Cell celebrates intersection of food and science in special issue

March 26 2015

Cover of *Cell*'s special issue on the Biology of Food. Credit: *Cell* 2015

Science enters the kitchen in a special "Biology of Food" issue from the leading scientific journal *Cell*. This set of Review and Commentary articles comes on the heels of a recent collaboration between Cell Press and the reality competition "Top Chef" and covers the latest research on

such topics as the biology underlying molecular gastronomy, our perception of food, the future of growing crops, how to tackle obesity, and the interplay between diet and the circadian clock.

"The multifaceted ways in which food factors into biological, social, and political issues seem to only be getting more complex," says *Cell* Scientific Editor João Monteiro. "This special issue, 'The Biology of Food,' explores the science behind food, nutrition, and metabolism. Like any great menu, it offers plenty of options that we hope will first tantalize and then satisfy each individual's palate."

The science of molecular gastronomy

"It is a sad reflection on our civilization that while we can and do measure the temperature in the atmosphere of Venus, we do not know what goes on inside our soufflés," remarked Nicolas Kurti in 1969. Kurti, an Oxford physicist who coined the term "molecular gastronomy," was one of the first to recognize the intersection between science and how chefs transform cells and proteins into other, more delicious, forms.

Even boiling an egg can be a surprisingly complex process, argues a Commentary by Michael Brenner, a Harvard Professor of Applied Mathematics and Applied Physics and core instructor in the university's popular "Science and Cooking" course, written with Preceptor Pia Sörensen. Cooking an egg in less than one degree increments, between 60 and 70 degrees Celsius, yields eggs with completely different textures that feel different in the mouth. "Even though it's a fairly common food, it's a completely new experience for people," Brennar says in a podcast accompanying the special issue.

In addition to culinary manipulations of food texture, Brenner and Sörensen discuss the science of producing flavor. They describe how chefs capture and concentrate aroma molecules, such as using

centrifuges to separate carotene butter from carrot juice or evaporators to capture the flavor of eucalyptus leaves and citrus peels. They also highlight how it may also be possible to create new flavors. Chefs, like David Chang in New York, are pioneering new types of fermentation reactions that use different microorgansms, for example, to make miso soup from cashews.

"In the process of optimizing the incorporation of new ingredients and equipment into the kitchen, chefs experiment in ways similar to scientists," write the authors. "Failure of a given idea gives rise to new ones, eventually leading to creations that might not even be related to the original idea." In the podcast, Brenner adds, "Teaching science through cooking is a way to capture wonder scientists who work in science have about the world."

M.P. Brenner and P.M. Sörensen: "Biophysics of Molecular Gastronomy" http://dx.doi.org/10.1016/j.cell.2015.03.002

How all of our senses contribute to enjoying a meal

Are potato chips more satisfying when there is a loud crunch? Does a glass of wine taste better in red or green ambient light? Can a color change make food taste sweeter? Charles Spence of Oxford University presents the latest research by psychologists and cognitive neuroscientists on how we use all of our senses to experience flavour and describes how chefs and the food industry are taking these insights into food design. "The last decade or so has seen an explosion of new research demonstrating the impact of visual, auditory, and oral-somatosensory cues in modulating our experience of food and drink," he writes. "There is intriguing preliminary evidence, at the both the behavioural and neural levels, to suggest that there may be some important differences [between flavor expectations and flavor experiences]."

C. Spence: "Multisensory Flavor Perception"
http://dx.doi.org/10.1016/j.cell.2015.03.007

To meet global food demand, increase crop photosynthesis

As the human population continues to grow, the already difficult problem of getting people access to food will soon be coupled with a deficiency in food production. Current estimates predict that 9.5 billion people will be walking the Earth by 2050, and the question now arises, can we plan today to feed them all? One solution, heralded by Stephen Long, a Professor of Plant Biology and Crop Sciences at the University of Illinois, is to increase the energy potential of major crops by genetically engineering them to be better at photosynthesis.

He argues that this is already possible as photosynthesis is the best understood of all plant processes, the emergence of high performance computing allows simulations to predict the best genetic changes to make, and genetic engineering has become routine for a wide range of crops. "Given the 20 to 30 year gap between demonstration of innovative solutions at the experimental level and provision of seed to farmers, the need to bridge and accelerate the gap between molecular engineering and practical crop breeding to achieve higher yields cannot be postponed," Long writes.

S.P. Long, A. Marshall-Colon, and X.-G. Zhu: "Meeting the Global Food Demand of the Future by Engineering Crop Photosynthesis and Yield Potential" http://dx.doi.org/10.1016/j.cell.2015.03.019

Unlocking the benefits of dietary restriction for humans

Scientists showed 80 years ago that rats given less to eat live longer and healthier lives. Since then, dietary restriction experiments have shown similar benefits in flies, fish, worms, chickens, dogs, monkeys, and other animals. It's time to start seriously pursuing this research in humans, say longevity researchers Luigi Fontana of Washington University in St. Louis and Linda Partridge of the Max Planck Institute for Biology of Ageing.

"Dietary interventions that avoid unrealistic levels of self-deprivation and pharmacological interventions that recapture beneficial effects of [dietary restriction] are important goals to improve human health during aging," they write in their Review of the field. From their analysis, they conclude that more work is needed to conduct human experiments, including the development for biomarkers (e.g., protein levels in a blood test) that can identify differences between an individual who is eating well versus someone who is starving, as well as that can be used as metrics in clinical trials.

L. Fontana and L. Partridge: "Promoting Health and Longevity through Diet: From Model Organisms to Humans"
http://dx.doi.org/10.1016/j.cell.2015.02.020

Provided by Cell Press