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History of Taste
It is believed that the first tastes to be recognized were sweet, sour and salty
Several thousand years ago, the Greek philosopher Democritus considered taste sensations and identified the fourth taste: ‘bitter’
So four it was—until along came Auguste Escoffier
He created meals that tasted like no combination of salty, sour, sweet and bitter—they tasted new
Escoffier had invented veal stock
According to science writer Jonah Lehrer: ‘[The stock] didn't just taste good, this was an epiphany. This was the best food you ever tasted in your life.’
Recipe for the Epiphanous Stock:
• Heat a large stock pot
• Put in a little pork rind, a little carrot, and some meat scraps
• Let it burn a little bit and wait for the ‘crackle’
• Add cold water and veal bones
• Boil, boil, boil
• Simmer, simmer, simmer (for 12 hours)
• Let it rest for 20-24 hours
• Add butter and let the magic begin!
But because the magic broth was neither sweet, bitter, sour, salty nor any combination of those four, scientists decided it could not be real
‘Experts’ said people may smack their lips, drool, savor and pay enormous amounts of money to M. Escoffier, but what they were tasting was not really there—the amazing taste sensation was all in their heads
Meanwhile, halfway across the world, chemistry professor Kikunae Ikeda of the Imperial University of Tokyo was curious about what made his ‘dashi’(seaweed soup) so tasty and wrote a paper describing the taste sensation
Dashi is used by Japanese cooks much the way Escoffier used stock—as a base for all kinds of foods and it was, thought Ikeda, simply delicious
Ikeda called the ‘new’ flavor ‘umami’—which derives from ‘umai’ (the Japanese word for ‘delicious’) And like Escoffier, most of the world did not accept the existence of the new taste
It turns out, almost 100 years after Escoffier wrote his cookbook and Ikeda wrote his article, a new generation of scientists took a closer look at the human tongue and discovered, just as those two had insisted, that there is indeed a fifth taste
In 2002, this became the new view with umami being recognized as the fifth taste representing ‘savory’ flavor
Headliners: Is there a Sixth Sense?; Akiba Y et al: Luminal L-glutamate enhances duodenal mucosal defense mechanisms via multiple glutamate receptors in rats. Am J Physiol Gastrointest Liver Physiol; 297. G781-G791
In the past, the recognition of fat stimuli was believed to rely mostly on textural, olfactory, and post-ingestive cues, but the finding that lipid sensors are present on the tongue suggests that fat can be considered as the 6th taste
Today more than one-third of adults in the United States are obese and obesity rates in other industrialized countries are catching up—the World Health Organization estimates 500 million adults worldwide are now obese
Update: It was recently reported by the National Center for Health Statistics (part of the Centers for Disease Control and Prevention) that adult obesity rates in the U.S. are continuing to level off after several decades of skyrocketing growth.

In 2012, ~34.9% of U.S. adults (representing 78 million citizens) were obese—meaning they were 35+ pounds over a healthy weight.

The 2012 stats were not significantly different from the 35.7% of adults who were found to be obese in 2010.

‘Even though it looks like a slight drop in the percentage of adults who are obese, the difference is not statistically significant. This is more evidence that we’re not seeing a change in adult obesity.’—Cynthia Ogden; epidemiologist; National Center for Health Statistics

‘The numbers are still at epidemic levels, and we need to continue to create smart strategies to address this health problem.’—Scott Kahan; director; STOP Obesity Alliance (an obesity policy think tank); George Washington University

Although the consequences of obesity are clear, its origins are poorly understood.

A great deal of progress has been made in identifying the genes that may contribute to obesity—many of the genes implicated in obesity modify how energy is spent, how fat is metabolized and stored, and how nutrients are partitioned.

Conspicuously absent from the list of obesity genes are genes involved in taste.

According to consumers, taste is one of the top three factors guiding food choices, along with cost/convenience and nutritional content.

Until recently, it was assumed that the perception of fat was based on textural cues and its role as a carrier for flavor in foods rather than any explicit lingually perceived taste because the presence of fat in the mouth did not evoke a recognizable taste sensation.

Another problem was the absence of any known receptor mechanism for fatty taste.

However, accumulating evidence now challenges this view.

Animal studies have shown that fatty acids placed on the tongue cause taste cells to depolarize, initiating a signal that is transmitted to the brain—T.A. Gilbertson et al.: Fatty acid modulation of K+ channels in taste receptor cells: gustatory cues for dietary fat. Am J Physiol Cell Physiol, 272:C1203-10, 1997.

Headliners: The Weight of the Nation for Kids; HBO; Episode 3; air date: 5/7/13

Food for Thought: Children spend an AVERAGE of 7 hours per day in front of a screen—and less than one hour doing physical activity.

And advertisers know this!!!! Studies have shown that RED and YELLOW stimulate hunger and cause people to EAT FASTER.

**Taste Defined**

Taste is the sensory modality designed to inform us about the nutritional qualities of the food we eat.

Let’s take a look at the FIVE Taste Sensations:

- Sweet
- Salty
- Umami
- Bitter
- Sour

**Sweet**

Sweet foods signal the presence of carbohydrates that serve as an energy source.

*Headliners: A Role for Sweet Taste: Calorie Predictive Relations in Energy Regulation by Rats; Swithers SE, Davidson TL; Department of Psychological Sciences; Ingestive Behavior Research Center; Purdue University; 2/08; Behav Neurosci; 122(1):161-73; accessed on 2/28/13 at: http://www.ncbi.nlm.nih.gov/pubmed/18298259*

It is thought that mammals use sweet taste to predict the caloric contents of food—researchers theorized that eating sweet nonnutritive substances may degrade this predictive relationship and could possibly lead to positive energy balance through increased food intake and/or diminished energy expenditure.
The researchers discovered that reducing the correlation between sweet taste and the caloric content of foods using artificial sweeteners in rats resulted in increased caloric intake, increased body weight, and increased adiposity—suggesting that consumption of products containing artificial sweeteners may lead to increased body weight and obesity by interfering with fundamental homeostatic, physiological processes.

Nonnutritive sweeteners are zero- or low-calorie alternatives to nutritive sweeteners—they are hundreds to thousands of times sweeter than table sugar. Often referred to as ‘artificial sweeteners’, the average American consumes 24 pounds of these non-nutritive products every year.

Although soda pop is the most common place to find artificial sweeteners, these sugar substitutes are also added to 6,000+ other products sold in the U.S.—including baby food, frozen dinners and yogurts. For decades, non-caloric sweeteners have been marketed as being ‘healthier’ because they have less calories—but numbers are showing a relationship between the percent of people using artificial sweeteners, the amount of products containing artificial sweeteners and the percent of the population that are obese.

**Headliners: Enhanced Sweet Taste: This Is Your Tongue on Pot;**
Robert Margolskee, MD, PhD; lead author; molecular biologist; Monell Center and Kyushu University (Japan); published online in the Proceedings of the National Academy of Sciences; as reported 12/22/09 on esciencenews.com; accessed 2/5/13 at: http://esciencenews.com/articles/2009/12/22

Recent research has found that endocannabinoids act directly on taste receptors on the tongue to enhance sweet taste. Endogenous endocannabinoids—substances similar to THC (the active ingredient in marijuana)—are produced in the brain and body.

‘Endocannabinoids both act in the brain to increase appetite and also modulate taste receptors on the tongue to increase the response to sweets.’—Yuzo Ninomiya, PhD; Professor of Oral Neuroscience; Graduate School of Dental Sciences; Kyushu University (Japan)

Sweet taste receptors are also found in the intestine and pancreas where they help regulate nutrient absorption, insulin secretion and energy metabolism. If endocannabinoids are found to also modulate the responses of pancreatic and intestinal sweet receptors, researchers are hopeful that the findings may open doors to the development of novel therapeutic compounds to combat obesity and diabetes.

**Headliners: Sleep More, Crave Less Sugar;**
McClatchy News Service; appearing in the Idaho Statesman; 5/11/14

Researchers from the University of Chicago are reporting that people who get less than 7 to 9 hours of sleep a night have dramatically skewed levels of appetite-controlling hormones—specifically, leptin (‘back away from the buffet’) and ghrelin (‘I’m starving!’)

In the Chicago study, a few sleepless nights not only correlated with a 18% drop in leptin levels and boosted ghrelin production by ~30%, but study participants demonstrated a 45% increase in cravings for sugary food. Sleep deprivation not only makes sugary foods more appealing, it may also lower a person’s ability to resist them—in part, because the parts of the brain that control cravings are not as active when a person is tired.

University of California (Berkley)

**Salty**

Salty taste governs the intake of Na+ and other salts—essential for maintaining the water balance of the body, controlling blood pressure and blood volume, and for proper muscle and nerve function.

**Headliners: Study Suggests Salt Might Be ‘Nature’s Antidepressant’;**
Kim Johnson et al; study results appearing in Physiology & Behavior; 7/08; accessed at http://esciencenews.com/articles/2009/03/10 on 2/5/13

A recent University of Iowa study may have discovered a potential reason why many people crave salt: it might put them in a better mood.

In animal studies, the researchers found that when deficient in sodium chloride, the animals tended to shy away from activities that they would normally enjoy—leading the experts to speculate that that the deficit and the craving associated with it can induce a loss of enjoyment associated with normally pleasing activities (an important marker for a diagnosis of depression).
When it comes to childhood obesity, experts are not shy about suggesting a link between consumption of calorie-filled sugary drinks and ballooning obesity rates in the United States. However, a recent study found a target that its researchers say may be a better way to head off the obesity epidemic in kids and prevent them from reaching for a sugary drink in the first place: Salt intake.

“In addition to the known benefits of lowering blood pressure, salt reduction strategies may be useful in childhood obesity prevention efforts.”--In a statement from researchers from the Centre for Physical Activity and Nutrition Research at Deakin University in Burwood, Australia

Researchers tracked the eating and drinking habits of 4,200 Australian children who were between 2 and 16 years old and found the children who took in the most salt through their diets also took in the most sugary drinks in the study.

For every one gram of salt per day, children took in 17 grams per day more of a sugary drink—or about 9 ounces of soda—were 26% more likely to be obese. Older children and those with a low socioeconomic status were found to be more likely to drink sugary drinks.

“We can't necessarily say childhood obesity is salt’s fault—or sugar-sweetened beverages' fault. Children learn by example, so if high-sodium foods and sugar-sweetened beverages are readily available in the house and consumed by the parents on a regular basis, [kids] are going to be more likely to consume those as well.”--Kirsti King, senior dietician at Texas Children's Hospital in Houston; spokesperson for the Academy of Nutrition and Dietetics, in a statement to HealthDay

The CDC reports that American children consume ~1000 mg too much salt daily—about the same amount of salt found in one Big Mac.

Previous research has shown similar results in adults but studies on salt, weight, and blood pressure were scarce in children until the CDC studied the dietary habits of 6,200 children aged 8-18 for five years.

Those children who ate the most salt faced DOUBLE the risk of having elevated blood pressure (overall, 15% of the participants had either prehypertension or high blood pressure). Among the overweight or obese study participants, the risk for elevated blood pressure was TRIPLED among those ingesting the most salt.

Researchers are unclear why heavier children in the study were more sensitive to salt but speculate it could be due to obesity-related hormone changes—in any case, studies demonstrate not only that elevated blood pressure in childhood can lead to full-fledged hypertension in adulthood, but potentially premature heart disease.

The CDC recommends daily salt or sodium intake for adults and children be no more than 2,300 mg (about one teaspoon) daily—on average, the study children ingested 3,300 mg every day.

The American Heart Association recommends an even lower amount, 1,500 milligrams—a recent AHA survey, however, found most Americans average 3,400 milligrams of sodium each day (mostly from processed and restaurant foods).

**QUIZ TIME:** What type of food contributes the most dietary salt for Americans?

The six biggest sodium contributors in Americans’ diets are breads and rolls, cold cuts and cured meats, pizza, poultry, soup and sandwiches—American Heart Association; 11/12

The CDC found that just 10 types of food are responsible for 40% of people’s sodium intake—leading the pack are bread and rolls followed by luncheon meat such as deli ham or turkey.

Centers for Disease Control and Prevention; study results released 2/7/12; reported by Robert Pear; New York Times News Service; appearing in the Idaho Statesman; 2/8/12

Pizza, poultry, soups, cheeseburgers and other sandwiches, cheese, pasta dishes and meat dishes such as meatloaf round out the list.

According to the CDC, snacks such as potato chips, pretzels, and popcorn are at the bottom of the 10 worst list.
About 75% of salt intake in the United States comes from processed food—there is a push for a modest and prolonged national reduction in sodium intake by persuading the food, restaurant, and other industries to reduce the salt content of their products.

The National Salt Reduction Initiative (‘NSRI’) is a coalition of cities, states and health organizations working to help food companies and restaurants reduce the amount of salt in their products.

The goal of the initiative is to reduce Americans’ salt intake by 20% by developing targets to guide company salt reductions in 62 categories of packaged food and 25 categories of restaurant food.

**Headliners:**

- Study: Cutting Salt Could Save Thousands of Lives; Researchers from the University of California (San Francisco), Harvard University’s School of Public Health, and Simon Fraser University (Canada) tasked by the CDC to do the research separately; results published in Hypertension; 2/13; as reported by Melissa Healy; Los Angeles Times; appearing in the Idaho Statesman; 2/13/13

A recent multi-institutional study estimated that reducing sodium by ONE-TWENTIETH of a TEASPOON in the foods Americans buy and eat could save a half-million people from premature deaths over the next 10 years. Researchers also projected that a more abrupt reduction to 2,200 mg of daily salt ingestion—representing a 40% drop in current consumption levels—could boost the tally of lives saved over 10 years to 850,000.

Put it another way: If lower salt diets could avert 500,000 deaths in the span of a decade, that would be like curing colorectal cancer and it would save more lives than preventing automobile fatalities.

‘No matter how we look at it, the story is the same—there will be huge benefits to reducing sodium.’—Pam Coxson; lead study author; mathematician; University of California (San Francisco)

**Umami**

Umami taste is associated with protein-rich foods. This unique taste derives from the palate’s ability to detect a specific aminio acid—glutamate—if it is unbound to other amino acids.

There are two forms of glutamate: bound and free-form.

- Glutamate exists in the ‘bound’ form as a part of protein, along with other amino acids.
- The glutamate breaks apart when meat is cooked, over time when cheese is aged, by fermentation as in soy sauce or under the sun as a tomato ripens.

When glutamate becomes L-glutamate (also known as ‘free glutamate’), that’s when things get ‘delicious’—UMAMI!

Free glutamate occurs naturally in many foods, such as meat, milk, mushrooms, Parmesan cheese, and tomatoes.

In the average human being, ~4.4 pounds of total glutamate and 0.35 ounces of free glutamate are present in the muscles, brain, blood, kidney, liver, and breast milk.

Given the systemic prominence of this amino acid, it is not incomprehensible that we have developed a way to taste it—many researchers are looking into umami’s evolutionary role in procuring necessary glutamate and other amino acids for use in building proteins.

Some experts refer to ‘umami’ as the taste of amino acids or nucleotides and believe it plays a role in signaling the presence of proteins.

With the discovery of glutamate receptors in the stomach, this theory seems plausible.

It has been ascertained that the pneumogastric vagus nerve only reacts to glutamate among amino acids—suggesting that when a piece of food enters the stomach and glutamate is detected, the brain is stimulated and signals the stomach to begin protein digestion.

Glutamate has also been shown to play a role in CNS function as an important signaling chemical at neuronal synapses.

More recently, it has become clear that glutamate signaling is also functional in non-neuronal tissues and occurs in sites as diverse as bone, pancreas and skin.

These findings raise the possibility that glutamate acts as a more widespread ‘cytokine’ and is able to influence cellular activity in a range of tissue types.

The impact of these discoveries is significant because they offer a rapid way to advance the development of therapeutics.

Agents developed for use in neuroscience applications might be beneficial in the modulation of pathology peripherally, impacting on conditions such as osteoporosis, diabetes and wound healing.
Glutamate as a Flavor Enhancer
In 1909, monosodium glutamate (‘MSG’) was born and arrived in the United States in 1917. Since its introduction, MSG has created some controversy as MSG-intolerant folks and asthmatics began complaining of ‘Chinese Restaurant Syndrome’ (chest pain, flushing, headache, numbness or burning in or around the mouth, sense of facial pressure or swelling, sweating and tingling after MSG ingestion).

It is worth noting that the FDA regards monosodium glutamate as being ‘generally regarded as safe’ (‘GRAS’).

Bitter
Bitter taste is innately aversive and protects against the consumption of poisons

Headliners: Small Intestine Can Sense and React to Bitter Toxins in Food; Timothy Osbourne; lead author; professor; Departments of Molecular Biology and Biochemistry; University of California (Irvine); study results published in the Journal of Clinical Investigation; 10/9/08; accessed on 2/5/13 at: http://esciencenews.com/articles/2008/10/09

Toxins in food often have a very bitter taste that makes people avoid food and beverages that contain them. Recent studies have demonstrated that bitterness also slows the digestive process—keeping bad food or beverages in the stomach longer increases the chance that it will be expelled.

A second line of defense against bitter dietary toxins in the gut triggers the production of a satiety hormone (‘cholecystokinin’ also known as ‘ghrelin’) that makes people feel full—presumably to keep them from eating more of the toxic food.

In the study, researchers also discovered that cholesterol regulates the activity of bitter-taste receptors in the small intestine—diets high in plant material (and potential toxins) are naturally low in cholesterol compared to low-toxin, high cholesterol, red meat-based diets.

Low levels of cholesterol triggered a stronger receptor response to cholecystokinin while higher levels caused a weaker response—additionally, lower cholesterol levels spurred intestinal cells to produce 2-3 times the amount of cholecystokinin.

In addition to the appetite-suppressing hormone, bitter taste receptors in the gut activate the production of glucagon-like peptide 1—a protein that stimulates insulin secretion in the pancreas (among other things). Pharmaceutical agents (such as Byetta) are currently on the market that attempt to stabilize GLP-1 in people living with diabetes—and new therapeutic modalities are being developed that will increase production of GLP-1.

Sour
Sour taste signals the presence of dietary acids that are present in spoiled foods and unripe fruits

Headliners: How People Perceive Sour Flavors: Proton Current Drives Action Potentials in Taste Cells

Of the five taste sensations—sweet, bitter, sour, salty and umami—sour is arguably the strongest yet the least understood.

Sour is the sensation evoked by substances that are acidic (such as lemons and pickles)—the more acidic the substance, the more sour the taste.

Acids release protons—how protons activate the taste system had not been understood.

A USC team expected to find protons from acids binding to the outside of the taste cell and opening a pore in the membrane that would allow sodium to enter the cell—the sodium’s entry would send an electrical response to the brain, announcing the sensation that we perceive as sour.

Instead, the researchers found that the protons were entering the cell and causing the electrical response directly. The ability to sense protons with a mechanism that does not rely on sodium has important implications for how different tastes interact.

‘This mechanism is very appropriate for the taste system because we can eat something that has a lot of protons and not much sodium or other ions, and the taste system will still be able to detect sour. It makes sense that nature would have built a taste cell like this, so as not to confuse salty with sour.’—Emily Liman; study investigator; USC College professor.
Mechanism of TASTE

One persistent myth is the idea that different regions of the tongue respond to different tastants. It has been known for some time that taste cells containing receptors for all 5 tastants are found all over the surface of the tongue and throughout the oral cavity.

Taste receptors are on the 50-150 taste cells found within a taste bud—the apical part of the taste cell projects into the taste pore which is in contact with saliva.

Tastants must dissolve in the saliva and mucus in order to enter the taste pore allowing the basal end of the taste cell to form a synapse with a primary sensory neuron.

Each taste cell is sensitive to only one type of tastant—receptors on the surface of a sweet cell, for example, bind to sugar molecules.

**Headliners: Neuroscience: Hardwired for Taste; Bijal P. Trivedi; Nature; 6/21/12**

Researchers have recently developed a ‘gustotopic map’ based on the idea that, just as each taste bud on the tongue responds to a single taste, so there are regions of the brain that are similarly dedicated.

The other recent revelation in taste research is that the receptors that detect bitter, sweet and umami are not restricted to the tongue—they are distributed throughout the stomach, intestine and pancreas, where they aid the digestive process by influencing appetite and regulating insulin production.

**Headliners: Stomach’s Sweet Tooth; Rachel Ehrenberg; reporting for Science News; 3/27/10**

Recently discovered taste receptors in the gut appear to send a ‘prepare for fuel’ message to the body.

People deceive their taste buds daily—drinking a dash of Sweet’N Low in their coffee or a diet soda or chewing a stick of sugarless gum—in an attempt to get a ‘sweet fix’ without the calories.

While taste receptors in the mouth make snap decisions about what should be let inside, gut taste cells serve as specialized ground forces charged with preparing the digestive system for the aftermath of the tongue’s decision.

When the gut’s taste sensors encounter something sweet, they send a ‘Prepare for Fuel!’ message that results in increased insulin levels.

Though researchers do not fully understand what follows, studies suggest that gut taste cell activity and metabolism may be connected—which, if proven, could help explain recent counterintuitive findings that link Type 2 diabetes and obesity to consumption of diet soda.

The success of many bariatric surgeries has led some experts to propose a new approach to the war on obesity—some researchers are concentrating their efforts on targeting taste receptors in the stomach.

The stomach has multiple sensor receptors identifying what is ingested—much like the tongue.

Stomach taste receptors use similar signaling mechanisms found on the tongue to release hormones to control satiety and blood glucose levels when food reach the gut.

The stomach taste receptors respond to excess food intake—their malfunction is what researchers believe may be implicated in the development of obesity, diabetes and metabolic conditions.

‘The effectiveness of bariatric surgery to cause profound weight loss and a decrease in the prevalence of diabetes and other obesity-related conditions is not completely understood, but it may involve changes in the release of gut hormones. Targeting extraoral taste receptors that affect the release of hormones that control food intake may offer a new road to mimic these effects in a nonsurgical manner.’—Dr. Sara Janssen and Dr. Inge Depoortere; Catholic University (Leuven, Belgium)

**Headliners: Differences in Taste Sensitivity Between Obese and Non-Obese Children and Adolescents; Overberg J et al; Archives of Disease in Childhood; 9/19/12; accessed on 1/29/13 at:**

[www.sciencedaily.com/releases/2012/09/120919190924.htm](http://www.sciencedaily.com/releases/2012/09/120919190924.htm)

It was recently demonstrated that obese children are likely to have less sensitive taste buds than children of normal weight—specifically, the overweight children were significantly less likely to identify individual taste sensations (particularly, salty, bitter, and umami).

The study authors speculate that this blunted ability to distinguish all five tastes may prompt youngsters to eat larger quantities of food in hopes of registering the desired taste sensation.

Researchers at the University of Maryland School of Medicine in Baltimore discovered that bitter taste receptors are not just located in the mouth but also in human lungs—what they learned about the role of the receptors could revolutionize the treatment of asthma and other obstructive lung diseases.
'I initially thought the bitter-taste receptors in the lungs would prompt a 'fight or flight' response to a noxious inhalant, causing chest tightness and coughing so you would leave the toxic environment, but that's not what we found. It turns out that the bitter compounds worked the opposite way from what we thought. They all opened the airway more profoundly than any known drug that we have for treatment of asthma or chronic obstructive pulmonary disease (COPD). New drugs to treat asthma, emphysema or chronic bronchitis are needed. This could replace or enhance what is now in use, and represents a completely new approach.'—Stephen B. Liggett, M.D., study investigator; professor of medicine and physiology, University of Maryland School of Medicine; director, Cardiopulmonary Genomics Program

Umami receptors, found on the sperm's surface, are thought to help control the release of DNA.

Understanding the implications of these taste receptors could provide insight into the development of new infertility treatments.

**Taste Tidbits**

A healthy person who is 20 to 40 years old will have about 10,000 taste buds but that number will decrease with age—a 65-year-old person might have fewer than 5,000 fully functional taste buds.

Many animals have far more taste buds than humans—the average 6-inch catfish has about 25,000 taste buds.

The body can detect taste in as little as 0.0015 seconds—compared to 0.0024 seconds for touch and 0.013 seconds for vision.

In a part of the brain—known as the anterior cingulate cortex—tastes get married to an emotional reaction (disgust for rotten meat; delight for a sweet strawberry).

Recently, researchers found ways to manipulate tastes—one chemical extracted from a West African fruit binds to taste receptors in a way that makes even the sourdest lemon taste as sweet as lemon pie!

Did you know that butterflies have taste buds in their mouths and on their feet?

Each taste bud is equipped with 50 to 150 receptor cells that function for a period of one to two weeks. The rapid replacement rate makes it possible to maintain a constant state of taste when receptors are killed by spicy food or when the tongue gets burned by food or a beverage that is too hot.

**Headliners:**

*Influence of Stimulus Temperature on Orosensory Perception and Variation with Taste Phenotype; Bajec M et al; Chemosensory Perceptions; 5/14/2012; accessed on 1/29/12 at: www.sciencedaily.com/releases/2012/05/120514104458.htm*

Researchers from Brock University (Canada) demonstrated that the temperature of foods and beverages has an effect on the intensity of sour, bitter and 'astringent' (ex. cranberry juice) tastes but not sweetness.

Most people are well aware that the same food or beverage can taste very different depending on its temperature when ingested.

What surprised the researchers was that 20%-30% of study participants can ‘taste’ without the presence of food or drink—known as ‘thermal tasters’, taste sensation can be created by heating or cooling an area on the tongue.

**Headliners:**

*Visual-Gustatory Interaction: Orbitofrontal and Insular Cortices Mediate the Effect of High-Calorie Visual Food Cues on Taste Pleasantness; Ohla K et al; Plos ONE; 3/14/12; accessed on 1/29/12 at: www.sciencedaily.com/releases/2012/03/120314172256.htm*

According to researchers from the Nestlé Research Center (Switzerland), tastes were perceived to be more pleasant when study participants viewed images of high-calorie foods when compared to low-calorie foods prior to ingesting the study foods.

**Headliners:**

*The Role of Congruency in Retronasal Odor Referral to the Mouth; Lim J and Johnson B; Chemical Senses; 5/30/12; accessed on 1/29/12 at: www.sciencedaily.com/releases/2012/05/120530133708.htm*

Researchers at Oregon State University have uncovered some interesting findings about how people taste, smell and detect flavor—and why they like some foods better than others.

As a survival mechanism, humans are wired to prefer sweet-tasting foods and avoid bitter substances.

The mechanisms of flavor perception probably evolved as a protective mechanism—foods that were sweet or salty were usually safe to eat and provided needed macronutrients like carbohydrates and salt (making them highly desirable).

Sourness and bitterness, by comparison, often meant the food was spoiled or contained toxins and, therefore, should be avoided.
Those mechanisms may have prevented the cave dweller from starving or getting poisoned but in today's world, they lead straight to ice cream, soft drinks and obesity. Even so, the researchers believe flavor perception is largely a learned behavior and, as such, it may be possible to find ways to work around these evolutionary instincts. ‘Hardly anyone really likes the somewhat bitter taste of coffee the first time they drink it, but they like the caffeine. Since the coffee makes them feel energized, they learn to like its flavor.’ --Juyun Lim, lead study author. As understanding improves of how taste and smell actually work to control our perceptions of flavor, it may be possible to use that knowledge to lead humans toward an improved diet—the research team is investigating whether people can learn to like vegetables and the potential mechanisms underlying that process. ‘Many people say they don’t like the taste of cruciferous vegetables like cauliflower or Brussel sprouts, for instance. But what they are mainly reacting to is the smell of these vegetables, which includes a defensive compound that makes even other animals shy away from eating them. Find a way to help improve their smell, and you’ll find a way to make people enjoy eating them.’--Lim

**Headliners:** *Genome, Vegetables Remain Active After You Eat Them; Sarah Stanley; reporting for Discover; 1/2/12*

In September 2012, a team of researchers reported that fragments of genetic material known as microRNAs are making their way from vegetables into the human bloodstream. MicroRNAs native to humans were first identified in 2009 and seem to help regulate gene activity—apparently, they are not ‘junk’!

Researchers suspected that foreign miRNA might also be present in humans so they tested hundreds of volunteers and found “50 different kinds of PLANT miRNA in the study participants’ blood samples!”--Chen-Yu Zhang; biochemist; Nanjing University; Jiangsu, China; study highlights appearing in Discover; 1/2/12

The scientists noticed that one such veggie molecule—MIR168a—paired up with a piece of human RNA that helps remove ‘bad’ LDL cholesterol. Preliminary study results are showing that miRNAs may have other beneficial properties such as enhancing the activity of vitamins and combating flu.

**Food for Thought:** 41% of American 2-year-olds consume their daily vegetable calories from french fries—by comparison, U.S. babies get 48% of their vegetable calories from yellow, orange, and dark green vegetables.

**Bottom Line:** EAT YOUR VEGETABLES!!!!

**Taste Disturbances**

Many of us take our sense of taste for granted, but a taste disorder can have a negative effect on a person’s health and quality of life—according to the National Institute of Deafness and Other Communication Disorders (a division of the National Institutes of Health) more than 200,000 people visit a doctor each year for problems with their chemical senses including taste and smell.

There are actually three ‘chemosensory’ systems in the nose and mouth:

- The first—olfaction—is the ability to detect and identify odors.
- The second is gustation or taste—taste function is limited to detection and identification of sweet, sour, salty, savory and bitter substances in the mouth.
- The third sense is known as the ‘common chemical sense’.

The common chemical sense involves thousands of nerve endings located primarily on the moist surfaces of the eyes, nose, mouth, and throat.

These nerve endings give rise to sensations such as the coolness of mint and the burning or irritation of chili peppers—other specialized nerves give rise to the temperature sensations of heat, cold as well as textural sensations associated with ingested foods.

When food is ingested, the sensations from the five taste qualities and the sensations from the common chemical sense combine with a food’s aroma to produce a perception of flavor.

The terms ‘flavor’ and ‘taste’ are often confused.

Flavor is determined by the aroma (smell), taste (sweet, sour, salty, savory or bitter quality), texture, temperature and spiciness (or irritation) of food and beverages— all of these sensory experiences together form ‘flavor’. Frequently, when individuals say they cannot taste, they cannot appreciate the flavor of food—because aroma of food contributes to about 75% of its flavor, oftentimes the problem is a comprised olfactory sense.
The Taste and Smell Clinic at the University of Connecticut Health Center estimates that approximately 2 million adult Americans have a taste and/or smell disorder. Many people who think they have a taste disorder actually have a problem with smell because when foods are chewed, aromas are released that activate the sense of smell by way of a special channel that connects the roof of the throat to the nose.

‘We can detect around 10,000 odors but how we tell one from the other is still unknown’

If this channel is blocked, odors cannot reach sensory cells in the nose that are stimulated by smells and, as a result, much of the sense of flavor is lost and food tastes bland.

**Headliners:** Humans Can Sniff Out 10 Basic Scents, Scientists Say; Dr. Jason Castro; lead researcher and neuroscientist; Bates College (Maine); results appearing in PLOS ONE; 9/13; as reported by Melissa Pandika for the Los Angeles Times; AP story appearing in the Idaho Statesman.; 9/22/13

Researchers are trying to establish a classification system that is meant to be the olfactory equivalent of the five basic tastes.

Analyzing data from a 30-year-old database that profiled 144 odors—each odor was assessed by study participants who were given a list of 146 words to use in describing each odor.

By the end of the analysis, the researchers came up with a list of 10 odor categories: fragrant, woody/resinous, minty/peppermint, sweet, chemical, popcorn, lemon, fruity (non-citrus), pungent, and decayed.

The research team further found that the chemical structures of several odors in any given category were similar—making the possibility for utilizing this knowledge for developing devices that ‘sniff out’ cancer and other medical conditions.

Although taste and smell abnormalities are linked to many medical and dental conditions, most are caused by only a handful of disorders.

**Common Taste and Smell Disorders:**
- Anosmia (complete smell loss)
- Hyposmia (partial smell loss)
- Ageusia (complete taste loss)
- Hypogeusia (partial taste loss)
- Parosmia (smell distortion or phantom smell)****
- Dysgeusia (persistent abnormal taste)

**Common causes for a poor sense of smell or taste include:**
- Head injury
- Upper respiratory infections
- Polyps in the nose or sinuses
- Hormone problems
- Dental problems
- Dry mouth
- Radiation therapy to head or neck
- Tobacco smoking
- Prolonged exposure to chemicals
- Certain medications

Taste disorders can weaken or remove an early warning system that most of us take for granted—taste helps detect spoiled food or liquids and, for some people, the presence of ingredients to which they are allergic. When taste is impaired, a person may change his or her eating habits leading to malnutrition and weight gain/loss—using too much sugar or salt to improve flavor can be a problem for people with certain medical conditions such as diabetes or high blood pressure.

The lessened ability to taste and the associated harmful eating habits that accompany taste decline might actually exacerbate the effects of depression and anxiety.

Depression and anxiety can alter a person’s ability to taste—it has been shown that people who have mood disorders that are related to disturbances in serotonin and norepinephrine levels are significantly less able to taste all flavors (especially sweetness).

Loss of taste and smell can also be a sign of certain degenerative diseases of the nervous system such as Parkinson’s disease or Alzheimer’s disease.
To properly diagnose and assess taste loss, several evaluations must be performed including a physical examination of the ears, nose, and throat; a dental examination and assessment of oral hygiene (including a thorough health history review); and a taste test supervised by a health care professional.

**Treatment for Taste Disorders:**
Diagnosis by an otolaryngologist is important to identify and treat the underlying cause taste disturbances. If a certain medication is the determined to be the cause, stopping or changing the medicine may help eliminate the problem—consultation with a physician is warranted before ANY changes are made.
People with respiratory infections or allergies most often regain their sense of taste when these conditions are resolved.
Proper oral hygiene is important to regaining and maintaining a well-functioning sense of taste.

According to study investigators, after only two weeks of tongue cleaning, taste sensation significantly improved—Quirymen M et al; J Clin Periodontol 2004; 31: 506-510
Cleaning the tongue is a vital component to comprehensive oral hygiene care—both professionally as well as in the home setting.
Periodontal conditions, poor plaque control and unresolved caries can impact taste in a negative way.
Many types of taste disorders are curable—for those that are not, counseling is available to help people adjust to their problem.
Dysgeusia is sometimes accompanied by burning mouth syndrome.

**Burning Mouth Syndrome**
A bit of history: People have suffered from burning mouth syndrome since ancient times—historic writings have mentioned the condition, and the ancient Incas and Egyptians drew pictures depicting the syndrome.
Burning mouth syndrome is the medical term for chronic or recurrent burning in the mouth without an obvious cause—the discomfort may affect the tongue, gingiva, lips, inside of the cheeks, palatal tissue or widespread areas of the whole mouth.
‘Besides reporting oral burning, patients describe experiencing a dry, gritty feeling in the mouth, as well as alterations in taste. But because many health practitioners are not familiar with BMS and cannot see any physical symptoms, patients often leave the doctor’s office frustrated and untreated.’—Eugene Antenucci, DDS, FAGD; AGD Spokesperson.
The syndrome occurs in 1%-5% of the population—and like many uncommon, nonfatal diseases, research and awareness has been relatively limited.
Although BMS can affect anyone, it occurs most commonly in middle-aged or older women.
BMS often occurs with a range of medical and dental conditions, from nutritional deficiencies and menopause to dry mouth and allergies—but their connection is unclear, and the exact cause of burning mouth syndrome cannot always be identified with certainty.
Experts generally classify the cause of BMS as being either primary or secondary.

**Primary burning mouth syndrome**
- When no clinical or lab abnormalities can be identified, the condition is called primary or idiopathic burning mouth syndrome.

**Secondary burning mouth syndrome**
- Sometimes burning mouth syndrome is caused by an underlying medical condition—in these cases, it is called secondary burning mouth syndrome.
Some research suggests that primary burning mouth syndrome is related to problems with taste and sensory nerves of the peripheral or central nervous system.
‘[Although] the cause of BMS is currently unknown, ...our findings support the theory that this is a neuropathic condition. For reasons unknown, it seems that the BMS patient's nerves are not sending and/or processing information correctly, there's a short circuit in the nervous system and the brain can't turn off the pain receptors.’—Gary D. Klasser, DMD; speaking on behalf of the AGD.
Although BMS can affect both sexes, a study by the Academy of General Dentistry (5/7/11) confirms by a 7:1 ratio that women in their menopausal and post-menopausal years are more likely to be affected by BMS.
'Supertasters’—those people with a really high density of lingual taste buds—seem to be slightly more prone to BMS (possibly because all those extra taste receptors are surrounded by basket-like clusters of pain neurons that may fire up if the taste buds stop functioning—as often happens during menopause). Menopause seems to be a key player in this health issue—as a woman’s estrogen levels drop in pre-menopause, it fades from her saliva as well. It is of interest to note that 40% of menopausal women suffer from BMS which generally starts about 3 years before menopause and lasts as long as 12 years after.

**Underlying problems that may be linked to secondary burning mouth syndrome include:**

- Hormonal changes
- Xerostomia
- Nutritional deficiencies (specifically, iron, zinc, folate [vitamin B-9], thiamin [vitamin B-1], riboflavin [vitamin B-2], pyridoxine [vitamin B-6] and cobalamin [vitamin B-12])
- Acid reflux
- Dentures (stressing muscles and tissues, poor fit, or allergic reaction in surrounding tissues)
- Allergies or reactions to foods, food flavorings, food additives, fragrances, dyes or dental materials
- Anxiety and depression
- Certain medications (particularly ACE inhibitors)
- Oral candidiasis
- Lichen planus
- Geographic tongue (‘migratory glossitis’)
- Blood abnormalities (anemia, dyscrasias)
- Chronic infection
- Inflammatory disorders
- Tobacco use
- Oral cancer
- Oral habits, such as tongue thrusting, biting the tip of the tongue and bruxism
- Endocrine disorders (such as Type 2 diabetes or hypothyroidism)
- Excessive mouth irritation (which may result from overbrushing the tongue, using abrasive toothpastes, overusing mouthwashes or having too many acidic drinks)

Although no cure currently exists, health practitioners who have an understanding of the syndrome can help patients manage their symptoms.

**Treatment Options:**

- Palliative care includes:
- Sipping water or sucking on ice chips frequently
- Avoidance of irritating substances like hot, spicy foods; mouthwashes that contain alcohol; and products high in acid such as citrus fruits and juices
  - The BreathRx System products contain cetylpiridinium chloride, an antibacterial, and Zytex®, a special complex of thymol, eucalyptus oil, and zinc—and it is alcohol-free!
- Chewing sugarless gum
- Brushing teeth/dentures with baking soda and water
- Avoiding alcohol and tobacco products
- Nutritional supplementation

Research continues on possible beneficial therapy for BMS via Low Level Laser Therapy (LLLT). But while some of those with burning mouth syndrome may find relief from doctors’ treatments, others go without any real hope of a cure—and many sufferers of BMS feel abandoned by the health care community.

**Tasty Headliners**

**Headliners: Introducing the Tomato Independence Project**

The Treasure Valley Food Coalition sponsoring the Tomato Independence Project for 2013-2014 following their successful ‘Year of Idaho Food’ campaign in an effort to find a tangible way for people to participate in growing the local food economy in the Treasure Valley.
When researching what it will take to meet their goal of having 20% of food consumption be local by 2020, the TVFC found that the average American eats over 90 pounds of tomatoes per year—and that most folks would agree that nothing tastes better than a tomato fresh from the garden in the summer, and nothing worse than a rock hard tomato in January.

TVFC decided to make it their goal to have as many people as possible grow and/or eat local, fresh tomatoes in 2013 and partnered with local nurseries to provide ‘TIP kits’ to anyone who wants to participate—these kits contain things like seeds, growing instructions, the TIP logo, etc.

www.treasurevalleyfoodcoalition.org

Headliners: The Secret to Good Tomato Chemistry; Current Biology; as reported in ScienceDaily; 5/24/13; accessed on 1/29/13 at: www.sciencedaily.com/releases/2012/05/120524123015.htm

Researchers are reporting that they have figured out just what makes certain tomatoes taste so good and what makes some of them taste so bad.

Tomato flavor depends on sugars, acids, and a host of less well-defined aroma volatiles (vaporized particles that send scent molecules into the air).

The research team set out to identify the chemical profiles of 278 tomato samples representing 152 heirloom varieties.

Their efforts turned up an unexpectedly large chemical diversity within the heirloom tomatoes—with variation in some volatile contents of as much as 3,000-fold across the cultivars.

A sophisticated statistical analysis of the chemistry and taste test associated with the study showed that flavor intensity traced to 12 different compounds and sweetness to another 12 (including 8 that were also important for overall flavor).

The researchers also found that some flavor volatiles influence the perception of sweetness through the sense of smell—specifically, volatile chemicals unrelated to sugars make things taste sweeter.

Could it be that this feature might be played up in tomatoes and other foods to make us experience no-calorie sweetness through our noses instead of our tongues???

‘This is the first step in restoring good flavor in commercial tomatoes. Consumers care deeply about tomatoes. Their lack of flavor is a major focus of consumer dissatisfaction with modern agriculture. One could do worse than be known as the person who helped fix flavor.’—Harry Klee; University of Florida; lead researcher

Headliners: Tasteless Tomatoes: Redness vs. Flavor; appearing in the Idaho Statesman; 6/29/12

Plant scientists have discovered a gene mutation deliberately bred into many tomato varieties because it makes them uniformly scarlet when ripe.

An unintended consequence was discovered: The mutation also deactivates a gene that plays an important part in producing the sugar and aromas that are the essence of tomato flavor!

Headliners: Many Parents Believe That Letting Young Children Taste Alcohol Discourages Later Use; Jackson C et al; Archives of Pediatrics & Adolescent Medicine; 2012

One in four mothers believe that letting young children taste alcohol may discourage them from drinking in adolescence and 40% believe that NOT allowing them to taste alcohol will only make it more appealing—Christine Jackson, PhD; lead researcher; RTI International

The researchers found a strong association between parents who were in favor of allowing their children to taste alcohol and children’s reported alcohol use—according to the study, this finding is noteworthy because early introduction to alcohol is a primary risk factor for problem drinking during adolescence.

‘The younger a teen is when he starts drinking alcohol, the more likely he is to hit the bottle to relieve stress once he’s an adult…the likelihood significantly increases for those who start at age 14 or younger.’

Headliners: Use of Alcohol Before Age 21 Impairs Brain Development, Multiplies Chances of Addiction; As reported by the Idaho Office of Drug Policy; www.odp.Idaho.gov

Medical authorities agree that much critical brain development occurs between the ages of 12 and 21—if alcohol is being abused during this critical time, ‘brain wiring’ is affected.

Alcohol acts as a depressant which slows brain activity and hinders development—research has demonstrated that the part of the brain responsible for learning and memory can be 10% smaller in young drinkers.
'The adolescent brain is much more sensitive to alcohol toxicity than adults’, including being vulnerable to cell death. Adolescents showed much more frontal cortical damage than adults. We found that one high dose of alcohol caused significant loss of brain stem cells.’—Dr. Fulton Crews; director; Bowles Center for Alcohol Studies; University of North Carolina School of Medicine

Young people who do not drink cite disapproval by parents as the number one reason for abstinence—adolescents say parents have more influence on their lives than peers and surveys show that fewer children drink when parents keep track of where they are

**Headliners: Scientists Discover Protein Receptor for Carbonation Taste**; National Institute of Dental and Craniofacial Research and researchers at the Howard Hughes Medical Institute (University of California, San Diego); results appearing in Science; 10/09; accessed on 2/5/13 at: http://esciencenews.com/articles/2009/10/15

Researchers discovered that the taste of carbonation is initiated by an enzyme (‘carbonic anhydrase 4’) tethered like a small flag from the surface of sour-sensing cells in taste buds.

The enzyme interacts with the carbon dioxide in soda and activates the sour-sensing cells of the taste buds—this prompts a sensory message to be sent to the brain where carbonation is perceived as a familiar sensation.

‘When people drink soft drinks, they think that they are detecting the bubbles bursting on their tongue. But if you drink a carbonated drink in a pressure chamber, which prevents the bubbles from bursting, it turns out the sensation is actually the same. What people taste when they detect the fizz and tingle on their tongue is a combination of the activation of the taste receptor and the somatosensory cells. That’s what gives carbonation its characteristic sensation.’—Nicholas Ryba, PhD; senior study author; NIDCR scientist

The scientists are not sure if carbon dioxide detection itself serves an important role or is just a consequence of the CA-IV enzyme on the surface of sour cells where it may be located to help maintain pH balance in taste buds

**Final note on Taste:**
It is ALWAYS in good taste to be kind to one another and appreciate all the world has to offer—THANK YOU for sharing your day with me!!!