Just mix in the ingredients – Câremé's originality and space age technologies

by Dr Svetlana Rodgers

As Professor in Food, Hospitality and Culinary Arts at the University of Brighton (UK), I spend several years in Brighton (UK) and was fascinated by Câremé's kitchen at the Royal Brighton Pavilion. This, in my opinion, is a good example how to solve the logistical problem of catering for hundreds of guests at a time. Câremé, the Prince Regent's personal chef, combined his art with the latest technological developments of the time. In modern terms, he was a product developer and food system designer. He would undoubtedly find a clamor of TV producers looking to make him a celebrity chef. His skills would be valued in banqueting, conferences centers, casinos, stadiums, cruise ships and airlines. But in the twenty first century technically competent operators can match and extend his brilliance because of technological advances borrowed from space exploration, military technologies, electronics, advanced engineering, medicine and nutrigenomics. In this article we follow cutting edge culinary developments from the past into the present and the future. I also would like to use this opportunity to reflect on my own contribution to the field.

INNOVATION

Antonin Câremé (1784-1833) was one of the first celebrity chefs, his clients included Napoleon, after his downfall the Prince Regent, the future George IV, and later Alexander I, the tsar of Russia. Câremé was known for his centerpieces, food sculptures designed to be admired but not eaten. He borrowed his ideas from texts on architectural history. Câremé also invented soufflé, the dish requiring gentle cooking – this was possible with better control of heating in the range designed by an American, Benjamin Thompson. Câremé introduced three basic sauces or *fonds* (*espagnole*, *veloute* and *béchamel*), which have become a foundation for more than 100 derivatives or 'compound' sauces. This is the 'food platform' principle - a combination of simplification and differentiation to achieve mass customization. Câremé was also an innovator in kitchen design. The Pavilion was famous for its steam table, which is now lost, central steam supply, running hot and cold water and the largest of its time ice house. This is an early example of functional design – a combination of hot holding boxes and plating surfaces, pre-heated lids and production flow. The kitchen was next to the dining hall, much more like a modern banqueting setting rather than the primitive medieval kitchen.

Today we can control not only cooking temperature, but air humidity, velocity and pressure, rotation speed, thermal conductivity and configuration of the cooking chamber. In fact, modern operations are becoming increasingly complex and it is easier to view them at the product, process and system level as shown in exhibit 1. The degree of complexity and integration increases from the left to the right of the continuum. At the product level, underpinning principles are represented by ingredient functionality; at the process level - by operational efficiency; and at the system level – by logistics of distribution. Now I would like to describe each of these in more detail.

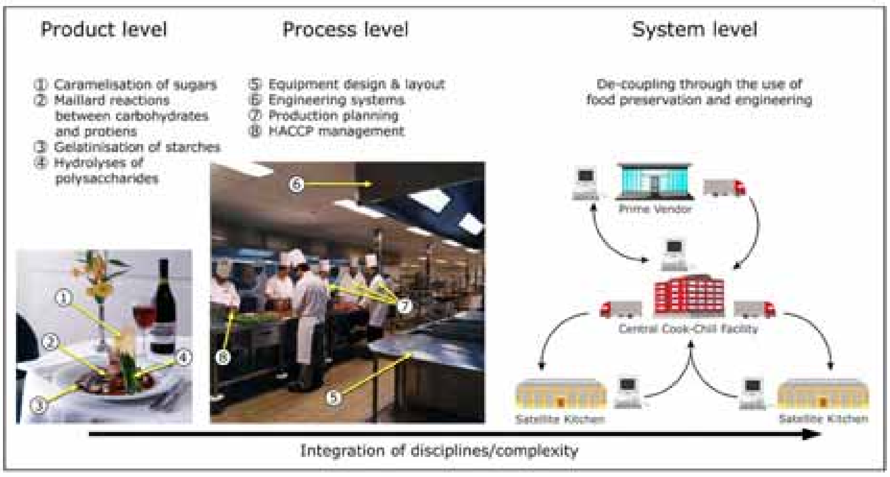

Exhibit 1. An overview of modern banqueting operations

The image representing the **product level** in exhibit 1 is the traditional meal. Except from intuitive insights into the effect of heat on food, chefs preparing this meal were not likely to contemplate the physico-chemical phenomena illustrated in 1-4. The radical departure from the 'meat and three veges' formula is the so-called Molecular Gastronomy meal (exhibit 2) created by the chef, Mads Nybro from Denmark. Here the chef actively used chemistry of cooking principles and processes borrowed from food manufacturing to achieve new culinary sensations. Câremé would be puzzled seeing these items.

Exhibit 2. Molecular Gastronomy meal

The green ‘skyscraper’ sauce at the back of the plate is made by freezing the sauce in a rectangular-shaped mold, then dipping it in alginate solution and then into calcium solution. The calcium ions attract polysaccharide polymers without the need for heating to achieve gelation; then the sauce was melted the shape remained. The piece at the front is the *sous vide* lobster. *Sous vide* is the process when a product is vacuum-packed and then cooked in a laboratory-style water bath. The cooked muscles are juicier with proteins being less denaturalized under gentle highly controlled heating. The two pieces in the middle of the plate are freeze-dried sauce and yoghurt. This is a new preparation technique borrowed from food manufacturing. To produce long shelf-life products by industrial methods, instant coffee powder for example, freeze-drying is carried out to the very low level of water activity. In restaurants, on the other hand, drying is stopped much earlier, the taste and texture are quite different – it melts in your mouth.

Molecular Gastronomy and its variation Industrial Gastronomy is a trend amongst top chefs to use industrial thickeners and laboratory-type equipment to achieve novel culinary sensations. This is a reverse of the notion of food technologists relying on the culinary expertise of chefs to enhance the quality of industrial products with the product stability being the primary goal. Not pre-occupied with the shelf-life extension, chefs can borrow industrial techniques (extrusion, freeze-drying, phase separation and others) to derive unusual texture, shape and appearance. Coincidentally, the two most successful restaurants, the Fat Duck in the UK and elBulli in Spain, participated in the EU project ‘Introduction of innovative technologies in modern gastronomy of cooking’. It is no co-incidence that at the launch of the £3.6 bn Large Hadron Collider built to discover antimatter in October 2008, Ferran Andria and Ettore Bocchia served a ‘molecular buffet’.

The image representing the **process level** in exhibit 1 is a typical banquet kitchen with the inputting disciplines shown in 5-8. This is a relatively old-fashioned setting unlike the new 2zones^2 kitchen concept shown in exhibit 3 – Câremé would not have recognized it as a kitchen, a sign of a radically new design. Instead of coolrooms, there are so-called ‘cold walls’, which define preparation zones supporting a continuous flow of products. Coolrooms, in my opinion, are the most wasteful part of the kitchen - the physical space they require, the energy it takes to chill empty volumes, the labour to operate. The 2zones^2 design uses the latest HVAC systems - humidity, temperature and chlorine levels are controlled in each point; the ventilation is operating according to the pollution; ice slurry is produced at night, when excess energy is available; washing and disinfecting is done with ionized water, no detergent is used.

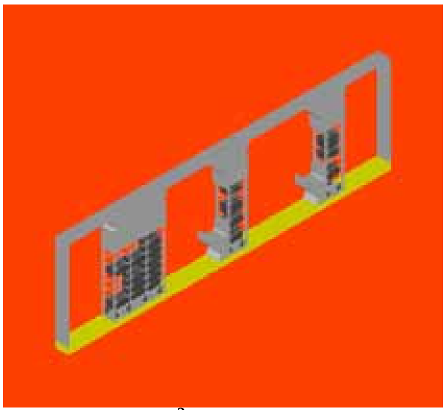

Exhibit 3. 2zones[2] kitchen design

At the **system level**, a central kitchen or CPU (central production unit) supplies serveries or satellite kitchens. Industrial Cuisine principles include the use of new technologies and in operational terms production line approach supported by de-coupling production from consumption. The resulting economies of scale are achieved in large organizations such as banqueting in hotels, convention centers, stadia, hotel/restaurant/resort chains, institutional and transport catering including in-flight catering. Few chefs can produce thousands of portions at a time. The output of 20 000 meals per day was impressive in the 1980s, now in-flight CPUs in Dubai produce 100 000 meals per day. The application of food service systems, cook-chill, cook-freeze and *sous vide*, have become possible through a combination of food microbiology principles (food preservation) and engineering (heating, refrigeration and packaging).

Now I would like to describe *sous vide* technology in more details. When I worked in the New South Wales Department of Health in Sydney (Australia), I oversaw the development of a *sous vide* CPU. Unlike bench-top water baths used in Molecular Gastronomy for gentle cooking of high quality items mostly in fine dining, water baths at a CPU have capacity to hold tons of products. In Industrial Gastronomy applications, the purpose of *sous vide* technology is the shelf-life extension (up to 30 days) to justify large production volumes. The liquid items such as casseroles, soups and some deserts are prepared in gigantic kettles and pumped whilst hot, then sealed in bags and chilled in water. One can appreciate the complexity of the engineering systems and food science supporting such settings – the impact on nutritional value and sensory attributes; the mechanical action of the agitator, pressure during pumping, tumble chilling and transportation. However, food safety is the major concern as it is associated with the most dangerous food poisoning known to humankind – botulism; 30-100 ng or 10^{-9}g of botulinal toxin is lethal. *Sous vide* products are mildly heated (pasteurized) so spores of *Clostridium botulinum*, bacteria causing botulism, survive processing and potentially could grow if the storage temperature exceeds 3^{o}C. Such low temperatures are difficult to maintain in practice. Could this problem be solved?

MICROBIAL GASTRONOMY

Ways of preventing botulism are limited to natural means – customers would not accept chemical preservatives in a restaurant meal. Harsh heating would result in a product quality typical to canned foods. The use of tomato paste and spices (both reduce the risk of botulism) is limited only to recipes calling for them. Thus, a more subtle and universal methods were needed. I suggested the use of the so-called protective cultures, lactic acid bacteria commonly isolated from cheese and fermented vegetables. I found that cultures producing bacteriocins (anti-microbial substances effective at very low levels, somewhat similar to anti-biotics) can kill botulism bacteria in prepared meals.

The exhibit 4 shows the results of six year's work on my PhD project in one image. Two samples of seafood chowder were inoculated with botulinum spores and stored at 10^{o}C, a gross temperature abuse scenario. The two cultures with protective qualities were lactic acid bacteria, *Lactococcus lactis* and *Pediococcus pentosaceus.* The high populations up to 10^7 cells per gram or 1-2 gram of the culture preparation per kilogram of product were needed to prevented toxin formation. Seafood is usually associated with the type of botulism, which can develop at low temperatures. This was the first practical demonstration of bio-preservation in non-fermented refrigerated products in action.

Exhibit 4. Seafood chowder – toxic control (left) and not toxic sample 'protected' with lactic cultures (right)

When we sent a press release to the mass media in Australia, we got numerous requests for newspapers, radio and TV interviews (please, see examples on http://www.smh.com.au/articles/2002/07/23/1027332379832.html). Some of the reporters were quite aggressive asking me to prove that botulism represents a real danger. Overall, the general public was fascinated with the notion of adding bacteria to food rather than killing them as in the mainstream practices in food preservation/sanitation. In fact, it was a Russian scientist, Nobel Price laureate, Ilea Metchnikoff, who was the first to articulate the concept of beneficial bacteria. In his book The Prolongation of Life (1910) he wrote:

> *"A reader who has little knowledge of such matters may be surprised by my recommendation to absorb large quantities of microbes, as the general belief is that microbes are all harmful. This belief, however, is erroneous".*

Metchnikoff recognized two different types of cultures – a food preservative such as in fermented drinks and health-improving gut microflora, which is now called probiotics. He hypothesized that the mode of action of probiotics lies in breaking down of toxins accumulated in the body. This has been proven by modern science - the reduction of carcinogens and blood cholesterol level. Probiotics can also improve immunity. In my earlier work, I studied survival of probiotics, *Lactobacillus acidophilus* and bifidobacteria, in Australian yoghurts. Later at the Conrad Hilton Hotel School in Houston (U.S.), I used the same cultures and techniques to develop novel meals for restaurants with probiotics.

I noticed that despite the fact that probiotics were one of the major category of functional foods, food service organizations did not play a role in the ‘health market’. The simple addition of probiotic preparations to products is less technically demanding then proving the bio-preservation effect of protective cultures. The practical challenge with probiotics is to deliver the therapeutic minimum, 10^7-10^8 viable cells per gram of product. I studied the survival of stock culture preparations of probiotics (frozen and freeze-dried) during storage to develop inoculation protocols for restaurant meals. I recommended products such as sandwiches, sushi, dips, cold desserts, milkshakes, smoothies and iced tea. If a product is not consumed immediately, it should not be acidic (pH<4.7). Otherwise, probiotic bacteria will die – the same outcome as during retail storage of yogurts I observed in Australia. As probiotic carriers, fresh meals represent a valid alternative to the sugar-laden dairy drinks and yoghurts. Could this be the beginning of the Microbial Gastronomy?

FUTURISTIC CONCEPTS

Technically, a meal with probiotics can be classified as a functional meal – a new term I suggested in 2003. The idea came to me whilst I was attending the New Functional Ingredients and Foods (NFIF) conference in Copenhagen, Denmark. In my opinion, fresh meals enhanced with functional ingredients are superior to highly processed functional foods in the retail sector. The examples of functional ingredients are dietary fibres including pre-biotics (indigestible polysaccharides promoting the growth of probiotics in the gut), bio-active proteins, anti-oxidants, vitamins and minerals. Câremé would not be surprised by this idea - the word ‘restaurant’ originated in the 1760s in France from the ‘restauratif’ or ‘pick me up’. Restaurants can capitalise of their ‘fresh food’ image and extend it to embrace such concepts as Functional and Personalised Nutrition or nutrigenomics. Personal genetic information can be saved on a computer chip, scanned during meal ordering and used to prepare a dish with scientifically selected functional ingredients. Perhaps, food services can go even further – networking with local pharmacies to test the ultimate health effects or clinical efficacy of functional meals – as offered for cholesterol lowering Flora-branded products (please see http://www.floraloveyourheart.com.au/Public/cholesteroladvice/getTested.aspx).

The concept of a functional meal is an example of possible developments at the product level. At the process level, I would suggest scanning ‘high tech’ industries such as military technologies and space exploration with the view of adopting latest breakthroughs to culinary practices. Such examples already exist – the design of filters in hoodless vents came from nuclear energy and microwave grills from aerospace industry. When I was at the University of Houston, I saw reports on the latest developments from the National Aeronautics and Space Administration, U.S. (NASA). I wondered what if the gas detectors used for safety reasons on space ships are ‘trained’ to detect the ‘cooked’ odor in ovens and grills. Perhaps, the process controlled by smell with the so-called ‘electronic noses’ would be superior in terms of culinary outcomes.

At the system level, I would recommend the system-based menu engineering. I have coined this term to reflect the need to match the ‘robustness’ of a product with the physical stresses imposed by the food service system used. An ‘intelligent’ fit between menu and technologies can alleviate geo-political pressures experienced by many high profile establishments in locations with prohibitively high real estate costs for back-of-house areas such as central London, Tokyo, Paris or New York. It is a common misunderstanding that Industrial Cuisine can not deliver high quality product. In fact, by rejecting these modern solutions, managers of famous land mark establishments may lose in operational efficiency and food quality. It is often the case that brilliant marketing ideas are not supported with innovative applications of technologies. Perhaps, in future such cutting edge projects as Jumeirah or Hydropolis Underwater Hotel (Dubai) would usher 'high tech' futuristic concepts not only in architecture, but also in meal and process design.

In general, the increase in technological sophistication would soften many of the current challenges including competitive pressures from the food manufacturing sector. To address threats from China, India and Brazil, the European Union funded the NovelQ project (high pressure and pulsed electric field processing, plasma, advanced heating technologies and packaging) to help produce packaged foods with 'fresh-like character'. Currently supermarkets shelves are full of ready-to-eat meals, bulk versions of which are supplied to food service outlets. Is the role of chefs going to be diminished? If Câremé were alive today he would not despair. He would re-invent himself to become a chef-scientist, a chef-doctor or both….

For more information, please read:

- Rodgers, S. 2009. Development of functional meals with bifidobacteria. Journal of Culinary Science & Technology (in press).
- Rodgers, S. 2009. Novel Concept of a Functional Meal: Technological, Industry and Consumer Perspectives. Journal of Foodservice (in press).
- Rodgers, S. 2009. The state of technological sophistication and the need for new specialized tertiary curricular in food services. International Journal of Hospitality Management 28: 71-77.
- Rodgers, S. and Young, N. 2008. The potential role of latest technological developments including Industrial Gastronomy in functional meal design. Culinary Science & Technology 6 (2-3): 1-18.
- Rodgers, S. 2008. Technological innovation supporting Industrial Cuisine, Fast Food and Fresh Food production philosophies. International Journal of Contemporary Hospitality Management 20 (1): 19-34.
- Rodgers, S. 2008. Novel applications of live bacteria in food services: probiotics and protective cultures. Trends in Food Science & Technology 19 (4), 173-222.
- Rodgers, S. 2007. Incorporation of probiotics in food service products: an exploratory study. Journal of Foodservice 18 (3): 108-118.
- Rodgers, S. 2006. Deriving operational efficiencies from the extended shelf-life of food service products. Journal of Culinary Science & Technology 5 (2/3): 111-129.

- Rodgers, S. 2007. Innovation in food service technology and its strategic role. International Journal of Hospitality Management 26: 899-912.
- Rodgers, S. 2005. Technological developments and the need for technical competencies in food services. Journal of Culinary Science & Technology 4 (2/3): 113-127.
- Rodgers, S. 2005. Applied research and educational needs in food service management. International Journal of Contemporary Hospitality Management, 17 (4): 302-314.
- Rodgers, S. 2004. Value adding with functional meals. Food Service Technology 4: 149-154.

The author can be contacted on svetlana0011@hotmail.com, tel +61 2 9698 8586