience umami now, in the future, they will be able to contribute to the development of food, and help improve the health of the global community.

Thomas Keller
Owner chef, The French Laundry (USA)

Even in classic French cuisine, you have components that today are recognized to be full of umami. For example, the ratatouille that I cooked was based on a classic recipe. Trying to describe umami is almost impossible. We just have to accept it, and say it is there. It is part of what we feel, part of what we taste and part of, most importantly, what we enjoy about food.

Kenzo Kurihara
Professor emeritus, Hokkaido University (Japan)

Umami is found universally in foods around the world, rounding other tastes to offer a smoother, more subtle flavor experience. Using foods particularly high in umami results in dishes with mellow taste.

Virgilio Martinez
Owner chef, Central (Peru)

As a chef, discovering the umami taste changed my way of thinking about cooking. I play with umami a lot more in the cold preparations, to enhance the taste of raw seafood with just a little seasoning and using the taste of the product to my advantage.

Nobuyuki Matsuhisa
Owner chef, Nobu (Japan)

What I always keep in mind when using umami in cooking is maintaining a balance with the other four tastes. Combining umami in a balanced way with other basic tastes such as sour and sweet gives flavors a well-rounded quality.

I intend to keep spreading the word about umami internationally, while incorporating local ingredients and flavors.

Harold McGee
Food writer (USA)

There is really no good culinary way of doing what time (aging, fermentation or curing) does, unfortunately. So when it comes to cooking and umami at least from my perspective it is really a matter of choosing the right ingredients to begin with and then not losing it once you have got it.

Kiyomi Mikuni
Owner chef Hotel de Mikuni (Japan)

French restaurants the world over now acknowledge the benefits of umami, for example by making stock from the likes of kombu and katsuobushi. French cuisine is my specialty, but I'm also from Hokkaido, which is renowned for its kombu. My cooking takes a French base and adds umami, the fifth taste, discovered in Japan, to create original "Mikuni" dishes.

Ole G. Mouritsen

Professor, University of Southern Denmark and Nordic Food Lab (Denmark)

In Nordic countries, we have utilized umami in traditional cooking more or less unconsciously. In recent years, umami has become a well-known concept and is used to enhance and describe deliciousness in e.g., cheeses and fermented products. Most recently Nordic seaweeds have been proposed for preparing dashi.

Yasuhiro Sasajima

Owner chef Il Ghiottone (Japan)

Italian cooking has no dashi concept, but does make generous use of umami foods such as tomatoes, cheese, cured ham and porcini. An opportunity to grapple with Buddhist vegetarian cooking for an Italian recipe book using Kyoto vegetables gave me a new appreciation of the influence of umami and kombu dashi, and transformed my view of cooking.

Takashi Tamura

Third-generation owner, Tsukiji Tamura (Japan)

I believe we Japanese have the instinctive ability at cellular level to detect umami. Accustomed from a young age to food made with dashi, we naturally learn to sense subtle, delicate umami flavors wherever they may be. You could say that umami is in our DNA.

Yoshihiro Murata

Owner, Kikunoi (Japan)

Interest in umami is blossoming among top chefs overseas. Umami is a part of Japanese culture of which we can be proud, that we should feel confident taking to the world. Umami is poised to explode on the international gastronomic scene.

Pedro Miguel Schiaffino

Owner chef, Malabar (Peru)

Umami creates deep taste and harmony. By combining umami ingredients, I can come up with dishes that are balanced and full of rich flavor. There are a lot of Peruvian ingredients rich in umami, and I love using them in the food at my restaurant.

Kunio Tokuoka

Executive Chef of Arashiyama Headquarters of Kyoto KITCHO (Japan)

The important thing to understand is which foods can be combined with umami, and how to eat them. Understanding umami allows you to try out new ingredient combinations. It's the entwining of multiple ingredients that produces taste of depth and intensity.

Keiko Nagae

Pastry chef (France)

While each ingredient here has its own distinct character, none dominates: thus balance is maintained. Tastes change as you eat, with umami lingering afterwards. Desserts that feature all five basic tastes are satisfying because umami compensates for any reduction in sugar.

Koji Shimomura

Owner chef, Edition Koji Shimomura (Japan)

Umami allows you to create dishes flavorsome yet light. It also strikes me that umami can be used to keep food appetizing in environments where impact on sense of taste is a concern, such as inflight meals. I imagine that from here on, chefs will need to learn increasingly more about umami and how to make the most of it.

Hiroshi Yamaguchi

General manager/ head chef, Kobe Kitano Hotel (Japan)

In French cuisine, seasonings are prepared from the foods. When the tastes of various ingredients expand from point to line to surface, it is umami that draws out the flavors of those ingredients and renders them harmonious. Umami plays a huge role in the creation of unique French recipes that excite and astound.

John Prescott

Food consultant (Australia)

Most of our dishes use tomatoes, stock, and vegetables that are sources of umami. I think that Western consumers have been very familiar with umami quality, but have used the term 'savory', which most likely reflects not only the taste component(umami) but also the odour/flavour component. It hasn't been clear to most people that there is a distinct taste like sweetness that is umami.

Yoshihiro Takahashi

Fifteenth-generation owner chef, Hyotei (Japan)

The stronger the flavor of the ingredients, the greater the need for the dashi to have umami to match: without it, the taste will be unbalanced. Conversely, if the balance is right, the tastes of the ingredients really stand out. This is what we mean by making the most of the ingredients. Dishes with umami linger on the palate pleasantly, and make a powerful impression; these are striking dishes that reassure and warm us.

Yuji Wakiya

Owner chef, Wakiya Ichiemi-charo (Japan)

Tang in Chinese cuisine comes in more variations than the dashi in Japanese cooking. Different types are skillfully divided into different uses, and blended to produce well-balanced, sophisticated stocks. These stocks can transform even a bland ingredient like *harusame* into an elegant, flavorsome dish. This is the secret of braised dishes in Chinese cooking.

Chefs the world over use umami

Umami may have been discovered in Japan, but chefs around the world who have noted the impact of umami are now actively incorporating it in their cooking. Umami is international, and with its ability to draw the maximum flavor from ingredients, will continue to open new doors in all cuisines.

David Kinch, Manresa (USA)

Umami is an important factor in all of my dishes, for the balance of flavors and synergistic effects. I'm trying to reduce the fat in what is served at the restaurant, and umami not only makes for healthier food, but makes dishes delicious and satisfying.

Alexandre Bourdas, SaQuaNa (France)

If I were to define umami, I would call it a comfortable taste. So I use it to give diners greater pleasure from their food. I want to keep making dishes that tap the power of umami in original ways, ranging freely beyond the bounds of convention and genre.

Love Apple Farms Tomatoes with Parmesan

Parmesan cheese and tomatoes are two of the leading umami foods in western cooking, the rind of ripened cheese being particularly rich in umami. Here an extract was made from this cheese rind and *Rishiri* kombu, and combined with vegetable stock in a sauce that serves up an intense umami hit for the palate.

Rye Brioche with Seaweed, Grilled Sardines, Soy Sauce, Spinach, and Roquefort Cheese

The sardines are basted with soy sauce during grilling and served with brioche made from dough containing umami-rich nori, in a flavorful dish that combines the ocean's bounty of fish and seaweed with the mountain's blessing of Roquefort cheese. Sea lettuce, dulse (a red algae) or similar seaweeds can be substituted for the nori with just as delectable results.

See *UMAMI: The Fifth Taste* for recipes.

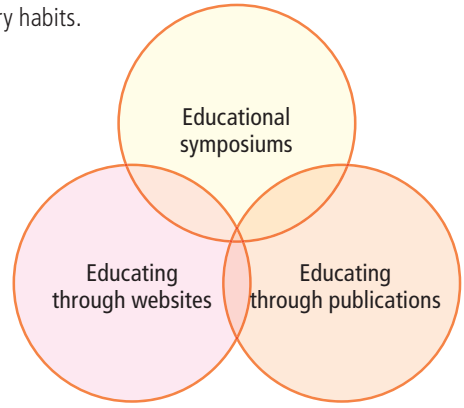
About the Umami Information Center

History

The Umami Information Center (UIC) was established in 1982 with assistance from the Umami Manufacturers Association of Japan to facilitate the global dissemination of information on umami. In order to maintain its neutral position, and ensure transparency and openness, in April 2007 the UIC was officially accredited and recognized as a Non-Profit Organization by the Tokyo Metropolitan Governor's Office.

Activities

The UIC is dedicated to supplying accurate and beneficial information concerning umami via umami education programs and activities across the globe, in order to further understanding of umami, and encourage healthy dietary habits.



1. Symposiums

The UIC runs symposiums and lectures on umami in conjunction with academic societies, cooking schools and other groups and institutions both in Japan and elsewhere. The aim is to promote accurate understanding of umami by providing basic information and helping people to experience umami for themselves.

2. Websites

Two websites—English and Japanese—supply the latest news on umami and UIC activities to a global audience.
English: www.umamiinfo.com
Japanese: www.umamiinfo.jp

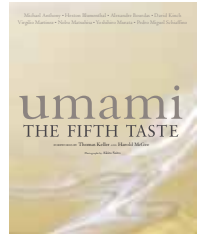
3. Publications

Information is provided through leaflets offering a basic guide to umami, umami-themed cookbooks, and videos featuring umami foods.

Major publications

UMAMI: The Fifth Taste

A comprehensive guide to umami and dashi including recipes from top international chefs, plus sections on the history and science of umami.



UMAMI the World

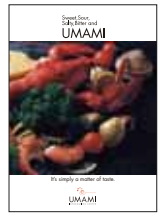
A handy, accessible guide to umami history and umami foods, available in six languages: Japanese, English, French, Spanish, Portuguese and German.

UMAMI World Recipes

Mini recipe books (in English) featuring umami recipes from Japan, Thailand, Vietnam, and the Philippines.

Sweet, Sour, Salty, Bitter and UMAMI

Booklet on umami with a scientific focus (English)

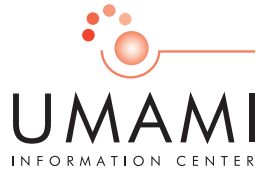


Sekai ni hirogaru umami no miryoku—Umami goes global

(Japanese)
Kenzo Kurihara, Professor emeritus, D.Sc
Hokkaido University
Booklet covering umami research and scientific information from the discovery of umami to the present day, by Japan's leading taste researcher

DVDs

Food education *Umami-tte naani?* (Japanese)
Umami wo shiru—What is umami? (Japanese/English)



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