

# 11 th International Workshop on Molecular and Physical Gastronomy (IWMPG 11)

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Room 30

**2-3 June 2022**

Organized by:  
**AgroParisTech-INRAE International Centre for Molecular Gastronomy**

**Under the patronage of the Académie d'agriculture de France**



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**Scales**  
**Describing and analyzing food and**  
**culinary transformations at various**  
**scales**  
**(from molecular to macroscopic),**  
**building food at all scales**

**INRAE**

**ICMPG**

AgroParisTech

**Director:** Hervé This vo Kientza

**Organization Committee:**

**Pr Róisín Burke (Technological University Dublin, Ireland), Pr Alan Kelly (Cork University, Ireland), Christophe Lavelle (MNHN, France), Pr Hervé This vo Kientza (AgroParisTech-INRAE, France), Pr Dan Vodnar (University of Cluj-Napoca, Romania)**

## Purpose of the Workshop

« *La gastronomie est la connaissance raisonnée de tout ce qui se rapporte à l'homme en tant qu'il se nourrit* » (Gastronomy is the reasoned knowledge about man's nourishment)

Jean Anthelme Brillat Savarin (1755-1826)

Writing about the application of the chemistry to the art of cookery:

« *In what art or science could improvements be made that could more powerfully contribute to increase the comforts and enjoyments of mankind* »

Sir Benjamin Thompson, Count Rumford, (1753-1814)

« *Molecular gastronomy is the scientific activity consisting in looking for the mechanisms of phenomena occurring during dishes preparation and consumption* »

Hervé This and Nicholas Kurti, (1988)

The above quotations from the writings of two founders of Molecular and Physical Gastronomy express in a nutshell the spirit and the objectives of the Workshop: the emphasis will be on gastronomy rather than nutrition, on domestic and restaurant cooking rather than industry.

The object of this workshop will be to bring together a group of scientists to discuss collectively the science behind the practices carried out in the kitchen.

### What is a workshop?

The *Oxford English Dictionary* defines a workshop as “a meeting at which a group of people engage in intensive discussion and activity on a particular subject or project”.

Workshops, similar to seminars, are usually much smaller than conferences – a workshop can be an element of the conference structure.

Workshops typically tend to be:

- Interactive
- Educational
- Conversational

May we also point out that, as the name IWMPG « N. Kurti » indicates, this is a workshop and that participants are encouraged to show experiments.

Talks should never be more than 30 min, so that discussion is promoted (of course, one can have more slides in order to be ready for the discussion).

The primary goal is not to make conferences, but to discuss actively in all scientific directions: materials and methods, results, interpretations, consequences, scientific strategy.

Also, as workshops are more informal than conferences, we could keep the visio links open during the break and lunches, so that discussions can go on, and one could discuss other questions than suspensions during such times.

**Mind that the texts from some talks can be submitted as manuscripts for the *International Journal of Molecular and Physical Gastronomy*.**

# Schedule

## Thursday June 2<sup>nd</sup> : Describing food at all scales

**9.00-10.00**

**Opening session**

Hervé This : Introduction (MPG, the IWMPG, active workshops)

Roisin Burke: About ‘describing and analyzing food and culinary transformations at various scales (from molecular to macroscopic), building food at all scales’. A brief overview of the presentation topics.

Dan Vodnar : Organization of the workshop

Alan Kelly : Discussing the Handbook of Molecular Gastronomy

Christophe Lavelle:

**Presentation of the participants**

**10.00-12.30**

**Session 1: Macroscopic organization**

**Chairperson: Alan Kelly**

**Christophe Lavelle : Kefir**

Water kefir is a fermented drink produced by the action of a Symbiotic COmmunity of Bacteria and Yeasts (SCOBY) contained in grains made from a polysaccharide matrix. It is supposed not only to be tasty but also to have many health benefits. From social studies

analyzing consumers motivations and statements to molecular understanding of the fermentation process, we will provide a brief multiscale (from human to molecule) description of this still mysterious but quite trendy drink.

Q/A, Discussion

### **Rodrigo Duarte Casar : Visual cues for doneness in traditional Ecuadorian preparations**

Abstract: The aspects that we can perceive in food are in good part macroscopic: changes in color, texture, glossiness and others are macroscopic. On the other hand, smells remain in the realm of the molecular. In this work the criteria for doneness of several traditional Ecuadorian dishes with emphasis in coastal dishes, are reviewed through interviews and classified as either macroscopic or non-macroscopic, and ingredient transformations are tentatively assigned to them: color, viscosity, transparency, smell, elasticity, with the objective of defining a study plan on Ecuadorian gastronomy from a scientific point of view.

**14.00-15.00**

**Session 2 : Microscopic organisation**

**Chairperson: Christophe Lavelle**

### **Anne-Laure Fameau<sup>1</sup>, & Carolina Dari<sup>1</sup> : Non-aqueous foams stabilized by crystalline particles: from design to applications**

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Liquid foams are complex colloidal systems based on gas bubbles dispersed in a liquid continuous phase (1). Two different categories of liquid foams exist: aqueous or non-aqueous. In contrary to aqueous foams, which have been extensively studied, non-aqueous foams represent a new promising emerging field 1. Two types of non-aqueous foams are gaining interest: oil foams based on vegetable oil (oleofoams) and alcohol-based foams (2,3).

Oleofoams are a promising option to develop new food products combining both a reduced fat content and new appealing textures and sensorial properties. Alcohol-based foams are gaining interest nowadays since the global pandemic due to COVID-19 and the frequent use of alcohol-based hand sanitizers as recommended by the World Health Organization. The main difference between aqueous and non-aqueous foams comes from the relatively large difference in the surface tension of the solvents (1). For non-aqueous systems, the low surface tension makes the adsorption of hydrocarbon-based surfactants energetically unfavourable. One way to produce and stabilize non-aqueous foams is to use surfactant crystalline particles, which can adsorb at the air-liquid surface (4).

In this talk, we will present how natural fatty acids crystalline particles can lead to the production and stabilization of both oleofoams and alcohol-based foams (2,5). The formation and stabilization mechanisms of these two types of non-aqueous foams are the same and

based on the adsorption of fatty acid crystalline particles at the air-liquid surface, which reduce the bare surface area by their presence rather than lowering the surface tension (4). The key parameter for fatty acid crystals to adsorb at the air-non-aqueous liquid surface is to exhibit a suitable three-phase contact angle below 90°. These foams are ultrastable due to the dense layer of adsorbed crystals at bubble surfaces that considerably reduce both disproportionation and coalescence. We will also show some recent results on the formation and stabilization of foams based on sucrose esters and various alcoholic beverages based on similar stabilization mechanisms.

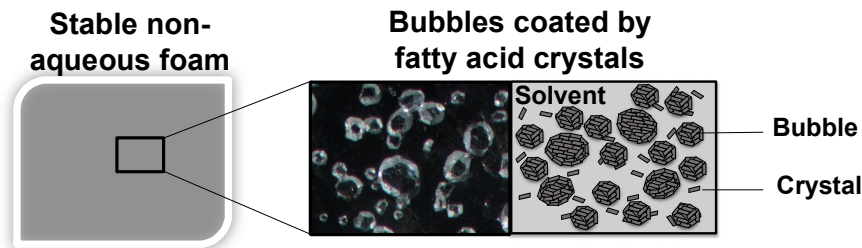


Illustration of non-aqueous foam stabilized by the presence of fatty acid crystals both in bulk and at the interface as observed by polarized light microscopy

## References

1. Fameau A-L, Saint-Jalmes A. Non-aqueous foams: Current understanding on the formation and stability mechanisms. *Adv Colloid Interface Sci.* 2017;247:454–64.
2. Fameau A-L, Ma Y, Siebenbuerger M, Bharti B. Foamitizer: High ethanol content foams using fatty acid crystalline particles. *J Colloid Interface Sci.* 2021;600:882–6.
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4. Fameau A-L, Binks BP. Aqueous and oil foams stabilized by surfactant crystals: new concepts and perspectives. *Langmuir.* 2021;37(15):4411–8.
5. Callau M, Sow-Kébé K, Jenkins N, Fameau A-L. Effect of the ratio between fatty alcohol and fatty acid on foaming properties of whipped oleogels. *Food Chem.* 2020;333:127403.

Q/A, Discussion

**15.00-15.30**

**Break**

**15.30-17.00**

**Session 3: Nanoscopic organization**

**Chairperson: Christophe Lavelle**

**Jose M. Aguilera, The concept of food matrix and opportunities in alimentation  
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The concept of food matrix (FM), which is not synonymous with food structure, provides a new approach to the understanding of the role of chemical components, nutrients and bioactives in real foods and in our alimentation. Food components are not in a free and isolated form (i.e. as traditionally studied in nutrition research) but are part of complex multicomponent systems and susceptible to multiple interactions at different time and length scales during food processing, preparation and digestion. The FM-effect represents the complex assembly of nutrients and non-nutrients interacting physically and chemically, which influences the release, mass transfer, accessibility, digestibility, bioactivity and stability of many food compounds. The FM-effect has implications in nutrition and health, sensory properties, and even the quality and relevance of results of analytical techniques.

### *References*

- Aguilera, J.M. 2022. Rational food design and food microstructure, *Trends in Food Science & Technology* 122: 256-264.
- Aguilera, J.M. 2018. The food matrix: Implications in processing, nutrition and health. *Critical Reviews in Food Science and Nutrition* 59(3):1-43.
- Feeney, E.L. & McKinley, M.C. 2020. The dairy food matrix: What it is and what it does. In *Milk and Dairy Foods* (book), pp. 205-225.

## **Schmidt, Svenja 1,2; Tran, Nam Nghiep 1; Fisk, Ian 2; Hessel, Volker 1 : Reimagining Space Foods: Fortified designer beverages for astronauts made in continuous micro-flow**

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Current space food systems are not appropriate for deep-space, long-term missions. The nutritional value, the palpability, and organoleptic properties of space foods need improvements to stimulate appropriate food intake. Therefore, we are developing a space beverage system that adjusts the beverage's taste and nutritional value to the astronaut's individual likes and needs, utilizing beverage nanoemulsions to incorporate hydrophilic (micro-)nutrients and flavour components while providing high bioavailability. Thereby, we can address space-specific health threats such as microgravity-related bone loss with an increased intake of omega-3 fatty acids. We continuously form the emulsions by microfluidics, a space-proven technology with excellent droplet-formation and mixing characteristics. Microfluidics also allows to compose a multi-product continuous processing plant, based on a modular design, as shown for the manufacturing of bespoke inks on a commercial scale. We aim for the multi-product design of the modular microfluidic units to provide a personalised drink offer.

By placing a hydrophilic surfactant in the organic phase (i.e., spontaneous emulsification) of a model system nanoemulsions ( $d_{32} \approx 100$  nm) were reliably obtained. Results showed that the initial position, concentration and nature of the surfactant influences the particle size

distribution, the Sauter diameter and the stability of the beverage emulsions, and are furthermore aligning with literature data. Compared to a macrofluidic setup (burette), a microfluidic device was able to form emulsions considerably faster (time reduction by a factor of 5) and potentially more efficiently, i.e. forming emulsions with smaller droplet sizes at certain surfactant concentrations. By using our random positioning machine that simulates micro/partial gravity conditions, we compared the emulsification process in simulated Moon gravity with terrestrial gravity conditions. In simulated partial microgravity, the spontaneous emulsification methodology also produced reliably emulsions, proving that the approach is suitable for a space application. However, compared to the mixing setups used under terrestrial gravity conditions, the particle size showed a high standard deviation as well as strong dependency to the oil content while the surfactant-to-oil-ratio was kept constant. Thus, simulated partial gravity alone is not sufficient to form the targeted emulsions, underlining the need for a sophisticated combination of surfactant system and microfluidic mixing setup for a resource-efficient device.

Next studies will investigate the impact of flavour and nutrient compounds on the characteristics of the emulsion in order to establish a library of suitable recipes for fortified designer beverages which enhance health and well-being in space.

Q/A, Discussion

# Friday June 3<sup>rd</sup> : Describing culinary transformations at all scales, and building food at all scales

**09.30-10.30**

**Session 4: Tools for the analysis of the systems**

**Chairperson: Alan Kelly**

**Hervé This, Building food at all scales using the DSF**

Traditionnally dishes are organized by cooks at macroscopic level (This, 2012), but each part of this structure is generally a colloidal system (emulsions, gels, foams, suspensions mainly)(This, 2009). Sometimes, nanostructures are present, within the various phases of these colloids. And also



molecular organization can be made, either spontaneously or on purpose. At each of these levels, a formal description can be given using the "dispersed system formalism" (This, 2017). Now, all this can be applied to control bioactivity of dishes, in particular within the framework of the next International Contest for Note by Note Cooking (<http://www2.agroparistech.fr/The-10th-International-Contest-for-Note-by-Note-Cooking-is-announced.html>).

### References

Hervé This. Molecular Gastronomy, a chemical look to cooking. Accounts of Chemical Research, May 2009, vol 42, N°5, pp. 575-583, Published on the Web 05/19/2009 [www.pubs.acs.org/acr](http://www.pubs.acs.org/acr), doi10.1021/ar8002078.

Hervé This, Solutions are solutions, and gels are almost solutions, Pure Appl. Chem., 2012, 85(1) 257-276. <http://dx.doi.org/10.1351/PAC-CON-12-01-01>,

Hervé This, Statgels and Dynagels, Notes Académiques de l'Académie d'Agriculture de France/Academic Notes from the French Academy of Agriculture, 2017, 1, 1-12.

Q/A, Discussion

**10.30-11.00**

**Break**

**11.00-12.00**

**Session 5: Molecular organization**

**Chairperson: Dan Vodnar**

**Roisin Burke, Using 3D food printing and Note by Note cooking to create appetising and nourishing foods for people with eating difficulties.**

In the last decade there has been a growing interest in using 3D food printers to print meals for those with eating difficulties (Dysphagia). According to Cordis (2015), for food producers, 3D food printing evokes unlimited customisation potential for their products, as well as unique food formulations for specific dietary needs.

Similarly Note by Note cooking and cuisine can be used to create bespoke foods (Burke *et al.*, 2020) and could be used together with 3D food printing to create appetising and nourishing foods for those with eating difficulties. As in Figures 1 and 2 below, 3D printed customized foods can be prepared using the International Dysphagia Diet Standardization Initiative (IDDSI) framework which describes food textures and drink thickness (<https://iddsi.org/>). The levels 1-4 are used for drinks and levels 3-7 for foods.

In this presentation results of initial trials for 3D printed steak and carrots will be discussed. Also discussed are the possibilities which Note by Note cuisine in combination with 3D food printing can provide for customizing foods for those with dysphagia.

Challenges included optimization of the recipe to ensure printing through the nozzle as well as optimization of the food for the diner who has dysphagia.



*Figure 1. Optimization of steak recipe before printing*



*Figure 2. Printing of a steak for those with dysphagia.*

#### *References*

Burke RM, Danaher P. and Hurley D.( 2020 )‘Creating bespoke note by note dishes and drinks inspired by traditional foods’, *Journal of Ethnic Foods*, 7(1). doi: 10.1186/s42779-020-00071-3.

Cordis (2015). Available at:3D-printed food to help patients with dysphagia | News | CORDIS | European Commission (europa.eu)

## **Alan Kelly: 3D Printing and dairy applications**

Q/A, Discussion

**13.30-14.30**

**Session 6: Can science, art and technology at all scales spice our food? - perspectives to our future food experiences**

**Chairperson: Roisin Burke**

**Anu Hopia, Bruno Mesz, Jean-Christophe Sakdavong**

Technology is an increasingly diverse part of our lives, and the dining experience is no exception. However, the essence of eating remains unchanged: when we eat, we are together, we share a common experience and we are present in a unique moment. The moment of dining is the element of our community. This is also the case in a technological world. We raised the question how to harness technology to serve that age-old meaning of communal dining. Could the combination of technology and art provide an experience of a shared meal with friends, even if we were sitting alone in our kitchen on the other side of the globe? What does cheese and wine flavored with virtual technology taste like? How can we enhance the feeling of communality and commensality by combination of technology and art? Maybe transferring the movement of the fellow-diners spoon into shared soundscape and further into the tactile sensation of your neighbors' body? More generally – How do these new technologies shape the sensory and emotional experiences of eating and dining?

Q/A, Discussion

**14.30-14.15**

**Break**

**14.15-16.00**

**Session 7 : About the International Contest on Note by Note Cooking: “savory cubes with fibers”, envisioning possibilities**

**Chairperson: Roisin Burke**

General discussion about the topic.

**16.00-16.40**

**Session 11: General discussion about:**

- next workshops,
- **International Journal of Molecular and Physical Gastronomy, with members of the Editorial Board**

**Chairpersons: Hervé This vo Kientza, Dan Vodnar, Roisin Burke, Alan Kelly, Christophe Lavelle**

Discussion of the next topic

Discussion of the structuration of the Workshop

Inviting chefs?

Introducing more of educational questions ?

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