





**SYNONYMS FOR DELICIOUS:**

Scrumptious // luscious // savory // delectable // and last but not least,  $C_5H_9NO_4$ .

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# What the Tongue Tastes

■ BY JONAH LEHRER // PHOTOGRAPHS BY HANS GISSINGER

*The mind has long been a source of fascination for scientists and artists alike. Though artists may have wielded a brush or pen to probe its mysteries, those tools are no less important, it turns out, than those at a scientist's lab bench. In fact, as Jonah Lehrer demonstrates in his new book, Proust Was a Neuroscientist, artists have sometimes uncannily foretold scientists' findings about memory, consciousness and—as he relates below—the senses.*

**A**uguste Escoffier invented veal stock (others had boiled bones before, but no one had codified the recipe), and he put it in everything. He reduced stock to gelatinous jelly, made it the base of pureed soups and enriched it with butter and brandy for sauces.

What every other chef was throwing away—scraps of tendon and oxtail, the tops of celery, the ends of onion and the irregular corners of carrot—Escoffier simmered into sublimity.

Although Escoffier introduced his *Guide Culinaire* in 1903 with the lofty claim that the 5,000 recipes in it were “based upon the modern science of gastronomy” (he wanted to do for fancy food what Antoine Lavoisier had done for chemistry), in reality he ignored modern science. At the time, scientists were trying to create a prissy nouvelle cuisine based on their odd, and totally incorrect, notions of what was healthy. Pig blood was good for you. So was tripe. Broccoli, on the other hand, caused indigestion. The same with peaches and garlic. Escoffier ignored this bad science (he invented peach melba) and sautéed away to his heart's malcontent, trusting the pleasures of his tongue over the abstractions of theory. He believed that the greatest threat to public health was the

modern transformation of dining from a “pleasurable occasion” into an “unnecessary chore.”

Escoffier’s emphasis on the tongue was the source of his culinary revolution. In his kitchen, a proper cook was a man of exquisite sensitivity, “carefully studying the trifling details of each separate flavor before he sends his masterpiece of culinary art before his patrons.” Escoffier’s cookbook warns again and again that the experience of the dish—what it actually tastes like—is the only thing that matters: “Experience alone can guide the cook.” A chef must be that artist on whom no taste is lost.

Oddly, though, in Escoffier’s labor-intensive recipe for stock, there seems to be little to interest the tongue. After all,

everybody knew that the tongue can taste only four flavors: sweet, salty, bitter and sour. Escoffier’s recipe seems deliberately to avoid adding any of these tastes. It contains very little sugar, salt or acid, and unless one burns the bones (not recommended), there is no bitterness. So what do we sense when we eat a profound beef daube, its deglazed bits simmered in stock until the sinewy meat is fit for a spoon? For the ambitious Escoffier, answering that question was a practical problem, because

understanding how the tongue worked was a necessary part of creating delicious dishes.

**D**eglazing was the secret of Escoffier’s success. The process itself is extremely simple: a piece of meat is cooked at a very high temperature—to produce a nice, seared Maillard crust, a cross-linking and caramelizing of amino acids—and then a liquid, such as a rich veal stock, is added. As the liquid evaporates, it loosens the *fronde*, the burned bits of protein stuck to the bottom of the pan, providing Escoffier’s sauces their divine depth; it’s what makes *boeuf bourguignon*, *bourguignon*. A little butter is added for varnish, and—voilà!—the sauce is *complet*.



Of course, the recipe that makes all of this possible is anything but simple. *Estouffade* (brown stock) is, Escoffier stresses early in *Culinaire*, “the humble foundation for all that follows.” Its concoction begins with the browning of beef and veal bones in the oven. Then, says Escoffier, fry a carrot and an onion in a stockpot. Add cold water, your baked bones, a little pork rind, and a bouquet garni of parsley, thyme, bay leaf and a clove of garlic. Simmer gently for 12 hours, making sure to keep the water at a constant level. Once the bones have given up their secrets, sauté some meat scraps in hot fat in a saucepan. Deglaze with your bone water and reduce. Repeat. Do it yet again. Then slowly add the remainder of your stock. Carefully skim off the fat (a stock should be virtually fat-free) and simmer for a few more hours. Strain through a fine *chinois*. After a full day of stock-making, you are now ready to *start* cooking.

Why is stock so essential? What is it about denatured protein (denaturing is what happens to meat and bones when you cook them Escoffier’s way) that we find so inexplicably appealing? The answer is *umami*, the Japanese word for “delicious.” Umami is what we taste when we eat everything from steak to soy sauce. It’s what makes stock more than dirty water and deglazing the essential process of French cooking.

To be precise, umami is actually the taste of L-glutamate (C<sub>5</sub>H<sub>9</sub>NO<sub>4</sub>), the dominant amino acid in the composition of life. L-glutamate is released from life-forms by proteolysis (a shy scientific word for death, rot and the cooking process). While scientists were still theorizing about the health benefits of tripe, Escoffier was busy learning how we taste food. His creations were acts of exploration, ways of grappling with mysteries he couldn’t understand. His genius was in getting as much L-glutamate on the plate as possible.

**T**he story of umami begins at about the same time Escoffier invented *tournedos Rossini*, a filet mignon served with foie gras and sauced with a reduced veal stock and a scattering of black truffles. The year was 1907, and the Japanese chemist Kikunae Ikeda, as curious about the tongue from a scientific perspective as was Escoffier from an artistic one, had asked himself a simple question: What does dashi taste like?

Dashi is a classic Japanese broth made from kombu, a dried form of kelp. Since at least A.D. 797, it has been used in Japanese cooking the same way Escoffier used stock: as a universal solvent, a base for every dish. But to Ikeda, the dashi his wife cooked every night didn’t taste like any of the four classic tastes or even like some unique combination of them. It was simply delicious. Or, as the Japanese would say, it was umami.

So Ikeda began his quixotic quest for this unknown taste.



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He distilled fields of seaweed, searching for the essence that might trigger the same mysterious sensation as a steaming bowl of seaweed broth. He also explored other cuisines. “There is a taste,” Ikeda declared, “which is common to asparagus, tomatoes, cheese and meat but which is not one of the four well-known tastes.” Finally, after patient years of lonely chemistry, during which he tried to distill the secret ingredient that dashi and veal stock had in common, Ikeda found his secret molecule. It was glutamic acid, the precursor of L-glutamate. He announced his discovery in the *Journal of the Chemical Society of Tokyo*.

Glutamic acid is tasteless. Only when the protein is broken down by cooking, fermentation or ripening in the sun does it degenerate into L-glutamate, which the tongue *can* taste. “This study has discovered two facts,” Ikeda wrote in his conclusion. “One is that the broth of seaweed contains glutamate and the other that glutamate causes the taste sensation ‘umami.’”

Ikeda’s research, though a seminal finding in the physiology of taste, was completely ignored. Science thought it had the tongue solved. Ever since Democritus hypothesized in the fourth century B.C. that the sensation of taste was an effect of the shape of food particles, the tongue has been seen as a simple muscle. Sweet things, according to Democritus, were “round and large in their atoms,” while “the astringently sour is that

which is large in its atoms but rough, angular and not spherical.” Saltiness was caused by isosceles atoms, while bitterness was “spherical, smooth, scalene and small.” Plato believed Democritus and wrote in *Timaeus* that differences in taste were caused by atoms on the tongue entering the small veins that traveled to the heart. Aristotle, in turn, believed Plato. In *De Anima*, the four primary tastes Aristotle described were the already classic sweet, sour, salty and bitter.

Over the millennia, this ancient theory remained largely unquestioned. The tongue was seen as a mechanical organ in which the qualities of foods were impressed upon its papillaed surface. The discovery of taste buds in the nineteenth century gave new credence to this theory. Under a



microscope, these cells looked like keyholes into which our chewed food might fit, thus triggering a taste sensation. By the start of the twentieth century, scientists were beginning to map the tongue, assigning each of the four flavors to a specific area. The tip of the tongue loved sweet things, while the sides preferred sour. The back of the tongue was sensitive to bitter flavors, and saltiness was sensed everywhere. The sensation of taste was that simple.

Unfortunately for Ikeda, there seemed to be no space left on the tongue for his delicious flavor. Umami, these Western scientists said, was an idle theory that related solely to Japanese food, a silly idea concerned with something called deliciousness, whatever that was. And so while cooks the world over continued to base entire cuisines on dashi, Parmesan cheese, tomato sauce, meat stock and soy sauce (all potent sources of L-glutamate), science persisted in its naive and unscientific belief in four, and only four, tastes.

Despite the willful ignorance of science, Ikeda's idea gained a certain cult following, and with time other pioneers began investigating their local cuisines and found their own densities of L-glutamate. Everything from aged cheese to ketchup was rich in this magic amino acid. Umami even seemed to explain some of the more perplexing idiosyncrasies of the cooking world: Why do so many cultures, beginning with ancient Rome, have a fish sauce? (Salted, slightly rotting anchovies are like glutamate speedballs. They are pure umami.) Why do we dip sushi in soy sauce? (The raw fish, being raw, is low in umami, since its glutamate is not yet unraveled. A touch of soy sauce gives the tongue the burst of umami that we crave.) Umami even explains (although it doesn't excuse) Marmite, the British spread made of yeast extract, which is just another name for L-glutamate.

Of course, umami is also the reason that meat—which is nothing but amino acid—tastes so darn good. If cooked



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properly, the glutamate in meat is converted into its free form and can be tasted. This also applies to cured meats and cheeses. As a leg of prosciutto ages, the amino acid that increases the most is glutamate. Parmesan, meanwhile, is one of the most concentrated forms of glutamate, weighing in at more than 1,200 mg per 100 g. (Only Roquefort cheese has more.) When we add an aged cheese to a pasta, the umami in the cheese somehow exaggerates the umami present elsewhere in the dish. (This is why tomato sauce and Parmesan are such a perfect pair. The cheese makes the tomatoes more tomato-like.) A little umami goes a long way.

**A**nd, of course, umami explains Escoffier's genius. The burned bits of meat in the bottom of a pan are unraveled protein, rich in L-glutamate. Dissolved in the stock, which is little more than umami water, these scraps fill our mouths with a deep sense

of deliciousness, the profound taste of decay. The culture of the kitchen articulated a biological truth of the tongue long before science did because it was forced to feed us.

For the ambitious Escoffier, the tongue was a practical problem, and understanding how it worked was a necessary part of creating delicious dishes. Each dinner menu was a new experiment, a way of empirically verifying his culinary instincts. In his cookbook, he wrote down what every home cook already knew. Protein tastes good, especially when it's been broken apart. Aged cheese isn't just rotten milk. Bones contain flavor. But despite the abundance of experiential evidence, experimental science continued to deny umami's reality. The deliciousness of a stock, said these haughty lab coats, was all in our imagination. The tongue couldn't taste it.

What Ikeda needed before science would believe him was anatomical evidence that we could actually taste glutamate. Anecdotal data from cookbooks, as well as all those people

who added fish sauce to their *pho*, Parmesan to their pasta and soy sauce to their sushi, wasn't enough.

Finally, more than 90 years after Ikeda first distilled glutamate from seaweed, his theory was unequivocally confirmed. Molecular biologists discovered two distinct receptors on the tongue that sense only glutamate and L-amino acids. In honor of Ikeda, they were named the umami receptors. The first receptor was discovered in 2000, when a team of scientists noticed that the tongue contains a modified form of a glutamate receptor already identified in neurons in the brain (glutamate is also a neurotransmitter). The second sighting occurred in 2002, when another umami receptor was identified, this one a derivative of our sweet taste receptors.

These two separate discoveries of umami receptors on the tongue demonstrated once and for all that umami is not a figment of the hedonist's imagination. We actually have a sense that responds only to veal stock, steak and dashi. What's more, as Ikeda insisted, the tongue uses the taste of umami as its definition of deliciousness. Unlike the tastes of sweet, sour, bitter and salty, which are sensed relative to one another (this is why a touch of salt is always added to chocolate, and why melon is gussied up with ham), umami is sensed all by itself. It is that important.

This, of course, is perfectly logical. The tongue craves sweet things because the body requires glucose for energy. Likewise, we love the flavor of denatured protein, because, being protein and water ourselves, we need it. Our body produces more than 40 grams of glutamate a day, so we constantly crave an amino acid refill. (Species that are naturally vegetarian find the taste of umami repellent. Unfortunately for vegans, humans are omnivores.) In fact, we are disposed from birth to savor umami: breast milk has 10 times more glutamate than cow milk. The first taste we ever know is deeply umami, preparing us for a lifetime of eating cheese, seared steak and deglazed-pan sauces. The tongue loves what the body needs. ■

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