Hosted by FOOD Aarhus University
June 13. - 16. 2022

DAIRY SCIENCE AND TECHNOLOGY SYMPOSIUM

DELIVERING WITH DAIRY:
From Primary production to Primary purpose

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WELCOME TO:

DAIRY SCIENCE AND TECHNOLOGY SYMPOSIUM

DELIVERING WITH DAIRY:
From Primary production to Primary purpose

What is the role of dairy in future diets?

Key for maintaining the role of dairy in sustainable and healthy diet is ensuring holistic views which cover the entire food system.

Any future food system will only function if it leads to diets that are not only healthy and sustainable, but also affordable, safe for all, and accepted.

This conference aims to bringing the dairy science community together, as the future food system will need to be created with input from many disciplines to future proof the role of dairy in this future food system, where the primary aim is to supply nutrition to billions of consumers world-wide via a balanced nutrient rich diet.

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PROGRAM OF THE WEEK

June 13th -16th 2022

The conference Delivering with dairy: from primary production to primary purpose' will focus on recent innovations in the field of dairy science and technology viewed from a central perspective of milk and dairy products as a means of supplying nutrient-rich products to billions of consumers all over the world.

SESSIONS	DATE AND TIMES	TITLES
SESSION 1	MONDAY, JUNE 13 15:00 – 17:30 CET	THE ROLE OF MILK AND DAIRY PRODUCTS IN HEALTHY AND SUSTAINABLE DIETS
SESSION 2	TUESDAY, JUNE 14 15:00 – 17:30 CET	DELIVERING NUTRITION WITH DAIRY: MATRIX EFFECTS
SESSION 3	WEDNESDAY, JUNE 15 15:00 – 17:30 CET	PROCESSING OF MILK AND DAIRY PRODUCTS FOR SAFE, STABLE AND NUTRITIOUS PRODUCTS
SESSION 4	THURSDAY, JUNE 16 15:00 – 17:30 CET	MILK: DESIGNED TO DELIVER

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SESSION 1

Monday 13th of June

TITLE

THE ROLE OF MILK AND DAIRY PRODUCTS IN A SUSTAINABLE AND HEALTHY DIET

Sustainable Healthy Diets are dietary patterns that promote all dimensions of individuals' health and wellbeing, have low environmental pressure and impact are accessible, affordable, safe and equitable and are culturally acceptable. Unfortunately, in the public debate, this is often reduced solely environmental impact on product level, thus ignoring the dietary level, as well as economic and social factors. Holistic approach on sustainable and healthy diets, particularly when include circular rather than linear food systems, clearly highlight importance of milk and dairy products in a sustainable and healthy diet. Key aspects in this are the nutrient density, the high digestibility and bioavailability, but also the affordability and social acceptance, combined with an ever-decreasing footprint. The role of milk and dairy products in a sustainable and healthy diet should, as such, be the foundation of a demand driven dairy chain.

CHAIR

THOM HUPPERTZ
FrieslandCampina Wageningen University and Research,
The Nederlands

SESSION 1

Monday 13th of June

15:00 CET	SESSION START
Conference opening	THOM HUPPERTZ
Keynote talk	**Linking environmental impact and nutrition in nutritional LCAs: opportunities and challenges** ELINOR HALLSTRÖM, RISE, Sweden
Flash presentations	**Effect of incubation temperature and Acetobacter orientalis level on in-situ production of lactobionic acid in yoghurt** Shamim Hossain, Dairy Technology Division, ICAR-National Dairy Research Institute, India
	Livestock in circular food systems Renée Cardinaals, Farming Systems Ecology Group, Wageningen University & Research, the Netherlands

SESSION 1

Monday 13th of June

Keynote talk

The role of dairy in combatting malnutrition

KATIE AYLING
Wageningen University & Research, The Netherlands

Flash presentations

Influence of Dairy Products on Bioavailability of Zinc from Other Food Products: A Review of Complementarity at a Meal Level

Blerina Shkembi, Food Quality & Design Group, Wageningen University & Research, The Netherlands

Quantitative proteomic profiling of bovine colostrum and milk at onset of lactation

Hannah K. Masterson[1,2,3]
[1] Teagasc Food Research Centre, Moorepark, Ireland
[2] VistaMilk, SFI Research Center, Moorepark, Ireland
[3] Department of Biology, Maynooth University, Ireland

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SESSION 1

Monday 13th of June

Keynote talk	**A world without cows** MITCH KANTER Global Dairy Platform, USA
Panel discussion	MITCH KANTER, KATIE AYLING, ELINOR HALLSTRÖM AND THOM HUPPERTZ

17:30 CET **SESSION END**

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SESSION 2

Tuesday 14th of June

TITLE **DELIVERING NUTRITION WITH DAIRY: FOOD MATRIX EFFECTS**

Nutritional sciences have taken some steps in the last decade changing focus from reductionistic component-based approaches to more holistic product-based approaches, wherein the (potential) interaction between constituents and a product and the influence of the structure of the food products is also considered. This has been key in e.g., the saturated fat discussion, where is has been clearly shown that findings from studies on saturated fatty acids in isolation cannot be translated to effects observed in a dairy matrix like cheese, but also for e.g., chocolate or red meat. However, also for other concepts this applies. Consider e.g., the (lack of) cariogenicity of milk and dairy products, due to lactose as a low-cariogenic carbohydrate source combined with the protective effects of the caseins and milk salts.

CHAIR **ULF ANDERSEN**,
Arla Foods Amba, Denmark

SESSION 2

Tuesday 14th of June

15:00 CET	SESSION START
Keynote talk	**Digestion of milk fat: Physicochemical, structural and nutritional aspects** SOPHIE GALLIER Dairy Goat Co-Operative Ltd., New Zealand
Flash presentations	**Bleu d'Auvergne, a blue-veined cheese with a complex matrix and interesting nutritional properties** Imène Ferroukhi, Université Clermont Auvergne, INRAE, VetAgro Sup, UMRF 545 Fromage, France
	Identifying glycation hot-spots in bovine milk proteins during production and storage of skim milk powder Inge Gazi[1,2], [1] Biomolecular Mass Spectrometry and Proteomics, Bijvoet Center for Biomolecular Research and Utrecht Institute for Pharmaceutical Sciences, Utrecht University, The Netherlands [2] Netherlands Proteomics Center, The Netherlands

SESSION 2

Tuesday 14th of June

Keynote talk

Delivering carbohydrates for exercise with dairy

GARETH WALLIS
University of Birmingham, United Kingdom

Flash presentations

Valorization of Greek yoghurt acid whey with a Thermothielavioides terrestris novel -galactosidase for GOS synthesis

Athanasios Limnaios, Laboratory of Food Chemistry & Technology, School of Chemical Engineering, National Technical University of Athens, Greece

Ultra- und nanofiltration applied to reduce the lactose

Peter Habermehl, Max Rubner Institut, Department of Safety and Quality of Milk and Fish Products, Kiel, Germany

Fermentation of acid whey by propionic acid bacteria

Carsten Nachtigall, Chair of Food Engineering, Institute of Natural Materials Technology, Technische Universität Dresden, Germany

SESSION 2

Tuesday 14th of June

Keynote talk	**Ultraprocessed foods: From ideology to nuance** THOM HUPPERTZ FrieslandCampina / Wageningen University & Research, The Netherlands
Panel discussion	THOM HUPPERTZ, GARETH WALLIS, SOPHIE GALLIER AND ULF ANDERSEN

17:30 CET **SESSION END**

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SESSION 3

Wednesday 15th of June

TITLE

PROCESSING OF MILK AND DAIRY PRODUCTS: FOR SAFE, STABLE AND NUTRITIOUS PRODUCTS

Within the dairy chain, processing of milk plays an extremely important role. First and foremost, it is required to improve the safety and extent the shelf-life of products, thereby ensuring that products can be safely distributed all over the world. This shelf-life extension can be achieved through heat treatment, but also through fermentation or drying. In addition, processing is also important to ensure that a dairy matrix is created which is preferable by consumers, which can be digested and from which nutrients bioavailable. Such processing can include similar steps as for shelf-life extension, but also other processing techniques, including e.g., non-thermal processing.

CHAIR

ALAN KELLY

University College Cork, Ireland

SESSION 3

Wednesday 15th of June

15:00 CET	SESSION START
Keynote talk	**Emerging technologies for production of dairy products** **LILIA AHRNÉ** University of Copenhagen, Denmark
Flash presentations	**Mapping out partial coalescence to optimize aerated dairy emulsions** **Abigail Thiel**, Wageningen University and Research, The Netherlands
	The impact of wild strains as starter cultures on goat milk cheese production **Angeliki Kourkoulakou,** Laboratory of Dairy Research, Department of Food Science and Human Nutrition, Agricultural University of Athens, Greece

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SESSION 3

Wednesday 15th of June

Keynote talk

Digital transformation for research and development

CARSTEN ERSCH
FrieslandCampina, The Netherlands

Flash presentations

Photopurification of whey-brine used in cheesemaking by turbulent flow UV-C treatment

Ioanna Neokleous, Cyprus University of Technology, Cyprus

Solubilization of individual caseins and minerals from rennet casein by disodium phosphate and trisodium citrate: influence of concentration, pH and temperature

Gaurav Kr Deshwal[1,2],
[1]Department of Food Chemistry and Technology, Teagasc Food Research Centre, Ireland
[2]Department of Agrotechnology and Food Sciences, Wageningen University, The Netherlands

SESSION 3

Wednesday 15th of June

Flash presentations

Storage stability of lactose-free UHT milk in relation to processing strategy and lactase preparation

Lotte Juul Knudsen[1,2],
[1]Aarhus University, Department of Food Science, Denmark
[2]CiFOOD Aarhus University Centre for Innovative Food Research, Denmark

Keynote talk

Novel drying technologies for drying ingredients

EOIN MURPHY
Moorepark Food Research Centre, Teagasc, Ireland

Panel discussion

EOIN MURPHY, LILIA AHRNÉ, CARSTEN ERSCH AND ALAN KELLY

17:30 CET **SESSION END**

SESSION 4

Thursday 16th of June

TITLE

MILK: DESIGNED TO DELIVER

Key in the ability of milk and dairy products to function as excellent food matrices is the fact that milk, in essence, is designed to deliver. It is the sole source of nutrition for the neonate and contains essential structural elements, e.g., in the form of casein micelles and milk fat globules, which deliver a multitude of nutrients, including salts, vitamins and proteins. In addition, colloidal stability of these structure elements in the GI tract also leads to important control of the kinetics of digestion and release of nutrients, enabling maximum utilization of nutrients from milk and dairy products. Hence, understanding of these key structure elements and their biological function, and their interaction with (micro-)nutrients is key to creating products that fit in a healthy and sustainable diet.

CHAIR

EFFIE TSAKALIDOU

Agricultural University of Athens, Greece

SESSION 4

Thursday 16th of June

15:00 CET	SESSION START
Keynote talk	**The sound of structure - understanding dairy structure formation** ULF ANDERSEN Arla Foods amba, Denmark
Flash presentation	**A Study on the Structural Conformation of Enzymatic Cross-linked Caseins Particles in Acidic Conditions** Angella Velazquez[1,2] [1] France National Institute of Agronomical Research (INRA) - Unité Matériaux et Transformation (UMET), équipe Processus aux Interfaces et Hygiène des Matériaux (PIHM), Université de Lille [2] Ingredia Dairy Experts, Arras, France
	Effect of whey proteins on micellar casein dissociation upon pH change and cool storage Thea Lykkegaard Møller, Department of Food Science, Aarhus University, Denmark

SESSION 4

Thursday 16th of June

Influence of sodium hexametaphosphate on heat-induced changes in micellar casein solutions

ARANTZA GARCIA[1,2]
[1] IS-FOOD, Public University of Navarra, Spain
[2] FrieslandCampina, The Netherlands

Keynote talk

Bovine milk protein modification to create human milk behavior

PENG ZHOU
Jiangnan University, China

Flash presentations

Screening of proteolytic activity and heat resistance of Pseudomonas strains

Miguel Aguilera Toro [1]
[1] Department of Food Science, Aarhus University, Denmark

The effect of Plasmin activity on Camel milks

Santhoshani Thiyaga Saumya Kumarihami Warakaulle
Department of Food Science, United Arab Emirates University, United Arab Emirates

SESSION 4

Thursday 16th of June

Flash presentations	**Effect of alternative nonthermal technologies on the production of acid gels prepared with sweet whey** **MARIA TSEVDOU,** Laboratory of Food Chemistry & Technology, School of Chemical Engineering, National Technical University of Athens, Greece
Keynote talk	**Chew on it: How oral processing behaviours impact food sensory perception and intake** **MARKUS STIEGER** Wageningen University & Research, The Netherlands
Panel discussion	**EFFIE TSAKALIDOU, ULF ANDERSEN, MARKUS STIEGER AND PENG ZHOU**
Closing remarks	**MILENA CORREDIG**

17:30 CET **SESSION END**

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FLASH PRESENTATIONS

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SESSION 1

Monday 13th of June

EFFECT OF INCUBATION TEMPERATURE AND ACETOBACTER ORIENTALIS LEVEL ON IN-SITU PRODUCTION OF LACTOBIONIC ACID IN YOGHURT

Shamim Hossain, Yogesh Khetra, Chandni Dularia, Ganga Sahay Meena[1]

1 Dairy Technology Division, ICAR-National Dairy Research Institute, India

Abstract

Lactobionic acid (LBA) is a potential lactose derivative formed by lactose oxidation. In the present study, the incubation parameters and Acetobacter orientalis inoculation level has been optimized based on LBA production and sensorial attributes of yoghurt. Three-level of Acetobacter orientalis (10, 15, 20%) were inoculated and incubated at three different temperatures (27, 30, 33°C) till the desired pH reached. The incubation time decreased with the increase in the incubation temperature. Acidity, pH, lactose content, lactic acid content, LBA content, lactic acid bacteria count, Acetobacter orientalis count were analysed during incubation. The final yoghurts were analysed for their whey syneresis, sensorial, rheological, and textural attributes. The yoghurt with 20% inoculum and 30°C incubation temperature had the highest LBA content (3.62±0.1 mg/100g) after 16 hours of incubation. This sample had optimum pH of yoghurt, less whey syneresis, acceptable overall sensoriay scores compared to other yoghurts. Hence, the incubation parameters (20% inoculum and 30°C /16 hours incubation) were optimized for lactobionic acid enriched yoghurt production.

Practical Relevance

There is a bright possibility to manufacture a fermented dairy product like yoghurt enriched with LBA by in-situ oxidation of lactose. Biocatalytic microbial conversion of lactose is the most possible way to produce edible quality LBA without any harmful by-products. This LBA enriched yoghurt may improve the calcium absorption rate in human.

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SESSION 1

Monday 13th of June

LIVESTOCK IN CIRCULAR FOOD SYSTEMS

Renée Cardinaals,

Farming Systems Ecology Group, Wageningen University & Research, the Netherlands

Abstract

How much animal-source food can be derived from (aquatic and terrestrial) farm animals fed solely with residual streams, depends on their capacity and efficiency to use biomass. Ruminants, for example, have the capacity to use grassland biomass, in contrast to pigs, poultry and farmed fish. Ruminant production has many societal benefits, including food, income, nutrients, fibre and employment, among others. Grazing prevents land use change in one of the most endangered ecosystems: grasslands. Grasslands produce low cost feed which is inedible for humans but can be used by ruminants to produce nutritious animal-sourced food. Grass-based ruminant systems, therefore, can play an important role in circular food systems. Even though ruminants can create nutritional value from grassland, they also emit significant amounts of greenhouse gases, including methane and nitrous oxide. This leads to trade-offs between grassland use for food production and related greenhouse gas emissions. The CiFoS team in the FSE Group of Wageningen University is developing a model to assess the potential of livestock to increase the efficiency of our food system, while minimizing environmental impacts.

Practical Relevance

The debate on the role of ruminant products in healthy and sustainable diets is often based on the current (linear) food system. When re-designing the food system, the amount and type of animal products that can be produced may change, and thereby the total impact of a population's diet. This is important to consider when designing food based dietary guidelines, as well as for policy making.

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SESSION 1

Monday 13th of June

INFLUENCE OF DAIRY PRODUCTS ON BIOAVAILABILITY OF ZINC FROM OTHER FOOD PRODUCTS: A REVIEW OF COMPLEMENTARITY AT A MEAL LEVEL

Blerina Shkembi[1], and Thom Huppertz[1,2]

1 Food Quality & Design Group, Wageningen University & Research, The Netherlands
2 FrieslandCampina, The Netherlands

Abstract

While the nutrient content of food products is generally determined on an individual product basis, but the nutritional value is difficult to assess on a product basis, because food products are consumed in most cases, as meals rather than as single products. In this study we reviewed evidence for the influence of dairy products on zinc absorption from other food products. Co-ingestion of dairy products can improve zinc absorption from many food products. Significant improvements were observed when dairy products were co-ingested with e.g., rice, tortillas or bread products, all of which are high-phytate foods with low inherent zinc absorption but major sources of zinc in many diets. For foods low in phytate, the co-ingestion of dairy products did not improve zinc absorption. Improved zinc absorption of zinc from high-phytate foods following co-ingestion with dairy products may be related to the beneficial effects of the citrate and phosphopeptides present in dairy products. The important role of dairy products in the human diet is not only because of the nutrients it provides, but also because of its impact on nutrients from other nutrients from other products in meals.

Practical Relevance

Dairy products not only provide a source of dietary zinc but also modulate the absorption of zinc from other food sources. Considering that the main dietary zinc sources in areas in the world where zinc deficiency is most prevalent are typically high in phytate, the inclusion of dairy products in meals may be a possible dietary strategy to improve zinc absorption.

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SESSION 1

Monday 13th of June

QUANTITATIVE PROTEOMIC PROFILING OF BOVINE COLOSTRUM AND MILK AT ONSET OF LACTATION

Hannah K. Masterson[1,2,3], Tom F. O' Callaghan[4], Michael O'Donovan[5], John Paul Murphy[5], Katie Sugrue[5], Rebecca A. Owens[2,3], Rita M. Hickey[1,2]

1 Teagasc Food Research Centre, Moorepark, Ireland;
2 VistaMilk, SFI Research Center, Moorepark, Ireland
3 Department of Biology, Maynooth University, Ireland.
4 School of Food and Nutritional Sciences, University College Cork, Ireland
5 Teagasc Animal and Grassland Research Center, Moorepark, Ireland

Abstract

In order to better understand the milk proteome and how it transitions from colostrum to mature milk, we investigated the protein profile of milk produced by cows maintained under the same diet, management and environmental conditions but with different parities using a label-free proteomic approach. Differences in the abundance of various proteins between colostrum and mature milk have been widely investigated. Changes in levels of proteins in bovine milk early in the lactation period are less well understood as is the influence of parity of the cow. Previous studies have indicated that many proteins with altered abundance in the first week of lactation are involved with the development of the immune system and GI tract. The objective of this study was to investigate the effects of early lactation and parity on the bovine milk proteome.

Practical Relevance

This study improves the understanding of the bovine milk proteome which will guide future developments in infant formulations.

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SESSION 2

Tuesday 14th of June

BLEU D'AUVERGNE, A BLUE-VEINED CHEESE WITH A COMPLEX MATRIX AND INTERESTING NUTRITIONAL PROPERTIES

Imène Ferroukhi[1], Cécile Bord[1], Sylvie Alvarez[2], Karine Fayolle[1], Sebastien Theil[1], René Lavigne[1], Christophe Chassard[1], Julie Mardon[1]

1 Université Clermont Auvergne, INRAE, VetAgro Sup, UMRF 545 Fromage, France
2 Département qualité et économie alimentaire, VetAgro Sup, France

Abstract

Blue-veined cheeses has a specific matrix that evolves during ripening and gives an authentic typicity to finished products. The aim of this work was to characterise, for the first time, the different physico-chemical, biochemical, nutritional, microbiological and sensory variations that occur in different regions of the cheese during the ripening of Bleu d'Auvergne. Cheeses were manufactured, ripened and sampled on three regions at 2, 6, 13, 21 and 34 days of ripening. An exchange of Na and Ca ions between the different regions of cheese with a significant increase in proteolysis, yeasts and moulds was observed during ripening. Cheeses contained a high salt content (2.87%) and a significant level of Calcium (6.14 g/kg) and B12 vitamin (1.14 µg/100 g). Vitamin B2 and B6 contents increased during ripening while B9 did not change. Lactococcus and Streptococcus, were predominant and correlated with B-vitamins levels. In conclusion, B vitamins content of Bleu d'Auvergne, is interesting and the link with bacterial composition should be considered in a nutritional optimisation approach. Also, the high salt content of this cheese should be investigated in order to meet health guidelines.

Practical Relevance

The composition in calcium and B vitamins represent an important data on the nutritional composition of Bleu d'Auvergne. Opitimisation pathways are possible by studying the relationship between the bacterial community able to synthesise B vitamins. The presence of a significant salt content should also be investigated.

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SESSION 2

Tuesday 14th of June

IDENTIFYING GLYCATION HOT-SPOTS IN BOVINE MILK PROTEINS DURING PRODUCTION AND STORAGE OF SKIM MILK POWDER

Inge Gazi[1,2], Vojtech Franc1[1,2], Sem Tamara[1,2], Martine P. van Gool[3], Thom Huppertz[3,4], Albert J. R. Heck[1,2]

1 Biomolecular Mass Spectrometry and Proteomics, Bijvoet Center for Biomolecular Research and Utrecht Institute for Pharmaceutical Sciences, Utrecht University, The Netherlands
2 Netherlands Proteomics Center, The Netherlands
3 FrieslandCampina, The Netherlands
4 Department of Agrotechnology and Food Sciences, Wageningen University, The Netherlands

Abstract

We investigated protein glycation in a complex milk system under controlled conditions representative of real-life consumer products, analysing intermediate and final products from skim milk powder production, and aged powder samples. We combined protein-centric LC-MS(/MS) with peptide-centric multi-protease LC-MS/MS focusing on the six most abundant bovine milk proteins. This strategy resulted in the identification of glycated proteoforms and of the extent of glycation per protein, high protein sequence coverage, and identification and relative occupancy of the glycation sites. We identified new glycation hot-spots additionally to the ones already described in literature. Primary sequence motif analysis revealed that glycation hot-spots were preceded N-terminally by a stretch rich in basic amino acids, and followed C-terminally by a stretch enriched in aliphatic and hydrophobic amino acids. Our study considerably extends the current understanding of milk protein glycation, discussing glycation hot-spots and their localization in relation to the primary sequences and higher-order protein structures.

Practical Relevance

Protein glycation is relevant to the dairy industry, because it is accelerated by thermal processing, and it continues to develop during storage. Furthermore, glycated proteins exhibit altered susceptibility to digestive proteases, and decreased bioavailability of the glycated amino acids. We provide further insight into the mechanism of reaction, revealing a preferential protein glycation motif.

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SESSION 2

Tuesday 14th of June

VALORIZATION OF GREEK YOGHURT ACID WHEY WITH A THERMOTHIELAVIOIDES TERRESTRIS NOVEL B-GALACTOSIDASE FOR GOS SYNTHESIS

Athanasios Limnaios[1], Nausika Korialou[1], Anastasia Zerva[2], Maria Tsevdou[1], Evangelos Topakas[2], Petros Taoukis[1]

1 Laboratory of Food Chemistry & Technology, School of Chemical Engineering, National Technical University of Athens, Greece
2 Laboratory of Biotechnology, School of Chemical Engineering, National Technical University of Athens, Greece

Abstract

Greek yoghurt is a popular dairy product of high nutritional value. Its production has raised by-products management issues, related to the large amounts of acid whey (AW) that have proven conventional waste treatment facilities problematic. Innovative and efficient processes are sought for AW valorization. In this context, prebiotic galactooligosaccharides (GOS) could be enzymatically synthesized, via the alternative exploitation of novel β-galactosidases.

In this research, GOS production catalyzed by a novel, in-house produced β-galactosidase from Thermothielavioides terrestris was studied in relation to lactose concentration, enzyme load, pH value and temperature. Reaction products were analyzed via High Performance Anion Exchange Chromatography with Pulsed Amperometric Detection. For results quantification, GOS yield was expressed as the percentage of total GOS concentration to initial lactose concentration. Maximum GOS yield (20.7%) was achieved using concentrated AW with 20% w/v lactose, after 10 h of enzymatic reaction at the optimum conditions for the novel β-galactosidase (50°C, pH = 4.5). Synthesized GOS were mainly di-, tri-, and tetra-saccharides.

Practical Relevance

The optimum biocatalysis conditions for GOS synthesis were explored for the novel, thermophile β-galactosidase, capable of producing GOS at conditions that allow simultaneous AW concentration. The proposed AW valorization into high added value products is compatible to the circular economy philosophy, turning the management of a high volume by-product from an environmental issue to an opportunity.

SESSION 2

Tuesday 14th of June

ULTRA- UND NANOFILTRATION APPLIED TO REDUCE THE LACTOSE

Peter Habermehl, Stefan Nöbel, Jan Fritsche

Max Rubner-Institut, Department of Safety and Quality of Milk and Fish Products, Kiel, Germany

Abstract

Ultrafiltration (UF) is well established in upstream processing of the production of fermented milks. A novel combination of UF and (ceramic) nanofiltration (NF) aims to separate lactose from milk already before fermentation. Using combinations of UF–NF allowed to adjust the protein-lactose ratio and absolute lactose content of the milk base independently and without fortification. A low lactose content (<2.5 g/100g) had a significant effect on the acidification rate during lactic acid fermentation and, thus, on the microstructure of yogurt. Yogurt with the lowest lactose content (< 1.5 g/100g) needs approx. 15 h for acidification (pH < 4.6), whereby mainly the lag phase was prolonged. The viscosity at low shear-rates (<10 1/s) of the stirred yogurt significantly increased with decreased lactose content. A low lactose content favored the denaturation of whey proteins, resulting in a firmer milk gel at the same protein content. The optimum protein-lactose ratio is determined by rheological (apparent viscosity and gel firmness) and sensorial parameters. Based on preliminary trials, the optimum lactose content was assumed to be 1.5 and 2.5 g/100g.

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The UF-NF combination provides a cost-efficient opportunity to adjust the protein-lactose ratio of milk without fortification. Milk proteins are retained and can be used to modify the yogurt microstructure. Reducing the native lactose content allows to optimize the sweetness by added sugars and therefore represents an opportunity for innovation and reformulation of fermented milk-products.

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SESSION 2
Tuesday 14th of June

FERMENTATION OF ACID WHEY BY PROPIONIC ACID BACTERIA

Carsten Nachtigall, Ramona Plebst, Georg Surber, Harald Rohm, Doris Jaros
Chair of Food Engineering, Institute of Natural Materials Technology, Technische Universität Dresden, Germany

Abstract
Acid whey with its high lactic acid content is a by-product of acid coagulation for which the industry has struggled to find a value-added application. Common approaches such as separation of ingredients are still challenging because of, e.g., membrane fouling, thus fermentation with microorganisms that possess QPS/GRAS status might be another possibility. The aim of this study is to ferment acid whey with lactate-metabolizing, mesophilic propionic acid bacteria that are able to produce viscosity-enhancing exopolysaccharides (EPS).
Ultrafiltration permeate concentrate (dry matter: 12 g/100 g) supplemented with different nitrogen sources (e.g., tryptone) was used as model substrate. To enable growth, it was necessary to adjust the pH to 6.0 prior to fermentation. Acidipropionibacterium acidipropionici DSM4900 produced ropy EPS and increased viscosity of the cell-free supernatant by $\Delta\eta$ = 1.08 mPa·s, whereas Propionibacterium freudenreichii PF12 produced non-ropy EPS but was able to metabolize lactate completely.

Practical Relevance
Fermentation with safe microorganisms presents a new approach for adding value to acid whey (permeates) and reducing its lactate content. The EPS-functionalized whey upon concentration can be used as ingredient in dairy products to improve their texture and avoid the use of commercial hydrocolloids.

SESSION 2

Tuesday 14th of June

MAPPING OUT PARTIAL COALESCENCE TO OPTIMIZE AERATED DAIRY EMULSIONS

Abigail Thie

Wageningen University and Research, The Netherlands

Abstract

In aerated dairy emulsions like whipped cream and ice cream, the characteristic sensorial and rheological properties are largely dependent on the formation of a three-dimensional fat globule network. This network is formed when fat globules undergo partial coalescence (also called arrested coalescence) meaning they are able to begin merging but do not fully combine into one spherical globule. Although the existence of partially-coalesced fat globule networks is well documented, the underlying mechanism of when and how partial coalescence occurs is not. For this reason, the coalescence behavior of fat globule pairs was studied using a technique called micromanipulation. By using two capillary tubes to manually put two fat globules into contact, the entire coalescence event could be observed. By utilizing micromanipulation, several studies have been undertaken to further understand how solid fat content, fat composition, emulsifier concentration, emulsifier type, and droplet size impact the extent of coalescence between fat globules. The overall goal is to map out regions where partial coalescence will occur to ensure the stability and high quality of aerated dairy emulsions.

Practical Relevance

Controlling partial coalescence in aerated dairy emulsions influences the stand-up, meltdown, and other rheological behaviors of the final product. The extent of partial coalescence can also alter the textural and sensorial properties of ice creams and whipping toppings. By understanding the underlying mechanism, these critical features of a food can be more easily manipulated.

SESSION 3

Wednesday 15th of June

THE IMPACT OF WILD STRAINS AS STARTER CULTURES ON GOAT MILK CHEESE PRODUCTION

Angeliki Kourkoulakou, Anna Tasiouli, Theodoros Paschos, Effie Tsakalidou, Maria Kazou

Laboratory of Dairy Research, Department of Food Science and Human Nutrition, Agricultural University of Athens, Greece

Abstract

Goat milk can be considered as a rich reservoir of strains with promising technological traits. Thus, in this study, strains isolated from raw goat milk, and selected on the basis of their technological properties, were evaluated as starters/adjuncts in two types of goat milk cheese. In type 1, a blend of lactic acid bacteria (LAB), namely strains of Lactococcus lactis, Lacticaseibacillus paracasei, Lactiplantibacillus plantarum and Leuconostoc mesenteroides was used, while in type 2, Lacticaseibacillus paracasei was replaced by a wild yeast strain of Debaryomyces hansenii. Milk and cheese samples during ripening were subjected to physicochemical and classical microbiological analysis, while the final products to sensory analysis as well. Microbiological analysis revealed that the total mesophilic counts and LAB initially increased and then remained stable throughout cheese ripening. As expected, yeast counts were lower in type 1 cheese compared to type 2 where the ripening yeast culture was added. No coliforms were detected, which is an indicator of the good hygiene practices followed. Both cheese types were characterized by a low pH, smooth texture and pleasant taste.

Practical Relevance

The practical relevance of this study is the exploitation of the indigenous raw goat milk microbiota as a tool towards the production of new cheeses of high quality and safety. A relevant patent application is in progress.

SESSION 3

Wednesday 15th of June

PHOTOPURIFICATION OF WHEY-BRINE USED IN CHEESEMAKING BY TURBULENT FLOW UV-C TREATMENT

Ioanna Neokleous, Justyna Tarapata, Photis Papademas

Cyprus University of Technology, Cyprus

Abstract

Halloumi cheese PDO is a white-brined cheese that is incredibly important for the economy of Cyprus and as increasing quantities of the cheese are produced, whey volumes, as a by-product of the manufacturing procedure, are also increased. Whey is often pasteurized before being further used in the cheesemaking procedure for purification purposes. UV-C photo-purification is used for the inactivation of microorganisms, but its use in highly turbid organic fluids might be challenging therefore the effect of UV-C technology on pathogens inoculated in whey-brine derived from the production of Halloumi PDO cheese, was studied.

Whey-brine (12% NaCl) was inoculated with five different pathogens; the most resistant microorganism was Listeria innocua, requiring a UV-C dosage of 320 J/L. The inactivation for the rest of the bacteria occurred at equal or less than 200 J/L dosage. The results from this study indicate that a continuous (UV-C) turbulent flow photo-purification processing system is a promising non-thermal processing method for the reduction of foodborne pathogens of turbid fluids (i.e. whey), and could replace relevant processes involving heat treatment.

Practical Relevance

Non-thermal processes are becoming even more popular in order to fulfil the demands of a sustainable production especially in the dairy industry. Studies on dairy, milk and novel non-thermal processes such as UV-C treatment, are targeting cost-efficient, minimal-processing methods in order to produce safe products while preserving the nutritional and organoleptic characteristics.

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SESSION 3

Wednesday 15th of June

SOLUBILIZATION OF INDIVIDUAL CASEINS AND MINERALS FROM RENNET CASEIN BY DISODIUM PHOSPHATE AND TRISODIUM CITRATE: INFLUENCE OF CONCENTRATION, PH AND TEMPERATURE

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Abstract

The effect of emulsifying salts (ES) on the solubilization of para-κ-, αs1-, αs2-, and β-casein and minerals from 5% (w/w) rennet casein suspensions containing variable amounts of disodium phosphate (DSP) and trisodium citrate (TSC) at pH 5.8 and 6.7, and heat treatment (95°C/5 min) was studied. Casein (CN) solubilization increased with increasing ES level up to 150 mM for DSP and 50 mM for TSC. TSC was more efficient than DSP in solubilizing all the casein fractions (> 85% solubilized at 50 mM TSC) except αs2-CN. A higher amount of individual caseins were solubilized at pH 6.7 in comparison to 5.8, whereas heating reduced levels of solubilized protein regardless of pH. The amount of solubilized αs2-CN was not affected by heating, and β-CN was more susceptible to heating at pH 5.8. DSP showed a decrease and TSC showed a constant increase in soluble Ca with increasing ES amount. Thus, ES act by solubilizing casein proteins by chelation of Ca, but the extent of casein micelles dissociation depends on the type and concentration of ES, pH, and temperature. TSC chelates Ca and forms soluble complexes while DSP forms insoluble para-caseinate-Ca phosphate complexes.

Practical Relevance

The results of this study will help in elucidating the critical role of emulsifying salts in modulating casein hydration and dispersion during processed cheese manufacture and understanding their effect on the final product attributes. The knowledge gained may also establish a framework for understanding the interactions and matrix formation of casein gelation products such as processed cheese.

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SESSION 3

Wednesday 15th of June

STORAGE STABILITY OF LACTOSE-FREE UHT MILK IN RELATION TO PROCESSING STRATEGY AND LACTASE PREPARATION

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Abstract

Lactose-free (LF) UHT milk has a shorter shelf-life (~6 months) than normal UHT milk (~9-12 months). In LF milk, lactose has been hydrolyzed to glucose and galactose which is more reactive in Maillard reactions compared to lactose. In addition, the lactase preparations may contain impurities such as residual proteolytic activity, which further contributes to Maillard reactions. Both mechanisms can influence the aggregation of milk proteins. This study investigates the storage stability of LF UHT milk, in relation to proteolytic side-activity, cross-links from Maillard reactions and dehydroalanine-pathway, and aggregation in the milk. Processed milk was treated with 3 different lactase preparations at a commercial UHT plant, either by pre- (lactase added prior to UHT treatment) or post-hydrolysis (lactase added after UHT treatment), and stored up to one year at 25 or 35 °C. Casein micelles were studied via Field Flow Fractionation and showed a decrease in size for all milk types during storage. A study of the residual proteolytic activity indicated proteolysis in some post-hydrolyzed samples. Finally, SDS-PAGE showed more covalent aggregation in LF milk compared to normal UHT milk.

Practical Relevance

The purpose of characterizing the storage stability of pre- and post-hydrolyzed milk added different lactase preparation is to gain insight into the molecular mechanisms occurring. This insight can be used in the design for optimal process pathways for production of the lactose-free milk.

SESSION 4

Thursday 16th of June

A STUDY ON THE STRUCTURAL CONFORMATION OF ENZYMATIC CROSS-LINKED CASEINS PARTICLES IN ACIDIC CONDITIONS

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Abstract

The casein micelle is a structure that dissociates at the isoelectric point (pH 4.6). The prevention of its dissociation can be achieved by the formation of covalent cross- links with the transglutaminase (mTGase). We evaluated the effect of mTGase cross- linking to improve the stability of the casein micelle in an acidic environment.

-Cross- linking performed at neutral pH induced a decrease in the size and an increase in the apparent density of the micelles.

-The decrease of pH (3.0) of non-cross-linked caseins are completely disrupted, while cross-linked particles were denser, more compact, and had a bigger molar mass than the native micelle as a function of the cross-linking degree.

-Highly cross-linked aggregates (pH 3.0) possess a spherical conformation that is rather constant and close to the native micelle (Rg/Rh= 0.72 -0.81) regardless of the molar mass and size. The non-cross-linked particles are very polydisperse, as the ratio Rg/Rh varies as a function of the molar mass and the size.

- The apparent viscosity (pH 3.0), measured at the value given at a shear rate of 150 s-1 decreases as a function of the incubation time and enzyme concentration.

Practical Relevance

Caseins represents about 80% of the proteins in milk. Most of the sports and nutritional acidic beverages uses whey or vegetal protein as the base on formulations. It is therefore relevant to explore different ways to stabilize the caseins in an acidic medium and to study the structural changes linked to these

SESSION 4

Thursday 16th of June

EFFECT OF WHEY PROTEINS ON MICELLAR CASEIN DISSOCIATION UPON PH CHANGE AND COOL STORAGE

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Abstract

Membrane filtration is increasingly employed as a gentle process to fractionate individual milk components. This is bringing new opportunities to create new ingredients, by changing the compositional balance between soluble and colloidal phases, and modulating their permeation through the membranes. Although the dissociation of caseins upon pH and temperature conditions has been studied in great detail, most of the research reported has been carried out with skim milk. The aim of this work was to assess if there are differences in the micellar dissociation of caseins and minerals when skim milk is depleted of whey proteins. Native casein micelles were resuspended in skim milk serum (containing whey proteins (WP)) or in ultrafiltration permeate, milk serum without whey proteins. The dissociation behavior of the casein micelles as a function of pH and temperature was studied.

Practical Relevance

Data showed that the absence of WP in the serum phase caused a decreased release of - and -caseins in response to cooling and pH decrease. The results suggested that WP interact with micellar caseins also in the absence of heating treatment. These results are relevant for dairy industries in which filtration processes are used to separate specific fractions of the skim milk protein pool.

SESSION 4

Thursday 16th of June

INFLUENCE OF SODIUM HEXAMETAPHOSPHATE ON HEAT-INDUCED CHANGES IN MICELLAR CASEIN SOLUTIONS

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Abstract

Calcium chelators are widely used in the dairy industry to modify physical properties of milk systems, like heat stability. They work by sequestering calcium ions from the continuous phase, modifying the electrostatic environment and the dissolution of calcium from the micelle, altering the mineral equilibrium. In this work, the influence of sodium hexametaphosphate (SHMP), a strong calcium chelator with 6 negative charges, on heat-induced changes in micellar casein (MC) during UHT treatment and retort treatment was investigated. SHMP was found to simultaneously bind free calcium ions and calcium from colloidal calcium phosphate nanoclusters, but also to bind to caseins (CN). These interactions promote several changes in the MC system, such as an important increase in viscosity and solubilization of micellar casein. During the heat treatment, the SHMP was hydrolyzed and, as a consequence, there was a notable decrease in pH. The formed complexes of SHMP-CN were broken on heat treatment and this induced an important reduction in viscosity. Another factor that contributed to these effects is the intensity of the heat treatments.

Practical Relevance

This study aimed to better understand the heat-induced changes of SHMP on micellar solutions. The SHMP can be used to improve heat stability and increase the shelf-life of micellar casein concentrate-based systems.

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SESSION 4

Thursday 16th of June

SCREENING OF PROTEOLYTIC ACTIVITY AND HEAT RESISTANCE OF PSEUDOMONAS STRAINS

Miguel Aguilera Toro[1], Amalie Vestergård Thomasen[1], Yinghua Xiao[2], Valentin Rauh[2], Vittoria Piccini[2], Lisbeth Truelstrup Hansen[3], Martin Laage Kragh[3], Lars Wiking[1], Nina Aagaard Poulsen[1], Lotte Bach Larsen[1]

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Abstract

One of the main problems in UHT production is the spoilage by exogenous enzymes from psychrotrophic microorganisms. Among these, AprX, a thermoresistant protease produced by Pseudomonas, is considered the most prolific and relevant. Prediction of the spoilage potential of Pseudomonas populations present in raw milk samples is a coveted analytical technology by the dairy industry. However, the high proteolytic and genetic variability of Pseudomonas strains is a challenge when trying to implement a detection method.
In order to understand the complex differences between strains, 59 Pseudomonas strains were tested for proteolytic activity before and after simulated UHT treatment. A high heterogeneity was found between strains. It was assessed that 32% were highly proteolytic, 29% intermediate and 39% low or no proteolytic. Furthermore, most of the strains showed a high residual activity after the lab-scale UHT treatment.
In addition, RNA expression of aprX was assessed by qPCR in selected Pseudomonas strains and correlated to proteolytic activity with promising results.

Practical Relevance

The knowledge generated in this project will help to understand better the spoilage of UHT milk by Pseudomonas. Prediction of spoilage potential will allow the dairy industry to be more efficient when handling, processing, storing and distributing UHT milk. Additionally, the optimization of the production of UHT milk will reduce the volume of wasted product and the overall environmental impact.

SESSION 4

Thursday 16th of June

THE EFFECT OF PLASMIN ACTIVITY ON CAMEL MILK

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Abstract

The significance of proteolytic effect of plasmin on camel milk has remained unexamined, thus forming the objective of this study using primarily HPLC to follow changes in milk exposed to plasmin. Fresh pasteurized camel and cow milks were centrifuged at 8000 rpm at 4°C for 15 minutes to remove the fat. Milk samples 160 mL were treated with plasmin 0.01 U at 37°C for 0, 3, 6, 12, 24, 36, 48, and 72 hours and analyzed by HPLC. The separation of milk protein was performed in a Poroshell 300SB C8 column and eluates were monitored at 214 nm by DAD detector. Significant peaks were observed to be eluted from 10 minutes up till 18 minutes. After 12 hours of incubation, many new small peaks were observed, at the early chromatogram for camel milk but not for cow milk and the hydrolysis of camel milk caseins was more compared to cow milk. The casein peaks were reduced and the hydrolysis peaks were increased with hydrolysis time.

Practical Relevance

The examination of the enhanced proteolytic process that occurs in camel milk as compared to other milk types during plasmin activity may reveal the reasons behind the unique texture of the camel milk products and enabling the identification of resulting proteolytic products. Thus, the information gained may prove of significant use in the optimization of protocols in the camel milk industry.

SESSION 4

Thursday 16th of June

EFFECT OF ALTERNATIVE NONTHERMAL TECHNOLOGIES ON THE PRODUCTION OF ACID GELS PREPARED WITH SWEET WHEY

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Abstract

Sweet whey (SW) is valorized via the production of soft cheeses or feed, in bioethanol production, and/or the production of whey protein concentrates and isolates. The study aims to investigate whether SW can be alternatively used for the production of yogurt-like products, and for this purpose, Pulsed Electric Fields (PEF) and Transglutaminase (TGase) pretreatment of SW was investigated. SW samples of 3.5-10% w/w protein content were prepared using skim milk powder. Mixtures were thermally treated (Control), and then subjected to PEF and/or TGase treatment. The mixtures were inoculated with yogurt starter culture, incubated until pH end point, and then evaluated in terms of acidification kinetics, and quality parameters. Results indicated that in order to produce acid gels from SW with equal or even improved quality properties than those of products from raw milk, fortification of SW with milk powder is necessary, and that mainly PEF and secondarily TGase treatment are capable of improving the characteristics of the final product. Particularly, samples prepared from SW mixtures followed by PEF and TGase pretreatment at 500 pulses exhibited the most improved quality attributes.

Practical Relevance

The reuse of SW in dairy-based products may constitute a useful alternative for the valorisation of cheese industry by-products.

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