What was discussed during the 12th International Workshop on Molecular and Physical Gastronomy

Thursday May 11:

Opening session:

Hervé This introduced the workshops, with historical perspective.

His powerpoint is here:
https://icmpg.hub.inrae.fr/international-activities-of-the-icmpg/workshops2/iwmpg-122/presentations-12-iwmg

Along with this presentation, and in order to invite the participants to make practical experiments, Hervé This made an demonstration for interpreting browning of food during cooking, showing that the most efficient reactions are sugar caramelization and protein pyrolysis: in a pan, there was the simultaneous heating of proteins (gelatine, egg proteins), flour (including starch and proteins), corn starch, potato starch, sucrose. Starch remained completely white.

If one to repeat the experiment, gelatine should be a powder rather than sheets. Milk proteins could be added, as well as hamp proteins, or other plant proteins. And one could also add a mixture of a reducing saccharide (D-glucose, D-fructose) and proteins.

Roisin Burke made a brief overview of the presentation topics and discussed the organization of the workshop.

Alan Kelly discussed the *Handbook of Molecular Gastronomy*, and the next book to be published, which will be a shorter book of recipes and techniques in molecular cooking/molecular cuisine, and note by note cooking, featuring commentary on the techniques and approaches; information about the inspiration and motivations of the creators of the featured recipes will be given (CRC Press).

Session 1: Flavour created by chemical processes (glycation, hydrolysis, oxidation, etc.)

The first talk was by **Hervé This**, based on a very recent paper published by IMARS (https://seafile.agroparistech.fr/f/ddbdcdbc388b45579805/?dl=1), demonstrating – with precise references to primary sources- that there one should not speak of “Maillard reactions”, as Louis Camille Maillard did not discover the reactions between amino

compounds and saccharides (it was Lucien Dusart, 50 years before), and he did not find either the mechanisms of these reactions (the main contributions were from Ugo Schiff, Emil Fischer, Mario Amadori and Kurt Heyns, plus others).

Accordingly, it is proposed to speak of « glycation reactions », or preferably « amino-carbonyl reactions ».

The ppt presentation here:
https://icmpg.hub.inrae.fr/international-activities-of-the-icmpg/workshops2/iwmpg-122/presentations-12-iwmg

Session 2: Flavour created by physical processes (the release of compounds by grinding, heating (no chemistry, but phase transition, i.e. flavour release) or chewing

Marisol Herrera Jimenez discussed chemical interactions between odorant compounds and a meat emulsion as a model system. She shared the results of a study focused on the release of a set of odor compounds that constitute meat aroma using a model system. Meat aroma comprises a wide variety of chemical compounds. It is the result of a number of factors such as substrate composition, pH, water activity, processing and storage conditions, and gas atmosphere, among others. It has been reported as composed of approximately 700 chemical compounds, generated in the fat and lean meat. However concentration and type of meat aroma compounds varies with species, breed, premortem handling, and processing, among other factors. Although type and concentration of volatiles present in meats result from diverse conditions and characteristics, aldehydes such as hexanal, octanal, and nonanal and pyrazines are indicators of meat aroma. Contribution of chemical compounds to meat aroma depends on their release from the food matrix which, in turn, depends on ion strength, temperature, presence and concentration of other compounds, and hydrophobicity. Proteins particularly affect aroma perception due to interactions with aroma-related compounds. Lipids greatly influence flavor through their effect on perception (mouth feel, taste and aroma), flavor generation and stability, whereas carbohydrates tend to increase retention in the matrix. Food structure is also associated with release of aroma compounds. In a two-phase system such as a protein emulsion, the concentration of these compounds in the lipid and aqueous phases, as well as the interface results in specific contributions due to diffusion to the gas phase.

H. This discussed the interpretation of these results, proposing to use the log P (or log.Kow), i.e. 1.8 for hexanal, 3.3 for nonanal, for interpreting the results. There was a lively discussion, and the works of Carole Chatelain and Elisabeth Guichard on emulsions was quoted.
Some references were exchanged:
- Maillard, M. N., Soum, M. H., Boivin, P. and Berset, C., (1996). Antioxidant activity of barley and malt: Relationship with phenolic content. Lwt-Food Sci Tech, 29(3), 238–244. https://doi.org/10.1006/fstl.1996.0035
- Van Boekel, M. A. J. S., (2001). Kinetic aspects of the Maillard reaction: A critical review. Nahrung - Food, 45(3), 150–159. https://doi.org/10.1002/1521-3803(20010601)45:3<150::AID-FOOD150>3.0.CO;2-9

- https://www.sciencedirect.com/science/article/pii/S0958694613002070
- https://www.scientificamerican.com/article/3-d-printed-chicken-dinner-cooked-by-lasers/
- https://www.sciencedirect.com/science/article/pii/S0958694613002070
- Marielle Charles, Valerie Rosselin, Laurence Beck, François Sauvageot, and Elisabeth Guichard, Flavor Release from Salad Dressings: Sensory and Physicochemical Approaches in Relation with the Structure, J. Agric. Food Chem. 2000, 48, 5, 1810–1816.

Ricardo Medina, from the Ambrosia Culinary Center, in Mexico City discussed how to use of cactus (nopal) mucilage (*Opuntia ficus indica*) as a stabilizing agent in an avocado (*Persea americana)* flavored emulsion.
An extraction of the nopal mucilage was carried out by cooking the nopal in water, at different nopal/water ratios, temperatures and cooking times. The samples of emulsion made with different concentrations of added nopal mucilage were photographed using an optical microscope to observe the distribution and particle size corresponding to the dispersed phase (olive oil). One more characterization was a flavor profile in which the sample with the highest acceptance was determined, for which an acceptance test was previously carried out consisting of the ordering of the samples made from the lowest to the highest level of satisfaction.

During the discussion, it was noted that:
-often, in the kitchen, the word “stabilization” is inexact, as the systems are not thermodynamically stable; it’s only metastabilization
- mayonnaise is a name that should be given only to mayonnaise, i.e. the emulsion obtained from egg yolks, vinegar, salt, pepper and oil ; any other system is not a mayonnaise, and the name for it should be “emulsions”; mind that if mustard is present, it becomes a “remoulade” ;
- about extraction: the more water the more solutes extracted in the solution during thermal treatment, as demonstrated by Antoine Laurent de Lavoisier in a paper on meat stock;
- the question of “quality” of emulsions was discussed: the question, about it, is to know what an “good” emulsion is, as there can be questions of flavour release, metastability, optical appearance, etc ;
- finally, it was repeated that an emulsion can hardly been produced with less than 5% water, and having less than that (in particular through evaporation or adding more oil) is a frequent cause of phase separation)
- if a gel was produced with the mucilage, a surfactant is probably extracted
- an emulsion with mustard is a “remoulade”
- from any plant or animal tissue, ground with oil, you can make an “olli” (proposal H. This, 1985); in particular, with avocado, you can make an avocadolli.
- for avoiding the enzymatic browning, ascorbic acid is efficient
- for sensory evaluation/comparison, triangular test should be generally performed, otherwise they are useless
- concerning food appreciation, we should never confuse the technique and the art (the “good” is the “beautiful to eat”).

Session 3: Flavours of drinks (infusions, macerations, decoctions, fermentations...)

In this session chaired by **Christophe Lavelle**, the first talk (by Christophe Lavelle) was about kefir and kombucha. Much work is done nowadays about such beverages, but more microbiology remains to be done, in particular for reproducing the kefir “seeds”. Effects on nutrition were discussed.

Slides here : https://icmpg.hub.inrae.fr/international-activities-of-the-icmpg/workshops2/iwmpg-122/presentations-12-iwmg

See also the corresponding chapters in the **Handbook of Molecular Gastronomy.**

During this session, **Hervé This** showed results from Stéphane Besançon, Valentine de Raigniac, Lorena Modestin, Damien Saveant and himself, about the distribution of sodium in roots of *Daucus carota* L. during a thermal processing in water (100°C). Processing solutions with or without added salt were studied, and the analysis was made using atomic absorption spectrometry.

H. This also discussed how saccharides move from roots of *Daucus carota* L. (“carrots”) to water during thermal processing. This had been studied experimentally by Anne Cazor *et al*. (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, J Agric Food Chem, (13):4681-4686 2006), but now a new model is proposed for the making of “carrot stocks”, i.e. aqueous solutions obtained by thermal treatment (100 °C) in water of carrots.
A quantification of sucrose hydrolysis is now possible *in situ*.
During the discussion, interesting questions of photochemistry were discussed, for the color of carrot stock as for lipid storage. Are there other cases in which this is important ?

Friday May 12:

Session 4: Flavour created by biological processes: fermentation, enzymes

This session was the opportunity to recognize that biology should be included in “molecular gastronomy”.

Because "molecular, physical and biological gastronomy" is too long (and useless), we decided for "Molecular Gastronomy", rather than “Molecular and Physical Gastronomy”, as this covers chemistry, physics and biology. For the three fields, we focus (this is science) on mechanisms. Changes will be made in the internet site of the Centre, as well as in the journal.

Session 5: Flavour and sensory analysis

After this presentation, **Andreas Reidl,** from Tereos, showed plant based aiguillettes. We discussed their flavor, their use, and the change of their colors.

Session 6: Flavour and cooking: the educational issue

Róisín Burke, from the School of Culinary Arts and Food Technology, TU Dublin, discussed how Culinary Science students could learn to use rotary evaporators. Indeed Rotary evaporators are primarily used in chemistry laboratories, however, they can also be found in some restaurant kitchens such as Alinea Restaurant in Chicago, or at Denis Martin, in Switzerland. In those restaurants the rotary evaporator is used to extract herb aromas like basil and to distil the pure chili's essence so that the chemical capsaicin, responsible for the heat, is left behind. Using a rotary evaporator in the kitchen classroom is a way for culinary science students to learn about the separation of food compounds, through evaporation and condensation. Culinary applications include (1) the concentration of non-volatile components in a mixture by the removal of water and (2) the gentle extraction of volatile aroma and flavour molecules from mixtures at low temperatures. Recipes can be developed to include infused flavours from concentrates which have been extracted with a rotary evaporator. The use of a rotary evaporator as an educational tool for culinary science students was discussed.

Second year Culinary Science students in TU Dublin.

This session was the opportunity to discuss molecular cooking, i.e. the use of new tools imported from laboratories. In particular, cryoconcentration was discussed.

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Also in this same session, **Rodrigo Duarte-Casar**, from Universidad Técnica de Manabí, Ecuador, and **Marlene Rojas-Le-Fort,** from Pontificia Universidad Católica del Ecuador, discussed STEM Teaching through Bar Service.
This programme was a way to deal with the students attraction to alcohol : this attraction can be turned as an opportunity to teach physics and chemistry (in this programme, to both culinary and non-culinary students in the Ecuadorian Coast region using a Bar Service class). Topics to be discussed are the physics of water and ice, cooling, dilutions, and the physical, chemical and perceptual bases of sweeteners, acids, infusions, tinctures and other flavor extraction and production processes. The learning objectives are: (1) prepare and serve an assortment of classic drinks, both alcoholic and non-alcoholic; (2) understand and apply principles of energy flow and phase changes in the chilling of drinks; (3) understand and use flavor and smell effectively in drinks; (4) control texture and mouthfeel in drinks; (5) learn how to drink responsibly.

During the discussion, the former contest for cocktails (how to increase the number of layers in a cocktail) was discussed : see the chapter on ‘’Welcome coffee’’ in the **Handbook of molecular gastronomy.**

It was also indicated that beverages such as Schweppes contain quinine, which is fluorescent.

Also it was observed that the speaker did not make the confusion, between molecular gastronomy and molecular cooking (forget the useless expression “modernist”), which is fine, and did not speak of “mixology”, which is also fine, as making cocktails is not the same as studying them.
Note by note cocktails were discussed: it was a topic of a former note by note contest.
The toxicology of thujone was discussed.

A discussion followed about the way to name such questions, based on the fact that the Handbook of molecular gastronomy used « educational practices ».

After discussion it was decided to call it « Molecular Gastronomy and Education »

Session 7: About the International Contest on Note by Note Cooking: food waste and losses; what about flavour?

Volker Hessel, from the University of Adelaide, School of Chemical Engineering, discussed the « Harmonic Psychology of a Space Salad’’, i.e. a computer-designed dish and opportunities for marketing.

Also, good news about where to find odorant notes were given : the activities of Iqemusu - Michael Pontif (cooking notes and training) are taken over by Kitchen Lab (Pasquale & Dao) from May 2023.
Cooking notes are now ready to order, just email : kitchenNlaboratory@gmail. com Fifteen cooking notes are available (see internet site).
Pasquale Altomonte is a chef-entrepreneur and culinary artist who has participated in more than 40 competitions (Bocuse d'Or, International Note by Note Cooking competition, Swiss Culinary Cup, etc.).
Dao Nguyen is a doctor in pharmaceutical sciences and passionate about cooking. Coached by Pasquale Altomonte, she participated in the MasterChef show.
Both regularly speak at conferences on the theme of science and the cuisine of tomorrow, where they present their culinary innovations, accompanied by demonstrations. Waste-free cooking is a subject close to their hearts.
Practical training in science and cooking are also available in Geneva.

Session 8: General discussion and planning

Christophe Lavelle insisted that we would make more experiments, i.e. a kitchen could be used. A culinary school will be approached.

About the I*nternational Journal of Molecular and Physical Gastronomy*, it was discussed that the Editorial Board should be increased. Cleo Croze applied, and other proposals can be sent to H. This, who will propose them to the board of Editors.

The topic of the next workshop was discussed, and it was decided that we would focus on « **Consistencies and Texture** ». A doodle has to be done about choosing the time of the year.