

# 12 th International Workshop on Molecular and Physical Gastronomy (IWMPG 12)

AgroParisTech, 22 place de l'agronomie, 91120 Palaiseau (France). Salle B43  
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**11-12 May 2023**

Organized by:

**AgroParisTech-INRAE International Centre for Molecular Gastronomy**

Under the patronage of the Académie d'agriculture de France



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## Flavours through cooking: the chemical and physical transformations

**Organization Committee:**

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

Director: Hervé This vo Kientza

## 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 exploring 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 speeches, but to give the information that can make a basis for active discussion in all scientific directions: materials and methods, results, interpretations, consequences, scientific strategy.

Also, as workshops are more informal than conferences, we could keep the video 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 May 11:

**9.00-10.00**

### Opening session

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

Roisin Burke: A brief overview of the presentation topics.

Dan Vodnar: Organization of the workshop

Alan Kelly: Discussing the new book after the Handbook of Molecular Gastronomy

Christophe Lavelle

### Presentation of the participants

**10.00-12.30**

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

**Chairperson: Hervé This**

1. Hervé This vs Kientza, AgroParisTech/Inrae : About amino-carbonyl reactions (again)

*As the number of scientific publications dealing with “Maillard reactions” is increasing, we have to observe that reactions between saccharides and amino compounds were discovered and investigated well before Louis-Camille Maillard, with such scientists as Lucien Dusart, Paul Thenard, Paul Schützenberger, Hugo Schiff, Emil Fischer or Oswald Schmiedeberg. After some limited work by Maillard, between 1911 and 1913, the mechanisms of these “amino-carbonyl reactions” were explored by Mario Amadori, John E. Hodge, and Kurt Heyns among others.*

2. Marisol Herrera Jimenez : *Chemical interactions between odorant compounds and a meat emulsion as a model system*

*The objective of the talk is to share the results of a study focused on the release of a set of odor compounds that constitute meat aroma using a model system.*

3. Hervé This vo Kientza, AgroParisTech/Inrae : *A simple experiment about browning.*

*A simple experiment will be shown in order to understand the various contributions of glycation, caramelization, protein pyrolysis.*

Q/A, Discussion

**14.00-15.00**

**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**

**Chairperson: Jose Miguel Aguilera**

4. Marisol Herrera Jiménez, Ambrosia Centro Culinario/Universidad Autonoma Metropolitana : *Contribution of oil (dispersed) and aqueous (continuous) phase to meat emulsion aroma.*

*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.[1] 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 [2,3] and pyrazines[4,5] 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.[6] Lipids greatly influence flavor through their effect on perception (mouth feel, taste and aroma), flavor generation and stability,[7] whereas carbohydrates tend to increase retention in the matrix.[8] Food structure is also associated to 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.[9]*

The objective of this lecture is talk about the contribution of oil (disperse) and aqueous (continuous) phase to meat aroma.

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5. Ricardo Medina, Culinary Arts Student; Ambrosia Culinary Center. Mexico City : *Use of cactus mucilage (Opuntia ficus-indica) as a stabilizing agent in an avocado (Persea americana) flavored mayonnaise: Determination of Flavor Profile.*  
Keywords: nopal, avocado, thickener, stabilizer, emulsion, endemic foods.

The objective of this work is to evaluate the nopal mucilage (*Opuntia ficus-indica*) as a stabilizing agent in an avocado flavored mayonnaise (*Persea americana*) and thus know what rheological, physical-chemical and sensory properties are provided by the mucilage in order to evaluate the stability of the dressing. To achieve this objective, 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 mayonnaise made with different concentrations of added nopal mucilage were photographed using a very basic 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.

*The winner sample was evaluated against a sample of avocado flavor mayonnaise following a standardized recipe and a sample of commercial origin. Panelists were randomly selected untrained tasters who rated texture and flavor attributes.*

6. Stéphane Besançon, Valentine de Raigniac, Lorena Modestin, Damien Saveant, Hervé This: Sodium distribution in roots of *Daucus carota* L. thermally processed in water.

*The transfers of the sodium ion was followed using atomic absorption spectrometry in roots of *Daucus carota* L (“carrots”). Contrary to sugars, a transfer through the lateral surface of the roots is likely to occur.*

Q/A, Discussion

**15.00-15.30**

**Break**

**15.30-17.00**

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

**Chairperson: Alan Kelly**

7. Dan Vodnar, Adrian Martău, Lavinia Mureșan, Bianca Vodnar ( Ștefănescu), Bernadette Teleky, Laura Coț (Mitrea) : *Bio-system for cereal waste-derived vanillin production.*

*The world market demand for flavors and fragrances, which are widely used in the food and feed as well as cosmetic and pharmaceutical industries, is continuously increasing. Vanillin (4-hydroxy-3-methoxybenzaldehyde ) is the second most important and widely used flavors in the food industry and is the main component of vanilla. *Vanilla planifolia* is the botanical source of natural vanillin and can only supply less than 1 % of the annual market demand.*

*Alternative natural sources for flavours production are needed and fermentation is, by far, the most attractive field of exploration. The goal is to move forward the knowledge in this field by using modern integrated pretreatments (physicochemical) for increased bio-accessibility of wheat bran ferulic acid, and solid-state fermentation by free and immobilized co-cultures as ONE-STEP approach in bio-vanillin production. The specific objectives of the projects were as follows: (a): Increased bio-accessibility of wheat bran ferulic acid via modern integrated pre-treatments, (b):*

*Enzyme-producing strains for ferulic acid release inside wheat bran via SSF, (c) Free and Immobilized Co-cultures and SSF for controlled bioconversion of ferulic acid into vanillin.*

Q/A, Discussion

## Friday May 12:

**09.30-10.30 Session 4: Flavours of drinks (infusions, macerations, decoctions, fermentations...)**

**Chairperson: Christophe Lavelle**

8. Hervé This : *Sugars in the solution formed through the thermal treatment (100 °C) of roots of *Daucus carota* L. in water.*

A model is proposed for the making of “carrot stocks”, i.e. aqueous solutions obtained by thermal treatment (100 °C) in water of roots of *Daucus carota* L. (carrots”).

A quantification of sucrose hydrolysis is now possible *in situ*.

Q/A, Discussion

**10.30-11.00**

**Break**

**11.00-12.00**

**Session 5: Flavour and cooking: the educational issue**

**Chairperson: Roisin Burke**

9. Róisín Burke, School of Culinary Arts and Food Technology, TU Dublin :  
Bringing rotary evaporation in the kitchen classroom

*Rotary evaporators are primarily used in chemistry laboratories, however, they can also be found in some restaurant kitchens such as Alinea Restaurant in Chicago. In that restaurant 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.



Second year Culinary Science students in TU Dublin.

*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 will be discussed.*

10. Rodrigo Duarte-Casar - Universidad Técnica de Manabí, Ecuador  
Marlene Rojas-Le-Fort , Pontificia Universidad Católica del Ecuador - Sede Manabí :  
*¡SALUD! - STEM Teaching through Bar Service*

*College students are attracted to alcohol, which can be problematic. We see an opportunity here to teach physics and chemistry to both culinary and non-culinary students in the Ecuadorian Coast region using a Bar Service class. We cover 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. The class is roughly based on the works of Dave Arnold and Jeffrey Morgenthaler. The preliminary study among students shows an interest in learning to prepare and create drinks for professional and social reasons, and even though they show moderate interest in learning STEM (Science, Technology, Engineering and Mathematics), they would use scientific tools to improve the*

*quality and impact of their culinary preparations. Even though the culinary gamut of the bartender is more limited than that of the cook, the motivation and variety is promising as a vehicle for science. Cheers!*

Q/A, Discussion

**13.30-14.30**

**Session 6: About the International Contest on Note by Note Cooking: food waste and losses; what about flavour?**

**Chairperson: To be defined**

11. Volker Hessel, The University of Adelaide, School of Chemical Engineering  
*The Harmonic Psychology of a Space Salad - a computer-designed dish and opportunities for marketing*

General discussion about the topic.

**Break**

**16.00-16.40**

**Session 8: 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