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EDITORIAL

Delivery of Functionality in Complex Food Systems: Physically Inspired Approaches from Nanoscale to Microscale: 5th Symposium

Yoav D. Livney · Ulrich Kulozik · Ronald Gebhardt

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Abstract The aim of this symposium, the 5th in the series "Delivery of Functionality in Complex Food Systems: Physically Inspired Approaches from Nanoscale to Microscale", was to discuss the various aspects of delivery systems for health-promoting compounds in foods and beverages. Initially, molecular level basic studies of amphiphilic proteins and their interactions and self-assembly, as well as processes for obtaining such functional materials were presented, followed by microstructure and functionality studies. These material science studies provided proper background for the following presentations dealing with structural engineering for entrapment and release of bioactives, lipid structuring for functionality and engineering lipid-based delivery systems. Next the more applied aspects of production and performance of delivery systems for bioactive components were discussed, followed by studies of the interactions with the human body during digestion, with emphasis on issues of micronutrient bioavailability. Finally safety of the delivery systems and regulatory aspects were addressed.

This special issue is a collection of papers which were presented during the symposium, highlighting many of the major topics presented in the symposium, including material science and lipid structuring for functionality, processes for obtaining functional materials, entrapment and release of bioactives, engineering lipid-based delivery systems, and interactions with the human body during digestion.

Y. D. Livney (✉)
Biotechnology & Food Engineering, Technion, Israel Institute of Technology, Haifa, Israel
e-mail: livney@technion.ac.il

U. Kulozik · R. Gebhardt
Department of Food Process Engineering and Dairy Technology, Technische Universitaet Muenchen , Freising, Germany

Introduction

This special Issue is published following the 5th symposium in the series entitled "Delivery of Functionality in Complex Food Systems: Physically Inspired Approaches from Nanoscale to Microscale".

The Symposia Series

This series of international symposia was initiated by Job Ubbink and Raffaele Mezzenga, who led the first edition held at the Nestlé Research Center in Lausanne, Switzerland in January 2005 organized jointly by the Polymer Group of Switzerland (PGS) and the Nestlé Research Center. The aim was to bring together experts from various fields (Food Science, Polymer Science, Biophysics and Nanotechnology) to conduct interdisciplinary research for enhancing the functionality of foods via physically-inspired, rational development of suitable delivery systems that can improve the functionality of sensitive ingredients such as flavors, micronutrients and texturizing agents. The symposium focused primarily on the nano- and micro-scale properties central to the rational design of foods. Key papers of the meeting are presented in a special Issue of Trends in Food Science and Technology [1].

The second international symposium in this series was led by David Julian McClements, Department of Food Science at Amherst, Massachusetts, USA, in October 2007. This symposium covered topics of multi-scale assembly of food components, strategies for delivery of active ingredients in foods, physicochemical performance, sensory attributes, and safety; controlling digestion and nutrient absorption through food structure, molecular gastronomy and new ingredients, processes, and analytical techniques. Selected papers from this symposium were compiled in a special issue of Food Biophysics [2].

The third International Symposium in the series was led by Erik Van der Linden and organized by the Graduate School Voeding, Levensmiddelentechnologie, Agrobiotechnologie en Gezondheid (VLAG) and the Laboratory of Physics and Physical Chemistry of Foods, Wageningen University, Wageningen, in the "Food Valley" of The Netherlands, October 2009. This symposium focused on the rational design of attractive, healthy and sustainable complex foods from a physical perspective, by controlled assembly of major food components. Topics included supramolecular organization in foods, molecular insights from spectroscopy, single molecule techniques, biophysics of nutrient digestion, food complexity: physics, physiology and perception, and food development for nutritional challenges. Main papers from this symposium were compiled into a special issue of Food Biophysics [3].

The fourth installment in this symposia series was led by Alejandro Marangoni, Department of Food Science, University of Guelph, and held in August 2011 at the University of Guelph, Guelph, Ontario, Canada. It continued the tradition by focusing on food structure-microscale-to-macroscale and the implications of structure for food functionality. Topics included novel structures for engineered bioactive delivery, food structuring as a means to modulate the physiological response of foods, engineering self-assembly in food systems: principles and applications. Selected presentations from this symposium were collected in a themed issue of Food & Function [4].

The 5th Symposium in the Series

The 5th symposium (http://dof2013.org) in this series, reported herein, was held in Haifa, Israel, during September 30th-October 3rd 2013 and was led by Yoav D. Livney, Biotechnology & Food Engineering Department, Technion, Israel Institute of Technology, and by Nissim Garti, Casali Institute, Hebrew University of Jerusalem. The conference hosted a meeting of COST ACTION FA1001: Food Structure Design. There were well over a hundred participants from 26 countries, among which 30 % students and 10 % COST action delegates. The event was supported by 12 sponsoring organizations.

The central role of food and nutrition in the prevention of global health problems, and the challenges posed by regulatory concerns, and by economic and environmental constraints, propel creative innovation and ingenuity, based on fast progress in our understanding of the physicochemical complexity of food systems. These fascinating aspects were addressed by the focused, yet diverse program of the symposium, comprising invited lectures, contributed talks, and posters.

The symposium was composed of nine scientific oral sessions (including the COST session) each introduced by a prominent invited speaker and there were two poster sessions. The symposium sessions covered the following topics:

- Amphiphilic proteins: interactions and self assembly
- Microstructure and functionality
- Structural engineering for entrapment and release of nutrients
- Engineering lipid-based delivery systems
- Lipid structuring for functionality
- Production and performance of delivery systems
- Delivery of bioactive and functional components
- Digestion bioavailability and safety of delivery systems

In this Special Issue

This special issue is highlighting a collection of papers which were presented during the symposium, covering many of the major topics discussed in the symposium:

- Material science & lipid structuring for functionality:

  – Ultra small angle x-ray scattering for pure tristearin and tripalmitin: Model predictions and experimental results
  – Structural study on hen-egg yolk high density lipoprotein (HDL) granules

- Processes for obtaining functional materials:

  – Acid and enzyme-aided collagen extraction from the byssus of Chilean mussels (*mytilus chilensis*): Effect of process parameters on extraction performance

- Entrapment and release of bioactives

  – Soybean β-conglycinin nanoparticles for delivery of hydrophobic nutraceuticals
  – Effects of ionic strength, pH and milk serum composition on adsorption of milk proteins on to hydroxyapatite particles
  – Interaction of β-lactoglobulin with small hydrophobic ligands - influence of covalent AITC modification on β-lg tryptic cleavage
  – Flavour release from monoglyceride structured oil-in-water emulsions through static headspace analysis

- Engineering lipid-based delivery systems

  - Engineering the functionality of blends of fully hydrogenated and non-hydrogenated soybean oil by addition of emulsifiers
  - Influence of temperature on the distribution of catechin in corn oil-in-water emulsions and some relevant thermodynamic parameters
  - Spray dried protein-stabilized emulsions as vitamin matrix carriers: contribution of protein aggregates and lipid nano- and micro-structures to vitamin long-term protection
  - Effect of olive oil phenolic compounds and maltodextrins on the physical properties and oxidative stability of olive oil o/w emulsions

- Interactions with the human body during digestion

  - Characterization of Pickering o/w emulsions stabilized by silica nanoparticles and their responsiveness to in vitro digestion conditions
  - Behavior of emulsions stabilized by a hydrophobically modified inulin under bio-relevant conditions of the human gastro-intestine

References

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