“Quality” is an elusive term, especially in regard to food, which we judge by rather complex criteria. Quality encompasses, but is not limited to, taste, since other considerations also come into play. In some contexts, nutritional benefits can be used to evaluate quality, but as we well know, nutritive value does not always coincide with taste. Furthermore, the notion of “quality” has a history. The term has been used differently by different groups, notably by consumers and food scientists, which leads us to ask whether the notion of quality might, in fact, exist independently for these two groups. If it does, should we assume that food scientists take little interest in what consumers have to say, and vice versa? If consumers were to disregard the conclusions of food scientists, could food scientists justify their pursuit of quality in food? Can a consensus about the meaning of “quality” ever be reached between these two groups who are so seemingly at odds? This article explores the history and nature of research in food science and suggests that the needs of consumers and scientists are not as divergent as they may appear.

Food Safety and Taste

Consider the work that food scientists do. The simplest way to understand their principal concerns is to analyze scientific databases. A quick survey of Current Contents for 2001, using “Food” as the keyword, reveals that most of the research in food science today deals with microbiology and food safety standards. These fields represent 84 percent of the articles surveyed; another 14 percent deal with food texture, a criterion used not only by food scientists but also by consumers. Gastronomy and food appreciation represent only 2 percent of the articles. For the most part, the methods used to evaluate taste in these studies are classic tests of sensory analysis and therefore differ from the notion of quality as consumers generally understand it.1 This brief overview of the literature suggests that consumer appreciation is not a subject that greatly preoccupies food scientists; on the contrary, it appears that food scientists generally consider food as raw material for research disconnected from any social purpose—disconnected, in fact, from human use.

On March 15, 2001, France celebrated a “Day of Consumer Rights,” one of many celebrations sponsored throughout Europe by the European Association for the Coordination of Consumer Representation in Standardization (ANEC).2 As part of the celebration, the Centre de Recherche pour l’Etude et l’Observation des Conditions de Vie (CREDOC) conducted a poll on the public perception of food quality and the criteria used to evaluate it.3 The poll revealed that for the French public, the main criteria of quality are taste and pleasure, a result that would not be at all surprising had the poll not taken place just when the bovine spongiform encephalitis (BSE) crisis was at its height, and shortly after a number of alerts had been issued regarding the contamination of food by Listeria and Salmonella bacteria. Despite these circumstances, French consumers put food safety in third place, after taste and pleasure. It is not clear whether the respondents were simply unaware of food safety issues or whether they had such confidence in the public health authorities that they hardly associated quality with food safety. In any case, the French consumer’s primary consideration in judging the quality of food is taste.

A comparison of the scientific literature from 2001 with the results of the food quality poll from the same year highlights the striking difference between the perspectives of food scientists and consumers. The former think first of safety; the latter seek enjoyment. Yet this has not always been the case.

The Beginnings of Food Science

Food science was originally more concerned with sensory perception than with food safety. The field emerged only when a large part of the Western European population was able to take an interest in food for reasons other than sheer survival, that is, when the urban bourgeoisie began to develop during the eighteenth century. It was then that an interest in science began to manifest itself and that food...
became more diversified. As early as 1750, the great botanist Carl Linnaeus defined twelve descriptors of taste in his *Systema Naturae*: moist, dry, acidic, bitter, fatty, astringent, sweet, sour, slimy, salty, harsh, and piquant. Some years later, in 1775, Polycarpe Poncelet described, for the first time, the chemistry of taste in his *Chimie du goût et de l’odorat*. From then on, the study of taste became a legitimate scientific pursuit; it formed the basis of what would eventually become the field of food science.

In its original incarnation, food science really came into its own at the beginning of the nineteenth century with the writings of Alexandre Grimod de la Reynière and Jean-Anthelme Brillat-Savarin. These two thinkers brought cooking and food into the modern world through their seminal works, *Le Manuel des amphytrions* (1808) and *La Physiologie du goût* (1826). No longer would people be content to eat for nourishment alone—they would now also expect satisfaction from a meal. In other words, taste was tantamount to appreciation. As an influential restaurant critic, Grimod regarded gastronomy as the highest and first among the sciences; his “science,” however, was a purely sensory affair and not in the least bit analytical. In retrospect, Grimod, with his innovative gatherings of gastronomes and cooks, may be seen as a pioneer in the sensory analysis of food. By contrast, Brillat-Savarin did not hesitate to try to analyze food scientifically, even though his conclusions were often erroneous, or only rough approximations. For example, he considered “osmazome” a constituent of meat, which proved to be wrong; even more uncomfortably for modern readers, he linked the consumption of rice with a weakening of the races that relied on it. But to be fair, the techniques of chemical analysis necessary for what Brillat was trying to do had not yet been invented. On the other hand, he did note the importance of retro-olfaction in food testing and wrote convincingly about the connections between food quality and health. He eventually gave up the idea of writing the first treatise on food chemistry and produced instead his famous meditation on the social, historical, scientific, and philosophical aspects of food, a work embellished not only by recipes but also by all sorts of advice concerning nutrition and food preparation. Because of Brillat’s genuine interest in cooking, we may regard him as an early practitioner of what is today known as molecular gastronomy.

**The Nineteenth Century**

The nineteenth century saw formidable developments in both chemistry and biology, including the invention of organic chemistry in 1820 by Michel Eugène Chevreul, the invention of biochemistry in 1833, and the discovery of proteins (1838), glucose metabolism (1854, by Claude Bernard), and protein metabolism (1862, by Carl Viot). The first in-vitro fermentation of alcohol was achieved in 1896. These and other analyses represented the work of a new generation of professional scientists, which replaced the earlier investigations of enlightened amateurs. Now approximation was no longer sufficient; precision was expected. Thus, in 1824, Chevreul reduced the number of tastes from Linnaeus’s twelve to only four: sweet, sour, salty, bitter. He also determined the principal biochemical constituents of food. However, his influence on the development of food science was initially negligible, since all of his work with food was subsumed under his major discoveries in chemistry.

By the first quarter of the nineteenth century, the different schools of thought—traditional home cooking, innovative cuisine from professional chefs, and the scientific analysis of food—diverged not only in theory, but in the kitchen as well. Gastronomy would, for the next century, be dominated by Antonin Carême and his monumentally doctrinaire cuisine. Under Carême, cuisine was professionalized, rather than being perceived primarily as pleasure for the passionate gastronome. Carême sought to codify French cuisine, and under his influence culinary professionals invaded the kitchen, chasing away the scholars and amateurs who had previously concerned themselves with food. However, although a scholarly approach to food was absent from the professional kitchen, it continued in laboratories and in some home kitchens; it is at this juncture that the paths of food science and the emergent industrial cuisine diverged. Where food science had grown out of the scholarly contemplation of cuisine, industrialized cuisine resulted from the exigencies of the professional kitchen, and while Carême’s grandiloquent cuisine concerned itself with aesthetics, food researchers retreated to nutrition. In both cases, the consumer was left somewhat stranded at the wayside, unable to follow so many new developments.

In the late nineteenth century, under industrialization, the approach to food science as a sensory pursuit was largely abandoned in favor of purely scientific method, particularly in regard to the development of the food industry. No longer were people nourished by products from neighboring fields and gardens, or even by food at the village tavern; rather, edible goods were now fabricated in factories created

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precisely to sever the connection between food and local environment. The main issues became food preservation and transportation. While techniques for preserving food had existed for many centuries (salting and drying, for instance), industrialization created the need for standardized appearance and taste. As early as 1809 Nicolas Appert had perfected a method for sterile canning; in 1865 another Frenchman, Louis Pasteur, demonstrated that bacteria could be destroyed by heating milk to a high temperature. The very end of the nineteenth century saw the use of the first chemical preservatives, and from these laboratory experiments modern food science was born; it can be seen as a union of industry and professional cookery whereby natural products undergo manufacture. Consumer taste consequently became secondary to the primary requirement of offering exactly the same kind of food everywhere, and with the spread of industry, this attitude came to predominate. The food shortages that occurred in the wake of the great upheavals of the first half of the twentieth century similarly served to privilege industry over consumer taste. For instance, in the United States during the Great Depression, the food industry drastically lowered food prices in order to make food more widely available, all the while keeping its own interests at heart. In 1941, with Europe devastated by war, Nestlé turned to other markets in South America and the United States, with the result that it could get back on its feet as early as 1947, when food was still rationed throughout most of Europe. Feeding people became the primary task; taste was less of an issue. The result of such corporate practices was that industry came to dictate the acceptable quality of food, based largely on the formula of large quantities at low prices. Only towards the end of the twentieth century did food science intervene in the form of a discussion about nutrition; by that time, however, consumer preferences in taste had long been forgotten.

The Twentieth Century

Food science did not evolve toward functionalism without eliciting strong reactions, the liveliest of which came from a surprising quarter: the Italian avant-garde movement of Futurism. Filippo Tommaso Marinetti’s _Futurist Manifesto_ of 1909 defended the absolute primacy of the aesthetic over all other values, and in his Futurist cookbook, _Cucina futurista_ (1932), Marinetti denied that food had any nutritional value whatsoever. Nutrition, he felt, should be taken care of by chemistry in the form of pills and powders, while food should serve only aesthetic or symbolic functions. Marinetti considered the perfect meal one in which the table setting and atmosphere harmonize with the tastes and colors of the food. Utterly original dishes should be combined with elements like music and perfume to enable the diner to have a complete sensory experience.7 Proclaiming that food is art, Futurism refuted the notion of functional gastronomy that had arisen with Carême and that still existed in the early twentieth century. The Futurists argued for new relationships among tastes, smells, sounds, and other sensory perceptions, such as the creation of shadows in the dining room to suggest the complementarity between lighting and the taste of a dish. Marinetti further proposed a lexicon of new terms to describe food, introducing such concepts as “cobruit” or concomitant sound—the affinity between a particular sound and a taste.

The Futurist attempt to revolutionize gastronomy was, however, constrained and ultimately destroyed by the political bent of its promoters, who leaned more and more toward Fascism. Nevertheless, the Futurist approach to food marked an effort to return to the original values of food science as a means of understanding the physiological nature of taste and a way of appreciating its sensual side. The Futurist project was the last systematic attempt to reorient food science strictly toward the enjoyment of food; the work of food scientists in the second half of the twentieth century supported the primacy of science over consumer desire.

Sensory Evaluation

Methods for the sensory evaluation of food were developed at the end of the 1950s and furthered through the work of RoseMarie Pangborn at the University of California, Davis, and Félix Deplay in France. Over a hundred years earlier Brillat-Savarin had proposed a similar type of analysis in his theories of “gastronomic samples” (_les éprouvettes gastronomiques_), which he imagined would bring him fame (they have been largely forgotten). The basic principle underlying sensory evaluation is simple: Because the best sensory tool of all is the human being, humans should be reintegrated into the scientific chain of analysis. This approach represents a kind of posthumous victory for early food scientists like Brillat-Savarin and Grimod.

Unfortunately, early advocates of sensory evaluation considered an obstacle the precise human characteristic that should (and could) be used in evaluation, namely the ability to integrate information gathered from several senses into an overall impression. In order to serve as analytical machines, people would have to dissociate the olfactory from the gustatory sense. Thus the choice was made to destroy a complex “machine” in order to use only a few of...
its parts. Only thirty years later would theories of complexity (the reintegration of these parts) appear as part of the renewed debate about whether human beings can be used as analytical “machines” for evaluating the overall quality of a given food. Caught in a Cartesian desire to dissect the senses, to break the whole into parts and examine each one separately, food science missed an important opportunity for reconciliation with the consumer.

Late-Twentieth-Century Developments

By the end of the twentieth century, practitioners of food science were once again questioning the basic premises of the field. Scientists studying food texture were having difficulty defining and elaborating the methods and analytical tools necessary to obtain useful results. It soon became apparent that successful evaluation required consumer input, since “quality” is a multifaceted entity that cannot be usefully broken down into discrete components. A number of scientists, led, notably, by Alina Szczesniak (who developed the now-standard Sensory Texture Profile), tried to bring the consumer to center stage.\(^8\) However, even though the study of food texture is currently alive and well, it has not yielded as extensive an understanding as had been hoped and thus remains rather marginal within the field of food science.

Another branch of food science, molecular gastronomy, arose in 1988,\(^9\) marking the first recognition, for modern food science, of the centrality of taste. Yet, unfortunately, even today taste is not considered the starting point, but rather the end result, of the chemical properties of food. In practice, molecular gastronomy attempts to link chemistry to culinary science, to explain transformations that occur during cooking, and to improve culinary methods through a better understanding of the underlying chemical composition of food. Nevertheless, because molecular gastronomy is still a developing field, we do not yet know whether it will one day yield a better conception of food quality as the consumer defines it—a conception in which scientific and non-scientific notions coincide.

Scientific Measurement

This brief overview of how the notion of quality has evolved during the past two centuries suggests that food science will not take the consumer’s viewpoint into account any time soon. The amount of work done in the last decade to guarantee the safety of food—work from which the notion of taste was entirely absent—obscures both the ability and the desire of food scientists to integrate the consumer into the food chain. However, there are indications from such fields as molecular gastronomy and psychorheology\(^10\) that quality is an ongoing concern. For one thing, commercial competition within the food industry means that quality is an important issue. By now, the microbiological, hygienic, and nutritive qualities of industrial products have been assured or, at the very least, standardized. Consequently, taste is the element now used to attract the consumer to a particular product and to distinguish that product from others. Taste has finally come into its own as an object of commercial interest.

Secondly, we now have a better understanding of the complex nature of taste and the appreciation of food. For a long time, finding a model for taste was considered a simple task: fruit should be sweet; meat should be tender; and so on. Current theory, which is becoming more and more acceptable in professional circles, holds that although quality has myriad aspects, it requires an overall assessment, one that encompasses texture, odor, and taste in addition to other characteristics. This theory would not be workable if the experimental methods for evaluating food quality had themselves not undergone an evolution. Today it is generally recognized that laboratory taste sensors do not have to be very specific, as, for example, neurological receptors must be. However, they must be exquisitely sensitive. This realization has led to the development of sophisticated new tools and methods for analyzing data, which can now be used to characterize taste more accurately and to construct models of the human senses.

A detailed description of the analytical tools now being developed is beyond the scope of this article, but briefly, they include

- the electronic nose and the electronic tongue, which mimic a human response to the flavor and taste of a given food;
- images that clarify the connection between the macroscopic aspects of food and their microscopic components;
- spectral analysis, which can be applied to measuring taste as well as to the sounds emitted by particular products when eaten, such as crunch, crackle, and so on;
- multidimensional statistics that make it possible to combine the results obtained.\(^{11}\)

Although these methods require lengthy and involved analyses, they yield results that are very close to the preferences expressed by consumers. Thus it proves possible to characterize food scientifically and still obtain results that closely resemble human responses.
The Variety of Tastes

At last food quality can be scientifically evaluated as it would be by a human subject. This innovation is still quite recent: the electronic tongue has existed for only five years—a very short time in scientific terms—which leads us to wonder what use scientists will make of this apparatus in the future. As noted above, the results of the new studies are first subjected to statistical analysis and then compared with results obtained with humans. But as soon as statistical analysis is used, the problem of sampling arises. How will the human subjects be chosen, and how broad a spectrum of people will be considered? Individual food choices are extremely diverse, particularly in terms of local culture. The value of the new methodology lies in the extent to which it can identify foods that satisfy the consumer. From the point of view of taste, there is no “average” person; rather, many individuals must be considered. Furthermore, mechanical analyses are intensive and hence quite costly, so they are not likely to be used by local or regional food industries. The multinational food corporations should take into consideration the diversity of human tastes and create new products adapted to culturally diverse populations. But the question remains whether the corporations are ready to diversify their products to this degree and thereby risk their profit margin, only in order to satisfy the consumer.

Clearly, even though quality can now be measured scientifically, there is no guarantee that the consumer’s notion of quality will be considered in the future. The problem is simply resituating itself, moving from a position of scientific concern to one of commercial interest. Will it take as long for industry to pay attention to quality as it once did to awaken food scientists to what consumers want?

NOTES

1. Classic tests are most often discriminative; that is, of two products offered, the panel must choose which one it prefers. Although this type of test is called “hedonic,” it has no connection with the notion of pleasure as understood by the consumer.

2. ANEC is headquartered in Brussels. For more information see www.anec.org.


6. Nestlé was created in 1866, the Lever Company (which eventually became Unilever) in 1885, and the Sanitas Nut Food Company, which ultimately gave rise to Kellogg’s, in 1894.


9. See Nicholas Kurti, But the Crackling Is Superb (Bristol, UK: Institute of Physics Publishing, 1997), and Hervé This, Casseroles et émouvelles (Berlin and Paris: Pour la science, 2002).

10. Psychorheology is the relationship between consumer preferences and the rheological properties of food, i.e., their texture in terms of viscosity or thickness (the resistance to flow).