**CA22161 – Future of plant-based food: Bridging the gap of new proteins and FLAVOURsome**

# 3rd FLAVOURsome Satellite Meeting

Satellite Event integrated into the 12th European Conference on Sensory and Consumer Research (EUROSENSE)

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**7th September 2026**

## Nofima

**Vitenparken Campus Ås**
**Høgskoleveien 1, 1433 Ås**
**Norway**

**DESCRIPTION**

On 7th September 2026, a special satellite meeting will be organized before the 12th European Conference on Sensory and Consumer Research (8-11th September 2026, Oslo, Norway). Before four full days in EUROSENSE, learning about emerging challenges, the latest knowledge, and out-of-the-box ideas in both fundamental and applied sensory and consumer science, this Satellite Meeting will bring together the FLAVOURsome COST Action community and EuroSense attendees to connect fundamentals of chemosensory perception with actionable, industry-relevant pathways for improving the sensory acceptance of plant-based protein foods. Building on FLAVOURsome's "whole food × human interaction" approach, spanning food-matrix chemistry, in-mouth release and receptor mechanisms, texture/tribology, and predictive modelling for implementation in the food chain, participants will align current advances with EUROSENSE themes. This will facilitate networking, allowing the scientific community to share knowledge and work on common interests and perspectives in the field of flavour and texture research.

Leading experts from the FLAVOURsome COST Action will be invited to deliver a talk at this satellite meeting around the Working Group topics.

Our objectives in organising this satellite meeting are:

- To spread knowledge about the research conducted at FLAVOURsome COST Action,
- Encourage networking and collaborations between FLAVOURsome researchers and attendees of the EUROSENSE.

**Local Organizing Committee**

Paula Varela, Kristine M. Svartebekk, Sara Gaber, Tzvetelin Dessev, Kamaljit Moirangthem (Nofima, Norway)

**Scientific Organizing Committee**

FLAVOURsome Core Group

**VENUE**
Vitenparken Campus Ås. Høgskoleveien 1, 1433 Ås. Norway
Venue Room - Vitenteateret

**RECOMMENDATIONS OF HOTELS NEAR THE VENUE**
It is advised to select an accommodation close to Oslo central station (Oslo S), that is both accessible (by train and bus) to reach Nofima for the FLAVOURsome meeting and to the Eurosense venue.

**HOW TO REACH THE VENUE**
There are no direct trains to Vitenparken - Campus Ås from Oslo Airport, you have to change trains (and tracks) at Oslo Central Station (Oslo S)
There is a direct bus from the airport to Ås(Aas) within walking distance to Vitenparken - Campus Ås.

**Travel Instructions**
From Oslo Airport to Oslo S by train:

a) Airport express train from Oslo Airport to Oslo S (FLY1 / FLY2): Leaves every 10th minute and takes 19 min – more expensive
b) Local train from Oslo Airport to Oslo S (R12, RE10, or RE11): Leaves x:03, x:13 and x:43 every hour (until 23:43) and takes 23 min

From Oslo S to Ås/Vitenparken - Campus Ås by train:

a) Local train R21 or RE20 to Ås station (about 17 min), then walk 15 minutes to Vitenparken Campus Ås. Høgskoleveien 1, 1433 Ås. Norway.
b) Local train from Oslo to Ski: Leaves appx every 10th minute every hour (until 00:50). Then take local bus from Ski to Vitenparken Bus 510 From Ski station to Universitetet i Ås (Aas), followed by an appx. 3 minute walk to Vitenparken Campus Ås. Høgskoleveien 1, 1433 Ås. Norway

From Oslo Busterminal to Ås/Vitenparken by Bus:

a) Express bus from Oslo bus terminal to Korsegården Ås(Aas) followed by an appx. 20 minute walk to Vitenparken Campus Ås. Høgskoleveien 1, 1433 Ås. Norway

From Oslo Airport to Vitenparken Campus Ås. Høgskoleveien 1, 1433 Ås. Norway by Bus:

Express bus FB11 from Oslo Airport to Korsegården Ås(Aas): Leaves x:10 and x:40 every hour, takes 1h, followed by an appx. 20 minute walk to Vitenparken Campus Ås. Høgskoleveien 1, 1433 Ås. Norway.

**MEALS**

Lunch and coffee breaks are included and will be served during the event.

**INTERNET ACCESS**

Access to a wireless network is available at the venue. More information will be provided in the place.

## PRELIMINARY PROGRAM

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| 08:00-08:30 | **Registration and Welcome desk**<br>*Sign the COST Action attendance sheet* |
| 08:30-08:45 | **Welcome Session**<br>Kristine M. Svartebekk, Nofima, Norway |
| **08:45-09:15** | **Framing Lecture**<br>**Oral lubrication of alternative proteins: From mouthfeel to market**<br>Ben Kew, University of Leeds, UK |
| **WG1 • Chemical and physico-chemical profiling of food matrices** | |
| **09:15-09:45** | **Oral Presentations (10min each)** |
| 09:15-09:25 Extracting Structured Chemosensory Data from the Scientific Literature - Alon Nissan<br>09:25-09:35 LC-ESI-MS/MS characterization of organic selenium compounds in red wine - Violeta Ivanova-Petropulos<br>09:35-09:45 Effect of alcohol concentration on nosespace dynamic aroma release, sensory perception and saliva composition in model drinks - José A. Piornos | |
| 09:45-10:00 | Q&A |
| **10:00-10:30 Coffee Break** | |
| **WG2 • Translation multimodal oral processing** | |
| **10:30-11:10** | **Oral Presentations (10min each)** |
| 10:30-10:40 Oral Perception and Sensory Quality of Tomato Pomace-Enriched Sourdough Gluten-Free Muffins - Elena Velichkova Nikova<br>10:40-10:50 Cross-sensory Effects on Taste Perception using Extended Reality - Funda Yildirim<br>10:50-11:00 Making plant-based protein more delicious: Food aroma modification as a multisensory driver of consumer acceptance - Yici Zhang<br>11:00-11:10 Effect of visual and olfactory food cue exposure on salivary biochemical composition: a gateway to further understanding flavour and food oral processing - Carla Simões | |
| 11:10-11:25 | Q&A |
| **WG3 • Food and oral rheology and tribology inputs to flavour properties** | |
| **11:25-12:05** | **Oral Presentations (10min each)** |

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| 11:25-11:35 Synthetic data and deep neural networks enable prediction of sensory perception attributes in texture-modified plant-based smoothies - Miodrag Glumac<br><br>11:35-11:45 Tailoring the rheological and aroma profile of pea-based fermented beverages via lactic acid bacteria fermentation - Francesca Bot<br><br>11:45-11:55 The Interplay Between Inulin-Rich Polysaccharide Matrices and Flavour Release Kinetics: A Rheological Perspective on Helianthus tuberosus Fortified Foods - Derya Ozalp Unal<br><br>11:55-12:05 Influence of plant proteins on rheological and sensory properties of semi-solid products - Andres Viadel | |
| 12:05-12:20 | Q&A |
| **12:20-14:00 Lunch and visit at Nofima (15 min walk from Vitenparken)** | |
| **13:30-14:00** | **Visit to NOFIMA installations** |
| **Walk back to Vitenparken for afternoon lectures** | |
| **14:00-14:30** | **Framing Lecture**<br><br>**A Generative AI Approach to Accelerating Flavor Creation**<br>Nicolas Pineau, DataInsight, Switzerland |
| **WG4 • Development of models toward implementation in food chain-production** | |
| **14:30-15:20** | **Oral Presentations (10min each)** |
| 14:30-14:40 Integrated strain selection and process optimisation for tailored fermentation of legume-based substrates - Alessia Levante<br><br>14:40-14:50 How plant-based food communicates with consumers Insights from implicit and explicit measurements - Tuong Thuy<br><br>14:50-15:00 Sensory Profiling of Fermented Pumpkin–Apple Beverages from Processing By-Products Using the RATA Method - Biljana Cvetković<br><br>15:00-15:10 Sensory dynamic profiles and salivary proteomic responses to beers with varying alcohol levels - Luis Cunha<br><br>15:10-15:20 Modelling sweetness perception in biscuits as a tool for sugar reduction strategies - Naz Erdem | |
| 15:20-15:35 | Q&A |
| **15:35-16:00 Coffee break** | |
| 16:00-16:30 | **Cross-WG integration discussion activity** |
| 16:30-16:40 | Presentation of EuroSense 2026 |
| 16:40-16:45 | Final remarks and closure |

# BOOK OF ABSTRACTS

## KEYNOTE LECTURE 1

**Oral lubrication of alternative proteins: From mouthfeel to market**

Ben Kew
*University of Leeds, UK*

Oral lubrication plays a critical role in food perception and consumer acceptance, yet it remains an underexplored dimension in food innovation. Astringency, a dry, rough, puckering mouthfeel resulting from poor oral lubrication, is a major sensory barrier to the acceptance of plant-based proteins, with its underlying mechanisms still poorly understood.

A recent multiscale investigation integrating Rate-All-That-Apply (RATA) sensory evaluation (n = 100), neural imaging via functional near-infrared spectroscopy (fNIRS; n = 29), and cellular assays reveal the impact of astringency, texture and mouthfeel in plant protein with our findings underscoring the critical need to address the mechanoreceptor-driven effects associated with these ingredients (1).

By researching these principles in food systems combining in vitro oral processing techniques, including tribology, rheology and QCM-D (2) we demonstrate how colloidal technologies, such as microgelation and polysaccharide self-assembly, can effectively improve mouthfeel and mitigate or eliminate astringency. Remarkably, microgelled plant proteins comprising up to 95% water also demonstrated ultra-lubricating properties comparable to fat (3). This dual functionality not only improves the sensory properties of plant proteins but also creates opportunities for calorie reduction, with oral tribology led approaches driving significant innovation in this area.

These plant-derived microgels were subsequently patented (4), leading to the formation of the university spin-out company Microlub (5), which reimagines food design based on lubrication rather than taste alone. These findings underscore the important role of mouthfeel and oral tribology in sensory perception that offers insights to enhance the palatability, acceptance and health aspects of sustainable proteins and food beyond.

(1) Kew, B. et al. Unveiling plant protein astringency perception through neural and cellular responses. Sci Rep (2025)
(2) Kew, B. et al. Oral tribology, adsorption and rheology of alternative food proteins, Food Hydrocolloids (2021)
(3) Kew, B. et al. Transforming sustainable plant proteins into high performance lubricating microgels. Nat Commun (2023)
(4) Sarkar, A; Kew, B; Mingduo, M; Pabois, O; Zhang, S (2024) Formulation. WO2024028584A1. World Intellectual Property Organization
(5) https://microlub.com/

## KEYNOTE LECTURE 2

**A Generative AI Approach to Accelerating Flavor Creation**

Nicolas Pineau
*DataInsight, Switzerland*

Flavor formulation is a knowledge-intensive process where speed-to-answer is a critical competitive differentiator. Yet today, flavorists often rely on personal expertise and product knowledge, with limited ability to systematically leverage decades of accumulated formulation data. This work presents several options for the development of an AI-assisted flavor creation tool able to bridge this gap by learning the latent relationships between technical and/or sensory characteristics and flavor formulations.

At the core of the system are generative models usually used for image generation and adapted to the case of flavor formulation. Trained on a proprietary flavor portfolio, capturing the complex, high-dimensional mapping between flavor descriptors (including odor type, sensory drivers, product application, or solvent base) and their corresponding ingredient compositions and concentrations. By framing flavor formulation as a conditional generation problem, the model learns to propose chemically plausible formula skeletons that flavorists can use as an advanced starting point, rather than a blank canvas.

The presentation will explain how advanced neural networks techniques (Generative Adversarial Networks and Variational Auto-Encoders) can achieve relevant results based on some training process on historical data. It will also point out some key criteria to make such an approach successful, like the data quality, the architectural choices in the algorithms, and the parameters to define a “good” model.

Beyond the modeling and data aspect, the conclusion will be dedicated to the human aspects behind the model, the way end-users can be involved in the building process to create a solution that can elevate their performance rather than substituting them, and the importance of training to be able to use such new capabilities at best.

## WG1 SESSION - CHEMICAL AND PHYSICO-CHEMICAL PROFILING OF FOOD MATRICES

**Extracting Structured Chemosensory Data from the Scientific Literature**

Alon Nissan[1], Tom Hope[2], Masha Y. Niv[1]

[1]*The Hebrew University of Jerusalem, Institute of Biochemistry, Food Science and Nutrition, Israel*
[2]*The Hebrew University of Jerusalem, School of Computer Science and Engineering, Israel*

Chemosensory perception - taste, smell, and chemesthesis - is a key determinant of food choice, dietary behavior, and health outcomes. Structured, machine-readable sensory data can yield powerful insights; for example, BitterDB, a curated database of bitter

compounds developed in our lab, enabled machine learning models to predict bitterness from molecular structure alone. Yet the vast majority of published chemosensory data remains fragmented across tens of thousands of papers, reported in heterogeneous formats, scales, and terminology, and largely inaccessible to computational analysis.
Alongside recent initiatives to create community-wide standards, and encouraging data sharing in platforms such as the Zenodo ChemoSensoryData Community, we aim to unearth the wealth of chemosensory knowledge currently buried in historical literature.
Specifically, we are developing an AI-powered pipeline that leverages large language models to discover, classify, and extract structured sensory data from published papers. Drawing on recent advances in LLM-based scientific information extraction, our system extracts experimental details including substances, concentrations, food matrices, and sensory attributes ratings. Next, organize them into a standardized, ingredient-centric knowledge base. I will present the challenges of parsing heterogeneous sensory literature and the role of manually curated data cohorts in validating automated data extractions. Finally I will illustrate how integrating extracted data opens new avenues for cross-compound generalization, mixture prediction, and the generation of novel, testable hypotheses in chemosensory science.

**LC-ESI-MS/MS characterization of organic selenium compounds in red wine**

Violeta Ivanova-Petropulos[1], Elena Bogeva[1], Aleksandra Sentkowska[2]
[1]*Faculty of Agriculture, Goce Delcev University, Stip, Stip, Republic of North Macedonia*
[2]*Heavy Ion Laboratory, University of Warsaw, Warsaw, Poland*

Selenium, in the form of selenoamino acids and selenoproteins, is an essential component of the immune system reducing free radicals, which may lead to chronic diseases, such as cancer and heart disease. Selenomethionine (SeMet) and Se-methylselenocysteine (MeSeCys) are the major selenium-containing amino acids in dietary sources. SeMet is a bioactive form of selenium with antioxidant properties, playing a significant role in cardiovascular health, autoimmune conditions, and the prevention of certain cancers. Additionally, selenomethionine oxide (SeMetO), which possesses a protective mechanism against oxidative stress, is the oxidized form of amino acid selenomethionine. In this study, a rapid and sensitive HPLC-ESI-MS/MS technique was applied for the first time to identify and quantify organic selenium compounds, including: selenomethionine, selenomethionine oxide and selenium methylselenocysteine in Kratošija wines (a synonym of Zinfandel, Primitivo and Crljenak Kaštelanski). The wines were produced by inoculating two commercial yeasts: ZymafloreTM Xpure (Laffort) and Lalvin ICVD80 (Lallemand) in order to study the effect of yeasts on selenium compounds content in the final wines. The effect of the yeasts on the selenium compounds in both wines was observed. Thus, wine fermented with Lalvin ICVD80 contained higher amounts of SeMet and MeSeCys, probably due to a better ability to transform the inorganic selenium into organic selenium compounds (especially selenomethionine). Both wines contained high levels of SeMetO, produced as a result of the oxidation of SeMet during fermentation and/or storage. The obtained results suggest that the red wine Kratošija can be considered as an adequate source of SeMet and SeMetO, possessing healthy properties.

**Effect of alcohol concentration on nosespace dynamic aroma release, sensory perception and saliva composition in model drinks**

Loïc Joubert-Laurencin, Isabelle Andriot, Hélène Brignot, Géraldine Lucchi, Eric Neyraud, Christian Salles, Thierry Thomas-Danguin, José A. Piornos
*CSGA - INRAE, France*

Despite the success of non- or low-alcoholic drinks, consumers usually find their flavour to be different from that of their alcoholic counterparts, which restrains their consumption. One reason behind this difference is the absence of alcohol affecting the dynamic release of volatile aroma compounds in the mouth and nasal cavity during consumption. Furthermore, the presence of ethanol in the mouth might induce changes in saliva composition due to stimulation of the salivary glands. The aim of this study was to study the effect of ethanol in drinks on the dynamic release of aroma compounds in the nasal cavity and how ethanol modulates saliva composition. To do this, we performed in vivo experiments were our panellists tasted different water/ethanol solutions (from 0% to 45% v/v ethanol) containing an aroma compound (3-methylbutyl acetate). The dynamic concentration of this aroma was monitored in the nasal cavity by PTR-MS for five minutes, and several sensory attributes were recorded every minute. Additionally, saliva was collected after 1 and 5 minutes. Results showed that the release of 3-methylbutyl acetate was reduced as ethanol concentration increased. Fruity aroma sensory attribute decreased too, although ethanol itself contributed to fruitiness at high concentration. Protein content in saliva increased significantly one minute after ethanol consumption, but it went back to basal values after five minutes. The differences between alcoholic and nonalcoholic samples were important in terms of aroma release, aroma perception and saliva stimulation, which could explain the differences in overall consumer experience.

## WG2 SESSION - TRANSLATION MULTIMODAL ORAL PROCESSING

**Oral Perception and Sensory Quality of Tomato Pomace-Enriched Sourdough Gluten-Free Muffins**

Mishela Temkov[1], Vikttoria Fernandes[1], Gjore Nakov[2], Bulgaria, Elena Velickova[1]
[1] *Department of Food Technology and Biotechnology, Faculty of Technology and Metallurgy, Ss. Cyril and Methodius University in Skopje, Republic of North Macedonia*
[2] *College of Sliven, Technical University of Sofia, Bulgaria*

This study investigates the development of gluten-free muffins formulated with rice flour, sourdough fermentation, and enriched with 10% tomato pomace as a sustainable functional ingredient. The influence of fermentation time (0, 24, and 48 h) on sensory attributes and oral processing was evaluated.
Sensory acceptability was assessed through conventional hedonic testing involving 58 participants from North Macedonia and Bulgaria, complemented by advanced biometric analysis using OCOsense™ smart glasses. This technology enabled real-time monitoring of facial expressions and chewing behavior, providing objective insights into consumer

responses. Additionally, saliva absorption capacity of the formed bolus was determined as an indirect indicator of palatability and textural comfort.
Results indicated overall positive consumer acceptance, particularly regarding appearance and overall impression. Extended sourdough fermentation (24–48 h) significantly improved taste and texture, with Bulgarian participants demonstrating higher and more consistent ratings, potentially reflecting cultural familiarity with fermented products. Biometric data revealed that prolonged fermentation reduced saliva absorption and increased chewing frequency, suggesting modifications in oral processing that may influence perceived mouthfeel. Notable variations were also observed across age groups and cultural backgrounds, highlighting the role of demographic factors in sensory perception.
The integration of traditional sensory methods with advanced biometric tools provides a comprehensive understanding of product quality, incorporating sensory attributes, emotional responses, and oral processing dynamics. This approach represents a novel framework for evaluating functional gluten-free bakery products enriched with upcycled ingredients. All procedures were conducted in accordance with established ethical standards for sensory research.

**Cross-sensory Effects on Taste Perception using Extended Reality**

Funda Yildirim, Cansu Malak, Ipek Coskun, Yusuf Gungor, Sibel Ozilgen
*University of Twente, The Netherlands*

Taste perception is inherently multisensory, shaped not only by gustatory input but also by visual, auditory, olfactory, and tactile cues. While previous studies have demonstrated cross-sensory influences on taste, these effects are typically a subset of all five senses. In the present study, we used an immersive virtual reality (VR) restaurant to systematically investigate how visual (color, font), auditory (music), olfactory (scent), and tactile (texture) cues modulate perceived taste intensity. Thirty participants sampled a constant, mildly flavored solution while individual sensory features of the virtual environment were manipulated. Participants rated perceived saltiness, sweetness, sourness, bitterness, and umami. We observed consistent cross-sensory effects across modalities. Specifically, black increased bitterness, while orange and yellow heightened sourness compared to red. Folk music amplified bitterness but reduced sweetness, whereas rock, blues, and classical music enhanced sweetness. Scents had the strongest influence: candle and smoke increased both bitterness and sourness, while ocean had little effect. Fonts with irregular shapes and smooth textures also increased perceived saltiness. The findings reveal how environmental context systematically shapes gustatory judgments, highlighting the multisensory foundations of taste. Overall, we suggest that strategically designed sensory environments may be used to influence flavor experiences across sustainable food development, consumer research, and experiential dining applications.

**Making plant-based protein more delicious: Food aroma modification as a multisensory driver of consumer acceptance**

Yici Zhang[1], Charles Spence[1]
*University of Oxford, UK*

Despite growing environmental and health motivations to shift toward plant-based diets, consumer adoption of plant-based protein foods remains constrained primarily by their multisensory shortcomings. Taste has consistently been identified as the most critical determinant of acceptance, yet olfaction contributes substantially to what we experience as taste/flavour, particularly through retronasal stimulation during eating. Crucially, orthonasal olfaction operates even before the first bite: we use smell to assess whether a food is edible and to form hedonic expectations about it. For plant-based protein products, whose characteristic beany and grassy off-notes are detectable orthonasally, this pre-ingestive olfactory evaluation may constitute an underappreciated barrier to initial trial.

**Effect of visual and olfactory food cue exposure on salivary biochemical composition: a gateway to further understanding flavour and food oral processing**

Carla Simões[1], María Botia Gonzalez[2], Maeva Wendremaire[3], Fabrice Neiers[3], Frédéric Lirussi[4], Ana Isabel Costa[5], Asta Tvarijonaviciute[2], Elsa Lamy[1]
[1] *MED&CHANGE - University of Évora), Anita Ramos (MED&CHANGE - University of Évora*
[2] *Interlab-University of Murcia*
[3] *Université Bourgogne Europe*
[4] *PACE, University Hospital of Besançon*
[5] *CATÓLICA LISBON School of Business & Economics, Universidade Católica Portuguesa*

Sensorial food cues, including visual and olfactory stimuli, play a key role in initiating preparatory physiological responses crucial for ingestive behavior priming the digestive system to receive food, by enhancing appetite and influencing sensory expectations.
By far one of the most widely perceived physiological response is the reflexive release of saliva in response to food cue exposure – i.e., the "mouthwatering sensation" experienced for instance when smelling or seeing favorite food. Although this salivary response is well described in the literature, it is still not well known whether sensory stimulation by food-cues can change saliva biochemical composition and whether those changes may influence sensory expectations, food preferences and choices.
Studies from our lab have been systematically trying to investigate potential changes in salivary biochemical composition triggered by visualization of foods presented as pictures, exposure to food odorants and visualization of real foods.
Findings from these studies will be presented focusing on how saliva composition can be modified by different food-related stimuli. Additionally, it will be discussed how potential changes in saliva composition may be related to different emotional responses offering insights to understand why different individuals may respond differently to food cues

Ultimately, the importance of studying saliva in advancing flavour science will be discussed, particularly strengthening its potential for designing multisensory interventions to promote healthier food choices.

## WG3 SESSION - FOOD AND ORAL RHEOLOGY AND TRIBOLOGY INPUTS TO FLAVOUR PROPERTIES

**Synthetic data and deep neural networks enable prediction of sensory perception attributes in texture-modified plant-based smoothies**

Miodrag Glumac, Alejandro Avila-Sierra Maryia Mishyna
*The Origin Institute, The Netherlands*

This work pioneers the integration of synthetic data generation and deep learning to predict sensory perception in plant-based food models systematically modified with hydrocolloids and novel proteins. The aim is to demonstrate the predictive power of deep neural networks and transfer learning on complex, multidimensional data derived from food and sensory science experiments. We engineered a comprehensive, literature-informed dataset simulating human sensory ratings across 10 smoothie formulations — each either unmodified or modified with fungal polysaccharides or insect proteins. By integrating rheological (shear, extensional), oral tribological, surface activity, and human anatomical and physiological parameters, we trained a multilayer perceptron regression model (MLPR) capable of accurately predicting 10 sensory texture attributes (MSE < 0.13; Test $R^2$ = 0.91). Our results show that fungal polysaccharides predominantly drive shear-thinning behavior and extensional resistance, while insect proteins amplify bulk and interfacial activity — consistent with known hydrocolloid and protein functionality. Beyond learning complex sensory–rheology interactions, the trained model demonstrated robust transfer learning performance on unseen formulation conditions, highlighting a largely underexploited opportunity for applying predictive models to complex food science datasets. This framework constitutes a proof-of-concept platform that complements traditional sensory evaluation by enabling scalable, rapid, and cost-efficient simulation of consumer texture perception — opening a new frontier in intelligent food design, ingredient screening, and novel food formulation development.

**Tailoring the rheological and aroma profile of pea-based fermented beverages via lactic acid bacteria fermentation**

Marcello Alinovi, Elena Bancalari, Martina Cirlini, Emma Chiavaro, Francesca Bot
*Department of Food and Drug, University of Parma, Parco Area delle Scienze 27/A, 43124 Parma, Italy*

This study investigates the fermentative performance of Lactobacillus delbrueckii subsp. bulgaricus (Ldb) and Streptococcus thermophilus (St), used individually or in combination,

in pea protein emulsion–based beverages. Microbial growth, physicochemical properties (including rheology, water molecular mobility, and color), and volatile profiles were evaluated during and after fermentation using two selected strains (St 5149 and Ldb 2214) and their blend.
The results showed that St 5149 and the mixed culture exhibited faster growth in the pea-based matrix, with a shorter lag phase (0.29–0.58 h), and promoted more rapid gelation kinetics compared to Ldb 2214, as confirmed by impedometric and rheological analyses. Water molecular mobility, assessed by $^{1}$H NMR, was also influenced by the starter culture, with St 5149 leading to a reduction in unbound water. Despite these differences, no significant impact on color parameters was observed, with L* values ranging from 12.16 to 13.56, a* from 15.15 to 15.92, and b* from 21.09 to 22.87. Notably, the volatile profiles indicated that the selected LAB strains, particularly when used in combination, effectively reduced off-flavor notes typically associated with pea protein isolates. These findings demonstrate that selected LAB strains can enhance the physicochemical and sensory properties of pea-based fermented beverages, providing a foundation for the development of innovative and sustainable alternatives to dairy and soy-based products.

**The Interplay Between Inulin-Rich Polysaccharide Matrices and Flavour Release Kinetics: A Rheological Perspective on Helianthus tuberosus Fortified Foods**

Derya OZALP UNAL
*Field Crops Central Research Institute, Turkiye*

The incorporation of prebiotic-rich fractions, such as inulin from Helianthus tuberosus (Jerusalem artichoke), into cereal-based and dairy-like food matrices introduces complex challenges regarding texture-flavour interactions. This review critically examines the role of non-starch polysaccharides in modulating the rheological and tribological properties of food systems and their subsequent impact on flavour perception. During oral processing, the viscosity and lubrication behavior of the food bolus are primary determinants of the residence time of volatile compounds in the oral cavity.
The analysis focuses on how the degree of polymerization of H. tuberosus inulin affects the formation of micro-gel structures within the food matrix. These structures significantly alter the mass transfer of hydrophobic and hydrophilic flavour molecules. By synthesizing current findings in food rheology, this paper discusses the "flavour-blunting" effect often observed in high-fibre systems, where structural hindrances or direct molecular binding limit the bioaccessibility of aroma compounds. Furthermore, the review explores the transition from bulk rheology to thin-film tribology, highlighting how the lubrication properties of Jerusalem artichoke extracts influence the sensory perception of "creaminess" and "thickness." Identifying these physico-chemical trade-offs is essential for the rational design of functional foods that do not compromise sensory quality. This work proposes a integrated framework for predicting flavour release profiles based on the structural dynamics of inulin-fortified matrices during the masticatory cycle.

**Influence of plant proteins on rheological and sensory properties of semi-solid products**

Andrés Viadel, Laura Laguna, Amparo Tárrega
Institute of Agrochemistry and Food Technology (IATA - CSIC), Valencia, Spain

In recent years, there has been a growing demand for high protein products from diverse consumer groups, including elderly people, athletes and vegetarians. However, incorporating higher levels of protein, particularly plant-based proteins, poses several technological and sensory challenges for food industry and research. Considering that, the aim of this study was to understand the impact of the incorporation of different protein types (animal and plant-based) on the rheological, tribological and sensory properties of semi-solid type products.
Six vanilla desserts were prepared, five of them were enriched (6.5% protein) with four different plant protein (pea, faba bean, chickpea and lentil) and one with milk protein. As a control a product with regular protein concentration (1.5%) was prepared using milk powder. The rheological and tribological properties of the products were measured. Sensory evaluation was carried out with 105 participants (54% female; 30.4 years) using a CATA question with 27 texture and flavour attributes and acceptability using a 9-point scale.
Results showed that the impact of adding protein on the rheological, tribological and sensory properties was significantly different depending on the protein type. Rheological properties highly varied among plant proteins with a no clear distinction form dairy products. However, tribological behaviour clearly distinguished plant proteins from the dairy ones. Sensory evaluation allowed to determine the sensory (flavour and texture) drivers of rejection of the different plant proteins.

## WG4 SESSION - DEVELOPMENT OF MODELS TOWARD IMPLEMENTATION IN FOOD CHAIN-PRODUCTION

**Integrated strain selection and process optimisation for tailored fermentation of legume-based substrates**

Alessia Levante[1], Irene Nicolini[1], Federica Barbieri[2], Martina Filippini[2], Fausto Gardini[2], Monica Gatti[1], Giulia Tabanelli[2]
[1] *Department of Food and Drug, University of Parma*
[2] *Department of Agricultural and Food Sciences, University of Bologna*

The controlled fermentation of plant based substrates offers a promising route to improve the sensory quality, safety, and functional attributes of legume derived foods. A diverse collection of 28 lactic acid bacteria (LAB) was evaluated on sterilised mashed cannellini beans, revealing that several species (particularly Latilactobacillus sakei, Lentilactobacillus buchneri, Lactiplantibacillus plantarum, and Leuconostoc mesenteroides) displayed suitable growth and efficient acidification, consistently reaching a safety critical pH range (between 4.4 and 4.6 in 48 hours). Based on these performances, eight LAB pairs were

selected and shown to generate distinct volatile organic compound profiles, reducing aldehydes responsible for “beany” notes and increasing acids, ketones, and aromatic alcohols. To increase the complexity of volatile profile, selected Staphylococcus spp. isolates were added to the consortia of LAB. The composed microbial starter led to varying results in terms of microbial growth, and a shift in volatile compounds profiles.
Building on these findings, the final phase of the work applied a Design of Experiment (DoE) approach to optimise fermentation conditions for two best performing consortia of LAB and staphylococci. Temperature, NaCl, and glucose were tested as key factors influencing acidification and microbial dynamics. While one mix showed higher microbial growth, the seconddemonstrated superior acidification efficiency, achieving the target pH in nearly all conditions. Response surface modelling enabled definition of optimal fermentation parameters, which were validated in subsequent trials.
Overall, the integrated results demonstrate that tailored LAB–staphylococci consortia, combined with data driven process optimisation, can effectively steer legume fermentations and support the development of innovative plant based fermented products.

**How plant-based food communicates with consumers  Insights from implicit and explicit measurements**

Thuy Ung-Pham, Laura Laguna, Amparo Tárrega
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Moving consumers towards plant-based protein foods depends not only on the products themselves but also on how their benefits are communicated. We studied consumer responses to video messages about a protein-enriched bread made with lentil and quinoa flours, combining implicit and explicit methods across two studies. The first recorded the changes in heart rate, skin conductance, and pupil diameter while participants watched health and sustainability messages presented in two formats: a formal video presented by a food expert and a TikTok video delivered by an influencer. Physiological responses varied with both content and format. A deceleration in heart rate simultaneous with an elevation in skin conductance towards the messages most relevant to consumer retention, mostly health and nutrition claims, while pupil dilation mainly impacted by the visual design of the video rather than memory. The second study conducted on 630 consumers, tested how video format and content influenced consumer explicit response measuring trust and retention on information, acceptability and purchase intention to protein-enriched bread and consumer’s attitudes. Formal videos were trusted more than TikTok ones. However, TikTok videos, helped consumers retain more specific information, particularly about sustainability. Although video format and content significant impacted on trust and message retention, plant-based product acceptability and purchase intention were driven by consumer attitudes (health interest, sustainability concern, and neophilia). The studies suggest that source credibility and visual format play different roles: credible sources build trust, while attractive social-media formats support attention and retention. An effective communication strategy may combine visual engagement formats with credible source to widen plant-based food acceptance and increase purchase intention.

**Sensory Profiling of Fermented Pumpkin–Apple Beverages from Processing By-Products Using the RATA Method**

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The growing demand for sustainable food systems has encouraged the valorisation by-products and underutilised plant materials in the food chain. Pumpkin pulp, a by-product of oil pumpkin (Cucurbita pepo var. styriaca) seed processing, is nutrient-rich but largely discarded. Fermentation has emerged as an effective approach to improve the functional and sensory properties of plant-based ingredients. This study aimed to evaluate fermented pumpkin puree as a functional ingredient in fruit–vegetable beverages and to assess its sensory impact. Purees from oil pumpkin (Cucurbita pepo var. styriaca) and Muscat pumpkin (Cucurbita moschata) were fermented and incorporated into apple juice at 10%, 20%, and 30% concentrations. A control sample containing non-fermented pumpkin puree was also prepared. Physicochemical properties, mineral composition, and colour were analysed. Sensory evaluation was performed using the Rate-All-That-Apply (RATA) method, where panelists assessed colour intensity, apple and pumpkin aroma, sweetness, acidity, texture, and overall liking. Data were analyzed by ANOVA, and multivariate relationships were explored using Generalized Procrustes Analysis (GPA). The results showed that both the concentration and type of fermented pumpkin puree significantly affected sensory properties. Lower puree levels resulted in higher apple aroma intensity. The beverage containing 20% fermented Cucurbita moschata puree achieved the highest overall acceptability (mean score 3.56), while the control showed moderate acceptability (3.31). Beverages with fermented oil pumpkin puree had slightly lower but still acceptable scores. These findings confirm fermentation as a promising strategy for the circular valorization of pumpkin by-products and their application in innovative plant-based beverages, enhancing sensory complexity and supporting sustainable food production.

**Sensory dynamic profiles and salivary proteomic responses to beers with varying alcohol levels**

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Recently, the role of alcohol in mouthfeel sensations has been broadly investigated, with its effects being partly mediated by interactions with phenolic compounds and salivary proteins, affecting protein precipitation and oral texture perception. This work aimed at establishing correlations between temporal sensory analysis of beers with different alcoholic levels and salivary proteomics.
Initially, 65 untrained participants evaluated the beers using a Temporal Check-All-That-Apply (TCATA) ballot containing taste and texture attributes. The participants rated overall liking (on a 9-point hedonic scale), provided open comments, and collected saliva samples after each tasting, for proteomics analysis.
Across samples, beers with intermediate alcoholic levels had significantly lower liking than control or non-alcoholic products. TCATA profiles showed few differences among samples in terms of attribute intensity, although the control beer stands out for having more citations of "typical"/"refreshing" taste. Open comments provided insight on sample-attribute correlations, with non-alcoholic beers being described as more "cereal"-tasting, and beers with higher alcohol levels had a "good amount of gas" and were more "quality-like".
Total salivary protein concentration (assessed by BCA) and corresponding salivary profiles (SDS-PAGE), salivary flow rates, and total phenolic content (assessed by Folin-Ciocalteu) were monitored to characterise oral biochemical responses. Across participants, these measures showed variability and differences between the samples and the control.
All in all, these results suggest different behavioural patterns in sensory perception across beers with varying alcohol content, while salivary measurements indicate potential variations in oral biochemical responses.

**Modelling sweetness perception in biscuits as a tool for sugar reduction strategies**

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Sugar is a key ingredient in bakery products, affecting sensory properties and overall quality. However, the relationship between high sugar consumption and health problems has driven the food industry toward sugar reduction strategies. Despite this, reducing sugar remains challenging due to its multiple roles in quality characteristics, taste, and consumer acceptance.
This study aims to develop a mathematical model, based on sensory evaluation, to explain how sugar concentrations affect sweetness perception. Biscuit formulations (AACC-10.54) containing 6–39% sugar were prepared using whole wheat flour (50% of total flour), 2% whey and pea proteins and flavouring agents (ethyl vanillin, furaneol, phenylacetaldehyde). An untrained sensory panel evaluated sweetness intensity using a line scale. The relationship between sugar concentration and perceived sweetness was modelled using a modified Weibull model in the MATLAB Curve Fitting Toolbox, given as follows;

S=Si +(Sm -Si)×[1-exp(-(C⁄α)^β )]
where, perceived sweetness (S) is a function of sucrose concentration (C), where Si represents initial sweetness and Sm represents maximum sweetness. The scale parameter (α) indicates the sucrose level required to reach 63% of maximum sweetness, while β is the shape parameter.
Replacement of whole wheat flour, adding proteins and flavour compounds, increase sweetness. The model fitted the data well along with a S-shaped curves. Whole wheat flour, pea protein, whey protein, and flavourings are promising ingredients for sugar reduction in biscuits. The modified Weibull model, which was used for the first time for the evaluation of sensory data, predicted well the sweetness perception of biscuits having a certain sugar concentration.

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