

Computational gastronomy*

The word ‘symposium’ is derived from a Latin phrase meaning to drink together. The symposium on computational gastronomy held recently at Indraprastha Institute of Information Technology Delhi (IIIT-Delhi) was not really a drinking party – the participants were drinking in the details of new scientific discoveries on food.

Chefs from five-star hotels, captains of food and beverage industries, faculty and students of hotel management and culinary arts, bureaucrats from the Department of Tourism, Government of India (GoI), journalists and plain ordinary foodies were trying to come to grips with the complexity of the big data related to cuisines.

The Complex Systems lab at the Centre for Computational Biology, IIIT Delhi – they call it cosy lab for short – is indeed cosy. No smell of chemicals, no glassware. But there is computer hardware galore, and B Tech and M Tech interns and Ph D scholars probing data to find patterns.

Probing data is something that Ganesh Bagler (IIIT-Delhi) has been doing for some years now. First, he extracted data from more than 2000 Indian recipes on the internet. He demonstrated that, in Indian recipes, food pairing is done by contrast, not by similarities as is the case in Western cuisine. Then, his team brought together data on more than 25,000 flavour molecules, organizing them into categories, mapping them to source raw materials to allow chefs to pick, find and innovate flavour pairs. A limited version of the database, FlavorDB, is now freely available as an Android application. However, the web application is more elaborate. It allows visual search, searching via textual query, or by drawing the chemical structure. You can search for structurally similar molecules within the database as well as from external sources.

Moreover, there is a list of 33 receptors known to be involved in gustatory

sensation and a list of 1068 odour receptors. Therefore, it is a useful database for biologists to explore the interaction of flavour molecules with receptors and to probe the mechanism of action responsible for flavour sensation.

Delineation of the network topology of data is still incomplete. Most nodes are in place and there are indeed missing links. Thus a virtual playground has been created for computational biologists. Rudraksh Tuwani (IIIT-Delhi) gave a quick tour of <https://cosylab.iiitd.edu.in/flavordb/> for the cuisine aficionados assembled there.

Products leverage on appeal to senses and brands subtly position themselves using colour, sound, smell, touch, taste, texture and flavour, said Jaspal Sabharwal (TagTaste) in his keynote speech. TagTaste is an app that helps companies generate data on customer reactions to food and beverage products. A short training of respondents is necessary so that they can confidently convey their sensory evaluations of food products. The app was demonstrated by collecting data on a specific brand of coffee and a chocolate from the participants.

Y. B. Mathur (Culinary Design and Application Group, New Delhi) said that computational data mining and analytics serve as an important aid not only to chefs, but to the gastronomy business as a whole – for purchase and vendor management, stores and inventory management, analysis of optimum saleable yield of raw ingredients, for control over costly food products and raw ingredients, to identify trends for forecasting the right quantities of food for à la carte, buffet and banquets, for expense analyses and so on. Hospitality majors use computational analytics with custom-made software. Gastronomy was considered a subjective arena, but not any more, given the new databases such as FlavorDB, proclaimed Mathur.

Diet and diseases

Diet and diseases are related. The constituent chemicals in our diet and their relationships with diseases have also been examined. Text mined from biomedical

literature using entity recognition tools brought together data. A deep learning-based relation classification model, trained with a significant amount of manually curated data, laid the foundations of another database – of 21,207 positive/negative food–disease associations for 1781 food entities belonging to 24 categories.

The next step was interlinking 6992 food chemicals and 20,550 disease-related genes, compiled from curated data sources. Bringing together available data on diets and their associated health consequences, on the chemical components of foods, and on genes associated with diseases is not a mean task. But now that it is done, it will enable data-driven inferences. The results can be used for culinary interventions, to generate insights into nutrigenomics as well as for drug discovery endeavours. Bagler and his students gave a quick overview of DietRx (<https://cosylab.iiitd.edu.in/dietrx/>)

Gurmeet Singh (Centre for Ayurveda Biology and Holistic Nutrition, The University of Trans-Disciplinary Health Sciences and Technology, Bengaluru) talked about *in silico* design principles of food. He pointed out the need for modernizing Ayurveda disciplines using algorithms and network pharmacology.

Mitali Mukherji (CSIR-Institute of Genomics and Integrative Biology, New Delhi) took the idea forward with a talk on Ayurgenomics. Her work on genomic and biochemical correlates of constitutional typologies in Ayurveda and her explorations in disease–gene interconnections in the Indian genetic landscape gave sufficient background data and impetus for research in Ayurgenomics.

Sweet or bitter?

Given a molecule, can we predict whether it will be sweet or bitter? There are about 3000 molecules with verified taste information from ten different resources which are divided into three taste categories: bitter, sweet or tasteless. Train the system with the given data and then predict the taste of 60,000 more. This is what another application, BitterSweet, does. Somini Wadhwa (IIIT-Delhi)

*A report on the Symposium on Computational Gastronomy: The emerging data science held at New Delhi on 8 December 2018.

demonstrated BitterSweet (<https://cosylab.iitd.edu.in/bittersweet/>).

The system not only distinguishes between bitter and sweet, but gives a relative measure of sweetness – a sweetness index – pointed out Bagler. The system is still under scientific review. But food industries catering to diabetics have all the data they need in one place.

Akshay Malhotra (ITC WelcomHotel, Dwarka) pitched a chef's intuition against data-driven computation. Good chefs overcome the limitations of their discipline by leveraging on experience and intuition. While data can indeed help nucleating new dishes, experience and expertise give chefs an edge. He took the simple example of making lemonade. Even people trained in hospitality and catering courses may squeeze the lemon and throw the rind away. But an experienced chef knows that by dropping the rind into the lemonade, the acidity is neutralized to some extent, and the lemonade tastes better.

In a panel discussion that followed, Bagler pointed out that the culinary fingerprints of regional cuisines in India as well as the data-driven analyses of culinary patterns in traditional recipes across the world are useful to the hospitality and tourism industry.

Gyan Bhushan (Ministry of Tourism, GoI) expressed his Ministry's interest in computational gastronomy and mentioned scope for funding.

Sabyasachi Mukhopadhyay (IISER-Kolkata) who has donned the hat of an entrepreneur, mentioned that commercial exploitation of the studies is limited. He pointed out that software apps can be patented only if there is a hardware component. So unless such studies are funded, there is little possibility of investment from venture capital.

This brought home the points that Ranjan Bose (IIT-Delhi) mentioned at the beginning of the symposium. He expressed willingness to collaborate with researchers from other institutions and

the corporate sector to vitalize the ongoing research further. He pointed out the possibilities for the corporate sector: establishment of professorial chairs, instituting scholarships, supporting internships, etc.

This is the only way forward, as the lead investigator, Bagler, is a proponent of open and free sharing of research data. For him, there is more in research than merely making money. The research avenues that are opening up because of the creation of such databases are exciting. For example, data analytics can also decipher culinary evolution. A Darwinian look at the culinary landscape of the world may even bring out parallel relationships between culinary evolution and the evolution of languages and human genetics.

K. P. Madhu, Science writing consultant, *Current Science*.
e-mail: scienceandmediaworkshops@gmail.com

MEETING REPORT

The art of science writing*

Science writing is the art of effectively communicating research. As with any other art form, to excel in science writing, one needs to use imagination to capture interest.

India is becoming a science hub with substantial growth in the research community and research output. Yet, science communication and reporting is poor in the Indian context. This is mainly due to a lack of understanding of the world of science publications and the availability of platforms for writing science. Effective communication and publication demand time and effort. With the challenges involved in science writing in mind, the Current Science Association, Bengaluru has organized workshops to improve science writing, provoke scientific temper and promote science writing

skills among researchers and science faculty.

The eighth science writing workshop was held recently, with an online discussion group formed a few weeks before the event.

A total of 14 participants – ten scientists, one postdoctoral researcher, one senior research fellow and two Ramaseshan fellows attended the workshop. They belonged to various age groups and were from different institutions across the country.

The welcome address was delivered by G. Madhavan (Executive Secretary, Current Science Association). The keynote address by S. K. Satheesh (Chief Editor, *Current Science*) provided a glimpse of the history and mandate of *Current Science*, and the types of research articles published in the journal. He also highlighted manuscript categories in the journal and some common problems from the editor's perspective.

The workshop was effectively monitored and conducted by K. P. Madhu

and Gita Madhu. Participants were orientated, in a scientific manner, to understand and report natural phenomena using logic. Madhu stressed on the need to overpower cultural, social and psychological barriers against asking questions.

Yateendra Joshi (freelance science editor) in the session on writing scientific papers, described the generally accepted IMRaD structure of scientific writing: introduction, materials and methods, results and discussion. He also explained how to interpret and discuss the results. Joshi also discussed what should and should not be considered as keywords, and how keywords impact the visibility of a research paper. He highlighted the common mistakes made by authors while submitting their manuscripts – overlooking aim, scope and reference style of the journal. He also warned against predatory journals and informed participants about websites which provide a detailed list of authentic journals.

The workshop was highly interactive and also provided background knowledge

*A report on the Science Writing Workshop held at Divecha Centre for Climate Change, Indian Institute of Science, Bengaluru, during 3 to 10 February 2019.