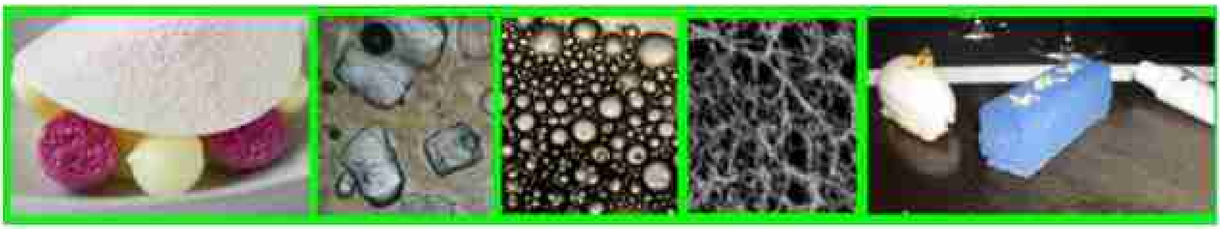
Science, technology, engineering and technique.

Hervé This, Vo Kientza



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Opinion

Science, technology, engineering and technique

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Abstract

The analysis of the articles published by a journal of "food science and technology" demonstrates that there is indeed very few science in this journal, and a lot of food technology.

Keywords

science, technology, engineering, technique, food, ingredients, molecular and physical gastronomy

Introduction

There has always been a confusion between science, technology, engineering and technique, so much so that the French biologist Louis Pasteur deplored it, with phrases of terrible energy such as "No, thousand times no, there cannot exist a category of sciences to which the name "applied sciences" can be given; there are rather sciences on the one hand, and applications of sciences on the other" (Pasteur, 1871). This observation is important as molecular and physical gastronomy is concerned, as it was introduced not as a technological activity, but rather as a science of nature ("investigating phenomena occurring during the transformation of food ingredients into food, in order to discover new objects, reactions, mechanisms") (This, 2009a; This vo Kientza *et al.*, 2021).

Of course, there are many applications of molecular and physical gastronomy, such as molecular cooking, synthetic cooking, various new food preparations, but also educational activities based on it: this is reflected in the internet site of the *International Journal of Molecular and Physical Gastronomy* (Editorial Board, 2024). However these applications are not molecular and physical gastronomy, but rather applications of molecular and physical gastronomy.

Because opportunities for discoveries are lost when scientific activity is insufficient, the main goal of this article to better define the boundaries

Figure 1. After alchemy gave birth to "chymie", Antoine Laurent de Lavoisier (1743-1794) finished making chemistry a science of nature. He clearly made the difference between science and technology, in particular during studies of meat stock.

of the fields of science, technology, engineering and technique. The nature and methodology of sciences of nature is discussed, before analysing the first articles of an issue of the journal *Food Chemistry*, whose title would indicate that it is a journal of food science, but that considers also the effects of processing (Food Chemistry, 2024).

About these articles (Food Chemistry, 2019), comments are given in order to better reveal the differences between science, technology engineering and technique. The analysis of the full table of content is not made, because it would be tedious, but the readers are invited to make their own judgment with the other titles, given in an annex of this article. As a whole, it will be observed that there is much more food technology than food science in the "scientific journal" examined, and this is a new demonstration that the *International Journal of Molecular and Physical Gastronomy* is important, as it is a place where scientific manuscripts can be submitted.

This analysis is performed in view of generating new scientific studies, in order to fill in the many gaps that are easy to observe in our current scientific knowledge. For example, although there are more than 7 000 articles displayed by the *Web of Science* with the keywords "tea" and "*Camellia sinensis*", no one (to our best knowledge) discusses how (mechanisms) the compounds of interest (odorant, taste, trigeminal, etc.) move from the leaves to the beverage. Or although the making of aqueous solutions by thermally treating the roots of carrots (*Daucus carota* L.), i.e. "carrots stocks", was much studied (Cazor *et al.*, 2006), the migration of solutes from the roots to the solution remains unknown.

Making the difference between science and other related activities is less being "purist" than being precise, and already in the 18th century the

French chemist Antoine Laurent de Lavoisier observed that using the right words is important for sound scientific activity:

"*When I began the following Work, my only object was to extend and explain more fully the Memoir which I read at the public meeting of the Academy of Sciences in the month of April 1787, on the necessity of reforming and completing the Nomenclature of Chemistry. While engaged in this employment, I perceived, better than I had ever done before, the justice of the following maxims of the Abbé de Condillac, in his System of Logic, and some other of his works. We think only through the medium of words. Languages are true analytical methods. Algebra, which is adapted to its purpose in every species of expression, in the most simple, most exact, and best manner possible, is at the same time a language and an analytical method. The art of reasoning is nothing more than a language well arranged. Thus, while I thought myself employed only in forming a Nomenclature, and while I proposed to myself nothing more than to improve the chemical language, my work transformed itself by degrees, without my being able to prevent it, into a treatise upon the Elements of Chemistry.*

The impossibility of separating the nomenclature of a science from the science itself, is owing to this, that every branch of physical science must consist of three things; the series of facts which are the objects of the science, the ideas which represent these facts, and the words by which these ideas are expressed. Like three impressions of the same seal, the word ought to produce the idea, and the idea to be a picture of the fact. And, as ideas are preserved and communicated by means of words, it necessarily follows that we cannot improve the language of any science without at the same time improving the science itself; neither can we, on the other hand, improve a science, without improving the language or nomenclature which belongs to it. However certain the facts of any science may be, and, however just the ideas we may have formed of these facts, we can only communicate false impressions to others, while we want words by which these may be properly expressed." (Lavoisier, 2019).

Figure 2. Claude Bernard (1813-1878) was the one would could clearly understand that medicine is a "technique", clinical research a technology, and physiology is the science behind both.

This being said, it is important to observe that in what follows, no hierarchy and no value judgments are made between the four kinds of activities that we consider, because having different goals and different methods, they cannot be compared, and even they benefit better from each other when correctly defined, and contribute differently to the human production. Also the analysis done here remains as factual as possible, and the proposed assertions (ideas, rather than opinions) are justified with references to publications recognized as important by the intellectual community.

In principle, the difference between sciences of nature, technology and technique is clear (Galilei, 1610). On the one hand, the sciences of nature seek to "know the material conditions of phenomena" (Bernard, 1865), or to "lift a corner of the great veil" (Einstein, 1924), to discover unknown "phenomena" (including objects of the world) and to explore the mechanisms of phenomena, using a method that is as certain as possible, and which involves (This, 2009b):

(1) identifying a phenomenon;

(2) characterizing quantitatively this phenomenon (judiciously chosen characteristics are measured);

(3) grouping the measurement results into synthetic "laws", i.e. essentially equations;

(4) searching - by induction, this is a central point - for concepts, notions, theories and mechanisms that are quantitatively compatible with the equations identified;

(5) searching for the consequences of the theories thus induced (more exactly abducted);

(6) experimentally testing of these consequences, with a view to disproving them so as to improve the still inadequate theories.

On the other hand, technology or technologies (the plural deserves discussion) aim to improve techniques, often using scientific results, and have a practical purpose, since the Greek *techne* means "to do", and *logos* means "to study". The difference is important in most domains. For food, an article explaining it well was published by Lavoisier (1791) about the aqueous solutions obtained by thermal treatment of muscular tissue of animals in water ("meat stock"): Lavoisier observed that Geoffroy le cadet (1733), before him, was interested by knowing the composition of meat stocks (science), and that, in this particular case, he (Lavoisier) wanted "practical" results (technology), in particular about the quantity of meat needed to feed the sick people of Paris hospitals (Lavoisier, 1865).

Another historical example in which a clear mind sees clearly the differences between science and technology is with medicine: the French physiologist Claude Bernard observed that medicine is a technique, clinical research is a technology, and the science of medicine is physiology (Bernard, 1865).

For all that, science is not above technology, and technology is not above science: they are separate activities. Pasteur himself observed that his desire to contribute to the well-being of humanity had diverted him from his scientific work (for example, the exploration of chirality) towards technology, but he had made a conscious decision to do so (Geison, 1974).

This last example illustrates that some people ("researchers") can perform the two activities (here science and technology) one after the other. However this does not mean that it is difficult to separate the two fields. In order to explain this better, the example of technique is useful: when doing a scientific research, a scientist can have to use technical means (analytical techniques, for example), but this does not mean that the scientist is a technician. And sometimes, scientists can spend some time for innovation (technology), and at that moment, they act as technologists; but this does not mean that sciences of nature and technology are the same. To take a last example, when a person is living, there are molecular modifications in his/her body, but this does not mean that the person is a chemist, i.e. a scientist studying chemistry.

Alongside the terms "science" and "technology", some speak of "engineering", or "engineering science". About it, the *Official Journal* (1980) indicates: "All functions ranging from design and studies to responsibility for construction and control of the equipment of a technical or industrial installation". This would mean that in the expression "engineering science", the word "science" means knowledge, rather than science of nature. Of course, some people or institutions may use the terms with various idiosyncratic meanings, but they run the risk of being understood only by themselves or to create confusion around them.

Finally, the following observations can be useful:

(1) The word "science", used in an expression such as "the science of the cook", or "the

science of the shoe maker", has nothing to do with the sciences of nature; for cooking or shoe making, the word "science" means knowledge in general, and certainly one cannot refuse to allow a professional body to have knowledge. However technical or empirical knowledge is not the same as the sciences of nature, which includes quantitatively based theory (Heidegger, 1963).

(2) Mathematics is not a natural science (the reason why so many universities speak of "school of natural sciences and mathematics"), and it should not be confused with calculation, which, as we have seen, is the everyday business of the sciences of nature (Wigner, 1960).

(3) There can be no such thing as "applied sciences", since sciences (of nature) are precisely not applied activities; the expression "applied sciences" is a faulty oxymoron, just like "round square" (Pasteur, 1871).

(4) People are not the same as human activities, and, as said, a "researcher" can make scientific research during part of his/her time, and turn to innovation (application), i.e., technology, during another part of his/her time, but it would be wrong to conclude from that that science and technology are the same.

(5) The intent is most important for making the difference between science and technology, but also for practising them: with different goals, different methods are to be used (it is probably good, to see this, to compare a goal to a destination, and a method to a way for reaching it).

(6) Good technology is sometimes based on knowledge produced by science, but this does not mean that technology is a scientific activity. To illustrate by a comparison, someone using a computer is not a computer scientist or a computer technologist.

(7) In epistemological discussions, some use the word "fundamental", but the analysis of such discussions shows that it most often means "scientific".

(8) About the journal for which some articles will be discussed, the title *Food chemistry* is already confusing, as some mix science, technology, and even technique in the word "chemistry". Yet a close look at the history of chemistry (Kahn, 2016) demonstrates that chemistry is a science of nature that grew out of alchemy in the 18th century; technical (industrial) or technological work is not chemistry as such, but technology or technique, i.e. applications of chemistry, that should not be called "chemistry" (but instead "applications of chemistry").

All this being said, the analysis of only the first articles of the volume 272 of *Food Chemistry* will be made, and the full table of content will be given in an annex, inviting the readers to make their own idea about the next articles from the same issue.

When one looks for mechanisms, it is science; when application is the goal, it is technology

The title of the first article published in the volume 272 of *Food Chemistry* is *Bioactive compounds of beetroot and utilization in food processing industry: A critical review*. Here there are indeed two successive steps, i.e. identifying "bioactive" compounds in beetroot, and using them in the industry. Reading only the title could make think that the first part is scientific, and the second technological, but this article is a review, and there is no scientific work done. Even the first part is written with the intent of using the bioactive compounds.

As discussed in the previous paragraph, the word "intent" is essential in the current discussion, because it is quite conceivable that engineers or technologists, or even technicians, interested in their work, could make a discovery, but they would need the intention to go further, and it is for this reason that Benjamin Thompson, count Rumford, has sometimes been said to have "discovered" convection (Kurti, 1969).

Finally about identifying the bioactive compounds, it must be recognized that technological characterisations can sometimes lead to discoveries, such as new bioactive compounds, or new mechanisms of bioactivity,

for example, but it is not the case here.
The issue of health is also important in the current discussion, as bioactive compounds have effects on the metabolism, so that their scientific study belongs to the field of physiology (a science of nature, see above) For these studies as for others, characterisation of the effects has to be done, and this characterisation corresponds to the two first steps of the scientific work. This leaves open the question of deciding when such works belong to science or to technology, as the two activities are well performed when based on sound information. This gives the opportunity to observe that there is no reason for which the quality of one of them could be less than for the other. Rigour is not enough to decide, contrary to what Escoffier *et al.* wrote (1907), and the goal (exploring the mechanisms of phenomena) is essential: for the article discussed, it was to applied knowledge produced formerly by science, which is not a scientific activity.

The second article in the journal, *Exploring the impacts of postharvest processing on the aroma formation of coffee beans*, is again a review, and its title seems to clearly announce that it is about exploring a technical field. However, as written before, technical facts can be the basis of technological or scientific studies, so that the title is not sufficient to decide what activity this article is about. Observing which odorant compounds are produced through postharvest processing would be only observing a phenomenon, and this is different from understanding the mechanisms by which these odorants compounds are produced, or detecting a new odorant compound.
In this big review, the authors describe the technique of coffee cultivation and processing, and using mainly published material they give the list of the odorant compounds at different steps of processing. They claim in particular that "the volatile constituents of green coffee beans have no significant influence on the final coffee aroma composition, as only a few such compounds remain in the beans after roasting", and they observe that much information is needed to better "influence the quality of the final coffee beverage".

Figure 3. With a complex system such as a synchrotron (here the Soleil Synchrotron, in Saint-Aubin, France), characterizations can be done: this is a technical activity. The results of the measurements can be used for technology or for science.

For sure, the discovery of new odorant compounds in some material (here coffee) is a scientific work (the chemistry of food ingredients), but here the authors write themselves that they want to find the impact of processing methods, and this is really food technology. We shall not analyse this article in details, but it is useful for the current discussion to extract some ideas from it. For example, in the paragraph dealing with mucilage fermentation, the authors observe that coffee yeasts appear to have low aldehyde dehydrogenase activity because no acetic acid is produced by selected single cultures: this is a reasonable assumption, based on observations, but it is a fact that the scientific work establishing the assumption is missing.
Anyway this article is a review, and a review is not always the production of new mechanisms, concepts or knowledge (moreover some scientific journals forbid giving personal results in such articles). As a whole, this article is useful for the current discussion in showing how technology and science are often mixed, in the fields of food technique, food technology, food engineering and food sciences.

The title of the next article is *Phenolic compounds and antioxidant activities of tea-type infusions processed from sea buckthorn* (Hippophaë rhamnoides) *leaves*. Here, the word "processed" brings to mind technology, but the case is more subtle, even if sea buckthorn is used in a technical way. What is at issue, more precisely, is the exploration of the antioxidant activities of the phenolic compounds from the plant. Is the aim simply to characterise them for (technological) use, or to find new objects or mechanisms (specific antioxidant mechanisms, or new compounds, or mechanisms of extraction)? The authors themselves write that their goal is to consider "the impact of different processing methods on phenolic compounds and antioxidant activities of tea-type infusions prepared from SB leaves". This is *stricto sensu* technology. Using various analytical methods, they observed that infusions made from leaves of two cultivars contained different phenolic compounds and that thermal processing decreased the antioxidant activities of the infusions. Here, new information about the composition of leaves and infusions was displayed, and it can be considered as chemistry or plant physiology. However no mechanism is studied.

For sure, also sound data is proposed ("It is possible that some enzymes such as phenol oxidase are present in the fresh sea buckthorn leaves, which might have played a major role in degradation of tannins during the drying process (Yoruk & Marshall, 2003)", or "Steaming combined with high temperature drying likely have led to deactivation of enzymes and resulted in better preservation of the tannin compounds in the leaves."), but this does not mean scientific research, that would be trying to refute theoretical ideas through experimental work.

This last observation calls for a comparison with the study of tea (*Camellia sinensis*), for which we have seen above that very few scientific work was done. Finally, the fact that phenolic compounds are different before and after processing of sea buckthorn leaves is a phenomenon whose exploration could reveal new mechanisms if it were studied: this shows again that technical and technological studies can usefully raises questions for science.

With regard to the article entitled *Chloroplast-rich material from the physical fractionation of pea vine* (Pisum sativum) *postharvest field residue* (Haulm), a new technique is proposed and characterized. This is obviously one goal of technology. Moreover the authors discuss its application to nutritional questions, such as the composition in nutriments. Mechanisms of compositional changes due to the new method are discussed (general ideas), but not studied in details. For example, the authors discuss "chlorophyll" (*sic*) (an old and expired word for a variable mixture of compounds) (Caventou and Pelletier, 1817; Chevalier, 1827), and they mention chlorophylls a and b, as the major pigments, but indeed this is not right, as there are also chlorophylls a', b', and their derivatives such as pheophytins and pheophorbides (Valverde and This, 2008). Observing this in particular is not a critic of the article, but the observation that there is more technological characterization of the method than scientific research in this article.

In the next article of the *Food Chemistry* issue, *Characteristics of flavonol glycosides in bean* (Phaseolus vulgaris L.) *seed coats*, the aim of the authors was to characterise a particular class of compounds in beans, and this is indeed part of the science of food ingredients. This is an opportunity to observe that the two expressions "food science" and "food sciences" are sometimes used. The second expression seems to be better than the first, because physiology, chemistry, sensory science, nutrition, toxicology and others are indeed natural sciences; when they deal with food, they deserve to be considered as food sciences.

Discussing this is also an opportunity to highlight another goal of this "Opinion" article: distinguishing better science and technology allows the food science and food technology community to better develop both fields, which are both useful differently. Molecular and

physical gastronomy can contribute in its own -scientific- way; this research was introduced in 1988 as a scientific discipline, because Kurti and This-Benckhard (1994) observed that, at that time "food science and technology" did not consider the phenomena occurring during the making of food from food ingredients.
For example, the textbook *Food Chemistry* (Belitz and Grosch, 1994) contained nothing about wine cooking, in spite of the fact that 48% of French classical sauces include wine that is cooked (Académie des gastronomes and Académie culinaire de France, 1991). It seemed clear that new phenomena and mechanisms could be discovered if little-considered phenomena occurring during culinary transformations were explored with the clear objective of identifying new mechanisms and phenomena (This vo Kientza *et al.*, 2021). For sure, molecular and physical gastronomy is studying phenomena occurring during technical processes (washing, cleaning, peeling, cooking, seasoning, etc.), but it does not mean technology, as the processes are not the topic studied: rather the phenomena are the basis of scientific studies.

The *Food Chemistry* issue goes on with *Wine production using free and immobilized kefir culture on natural supports*: a production is a technical activity, and improving a technique is a question of technology. In this article, the result of analysis by different analytical and sensory methods are given, but this is technical characterization, even if the methods are "advanced".

On the other hand, the article entitled *Variations in chlorophyll and carotenoid contents and expression of genes involved in pigment metabolism response to oleocellosis in citrus fruits* is certainly a scientific article. In this case, the goal is no only to characterise food ingredients, but to understand how they are produced. It can be observed that the studies of "bioactivity" of food ingredients or of food preparations is more a question of physiology. As a consequence, molecular and physical gastronomy studies would usefully keep an eye on biology for the interpretation of phenomena. As Dobzhansky said, "Nothing in biology makes sense except in the light of Evolution" (Dobzhansky, 1973). For sure, molecular and physical gastronomy is not biology, but plant and animal tissues are often at the centre of researches.

About the next article, *Use of a smartphone for visual detection of melamine in milk based on Au@Carbon quantum dots nanocomposites*, it can be observed that the analysis of milk is a technical characterisation, and the introduction of a new method for such an analysis is technology.

With *Physicochemical properties and phenolic content of honey from different floral origins and from rural versus urban landscapes*, on reading the title alone, the two scientific and technological possibilities present themselves, i.e. that the compositions and characteristics of honeys from different origins could be explored, with a view to understanding how they are formed, for example, or the properties of honey based on the production environment could be analysed. This example can be used to observe that some published work stops at characterisation: this could be considered as scientific, as it falls under to one or two of the steps stated in the introduction. However, scientifically, characterisation only makes sense if mechanisms are explored.

Let us sweep the table of content faster. With *Effect of interesterified blend-based fast-frozen special fat on the physical properties and microstructure of frozen dough*, we have technology again. With *Effect of phosphates on gelling characteristics and water mobility of myofibrillar protein from grass carp* (Ctenopharyngodon idellus), again we have to read the paper to decide that it is again technology. With *Hydrolysis and oxidation of lipids in mussel* Mytilus edulis *during cold storage*, it could have been a scientific study, but indeed it is a technological one. With

Comparative studies on the yield and characteristics of myofibrillar proteins from catfish heads and frames extracted by two methods for making surimi-like protein gel products, the technological intention is clear. Idem with *Point-of-use detection of ascorbic acid using a spectrometric smartphone-based system*.
It would be too long to analyse all articles from this table of content, and it can be concluded that scientific work is really rare in this volume 272 of this particular journal of "food science" that is *Food Chemistry*. As a consequence, it appears that much scientific work remains to be done. This seems to be precisely what molecular and physical gastronomy is all about.

References

Académie des gastronomes et Académie culinaire de France. 1991. *L'art des sauces*, L. T. Lanore, Malakoff (France).

Belitz HD, Grosch W. 1994. *Food Chemistry,* Springer, Heidelberg.

Bernard C. 1865. *Introduction à la médecine expérimentale*, Baillère, Paris.

Caventou, Pelletier. 1817. Sur la matière inerte des feuilles, *Journal de pharmacie*, 3rd volume, 486-489.

Cazor A, Deborde C, Moing A, Rolin D, This H. 2006. Sucrose, Glucose and Fructose Extraction in Aqueous Carrot Root Extracts Prepared at Different Temperatures by Means of Direct NMR Measurements, *Journal of agricultural and food chemistry*, 54, 4681-4686. DOI: 10.1021/jf060144i.

Chevalier A. 1827. *Dictionnaire des drogues simples et composées - ou Dictionnaire d'histoire naturelle médicale, de pharmacologie et de chimie pharmaceutique*, 2, Béchet, Paris.

Einstein A. 1924. Letter to Langevin, 16th December. In *Collected Papers of Albert Einstein, 1925-1927*, Princeton University Press (2018), Princeton, NJ (USA).

Dobzhansky T. 1973. Nothing in Biology Makes Sense except in the Light of Evolution, *The American Biology Teacher,* 35, 125-129.

Editorial Board. 2024. The various sections, https://icmpg.hub.inrae.fr/international-activities-of-the-international-centre-of-molecular-gastronomy/international-journal-of-molecular-and-physical-gastronomy/sections, last access 2024-02-09.

Escoffier A, Gilbert Ph, Fetu E, Suzanne A, Reboul B, Dietrich C, Caillat A. *Guide culinaire*, Paris (France).

Food Chemistry. 2019. Volume 272, https://www.sciencedirect.com/journal/food-chemistry/vol/272/suppl/C, last access 2024-02-07.

Food Chemistry. 2024. Aims & Scope, https://www.sciencedirect.com/journal/food-chemistry, last access 2024-02-07.

Galileo Galilei. 1610. *Sidereus nuncius, Venetiis : apud Thomam Baglionum*, https://doi.org/10.3931/e-rara-695, last access 2024-02-22.

Geison G. 1974. Louis Pasteur. In *The Dictionary of Scientific Biography*, Charles Scribner's Sons, New York (USA), 10, 362.

Geoffroy le cadet M. 1733. Examen chimique des viandes qu'on employe ordinairement dans les Bouillons. Pour lequel on peut connoître la quantité d'Extrait qu'elles fournissent, & déterminer ce que chaque Bouillon doit contenir de suc nourrissant, *Histoire de l'Académie royale des sciences, Mémoires de l'Académie royale,* Pierre Mortier, Amsterdam (Netherlands), 312-332.

Heidegger M. 1963. *Tractatus Logico-philosophicus*, Suhrkamp, 5, 632.

Journal Officiel. 1980. Arrêté du 12 janv. 1973 ds Lang. fr., Paris, 21.

Kahn D. 2016. *Le fixe et le volatil,* CNRS Edition, Paris.

Kurti N. 1969. The physicist in the kitchen, *Proceedings of the Royal Institution of Great Britain*, 42, 451-467.

Lavoisier AL. 1865. Expériences de novembre 1783, *Œuvres complètes*, t.iii, 563-578.

Lavoisier AL. 2019. *Elements of Chemistry, In a New Systematic Order, Containing all the Modern Discoveries* (Translator: Robert Kerr), https://www.gutenberg.org/cache/epub/30775/pg30775.txt, last access 2019-11-23.

Pasteur L. 1871. Pourquoi la France n'a pas trouvé d'homme supérieur au moment du péril, *Salut public*, Lyon.

This H. 2009a. *Molecular Gastronomy, a chemical look to cooking.* Accounts of Chemical Research, 42(5), 575-583

This H. 2009b. *Cours de gastronomie moléculaire: Tome 1, Science, technologie, technique... culinaires : quelles relations ?*, Belin/Quae, Paris.

This-Benckhard H, Kurti N. 1994. Chemistry and physics in the kitchen, Scientific American, 270(4), 44-50.

This vo Kientza H, Lavelle C, Burke R, Kelly A. 2021. Introduction to molecular gastronomy and its applications. In Burke R, Kelly A, Lavelle C, This vo Kientza H (eds) *Handbook of Molecular Gastronomy*, CRC Press, Boca Raton (FL).

Valverde J, This H. 2008. 1H NMR quantitative determination of photosynthetic pigments from green beans (*Phaseolus vulgaris* L.), *Journal of Agricultural and Food Chemistry*, 56 (2), 314-320. doi. 10.1021/jf070277j.

Wigner E. 1960. The unreasonable effectiveness of mathematics in the natural sciences, *Communications in pure and applied mathematics*, 13(1), John Wiley & Sons, New York.

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Annex

Here are the other titles of the volume 272 of *Food Chemistry*, so that the readers can train yourself in deciding between science and technology:

- *Development and validation of a method for simultaneous determination of trace levels of five macrocyclic lactones in cheese by HPLC-fluorescence after solid-liquid extraction with low temperature partitioning.*
- *Rapid quantification of the adulteration of fresh coconut water by dilution and sugars using Raman spectroscopy and chemometrics.*
- *Effect of pH and holding time on the characteristics of protein isolates from* Chenopodium *seeds and study of their amino acid profile and scoring.*
- *Antioxidant activity of a winterized, acetonic rye bran extract containing alkylresorcinols in oil-in-water emulsions.*
- *Chemical profiles and antioxidant properties of roasted rice hull extracts in bulk oil and oil-in-water emulsion.*
- *Comparative studies on the yield and characteristics of myofibrillar proteins from catfish heads and frames extracted by two methods for making surimi-like protein gel products.*
- *Distribution and effects of natural selenium in soybean proteins and its protective role in soybean β-conglycinin (7S globulins) under AAPH-induced oxidative stress.*
- *Peels of tucumã (*Astrocaryum vulgare*) and peach palm (*Bactris gasipaes*) are by-products classified as very high carotenoid sources*
- *Diffuse light affects the contents of vitamin C, phenolic compounds and free amino acids in lettuce plants*
- *Solid-state fermentation of black rice bran with* Aspergillus awamori *and* Aspergillus oryzae*: Effects on phenolic acid composition and antioxidant activity of bran extracts*
- *Modifying Robusta coffee aroma by green bean chemical pre-treatment*
- *Microwave and ultrasound pre-treatments to enhance anthocyanins extraction from different wine lees*
- *Effect of sex on the nutritional value of house cricket,* Acheta domestica *L.*
- *Effect of anthocyanins on lipid oxidation and microbial spoilage in value-added emulsions with bilberry seed oil, anthocyanins and cold set whey protein hydrogels*
- *Comparison of real-time PCR methods for quantification of European hake (*Merluccius merluccius*) in processed food samples*
- *A unified approach for high-throughput quantitative analysis of the residues of multi-class veterinary drugs and pesticides in bovine milk using LC-MS/MS and GC–MS/MS*
- *Novel insight into the role of withering process in characteristic flavor formation of teas using transcriptome analysis and metabolite profiling*
- *High-sensitivity determination of cadmium and lead in rice using laser-induced breakdown spectroscopy*
- *Characterization and storage stability of chlorophylls microencapsulated in different combination of gum Arabic and maltodextrin*
- *Determination of serotonin in nuts and nut containing products by liquid chromatography tandem mass spectrometry*
- *Development of a DNA metabarcoding method for the identification of fifteen mammalian and six poultry species in food*
- *Comparisons of nutritional constituents in soybeans during solid state fermentation times and screening for their glucosidase enzymes and antioxidant properties*
- *Characterization of three different types of extracellular vesicles and their impact on bacterial growth*
- *Taste-guided isolation of sweet-tasting compounds from grape seeds, structural elucidation and identification in wines*
- *A value-added approach to improve the nutritional quality of soybean meal byproduct: Enhancing its antioxidant activity through fermentation by* Bacillus amyloliquefaciens *SWJS22*
- *UV and storage stability of retinol contained in oil-in-water nanoemulsions*

- *Screening of antimicrobials in animal-derived foods with desorption corona beam ionization (DCBI) mass spectrometry*
- *Effect of hulling methods and roasting treatment on phenolic compounds and physicochemical properties of cultivars 'Ohadi' and 'Uzun' pistachios (*Pistacia vera *L.)*
- *Traditional rose liqueur – A pink delight rich in phenolics*
- *In vivo anti-hyperuricemic and xanthine oxidase inhibitory properties of tuna protein hydrolysates and its isolated fractions*
- *Sensory descriptive and comprehensive GC–MS as suitable tools to characterize the effects of alternative winemaking procedures on wine aroma. Part I: BRS Carmem and BRS Violeta*
- *Kinetics of lipid oxidation in omega fatty acids rich blends of sunflower and sesame oils using Rancimat*
- *Encapsulation of grape seed phenolic-rich extract within W/O/W emulsions stabilized with complexed biopolymers: Evaluation of their stability and release*
- *Evaluation of near-infrared (NIR) and Fourier transform mid-infrared (ATR-FT/MIR) spectroscopy techniques combined with chemometrics for the determination of crude protein and intestinal protein digestibility of wheat*
- *Impact of consumer behavior on furan and furan-derivative exposure during coffee consumption. A comparison between brewing methods and drinking preferences*
- *Effects of heat-moisture treatment after citric acid esterification on structural properties and digestibility of wheat starch, A- and B-type starch granules*
- *Glycine betaine reduces chilling injury in peach fruit by enhancing phenolic and sugar metabolisms*
- *Effects of skim milk pre-acidification and retentate pH-restoration on spray-drying performance, physico-chemical and functional properties of milk protein concentrates*
- *Simultaneous determination and risk assessment of fipronil and its metabolites in sugarcane, using GC-ECD and confirmation by GC-MS/MS*
- *Extraction of lycopene using a lecithin-based olive oil microemulsion*
- *Discrimination of geographical origins of Chinese acacia honey using complex 13C/12C, oligosaccharides and polyphenols*
- *β-Agarase immobilized on tannic acid-modified Fe3O4 nanoparticles for efficient preparation of bioactive neoagaro-oligosaccharide*
- *Influence of fried food and oil type on the distribution of polar compounds in discarded oil during restaurant deep frying*
- *Structural elucidation of fucoidan from* Cladosiphon okamuranus *(Okinawa mozuku)*
- *Determination of lipophilic marine toxins in fresh and processed shellfish using modified QuEChERS and ultra-high-performance liquid chromatography–tandem mass spectrometry*
- *Discrimination of Brazilian lager beer by 1H NMR spectroscopy combined with chemometrics*
- *Synergistic effect of mixture of two proline-rich-protein salivary families (aPRP and bPRP) on the interaction with wine flavanols*
- *Impact of a post-fermentative maceration with overripe seeds on the color stability of red wines*
- *Inhibitory effects of dietary soy isoflavone and gut microbiota on contact hypersensitivity in mice*
- *Metabolite characterization of powdered fruits and leaves from* Adansonia digitata *L. (baobab): A multi-methodological approach*
- *Isolation of antioxidative compounds from* Micromelum minutum *guided by preparative thin layer chromatography-2,2-diphenyl-1-picrylhydrazyl (PTLC-DPPH) bioautography method*
- *Effect of guar gum on the physicochemical properties and in vitro digestibility of lotus seed starch*
- *Preparation of an intelligent pH film based on biodegradable polymers and roselle anthocyanins for monitoring pork freshness*
- *Extraction, structural characterization and stability of polyhydroxylated naphthoquinones from shell and spine of New Zealand sea urchin (*Evechinus chloroticus*)*
- *A review of microencapsulation methods for food antioxidants: Principles, advantages,*

drawbacks and applications

- *Transcriptome and proteome analyses of the molecular mechanisms associated with coix seed nutritional quality in the process of breeding*
- *The synthesis and characterization of a xanthan gum-acrylamide-trimethylolpropane triglycidyl ether hydrogel.*