

# Tasty science

Exploring the  
Gastronomic  
dimensions of  
liking

Dr. Peter Klose

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Exploring the Gastronomic  
dimensions of liking

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Inaugural lecture delivered on accepting the post of Lector in Gastronomy in  
Foodservice at Zuyd University of Applied Sciences on Monday 25 November 2013.



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# Introduction



**Honourable members of the Executive Board of Zuyd, University of Applied Sciences and the Hotel school, academic colleagues, colleagues in hospitality, representatives of the press, dear family, ladies and gentlemen.**

It is a great pleasure for me to give this public lecture on a subject that unites us all: tasty foods and beverages. Especially here, today, in Maastricht, and at the Hotel Management School, where students are prepared for a future in Hospitality.

We are going to discuss 'tasty science'. I have chosen this topic because I think it contains elements that are likely to amaze you. Gastronomy is surprising. Ever since I became involved in research on taste and flavor in 1988, I have been astounded many times. The gastronomic world has many unsuspected dimensions which have been unveiled by a taking a different approach that has yielded completely new insights. And the good news is: we have just started.

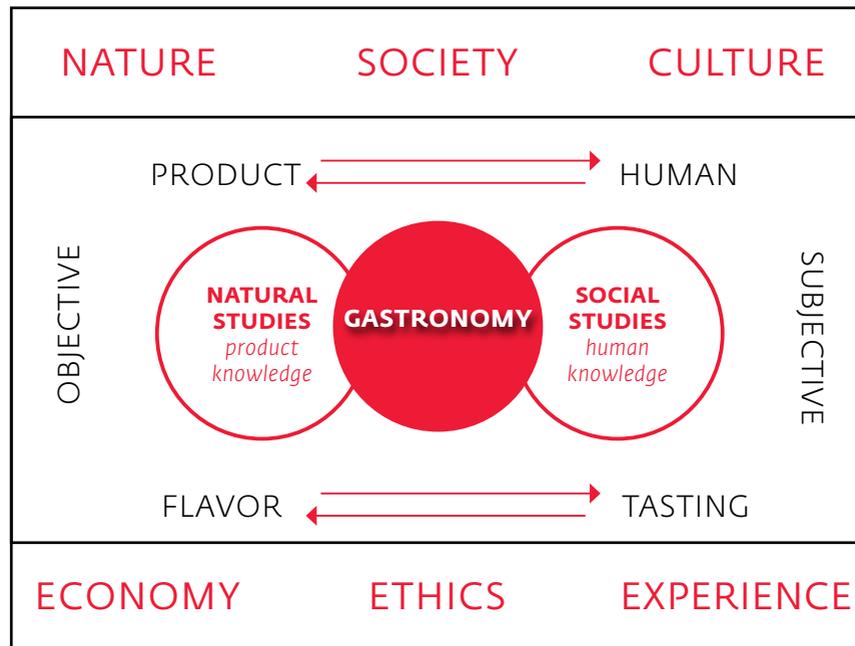
In this address, I will start with the new definition of Gastronomy and its mission. Next, I will give an overview of what we know of 'Tasty', supported by scientific evidence. I will conclude with the role and plans of the Gastronomy in Foodservice research centre at Hotel Management School Maastricht.





# 1 Defining Gastronomy

Gastronomy is defined as *the science of flavor and tasting*. Flavor is what edible products have and tasting is what people (not animals) do. Gastronomy focuses not solely on food and beverages and their composition, but on the human being that consume them as well. And, in doing so, gastronomy is especially interested in why this human being likes the things he eats or drinks. This requires that we know how we taste, which is complicated, because tasting is by definition subjective as it is the subject that tastes. Furthermore, we use all our senses to register flavor, and there are quite a few factors that may influence this registration, many of which have hardly been studied. This makes the study of gastronomy quite challenging and interesting. I dare say: gastronomy is a holistic concept and



I am aware that for some people this is a reason to stop reading or to take it seriously. That would be too bad, for the science of gastronomy has a lot to offer and may help to find answers to ancient questions that have not been found so far.

Understanding taste and flavor and how humans reacts to them is not merely a hedonistic exercise. Gastronomy relates to big societal issues such as nourishing the elderly and the food children eat at school – concerns that are certainly not trivial and hardly hedonistic. And in the hospitality industry, where people pay for their food and an accompanying beverage, it is highly functional to ascertain that people are going to enjoy what they bought. It is the basis of commercial success; but also outside of the traditional industry, gastronomy merits much more interest.





## 2 Gastronomy on the roll

*"It is inconceivable that gastronomy, before too many years, will not have its own academics, its professors, its yearly courses, and its contests for scholarships. First of all, a rich and zealous enthusiast must organize in his own home a series of periodical gatherings, where the best-trained theoreticians will meet with the finest practitioners, to discuss and penetrate the branches of alimentary science."<sup>1</sup>*

This quote is from the 'godfather of Gastronomy', Jean-Anthelme Brillat-Savarin, and taken from his book 'Physiologie du goût' which was published in – mind you – 1826. His prediction became reality, but it took quite a lot more time than he thought. Nevertheless, over the past couple of decades, it has happened after all. One of the first books that elucidated 'the branches of alimentary science' was Harold McGee's *On Food and Cooking: The Science and Lore of the Kitchen*. It was first published in 1984 and revised in 2004. I remember reading it like a novel; it kindled my interest in food science during the time when I had just started as a restaurateur. The epic work of Nathan Myhrvold and his team, *Modernist Cuisine: The Art and Science of Cooking*, appeared in 2011 and will undoubtedly be an inspiration for the generations of curious cooks to come.

I published my first (rudimentary, if you look at now) book on gastronomy in 1998.<sup>2</sup> My thesis<sup>3</sup> and consumer edition<sup>4</sup> date from 2004. Simultaneously, but unknowingly and independently, others started developing building stones for a new approach. A neuroscientist, Charles Zuker, challenged the assumption that taste cells were 'broadly tuned', meaning that cells carry sensors for all 'basic tastes.' He supposed instead that we had separate receptors for basic tastes and went looking for them.<sup>5</sup> In 2000, over 25 different bitter receptors were identified<sup>6</sup>, and in 2001, the sweet receptors.<sup>7</sup> The others followed. By 2010, the receptors for the traditional basic tastes were identified, including umami. Zuker's challenge triggered a whole new way of looking at cells and receptors and also led to the identification of 'new' basic tastes such as fat, calcium, carbonic acid, and metallic. Some of their receptors still have to be established, and there are likely more to come.<sup>8</sup>

Another neuroscientist, Gordon Shepherd, studies the neural signals to the brain. His book, *Neurogastronomy: How the Brain Creates Flavor and Why It Matters*, was published in 2012. Note that he uses the words flavor and gastronomy in his book title. It is important to understand how our brain functions, and how all the sensory signals that it receives when we eat or drink are bundled together to 'create' the perception flavor.

Not only in neurology progress was made. Carolyn Korsmeyer published her well documented philosophical work, *Making Sense of Taste*, in 1999. She convincingly argues that tasting merits more respect and attention and explains why – up to now – it has had to do without. In the meantime, great chefs discovered how science can help them make new and spectacular dishes. Ferran Adrià (restaurant: El Bulli, Rosas, Spain), Heston Blumenthal (restaurant: The Fat Duck, Bray, UK), and René Redzepi (restaurant: Noma, Copenhagen, Denmark), among others, are modern chefs that popularized new techniques that also brought them to the center stage of world gastronomy. Scientists such as Hervé This (Collège de France, Paris) have done their share in explaining what really happens in cooking. *The Kitchen as Laboratory: Reflections on the Science of Food and Cooking*, edited by César Vega, Jos Ubbink, and Erik van der Linden (2012) epitomizes the state of the art in what is called 'molecular gastronomy'. At Wageningen University in the Netherlands, a new master study – advanced molecular gastronomy – was introduced.

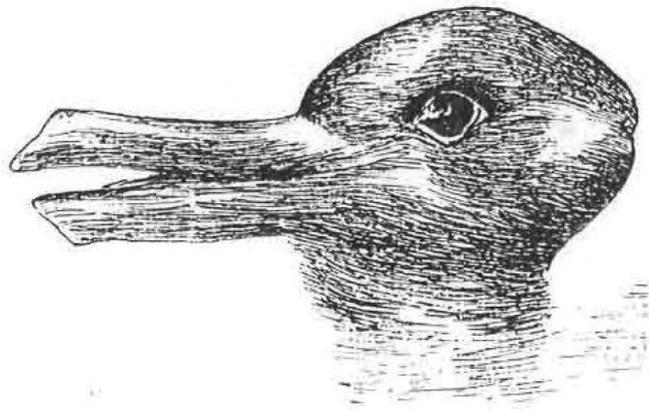
Within just a decade, flavor and tasting developed from being bit players in the world of science to actors that attract attention. When this all started, it seemed outlandish to presume that the esteemed journal *Nature* would publicize a supplement on flavor, yet it did so in 2012. That same year, Peter Barham and Per Møller published a dedicated online scientific magazine, *Flavour*<sup>9</sup>, to share all new findings. Gastronomy, the science of flavor and tasting, is on a roll.





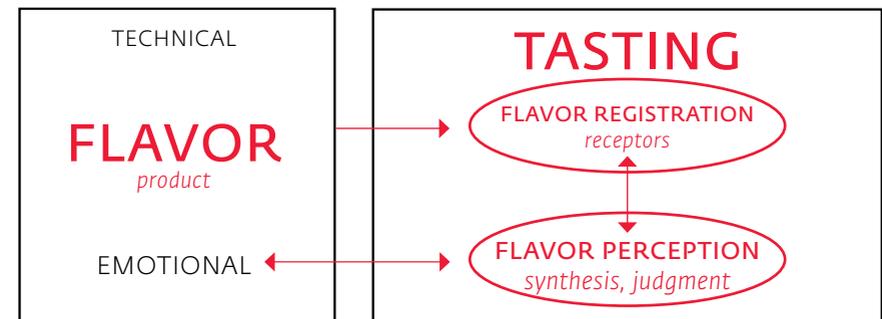
# 3 Different perspectives lead to new insights

In retrospect, the development of Gastronomy has taken place because paradigms were challenged. The word paradigm was first introduced by Thomas Kuhn in his influential book *The Structure of Scientific Revolutions*, first published in 1962<sup>10</sup>. Do you see a rabbit or a duck? In his book, Kuhn defied the notion that scientific progress was a process of 'development by accumulation' of accepted facts and theories. Instead, he argued that the discovery of 'anomalies' leads to a revolution in science and new paradigms. These question the old data, change existing views and set out the direction for new research. Paradigm shifts are a mix of enthusiasm, sociology and scientific promise, according to Kuhn. The development of Gastronomy as a science contains all the ingredients of a paradigm shift.



Both on the tasting and at the flavour side, existing theories were challenged and have partly already been abolished. Charles Zuker questioned if it was logical to assume that a cell could carry both sensors for sweet, signaling an energy-rich food, and bitter, which could warn of spoiled or toxic food. He considered that an anomaly and it started the quest for finding receptors in cells and (re-)thinking neural pathways.<sup>8</sup> The primary focus on the gustatory system in flavor could be considered another anomaly. It is the system that registers the basic tastes. Tasting is a multisensory experience which implies that a singular focus on one of the sensory systems will never yield comprehensive answers. Chefs and winemakers never used the basic tastes as a their guiding principle in understanding their goodies. And when we started our initial research to describe differences in the flavor of wines in 1988, the basic tastes rarely came up. What did come up were the concepts that we later baptized as the Universal Flavor Factors: Mouthfeel and Flavor Richness. These parameters have proven to be valuable descriptors of flavor as they are integrative concepts that include all sensory systems. The basic tastes are still there, but now from the perspective of how they contribute to Mouthfeel and Flavor Richness. The same needs to be done for all other elements of flavor. Moving away from the basic tastes is yet another good example of changing perspectives.

Another perspective in sensory research is shifting as well. The interest is moving from the receptor level to the brain. Receptors do 'just' what the word says: receive the information. Our senses register the flavor, but the information is processed and interpreted in the brain. The question is where, when and how these signals are synthesized to become the individual perception of flavor. Therefore, liking beauty and appreciation are functions of the brain, not of one of the senses. To put more emphasis on brain research when studying flavor is a part of the new paradigm. The illustration below shows the different elements of tasting. Note the two-way arrow between flavor registration and flavor perception and the product and flavor perception. Indeed, our brain is a powerful piece of machinery. We will discuss examples of how this works.



# 4 The mission of gastronomy: unveiling tasty



From the perspective of gastronomy, it is fascinating to explore how people perceive, desire, enjoy, or dislike, foods and beverages. Especially when the added value of foods and drinks is high, as happens to be the case in hospitality (hotels, restaurants, bars), it is essential to make food desirable. This is an important key to commercial success. Consequently, it is important in hospitality, and thus in gastronomy, to know more about the pleasure side of food. In our gastronomic mission to get a better understanding of tasty, the illustration above gives us three angles to look at: tasty on the product level, tasty at the registration level and tasty in the brain. We'll present interesting scientific findings and add that, although we have separate perspectives on tasty, the frontiers are somewhat blurred. After all, liking is, ultimately, the brain's monopoly.

## Tasty products: understanding flavor

Fundamental thinking on gastronomy on the flavor side started with an experiment focused on wine. A group of experts, supported by scientific researchers, met on a regular basis for tastings to describe the differences between wines. Gradually, it yielded all kinds of useful, practical information. It marked the beginning of an interesting period in which many different things started to become clear – a period of searching for fundamental answers, of testing an evolving theory and trying to validate it. This process had all the pitfalls and deceptions you might expect. We experienced how a beautiful, ripe, and voluptuous Corton Charlemagne of a good producer turned into a horrific acidic beverage when served with a spicy risotto and prawns. And also how another white Burgundy, too old and forgotten and by far not as exclusive as the Corton Charlemagne, magically turned into something great with a roast leg of lamb – completely unexpectedly. Based on what we experienced in wine and food pairing, we gradually started formulating and using new guidelines. It culminated in my thesis on flavor classification<sup>3</sup> that has led to a better understanding of flavor as a whole. It has proven to be useful in finding pleasant combinations of wines (and other beverages) and foods, and in helping to determine menu order or the composition of a

particular dish. It is fascinating to observe in daily practice that the chance of liking food or a beverage increases when the flavor theory is applied. Furthermore, the theory has been used to formulate the Culinary Success Factors. This was done by analyzing the signature dishes of the best chefs in the Netherlands. These principles of composition have not only been applied in restaurants, but also improved hospital meals in Denmark, much to the satisfaction of the patients.<sup>11</sup> Knowing about what flavor is, ultimately contributes to the satisfaction of the consumer by serving foods and beverages that are well made and go well together.

Indeed, tasty is not a coincidence. It can be enhanced by understanding flavor. It is beyond the scope of this address to include and stress the importance of technical skills. Where it concerns cooking, wine making, beer brewing, even making a cup of coffee or tea, it is all about understanding what you need to do to get at least a satisfactory result. Bad products are seldom liked.

## Tasty at the primary level: registration and synesthesia

All the human senses are involved in flavor perception. One sensory system can evoke effects in another system. The general word for this phenomenon is synesthesia, which is defined as an involuntary conscious sensation that is induced by a stimulus in another modality. Synesthesia-like, cross-modal effects are abundant in tasting and occur every time we eat or drink. They are likely to influence our perception of flavor, and therefore of tasty as well. We will mention some examples.

To start with, it is interesting to see how our sense of touch, which leads to mouthfeel in flavor, can have an impact on other flavor characteristics. Especially temperature has a strong influence on flavor perception. Melted ice cream tastes much sweeter than when cold, and warm beer tastes more bitter. In contrast, salty flavors seem to be enhanced at lower temperatures. This implies that foods and drinks have ideal temperatures. Cooling and irritating compounds are reported to have various effects on basic tastes as well.<sup>12</sup>

The importance of smell to flavor can hardly be underestimated. In general, the aroma of food can have a great influence on appreciation and palatability. The pleasing smell of freshly baked bread, just as that of baking cookies and cakes, roasting meat, coffee beans, or almonds is the result of the Maillard reaction – a complex chemical reaction that influences the color, flavor, texture, and nutritional value of foods. Its flavor component is sought after, for it is known to be generally liked and appetizing.<sup>13</sup> It is the reason that ovens are placed in the supermarket around where bread is on sale. Similarly, the sweetness and saltiness of foods can be enhanced by certain aroma compounds, which is good to know if a degree of sugar or salt reduction is desired.<sup>14</sup>





It is interesting to see how smell 'needs' other senses. We may have a hard time identifying a smell blindly; it gets much better when seeing the right color or with other sensory information. One study showed that smells that match the right color are perceived as being more intense than when in combination with another color. Good examples are lemon-yellow, strawberry-red, and caramel-brown.



Specific brain areas showed higher activity if odors were paired with the matching colors, implying (for example) that caramel has a stronger odor when seen with the color brown rather than with other colors.<sup>15,16</sup>



The effect of what we see in general is important. A well-known example is red colored yoghurt, which is perceived to be sweeter than plain white yoghurt. When this same red yoghurt is served in a black bowl, it tastes even sweeter. The contrast makes the red look redder and, consequently, the taste sweeter. Yoghurt was also judged to be more dense and expensive when it was eaten from a heavier bowl. These heavier bowls even made people feel fuller. Indeed, the plate can have an influence on the flavor of a dish. Food served on a star-shaped plate is perceived as bitterer than when served on a round plate. In general, presentation is important. Good-looking food will induce one to eat it, just as seeing people enjoy a certain food will do so. Just plain seeing foods and having foods at hand leads to an increased intake.<sup>17,18</sup>



Research involving colors gives a fascinating insight into the functioning of our brain. In a French study, a white wine was artificially colored red, and subsequently wine experts olfactorily described it as a red wine. Apparently, in seeing things, we open virtual drawers in our brain and start looking for answers.<sup>19</sup> And this influence goes even further. In a tasting of Riesling wines in a winery in Germany, the ambient lighting of the room was changed from white to blue, red, or green, while 200 wine buyers rated a certain wine. The wine itself was served in a black glass to prevent the influences of the color of the room upon the perceived color of the wine. Under blue and red light, the quality of the wine was rated significantly higher than under green or white light. People were even willing to pay 50% more for the wine tasted under red light compared to the same wine under green or white light. Further research revealed that blue and green room lighting made wines taste spicier and fruitier, while under red light, the wine was perceived wine to taste nearly 50% sweeter, which also suggests that people apparently want to pay more for sweetness in these wines.<sup>20</sup>

Other experiments show the influence of environmental sounds. Music in restaurants, for instance, may well prove to influence the flavor experience. A dish of bacon and eggs tasted more 'bacony' when listening to the sound of

sizzling bacon than to a farmyard of clucking chickens. People enjoyed eating oysters much more when hearing breaking waves than farmyard sounds. Heston Blumenthal's dish 'the sound of the sea' (served with an I-pod with the appropriate sound) is a good example of how this knowledge can be set to use.<sup>21</sup>

### Tasty and the brain: the creation of flavor perception

The brain is the place where all sensory information comes together; the processing takes place, conclusions are drawn, and actions are initiated. And, as stated before, the role of the brain is attracting more interest. This is mainly the result of the invention of functional magnetic resonance imaging in 1991. fMRI is based on imaging blood flows in the brain. More blood goes to the areas that work hardest. The scans reveal bright splotches of neural activity inside people's heads as they engage in different tests of their capacity to see, feel, remember or taste. Even though this spectacular new invention enables all kinds of new types of research, and much progress has been made, difficulties in understanding why we like something will remain. This has to do with culture and cognition, for instance. Take proteins. Our body needs them, but many Western people object when these proteins originate in a worm, maggot, dog, or a snake; Indian people revolt at the idea of eating a sacred cow, and Anglo-Saxon people feel so about their beloved horse. This demonstrates that even aspects that have little to do with actual flavor may indeed influence liking. The brain does not only synthesize all the sensory information it gets, it also connects it to beliefs, previous experiences and to expectancy.

Flavor, tasting, and language have an intimate relationship. After all, we need words to express ourselves. The flavor experience in the brain needs to be labeled with words which requires learning and grows with experience. These words in turn are often loaded with personal beliefs and therefore they create a certain expectancy. What happens when words are used that are in marked contrast to the actual flavor characteristics? In an experiment, smoked salmon ice cream was used to test this. First, it was named what it factually was: ice cream. In the test, it was strongly disliked. Apparently, people expect ice cream to be sweet and fruity. When it was labeled as a frozen savory mousse, it was accepted. This shows the power of words and the importance of using the right words in the right context. There was another result as well: under the ice cream condition, it was also rated as being more salty than when labeled as a savory food.<sup>22</sup>

Flavors are also related to expectancy in another respect. The odor of a cheese can, for instance, be accepted in relation to the cheese but not when it is taken out of context. This was tested with isovaleric acid. In several trials, it was





alternatively labeled as cheddar cheese and body odor. When the odor was presented as body odor in combination with cheddar cheese, it was rated as significantly more unpleasant than when labeled cheddar cheese. The implication is that cognitive factors can have profound effects on our liking foods.<sup>23</sup>



These findings have important implications for gastronomy professionals. Preparing a perfect meal or serving the best wine is not enough. Flavor needs to be explained and presented to the customer in comprehensible words and



without raising false expectations. This supports the hypothesis that people in service need to be very well trained and in close contact with the products that they serve. Furthermore, it is wise to pay attention to how dishes are described



on the menu.

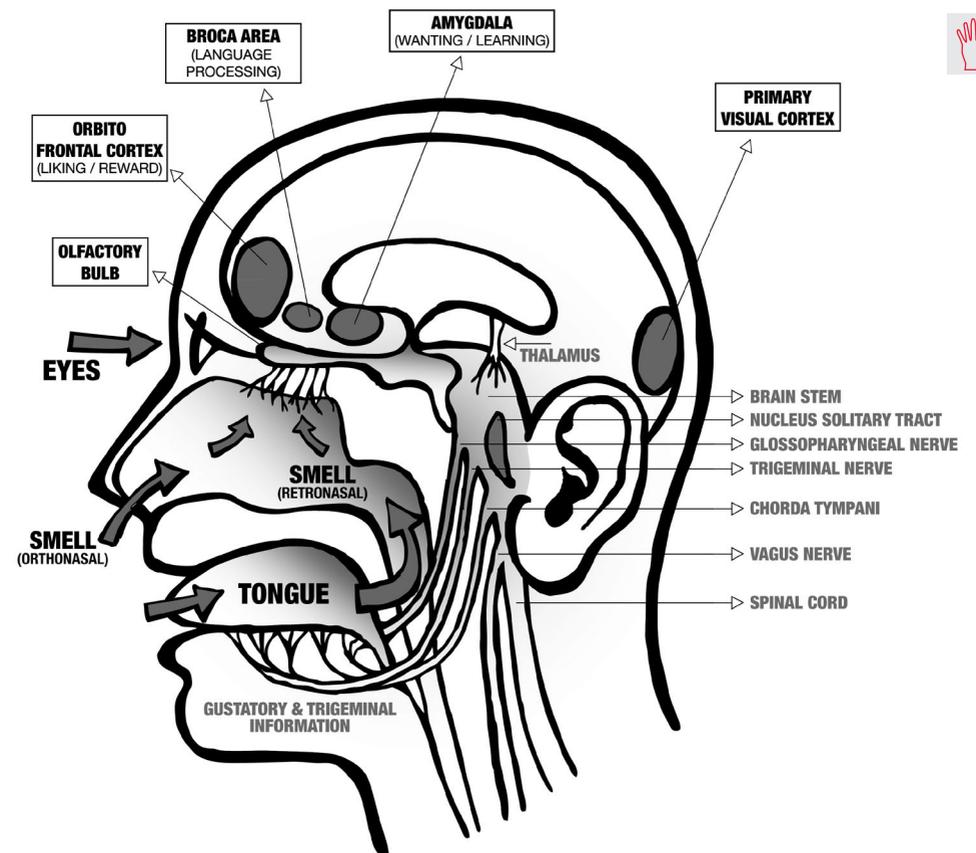


# 5 Wanting and Liking

It is tempting to delve much deeper in the brain, but modesty is required. The human brain is a huge machine with billions of neurons interacting via electrical and biochemical signals. Therefore, it is impossible to grasp its complexity, certainly with respect to the scope of this address. However, one crucial aspect related to tasting needs to be mentioned here, as it is fundamentally related to tasty.

In our brain, there are two distinct areas that process flavor information. They represent different motives for eating. The first brain area is operated by our biological system and monitors constantly what is needed, such as salts and other minerals, fats for energy and specific fatty acids, certain proteins with specific amino acids, vitamins, etc. After all, the first and principal reason for eating and drinking is a biological one: food is fuel and building materials which are needed to keep our system intact and going, in terms of energy and quality. This is done by the amygdala. It is interesting to note that this system is organized to like what we need. It is epitomized in sayings like 'hunger is the best spice'.

The other brain area that is involved in the reconstruction of flavor is the orbito-frontal cortex. Its functioning and orientation is quite different: it is the part of the brain where pleasure or reward is created. The level of pleasure is associated with the release of dopamine. In neurobiology, this neurotransmitter is widely recognized as being critical in our behavior, and involved in addiction. Over the past 50 years, a lot has changed in the world of food: it has become abundant and basically safe in the Western world. We are generally in a state of good health, abundance, and prosperity, and our interest has moved to the pleasure side of food. We eat for fun and share with friends. If there is a choice, why not choose the foods and drinks that we enjoy the most? Consequently, palatability has become more important and, with it, aesthetic values, cognition, and experience. In conjunction, new problems associated with food intake have arisen. How to control the pleasure side of food and drinks?<sup>24</sup>



# 6 The future of gastronomy

Gastronomy is a versatile science. Its natural habitat is the world of hospitality; it is even at the heart of it. If the management of hospitality organizations is discussed, it is mostly about numbers: costs, percentages, turnover, revenue, budgets, targets, and so forth. It would be silly to deny that numbers are important, but we should never forget that it is people that are at the base of it all. People who often have a choice, who want to enjoy themselves, mark an occasion, meet friends, have fun, want to be amazed, or just have a decent meal, snack, sip, or bite. It is good to know about a lot about the people side of the business. Satisfied customers are likely to want to come back and that is the best guarantee for the future of a hospitality organization.

The focus on satisfied customers makes that gastronomy is strongly related to management. It is not – or rather should not be seen as – a fun class in the curriculum. In this lecture I have introduced many examples of influences that a hospitality professional should know about in order to ensure the quality of the experience.

Hotel Management School Maastricht wants to excel in Gastronomy. The main mission of a lectorate at a University of Applied Sciences is to initiate and coordinate research in its field. The results should be applicable in daily practice.

Besides being beneficial to the trade, the educational programs and the teaching staff should also profit from the research that is done.

To meet these objectives, the Gastronomy Research Center has formulated four foci of interest. The fields are both interrelated and related to other research centers, both internally and externally. They are mentioned below.

1. **Gastronomy – Hospitality mission:** initiating research that gives better insights in the factors that influence appreciation of foods and beverages
2. **Gastronomy – Sustainability mission:** contributing to research that involves the future of (organic) food in hospitality and health care

3. **Gastronomy – Local food | tourism | economy mission:** strengthening the position of local foods both with an eye to production and use on a regional and a national level
4. **Gastronomy – Health | healthy ageing mission:** show that tasty food will result in lower health care costs

## RESEARCH LINES IN GASTRONOMY



The first three areas mentioned are more or less to be expected. Traditionally, gastronomy and health are not considered to be natural partners. Under the current definition, however, the two concepts are much closer. What we eat or do not eat has a profound effect on our health and well-being. It is like Hippocrates already said 2300 years ago: *let food be thy medicine and medicine thy food*. With all the progress that has been realized in health care, it seems as if we have lost view of that notion. We think that we need pills to solve our medical problems.

The science of Gastronomy takes a different perspective and wants to investigate, support and promote the use of whole foods. If food choices are at the basis of health problems, food should not be neglected in finding solutions for these problems. The aspirations of Gastronomy are ambitious and clearly need the strong support of the School and other institutions with their enthusiastic coworkers and students. We have set out on a long, fascinating and tasty journey that will hopefully inspire many people.

Peter Klosse,  
25 November 2013

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