-

Book of Abstracts of the 1st Congress on Food Structure Design

Fundação Dr. António Cupertino de Miranda, Porto, Portugal

15-17th October 2014

This volume contains the abstracts presented at the **1st Congress on Food Structure Design**, held in Fundação Dr. António Cupertino de Miranda, Porto, Portugal, 15-17th October, 2014.

Title: **Book of Abstracts of the 1st Congress on Food Structure Design**

Editors: A. A. Vicente, C. L. M. Silva, L. Piazza

First edition: October 2014
ISBN: 978-989-97478-5-2

Publisher:
Universidade do Minho, Departamento de Engenharia Biológica
Campus de Gualtar, 4710-057 Braga, Portugal
Universidade do Minho

Organizing Institutions

Universidade do Minho

CATÓLICA PORTO
BIOTECNOLOGIA

UNIVERSITÀ
DEGLI STUDI
DI MILANO

EUROPEAN COOPERATION
IN SCIENCE AND TECHNOLOGY

CONSILIUM

European
Commission

Endorsed by


EFFoST
European Federation of Food Science and Technology


ISEKI - Food
Association


IUFoST

Preface

The food industry is constantly challenged to meet consumer demands for new food products that are safe, convenient, affordable, pleasurable and healthy. An understanding of fundamental structure and function relationships of food components is a key to the design of new foods: ingredient formulation and production processes have a major role in commercial food development but their impact on food structure is poorly characterized.

The goal of the Congress on Food Structure Design was is to strengthen at academic and industrial levels the scientific understanding of product design and engineering, and to stimulate and accelerate the development of innovative, complex and highly structured products and suitable production processes.

The main topic of the 1st edition of the Congress has been therefore the design of **health-supporting food functions** with development of **food structure/health benefits relationships** in complex real multiphase structured foods with optimal sensory quality.

This conference was meant to gather an interdisciplinary team of scientists from different research areas (food engineering, biophysics, applied soft matter, food technology, applied human nutrition, creative design) in the frame of an integrated process & product design approach for creating innovative multiphase structured foods.

Sharing knowledge and technologies for healthy foods design among academic institutions and private enterprises for the purpose of further development has also been addressed.

The Congress was developed on three directions of "Food structure design":

I. Engineering of structures for tailored delivery of health-related functionalities

II. Process and product engineering for food properties generation/preservation/delivery

III. Sharing knowledge and technologies between academia and industry for healthy foods design

With the following sub-topics:

I. Engineering of structures for tailored delivery of health-related functionalities

Elucidating structure-property functions and designing model multiphase food systems

a. Biophysics/Biochemistry-driven strategies for structure design in model multiphase foods

b. Engineering self-assembly nano- and microstructures in food systems

c. Designing complex (bio)polymer and colloidal systems

d. Designing of novel and/or tunable structures for engineered nano- and microstructures for stability and controlled release of bioactives

e. Development of advanced and appropriate analytical and theoretical tools to elucidate the effects of structure on the health and nutritional attributes of the final food product

II. Process and product engineering for food properties generation/preservation/delivery

Assessing the role of processing in stabilizing of complex multiphase real foods or new food ingredients and in reformulating the nutrient contents of foods to enhance their nutritional profile

a. Understanding and controlling the behavior of functional ingredients/ingredient design with targeted health functionality

b. Redesign of traditional processes to meet new consumer needs

c. Biophysical and gastro-intestinal engineering aspects of nutrient absorption and physiological function

d. Process innovations in encapsulation technology, drying, structuring technologies, non-thermal processing following a criterion for structure/process design

e. Structure-sensory properties relationship and consumer perception as a criterion for process design

f. Meeting consumer sensorial demands and nutritional needs through rational design of structures and processes

III. Sharing knowledge and technologies between academia and industry for healthy foods design

Bridging the innovative food structure design approach with the criteria for the market driven food research

a. New concepts and processes for creating healthy foods

b. Structure design for gastronomy applications

c. Enterprise-based innovation system in food structure design

d. Case studies on structure/process development with relevance to different food manufacturing processes

e. Transferring skills, knowledge, technologies to private companies: role of Technology Transfer Mediators and of Transfer Agencies

Overall participation has resulted in 10 plenary and keynote lectures, 23 oral presentations and over 140 posters, in a total of 37 countries represented.

António A. Vicente **Cristina L. M. Silva** **Laura Piazza**

(Conveners of the 1st Congress on Food Structure Design)

Committee Members

Scientific Committee

Laura Piazza (Co-Chair) | University of Milano | Italy

António A. Vicente (Co-Chair) | University of Minho | Portugal

Cristina L. M. Silva | Portuguese Catholic University | Portugal

Bart Nicolai | Katholieke Universiteit Leuven | Belgium

Chelo González | Technical University of Valencia | Spain

Christophe Schmitt | Nestlé Research Centre Lausanne, Nutrient Technology | Switzerland

Costas Biliaderis | Aristotle University | Greece

Cristóbal Aguilar | Universidad Autónoma de Coahuila | Mexico

Dietrich Knorr | EFFoST | Netherlands

Dolores O'Riordan | University College Dublin | Ireland

Erich Windhab | ETH - Swiss Federal Institute of Technology | Switzerland

Erik Van Der Linden | Wageningen University | Netherlands

Gabriela Lordachescu | Dunarea de Jos University | Romania

Gerhard Schleining | BOKU - University of Natural Resources and Life Sciences | Austria

Gilles Trystram | Agriparistech | France

Giovanna Ferrari | University of Salerno | Italy

Gustavo Barbosa-Canovas | Washington State University | USA

Javier Raso | University of Zaragoza | Spain

Jose Miguel Aguilera | Pontificia Universidad Católica de Chile | Chile

José Teixeira | University of Minho | Portugal

Kirsi Jouppila | University of Helsinki | Finland

Lilia Ahrné | SIK - The Swedish Institute for Food and Biotechnology | Sweden

Manuela Pintado | Portuguese Catholic University | Portugal

Marc Anton | INRA Angers - Nantes | France

Maria Luisa Beirão da Costa | University of Lisbon | Portugal

Mike Boland | Massey University | New Zealand

Mladen Brncic | University of Zagreb | Croatia

Natasa Poklar | University of Ljubljana | Slovenia

Paola Pittia | University of Teramo | Italy

Paolo Masi | Università degli Studi di Napoli Federico II | Italy

Paul Singh | UC Davis - California | USA

Paulo Sobral | University of São Paulo | Brazil

Petros Taoukis | National Technical University of Athens | Greece

Pilar Buera | School of Exact and Natural Sciences, Buenos Aires | Argentina

Rosiane Lopes da Cunha | Universidade Estadual de Campinas | Brasil

Simeon Stoyanov | Unilever Research & Development, Vlaardingen | Netherlands

Uri Lesmes | Israel Institute of Technology | Israel

Victor Nedovic | University of Belgrade | Serbia

Organizing Committee

António A. Vicente (Co-Chair) | University of Minho | Portugal

Cristina L. M. Silva (Co-Chair) | Portuguese Catholic University | Portugal

Ana Cristina Pinheiro | University of Minho | Portugal

Fátima Miller | Portuguese Catholic University | Portugal

Inês Ramos | Portuguese Catholic University | Portugal

Joana Fundo | Portuguese Catholic University | Portugal°

Joana Martins | University of Minho | Portugal

Miguel Cerqueira | University of Minho | Portugal

Óscar Ramos | University of Minho | Portugal

Ricardo Pereira | University of Minho | Portugal

Sara Oliveira | Portuguese Catholic University | Portugal

Teresa Brandão | Portuguese Catholic University | Portugal

Table of Contents

Plenary Lectures

Ref: 5436

Elucidating structure-property functions and designing model multiphase food systems

Roos, Yrjö H. [1]

[1]School of Food and Nutritional Sciences, University College Cork, Cork, Ireland

E-mail: yrjo.roos@ucc.ie

Abstract

Numerous food systems are manufactured using ingredients and processes aiming at production of novel high quality foods satisfying consumer needs. Examples of such traditional foods include many baked products and confectionary. White bread production is an example of a food process that uses food material properties to achieve formation of a gluten network with partial gelatinization of starch and dehydration of the crust components at oven temperatures to develop a characteristic flavor and colour, and form a solid structure that supports the final product. The process results in a multiphase system containing crosslinked and deformed ingredient components, water and air. The structure-property relationships of food components are extremely important in understanding food behaviour in freezing and consequently in the design of frozen, multiphase formulated foods. The food industry is increasingly looking for technologies that preserve food quality and materials and ingredients which can be used to deliver bioactive and functional food components. A number of multiphase systems, including carbohydrates, protein, lipids and bioactive components for inclusion, protection and delivery in food ingredients and consumer foods are being made available. Such systems may use interface engineering to stabilise nanoemulsion particles and active lipophilic and hydrophilic components in solid and liquid states. Our studies have indicated improved stability of carotenoids in freeze-dried and spray dried multiphase systems. We are gaining further understanding of structure formation in food materials dehydration and freezing. The characterization of food solids has allowed mapping of carbohydrate-protein systems states and model relaxation times in concentrated solids systems. Understanding of component relationships and engineering properties is expected to enhance the development of improved food ingredients and design of food formulations with desired processing and stability characteristics.

Ref: 5481

Assessing the role of processing for improved food properties through the building of food structure

***Trystram, Gilles*[1]; *Vitrac, O.*[1]; *Flick, D.*[1]; *Michon, C.*[1]; *Lucas, T.*[1]**

[1]AgroParisTech

E-mail: Gilles.trystram@agroparistch.fr

Abstract

The structure of food is well recognised as a key parameter for the engineering of food properties. Numerous works report the relationship between structure at different scales and related properties, covering a large spectra of properties: organoleptic, nutritional, usability, safety, bioavailability, … All the form of products are concerned: powder, liquid, semi liquid, foam (solid or liquid), emulsion.

In most of the case, the structure is obtained during processing as a combination between the interaction effect of ingredients, the native structure of the product (cell network for example) and the influence of physical, chemical en biological transformation ways.

From a long time, numerous studies are dedicated to the characterisation of the food structure at different scales. Initially mechanical properties were investigated and the relation between these properties and sensory properties was investigated. Numerous correlations are used in order to predict food behaviour in relation with structure. More recent results establish that structure, and microstructures are related with nutrition impact of food. As a consequence a lot of research is dedicated to the building of structure of food and to study the influence on nutrition or sensory impacts. Again numerous “black box” results shown that the relationship is an effective one. The question today is more to be able ton engineers the structure of food, in such a way that it will be possible to obtain a set of properties, available at the same time, that influence different food properties.

Looking at the research in progresses, 3 main ways are discussed as contribution to the building of structure in relation with expected food properties.

The first important set of approaches concerns the characterisation of food structure using microscopy techniques. Numerous works are available, that permit to quantify food samples, and other that are very useful to help for the study of the dynamic building of structure during processing. Experimental approaches coupling microscopy techniques and other characterization tools become available and are very promising. The second set of approaches concerns the understanding of processing for structure building and the way that modelling helps to study difficult to measure properties. First principle models, at different scales are available, more and more precise, and some significant results become available for prediction

of some food structure related properties. The third approach, still available concerns the coupling between final food properties and structure characterisation.
All these approaches are promising avenues for research in Food processing.

Ref: 5434

Bridging the innovative food structure design approach with the criteria for the market driven food research

***Arnhé, Lilia*[1]**

[1]SIK- the Swedish Institute for Food and Biotechnology, Sweden

E-mail: lilia.ahrne@sik.se

Abstract

Chocolate confectionery is one of the most appreciated indulgence food categories for consumers. It is related to feeling good and comprehended as an affordable luxury product. However, trends in obesity for adults, but also in particular for children, during the past 2-3 decades is driving the development of more healthy products. Reduction or replacement of sugar and/or fat in chocolate confectionery fillings, in addition to sensorial problems, may cause quality problems during storage like fat bloom - a greyish coating on the surface of the chocolate and crack formation in chocolate shell causing the filling to seep out. These problems are related to chocolate microstructure formation during processing which affects chocolate mechanical strength, stability-related mass transport properties and consequently product quality characteristics and shelf-life.

In the framework of the European project ProPraline, leading scientist from different European research centres working together with industrial partners have developed knowledge and new technical solutions to prevent cracking and fat bloom. In order to determine the mechanisms behind the two problems the understanding of process- structure - property relationships has been used as base to identify the structural aspects of relevance triggering crack formation and fat bloom in the chocolate shell and fillings from a molecular to a macro-disperse structure scale.

Post-treatment effects on fat bloom, new possibilities for controlling fat crystallization and cooling, new methodologies to quantify chocolate microstructure and fat bloom, novel methods to measure fat/water migration, are some examples of the results obtained being relevant to industry, especially SMEs and having contributed to a better understanding quality problems in chocolate products. Additionally results regarding sensorial evaluation and consumer perception about cracking and fat blooming will also be presented.

Session 1: Engineering of structures for tailored delivery of health-related functionalities

Session 1: Keynote lectures

Ref: 4422

Design of novel nano and microstructures for stability and controlled release of bioactives

***Kristbergsson, Kristberg*[1]**

[1]University of Iceland

E-mail: kk@hi.is

Keywords: nanotechnology, delivery systems, Solid Lipid Nanoparticles, liposomes controlled release

Abstract

Many desirable compounds that have been isolated from their natural environment are very unstable to many environmental factors and may react with other components if they are to be used in foods. The inclusion of bioactive compounds such as omega-3 fatty acids, lycopene or beta carotene is an essential requisite for the production of some functional foods designed to improve the long-term health and well-being of consumers worldwide. In order to incorporate these functional components successfully in a food system, structurally sophisticated encapsulation matrices have to be engineered that provide maximal physical stability, protect ingredients against chemical degradation and allow for precise control over the release of encapsulated components during mastication and digestion to maximize adsorption. In addition to delivering nutritionally beneficial components the engineered delivery systems may be used to enhance physical properties like color in foods or to deliver functional components like antimicrobial agents. The functionality of these encapsulation systems may be controlled by the materials used, preferably natural food components like lipids, proteins and carbohydrates. There properties may further be influenced by the physical state of the encapsulation material and by using a combination of materials in layered heterogeneous systems. The functionality of the delivery system can also be controlled by the shape of the encapsulation system where spherical and tubular systems are most popular. The size of the encapsulated particles is fundamental in controlling properties where micro and nano systems have their unique properties and capabilities with respect to delivery, protection, release and effect on the physical state of the food system. The presentation will introduce the most common functional components to be delivered, type of materials used in the delivery systems, there structure, properties, stability, manufacturing and the mechanisms most prominent for controlled release in foods.

Acknowledgements: To my coworkers professors Jochen Weiss at Universität Hohenheim, David Julian McClements and Eric Decker at University of Massachusetts, Amherst and all our graduate students and post This research has been supported by many including, US Department of Agriculture (USDA), European Union (EU). Further financial support was

provided by Deutscher Akademischer Austausch Dienst (DAAD) Bonn, Germany, Research Fund University of Iceland, Reykjavik, Iceland and Thomas H. Smouse Memorial Fellowship located in Urbana, IL, USA.

Ref: 4425

Development of analytical and theoretical tools to elucidate the effects of structure on the health and nutritional attributes of the final food product

***Kedzior, Zenon*[1]**

[1]Poznan University of Life Sciences, Institute of Food Technology, Poland

E-mail: kedziorm@up.poznan.pl

Keywords: food structure, analytical methods, theoretical models, nutritional quality, bioactive compounds delivery, health

Abstract

Some foods are liquids representing simple molecular system or colloidal and emulsified multiphase structure. However, the majority of foods are complex solid-like systems containing some quantities of water. A hierarchy of structures can be applied to describe solid-like food products. These structures range from molecular level of single components used to evaluate the behaviour of individual biopolymers, through binary networks or mixed gel used as the simplified models for multicomponent structures present in real foods, to composite filled porous gels used to assess the role of polydisperse particulates such as emulsified fat globules, liquid droplets, fibres, gas bubbles, crystallites or suspended cellular components present in complex food systems.

All relevant physical, chemical, biochemical and physiological analytical methods should be considered as tools for studying transformation of structured solid-like foods to chyme upon ingestion. Controlling the health and nutritional attributes of the final food product includes elucidating the susceptibility of solid-like foods to size reduction in mouth by chewing and grinding by gastric motility, their surface wettability, water penetrability and capability of hydration, accessibility to digestive enzymes, availability of lipids to emulsifying by bile acids in the digestive tract, dynamics of digestion, release of nutrients and bioactive compounds and their absorption into blood and lymphatic vessels. Reliable theoretical models could bring a tool for improving process of designing food structure to meet particular needs of healthy and suffering various diseases groups of consumers.

A perfect set of analytical methods and verified theoretical models should allow designing and control all aspects of structural-functional properties of a food product from its industrial and culinary processing to its behaviour upon ingestion, digestion and absorption from gastrointestinal tract including controlled delivery of bioactive compounds, joining together optimal palatability of a food product and its nutritive, and therapeutic value, if required.

Acknowledgements: The author thanks EU grants: „Innovative economy” – “New bioactive food of programmed pro-health properties”, COST FA 1001 “The application of innovative

fundamental food-structure-property relationships to the design of foods for health, wellness and pleasure". Polish National Research Centre grants: "Characterizing physicochemical and rheological properties of gluten proteins of primitive wheat species for its technological valorization" "Studies on bioavailability *in vitro* and *in vivo* of the selected mineral components of the gluten-free bread enriched with some natural products".

Session 1: Oral presentations

Ref: 3240

Rheological and structural properties of monoglyceride hydrogels containing milk

Valoppi, Fabio[1]; Calligaris, Sonia[1]; Barba, Luisa[2]; Nicoli, Maria Cristina[1]

[1]Department of Food Science, University of Udine, Italy;
[2]Institute of Crystallography, National Research Council, Italy

E-mail: fabio.valoppi@uniud.it

Keywords: Monoglyceride, Gel, Synchrotron XRD analysis, Polarized light microscopy, Rheology

Abstract

Monoglycerides (MGs) are considered the most important group of emulsifiers in food industry. Recently, they were used as structuring agents in the preparation of MG-oil-water gels (hydrogels) that can be used as fat replacers. Generally, the water phase of these systems is represented by a NaOH containing solution at a given pH range. The possibility to substitute NaOH aqueous solutions with milk could be of considerable interested in the light to exploit these structures in food formulations. The present research was addressed to study the possibility to use UHT defatted milk as water phase to obtain monoglyceride hydrogels. The phase behavior of milk-oil-monoglyceride ternary mixtures was studied by determining the state compositional diagram of systems having different ratio among ingredients. Synchrotron XRD analysis, polarized light microscopy and rheological analysis were used to study the monoglyceride structure organization within the systems. To better understand the influence of milk constituents on monoglyceride structuring behavior, simulated milk ultrafiltrate solutions (SMUF) added or not with whey proteins and/or caseins were considered as water phase in ternary systems.

Results highlighted that milk can be used to obtain MG-gels delivering up to 65% (w/w) of oil. The systems were structured by lamellar phases formed by crystallized saturated monoglycerides surrounding oil. Synchrotron XRD results highlighted that the thickness of lamellar bilayer was about 62 Å with glycerol head in hexagonal packing. The relative ratio among ingredients determined the rheological properties of the systems. In general, as the oil and/or MG content increased, the gel strength also increased, in concomitance with mean diameters of oil droplet. Results suggest that the structure of the gels can be tailored on the basis of formulation needs. These gels could be exploited for the substitution of saturated fats in different food categories, such as spreads, bakery products, and dairy derivatives.

Ref: 3257

Preparation of monodisperse O/W emulsions loaded with ergocalciferol using microchannel emulsification and their stability evaluation

Khalid, Nauman[1,2]; Kobayashi, Isao[1]; Wang, Zheng[1,3]; Neves, Marcos A. [1,3,4]; Uemura, Kunihko[1]; Nakajima, Mitsutoshi [1,3,4]; Nabetani, Hiroshi[1,2]

[1]Food Engineering Division, National Food Research Institute, NARO, Japan;
[2]Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan;
[3]Alliance for Research on North Africa, University of Tsukuba, Japan;
[4]Graduate School of Life and Environmental Sciences, University of Tsukuba, Japan.

E-mail: isaok@affrc.go.jp

Keywords: Monodisperse emulsion, O/W emulsion, Vitamin D2, Microchannel emulsification, Stability

Abstract

Monodisperse emulsions have been widely used in the pharmaceutical and food industries in the last two decades and have received increasing attention from food scientists due to its practical applications in encapsulation and controlled delivery. Ergocalciferol (vitamin D) is a bioactive compound whose deficiency may lead to rickets and osteomalcia. In this study, ergocalciferol was encapsulated in different food grade oil-in-water (O/W) emulsions stabilized by polyoxyethylene (20) monolaurate (Tween 20) using microchannel emulsification (MCE). This study used a 24 x 24-mm silicon MCE device (model WMS 11-1) with 27,400 asymmetric through-holes within a 10 x 10-µm central area. Asymmetric through-holes were microfabricated via two steps of deep reactive ion etching. Each micro-hole consisted of microslots (10 x 80-µm size and 40-µm depth) and circular microchannels (MCs) (10-µm diameter). Different food grade oils each containing 0.5% (w/w) vitamin D were used as dispersed phase, while Milli-Q water containing 1% (w/w) Tween 20 was used as continuous phase. MCE was performed by injecting the dispersed phase via asymmetric through-holes into the channels filled with continuous phase. The flow rates of the dispersed and continuous phases were 0.5 and 9 mL/h, respectively. Monodisperse ergocalciferol-loaded O/W emulsions with average droplet diameters of 33 to 36 µm and span width below 0.2 were successfully prepared using the MCE device. The collected O/W emulsion droplets remained stable over 15 days, with span width below 0.3 and encapsulation efficiency of higher than 85%. The ergocalciferol-loaded emulsion products obtained in this study have potential applications in designing functional foods with reduced oil contents and functional beverages to reduce oestomalcia in adults.

Ref: 4354

Association of riboflavin in whey protein hydrogels produced through application of moderate electric field and cold induced gelation

Pereira, Ricardo N.*[1]; Altinok, Emir[2,3]; Rodrigues, Rui M.[1]; Ramos, Óscar L.[1,4]; Malcata, F. X.[4,5]; Ferrari, Giovanna[2,3]; Teixeira, José A.[1]; Vicente, António A.[1]

[1]Centre of Biological Engineering, University of Minho. Campus de Gualtar, 4710-057 Braga, Portugal;
[2]Department of Industrial Engineering, University of Salerno, Fisciano (SA), Italy;
[3]ProdAl Scarl, University of Salerno, Fisciano (SA), Italy;
[4]LEPABE-Department of Chemical Engineering, Faculty of Engineering, University of Porto, Porto, Portugal;
[5]Department of Chemical Engineering, University of Porto, Rua Dr. Roberto Frias, Porto, Portugal.

E-mail: rpereira@deb.uminho.pt

Keywords: Moderate Electric Field, whey proteins, aggregation, cold gelation, riboflavin

Abstract

Protein hydrogels are one of the most convenient and widely used matrix in food applications. Recently, cold gelation ability of whey protein isolate (WPI) is taking interest in protection and delivery of value-added bioactive compounds through micro and nano-association techniques. This study aims to combine an electro-heating treatment at moderate electric fields (MEF) together with cold gelation ability of whey proteins in order to reduce size of protein aggregates at nano-scale and improve association efficiency of riboflavin. Divalent iron cation assisted cold gelation of electro-heated WPI and effects of MEF on the produced hydrogels were reported and encouraged during this experimental research. Particle size was characterized, through dynamic light scattering. While spectrofluorimetric analyses were performed in order to examine the effects of MEF and cold induced gelation on the association of riboflavin within WPI hydrogel network structure. Under MEF application smaller sized particles were produced and riboflavin association efficiencies ranged from 40 to 60%. Results also show that MEF treatment allowed producing WPI nano-hydrogels with associated riboflavin less susceptible to light oxidation. This novel approach that combines electro-heating treatment together with cold gelation can be used to design and develop entirely biodegradable whey protein-based gels as potential devices for controlled release of riboflavin. MEF can be used to improve or create novel applications not only in food and bioprocessing industries, but also in the pharmaceutical area.

Acknowledgements: Ricardo N. Pereira and Oscar L. Ramos gratefully acknowledge their Post-Doctoral grants (SFRH/BPD/81887/2011 and SFRH/BPD/80766/2011, respectively) by Fundação para a Ciência e Tecnologia (FCT, Portugal). The authors thank the FCT Strategic Project PEst-OE/EQB/LA0023/2013 and the project “BioInd - Biotechnology and Bioengineering

for improved Industrial and Agro-Food processes", REF. NORTE-07-0124-FEDER-000028 Co-funded by the Programa Operacional Regional do Norte (ON.2 – O Novo Norte), QREN, FEDER.

Session 1: Poster Presentations

Ref: 3230

The influence of participant age on dynamic texture perception of different food structures

Scott, Hutchings[1]; Marco, Morgenstern[2]; Kylie, Foster[3]; John, Grigor[3]

[1]University College Dublin, Ireland;
[2]The New Zealand Institute for Plant and Food Research Limited, New Zealand;
[3]Massey University, New Zealand.

E-mail: scott.hutchings@ucd.ie

Keywords: texture, oral processing, aging, dynamic sensory methods

Abstract

As the baby boomer generation continues to age, the food industry has been presented with a significant challenge to design food structures to meet the demands of this growing demographic. Opportunities exist to design food structures with specific textures to improve food acceptability and food intake for these older generations. However, an understanding of changes in the ability to perceive food texture with age is required. The aim of this study was to compare the ability of an older age group (55-70 yrs) and a younger age group (21-29 yrs) to dynamically perceive food texture.

Using the Temporal Dominance of Sensations (TDS) technique, subjects assessed the texture of a series of nuts, which had similar yet slightly different textures (almonds, cashews, macadamia nuts, and peanuts). Subjects were then required to report the texture of vastly different food textures (cheese, chocolate, gelatine gels, and shortbread), also using the TDS technique. Finally, subjects were required to assess texture using the Time Intensity (TI) technique, of cashew nuts served at a large particle size (typical cashews), and cashews served at a very fine particle size (which simulated a ready to swallow food bolus).

Results with the TDS technique showed that the older group had a well retained ability to dynamically perceive food texture in comparison with the younger group. Both age groups successfully discriminated differences in food texture across all the foods served, showing clear progression in dominating texture attributes. However, some differences in the selection of texture attributes were noted, particularly a higher selection of stickiness by the younger group. Results with the TI technique also found the older group also had a well retained ability to dynamically sense the texture of cashews served at a large particle size and cashews served in the form of a food bolus.

Ref: 3239

Design of liquid emulsions to structure spray dried particles

***Hernandez Sanchez, Maria del Rayo*[1,2,3]; *Cuvelier, Marie-Elisabeth*[1,2,3]; *Turchiuli, Christelle*[1,2,3]**

[1]AgroParisTech, UMR 1145 Ingénierie Procédés Aliments, 1 Avenue des Olympiades, F- 91300, Massy, France;
[2]INRA, UMR1145 Ingénierie Procédés Aliments, F- 91300, Massy, France;
[3]CNAM, UMR1145 Ingénierie Procédés Aliments, F- 91300, Massy, France.

E-mail: mariadelrayo.hernandezsanchez@agroparistech.fr

Keywords: liquid emulsions, antioxidants, spray drying, spray dried particles, depletion, encapsulation efficiency

Abstract

Lipophilic active compounds such as antioxidants, fatty acids and vitamins have positive effects on human health and food preservation. To preserve their functional properties, they can be dispersed in oil-in-water emulsions and encapsulated by spray drying. The aim of this work is to design liquid emulsions to produce spray dried emulsions with good antioxidant encapsulation efficiency. Liquid emulsions, containing 4% w/w of sunflower oil (in which antioxidants will be dispersed), must be physically stable until the end of the drying process (2 h) and have a viscosity and support content convenient for pumping and drying. Tween 20, chosen as emulsifier, has not to be in excess to avoid the engulfment of antioxidants in the aqueous phase. Spray dried particles obtained at pilot scale (Niro Minor) will be about 20 µm. Therefore, oil droplets must have a size around 2 µm in order to be protected.

Liquid emulsions were prepared varying the Tween concentration and the support material (maltodextrin DE 12 and agave inulin). They were characterized for the physical stability, oil droplet size distribution and viscosity. The powders were characterized for the particle size distribution and surface oil content. They were dissolved in water to reconstitute the initial emulsions and evaluate the impact of spray drying on the emulsion structure.

It was possible to produce stable liquid emulsions (against depletion phenomena) suitable for spray drying using:

1) inulin (46% w/w) and Tween (0.05% w/w);
2) maltodextrin (36% w/w) and Tween (0.14% w/w).

The encapsulation efficiency in spray dried powders was good (15% w/w of total oil unprotected).

This study allowed defining formulations and protocols for designing liquid emulsions suitable for spray drying. They will be used to study the influence of process conditions and antioxidant polarity on its distribution within the particle in relation with the protection against oxidation.

Acknowledgements: The authors would like to thank the Mexican National Council of Science and Technology (Consejo Nacional de Ciencia y Tecnología, CONACYT) for financial resources provided to Maria del Rayo Hernandez Sanchez.

Ref: 3241

Formation of complexes and coacervates between bovine beta-Lactoglobulin and Lactoferrin modulates *in vitro* protein digestion

Donato-Capel, Laurence[1]; Schmitt, Christophe[1]; Bovetto, Lionel[1]

[1]Department Food Science and Technology, Nestlé Research Center, P.O. Box 44, CH-1000 Lausanne 26, *Switzerland*

E-mail: christophe.schmitt@rdls.nestle.com

Keywords: coacervation, milk proteins, digestion

Abstract

There is a great interest in tailoring design of functional ingredients based on proteins in order to address specific biological responses associated to them (satiety, blood glucose control, hypertension…). Indeed, not only amino-acid sequence and structure of proteins are impacting their digestion, but also their possible interactions with other food ingredients (proteins, lipids, carbohydrates) to form complex assemblies.

The aim of this work was to determine the conditions for formation of electrostatic complexes or coacervates between bovine beta-Lactoglobulin (BLG) and Lactoferrin (LF) as a function of pH, ionic strength, molar ratio and total protein concentration. It was shown that soluble complexes could be obtained on a wide range of physicochemical conditions but that coacervates were formed in a much narrow range of about pH 5.8-6.1, less than 20 mM NaCl, BLG/LF molar ratio of 4:1 and total protein concentration of 4 wt% [1].

The impact of complex or coacervate formation on the *in vitro* digestion kinetics and resulting peptidic profiles of the proteins was further assessed. It was shown that BLG/LF complexes or coacervates delayed BLG digestion kinetics and modified the peptidic profile at a given hydrolysis time compared to single protein used as a control. The largest effect was obtained with coacervates which might be due to the specific electrostatic network-like structure formed, reducing accessibility for the digestion enzymes to the hydrolysis sites [2].

References:

[1] E. Kizalay, D. Seeman, S. Flanagan, P.L. Dubin, L. Bovetto, L. Donato, C. Schmitt. (2013). Heteroprotein complex coacervation: bovine beta-lactoglobulin and lactoferrin. Langmuir, 29, 15614-15623.

[2] L. Bovetto, D. Breuillé, L. Donato, E. Pouteau, C. Schmitt, A. Panchaud. (2012). Lactoferrin based complex coacervates and their uses. World patent application WO2012045801.

Ref: 3244

Functional properties of mango peel pectin extracted by citric acid

***Jamsazzadeh Kermani, Zahra*[1]; *Shpigelman, Avi*[1]; *Pham, Huong*[1]; *Van Loey, Ann*[1]; *Hendrickx, Marc*[1]**

[1]Laboratory of Food Technology and Leuven Food Science and Nutrition Research Centre (LFoRCe), Department of Microbial and Molecular Systems (M2S), Katholieke Universiteit Leuven, Kasteelpark Arenberg 22, 3001 Leuven, Belgium

E-mail: Zahra.jamsazzadeh@biw.kuleuven.be

Keywords: Mango peel pectin, citric acid extraction, emulsifying properties, gelling properties, stabilizing properties

Abstract

Pectin, one of the main polysaccharides of the higher plant cell walls, can be extracted and applied in food systems as gelling agents, emulsifier and stabilizer. The chemical structure of pectin is dependent on source and extraction method thus affecting its functional properties. The objective was to evaluate whether mango peel is a potential source of functional cell wall polymers. Hence, the chemical characteristics and the functional properties of mango peel pectin extracted using a weak acid with chelating properties (citric acid, pH 2.5, 2 h at 80 °C), were examined. Apple pectin was compared with the citric acid extracted mango peel pectin (CAMP) in terms of functional properties.

The obtained CAMP was branched and had an extremely high degree of methoxylation (DM) and a high molecular weight (Mw). Comparing the Fourier Transform Infra-Red spectroscopy of extracted and native WSF showed that citric acid remained partially associated with the CAMP due to its chelating properties even after dialysis. Comparison between the CAMP and laboratory grade apple pectin showed that CAMP had rather low uronic acid content (41 versus 74.5% w/w), a high DM (78.1 versus 70.7), a similar degree of acetylation (3.4 versus 3.3%), and higher M_w (1480 versus 266 kDa).

A gel-like behavior was observed for CAMP (5% w/v) in presence of 70% w/w sucrose (pH 3.2). Emulsification properties of CAMP in oil-in-water emulsion were comparable with apple pectin over 30 days of storage. CAMP (0.2 to 0.5% w/v) was shown to decrease the particle size of acidified milk drink (AMD) (compared to no pectin added) by stabilization of casein against aggregation. However, it was not stable after 10 days of storage, probably due to insufficient amount of added pectin. This study showed that the extracted pectin may be a potential emulsifier in oil-in-water systems.

Ref: 3249

Structure and properties of ultrasonically modified starch

Rimac Brncic, Suzana[1]; Brncic, Mladen[1]; Badanjak Sabolovic, Marija[1]; Bosiljkov, Tomislav[1]; Ukrainczyk, Neven[2]

[1]Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia;
[2]Faculty of Chemical Engineering and Technology, University of Zagreb, Croatia.

E-mail: mbrncic@pbf.hr

Keywords: Starch, Ultrasound, SEM, XRD, Rheology Properties

Abstract

Starch is widely used in the food industries. Industrial applications of starch require specific functionalities which are imparted through chemical or physical modifications. In this work, aqueous starch suspensions (10.0%) were sonicated (ultrasound bath; 37 kHz, power of 170 W, propagation time of 30 min and 24 kHz ultrasound probe, nominal power of 400 W; propagation time of 15 minutes). The effect of sonication on morphological and functional changes of wheat starch was examined. Starch granules were observed using scanning transmission electron microscopes. Rheological parameters, cristallinity and particle size have been also determined. SEM micrographs of starch granules after ultrasound modification in water showed damages small fissures and depressions on the surface. Influences of ultrasound activity on rheological parameters of the treated starches were much more evident in the case of ultrasound treatment with sonotrode than ultrasonic bath. Such changes are caused due to the physical effects of high intensity ultrasound that relies on cavitation phenomenon. After the sonication treatment crystallinity degree were decreased. Sonication presents a useful method to modify properties of wheat starch.

Ref: 3254

Nanovesicles lipid produced by purified phospholipids

***Machado, Adriana*[1]; *de Assis, Letícia*[2]; *Machado, Maria Inês*[3]; *Souza-Soares, Leonor*[4]**

[1] Student in Engineering and Food Science , Federal University of Rio Grande-FURG, Rio Grande, RS. Brazil;
[2]PhD in Engineering and Food Science , Federal University of Rio Grande-FURG, Rio Grande, RS. Brazil;
[3]PhD Student in Food Science and Technology, Federal University of Pelotas-UFPEL, PELOTAS, RS. Brazil;
[4]Professor Holder, Graduate Program in Engineering and Food Science, Federal University of Rio Grande (FURG), Rio Grande, RS, Brazil.

E-mail: adririso@hotmail.com

Keywords: Lecithin, liposomes, stability

Abstract

The term lecithin is often used as a synonym for pure phosphatidylcholine, a phospholipid which is the major component of the phosphate fraction obtained from grains, especially soybeans (*Glycine max* L Merrill). The goal was to prepare lipid nanovesicles from purified phospholipids, and check your size and stability. The phospholipids were obtained from purified soy lecithin, and studied its use in formulations of lipid nanovesicles as liposomes, targeting the encapsulation of bioactive compounds. Liposomes are basically composed of one or more bilayers of phospholipids vesicles encapsulating an aqueous volume. Liposomes were prepared by the method of hydrating the lipid film, consisting of adding to a round bottom flask, 1g of a source compound phospholipid, soybean lecithin purified, dissolved in 10 ml of chloroform and stored at 4 °C in amber glass bottles, protected from light and oxygen. Samples were taken at different times to determine pH and zeta potential using equipment Zetasizer Nano-Z Nanoseries (20 °C) were evaluated as: To medium size; polydispersity by dynamic light scattering (He-Ne laser, λ = 632.8 nm, BI-200M goniometer and BI-9000AT digital correlator); and morphology by scanning electron microscopy. The average particle size was 211.00 nm and the polydispersity index of 0.283. The liposomes were stable during storage at pH values of around 8.50 and zeta potential of -27.20 mV and -25.66 mV, the beginning and the end of the 21 days, respectively. The results of the analysis undertaken in relation to the nanometer size and stability of lipid nanovesicles lead us to conclude that the preparation of liposomes from phospholipids obtained from purified soy lecithin, can be an efficient conduit for encapsulating compounds, especially bioactive.

Acknowledgements: UFRGS; UFPEL; FURG; CAPES

Ref: 3255

Effect of thermal treatment over the structure and textural properties of aerated whey protein isolate gels

***Zúñiga, Rommy*[1]*; Orrego, Macarena*[1]

[1]Universidad Tecnológica Metropolitana, Chile

E-mail: rommy.zuniga@utem.cl

Keywords: whey protein, aerated gels, thermal treatment

Abstract

Dispersed air provides an additional phase within foods may accommodate new textural and functional demands. The objective of this work was to study the effect of thermal treatment and pH of whey protein isolate (WPI) dispersions on the structural and textural characteristics of aerated WPI gels (AG). Thermal treatment of WPI dispersions (9% WPI and 0.4% NaCl, by weigth) was performed at three pH's (6.50, 6.75 and 7.00) and three heating temperatures (70, 75 and 80 °C) for different times. Aerated dispersions were made at 2000 rpm for 3 min using and overhead stirrer. The aerated dispersions were kept at 5 °C for 24 h to set the matrix of the AG. The structure of AG was characterized in terms of gas hold-up, bubble sizes and bubble size distributions. Aerated and control gel cylinders (50 mm diameter, 30 mm height) were compressed between parallel plates at a constant speed of 0.1 mm/s until break, stress at break was recorded. Temperature of the thermal treatment influenced the gas hold-up of AG. Gas hold-up decreases as temperature of the thermal treatment increased, this effect was very similar for the three pH studied, with a maximum gas hold-up of about 70%. Microscopy images showed that a change in pH of the WPI dispersion had no effect on bubble size distributions of AG after the thermal treatment; however, mean bubble diameters increased with higher processing temperature. The range of mean bubble diameters was found between 530-700 mm. Higher viscosities of WPI dispersions after thermal treatment lead to lower incorporation of gas and higher bubble diameters in the AG structure. Stress at break of AG decreased as temperature of thermal treatment increases, for the three pH studied. Probably, larger bubbles acts as points for fracture initiation, thus decreasing the strengh of AG. Controlling the pH and the thermal treatment of WPI dispersions allow to fabricate AG with different structures and textural properties.

Acknowledgements: Zúñiga thanks CONICYT for financial support by means of the FONDECYT Project 1140031 CONTROLLED PROTEIN DENATURATION FOR THE ENGINEERING DESIGN OF AERATED FOOD PRODUCTS WITH ENHANCED TEXTURAL AND NUTRITIONAL PROPERTIES.

Ref: 3256

Generation characteristics of nonspherical multiphase droplets using microchannel array chips

Kobayashi, Isao[1]; Zhang, Yanru[1,2]; Hori, Yuko[1]; Neves, Marcos A.[1,2]; Uemura, Kunihiko[1]; Nakajima, Mitsutoshi[1,2]

[1]Food Engineering Division, National Food Research Institute, NARO, Japan;
[2]Graduate School of Life and Environmental Sciences, University of Tsukuba, Japan.

E-mail: isaok@affrc.go.jp

Keywords: Microchannel array, nonspherical droplet, multiple droplet

Abstract

Nonspherical microcapsules have received much attention in various industries including chemicals, cosmetics, foods, and pharmaceutical. Nonspherical multiple droplets present in a continuous phase can be used as templates for producing nonspherical microcapsules via commonly used processes. Microchannel (MC) array chips that we developed are capable of generating and transforming monodisperse nonspherical droplets. The aim of this study was to investigate the generation characteristics of nonspherical multiphase droplets and their transformation using MC array chips. Silicon MC array chips used in this study had two upstream MC arrays with steps (200 channels) for droplet generation and/or two downstream MC arrays (200 channels) for droplet transformation. The internal phase was an aqueous solution containing 5 wt% glucose, the middle phase was a refined soybean oil solution containing 5 wt% hydrophobic surfactant, and the external phase was an aqueous solution containing 1 wt% hydrophilic surfactant and 5 wt% glucose. Submicron W/O emulsions were prepared by homogenization at 5000 rpm for 5 min and subsequent high-pressure homogenization at 140 MPa (1 pass). The resultant submicron W/O emulsion was injected via upstream MC arrays to generate nonspherical multiphase droplets. The external phase supplied into flow channels was used only for making the generated nonspherical multiphase droplets flow into downstream MC arrays. Uniformly sized discoid multiphase droplets with a 20.9 mm average diameter and a 8.0-mm height were smoothly generated from an upstream MC array. Afterwards, the discoid multiphase droplets that moved downward transformed into uniformly sized plug-like multiphase droplets with a 55.1-mm average length, an 8.0-mm height, and an 8.2-mm width near the inlet of a downstream MC array on the same chip. Our MC array chips are believed to have potential to large-scale production of uniformly-sized nonspherical multiphase droplets whose shape is precisely controllable.

Acknowledgements: This study was supported by JSPS KAKENHI Grant Number 24760656.

Ref: 3258

Formulation and stability evaluation of water-in-fat emulsions loaded with short-chain fatty acid

***Yamanaka, Yohei*[1,2]; *Kobayashi, Isao*[2]; *Neves, Marcos A*[1,2]; *Uemura, Kunihiko*[2]; *Nakajima, Mitsutoshi*[1,2]**

[1]Graduate School of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan;
[2]Food Engineering Division, National Food Research Institute, NARO, Tsukuba, Japan

E-mail: spt23w89@leaf.ocn.ne.jp

Keywords: Short-chain fatty acid, W/F emulsion

Abstract

Short-chain fatty acids are very important nutrients for maintaining healthy human large intestine. Supplementation of short-chain fatty acids is gaining attention, considering that they are very important nutrients for maintaining healthy human large intestine, and that the amount of these fatty acids in our daily diet is insufficient for such a major role. Their production depends on the condition of intestinal bacteria. Development of a novel deliver system for short-chain fatty acids is highly desired for improving large intestine condition more effectively. Short-chain fatty acids have undesirable smell, making their oral ingestion difficult. Formulation of water–in-Fat (W/F) emulsion loaded with a short-chain fatty acid could orally partake short-chain fatty acid without feeling a bad smell. The aim of this study was to formulate W/F emulsions loaded with a short-chain fatty acid and to evaluate their storage stability. Pre-mixtures containing 1 to 20 wt% water phase (loaded with 5 wt% butyric acid) and 99 to 80 wt% oil phase (palm stearin (m.p. 54.2 ^{o}C) contaning 5 wt% hydrophobic emulsifier: TGCR) were used to formulate W/F emulsions, initially by rotor-stator homogenization (10000 rpm, 5 min) at 80 ^{o}C, followed by high-pressure homogenization (100 MPa, 1 pass) at 80 ^{o}C. The droplet size and droplet size distribution of formulated W/F emulsions were monitored for 28 days. At the water phase ratios of 5 wt% or less, submicron W/F emulsions with average droplet diameters of 0.26 µm to 0.36 µm were formulated. Their average droplet diameter hardly changed during 28 days of storage at 4 ^{o}C. In contrast, at the water phase ratios of 10 wt% or more, the unstable W/F emulsions with much greater average particle diameters were obtained. Our results demonstrated that stable submicron W/F emulsions could be formulated when using appropriately controlled compositions.

Ref: 3259

Analysis of disintegration of agar gels with different texture parameters using human gastric digestion simulator

***Kozu, Hiroyuki*[1,2]; Nakata, Yuuki[1]; Nakajima, Mitsutoshi[1,2]; Neves, Marcos A.[1,2]; Uemura, Kunihiko[2]; Sato, Seigo[1]; Kobayashi, Isao[2]; Ichikawa, Sosaku[1]**

[1]Graduate School of Life and Environmental Sciences, University of Tsukuba, 1-1-1 Tennoudai, Tsukuba, Ibaraki 305-8572, Japan;
[2]Food Engineering Division, National Food Research Institute, NARO, 2-1-12 Kannondai, Tsukuba, Ibaraki 305-8642, Japan

E-mail: s1330289@u.tsukuba.ac.jp

Keywords: Gastric digestion, peristalsis, *in vitro* model, solid food texture

Abstract

Physical digestion of solid foods in human stomach is as important as chemical digestion promoted by digestive juice and enzymes. Gastric peristalsis is assumed to play an important role in physical digestion by grinding solid foods and mixing gastric contents. Quantitative understanding of this process may provide important information about designing new food products, for instance, controlling food texture so that it is digested easily or hardly. We have developed a novel *in vitro* digestion model, human Gastric Digestion Simulator (GDS), aiming to directly observe gastric digestion process and quantitatively analyze physical digestion by simulating gastric peristalsis. Previous GDS study using Tofu as a typical solid food indicated that Tofu texture affects gastric digestion (H. Kozu, et al., Food Sci. Technol. Res., 20, 225-233, 2014). However, it is difficult to control texture parameters of Tofu. The aim of this study was to quantitatively analyze how solid food texture affects digestion using GDS. The agar gel was used as a model solid food so that we can control texture parameters. To analyze the effect of fracture stress on gel digestion, agar gels with different fracture stress (70 – 260 kPa) and constant fracture strain (20%) were prepared. The digestion process of agar gel using GDS was directly observed. Agar gel particles cut into 5 mm cubes before digestion were gradually disintegrated into smaller pieces in all types of agar gels. The initial cubic shape of agar gel particles was corrupted, changing into random shape during digestion experiment. The size distribution after 180 min digestion was hardly changed regardless of gel fracture stress. The results indicated that fracture strain is more important texture parameter compared to fracture stress in the case of agar gel disintegration. Also, the results provide us an insight of the relationship between gastric digestion and solid foods texture.

Acknowledgements: This work was partially supported by Grant-in-Aid Japan Society for the Promotion of Science (JSPS) Fellows 25-1035.

Ref: 3262

Multi-scale construction of dry emulsion structure by spray drying

Munoz-Ibanez, Marta[1,2,3]; Hernandez-Sanchez, Maria del Rayo[1,2,3]; Azagoh, Christiane[1,2,3]; Almeida, Giana[1,2,3]; Cuvelier, Marie Elisabeth[1,2,3]; Turchiuli, Christelle[1,2,3]

[1]AgroParisTech, UMR 1145 Ingénierie Procédés Aliments, France;
[2]INRA, UMR 1145 Ingénierie Procédés Aliments, France;
[3]CNAM, UMR 1145 Ingénierie Procédés Aliments, France.

E-mail: christelle.turchiuli@agroparistech.fr

Keywords: Encapsulation, lipophilic compounds, emulsion, structure, multi-scale

Abstract

The protection and vectorization of active food and pharmaceutical molecules, requires their entrapment in structured matrices. For lipophilic compounds (antioxidants, fatty acids, vitamins), their encapsulation in spray dried emulsions also permits stabilizing the emulsion and an easier handling. The spray dried particles structure is built under mechanical, thermal and water constraints applied during the three stages of the process (homogenization, atomization and drying of the liquid emulsion), and depends on the emulsion properties (viscosity, size distribution, composition).

Formulations and methods for designing liquid oil-in-water emulsions suitable for spray drying were defined. The influence of the atomization step on the emulsion size distribution was studied for model oil-in-water emulsions (sun flower oil in maltodextrin and acacia gum aqueous solution) with different oil content (10 – 20%w/w), solids content (33 – 48%w/w) and emulsion size (0.1 – 1 µm). A rotary wheel and two-fluid nozzle were used in a large range of conditions (liquid feed rate, rotation speed/air feed rate). The distribution of oil droplets and constituents within the solid spray-dried particles were characterized using: (1) solvent extraction and X-ray Photoelectron Spectroscopy to measure the composition of the particle surface, (2) Raman spectroscopy to obtain the distribution of the components (oil, carbohydrates, gum) in the whole particle (25 µm depth scans) and (3) Scanning Electron Microscopy to visualize the outer and inner structure of the particles.

Some segregation of the constituents was observed and, further to the modification of the initial structure, the breakage of oil droplets during atomization also decreased the encapsulation efficiency with higher surface oil content. Critical values of Capillary number above which breakage occurs were determined. They are a useful tool to define spraying conditions allowing keeping the emulsion structure. Further work will be done to investigate the distribution of antioxidants in relation with protection against oxidation.

Acknowledgements: The authors would like to thank Marine Nuzzo and Anna Millqvist-Fureby from SP Technical Research Institute of Sweden in Stockholm for the XPS and Raman analysis and Marie Curie ITN PowTech, and CONACyT (Mexico) and French government for the PhD grants provided to Marta Munoz and Maria del Rayo Hernandez Sanchez respectively.

Ref: 3266

Preparation and application of taro starch hollow microspheres in controlled tea polyphenol release

Suwei[1]; Lv, Jian[1]; Wang, Hualin[1]; Jiang, Shaotong[2]; Zhong, Xiyang[2]; Yang, Xuefei [2]

[1]School of Chemistry and Chemical Technology, Hefei University of Technology, China;
[2]School of Biotechnology and Food Engineering, Hefei University of Technology, China.

E-mail: zhengzhi@hfut.edu.cn

Keywords: Taro starch hollow microspheres, tea polyphenol, release behavior, antioxidant activity

Abstract

Taro starch hollow microspheres were prepared with composite enzyme consisted of alpha-amylase and diastatic enzyme as catalysis. A series experiments were carried out to investigate the effect of various factors such as enzyme activity, dosage and constitute of composite enzyme, enzymatic hydrolysis time and temperature on the morphology of Taro starch hollow microspheres, and the hollow microspheres were characterized by scanning electron microscopy (SEM), Fourier transform-infrared spectroscopy (FT-IR), X-ray diffraction (XRD) and Nitrogen adsorption -desorption analysis. The Taro starch hollow microspheres were fabricated at 45 ^{o}C and pH 5.4 for 2h with 0.3 % composite enzyme (alpha-amylase / diastatic enzyme=1:4) as catalysis. The microspheres with specific surface area at 4.0 m^2/g are about 500 nm in diameter, which show well controlled release of tea polyphenol. The release process of tea polyphenol from microspheres can be well described by the Fick's second law. Furthermore, the thermodynamic parameters (ΔH^{o}, ΔS^{o} and ΔG^{o}) calculated from the temperature-dependent release indicates that the release process of tea polyphenol from microsphere is spontaneous and endothermic.

Acknowledgements: Financial support from National Natural Science Foundation of China (31371859, 31101352, 31271931) are gratefully acknowledged.

Ref: 3269

Interaction of milk proteins with resveratrol and their properties as carriers of resveratrol

***Ghorbani Gorji, Elham*[1]**

[1]Department of Food Science and Technology, University of Natural Resources and Life Sciences, Vienna (BOKU), Muthgasse18, Vienna, A-1190, Austria

E-mail: elham.ghorbani-gorji@boku.ac.at

Keywords: Resveratrol, beta-lactoglobulin, beta-casein, bovin serum albomin, spectroscopic methods

Abstract

Resveratrol (3,5,4′-trihydroxystilbene), a natural polyphenolic compound found in grapes and red wine, exhibits many physiological effects associated with health benefits. Bioactive compounds like resveratrol that are poorly soluble in water often exhibit low bioavailability because their absorption may be kinetically limited by low rates of dissolution and capacity-limited by poor solubility. In this study the interaction of resveratrol with β-lactoglobulin, β-casein and bovine serum albumin has been investigated using spectroscopic methods (circular dichroism (CD), steady state fluorescence) and zeta potential to characterize the potential of these proteins as carriers of resveratrol. CD results showed that protein-resveratrol interaction has no apparent influence on protein secondary structure but partially disrupts tertiary structure. Fluorescence is a useful approach to investigate intermolecular interactions because the photophysical character of the fluorophore is sensitive to the polarity of its surrounding environment. Generally, λmax shifted to a shorter wavelength and fluorescence intensity increased as the polarity decreased.

Ref: 3271

Characterization of food structure by different Imaging Techniques and Image Analysis

***Altan, Aylin*[1]**

[1]Mersin University, Department of Food Engineering, Turkey

E-mail: aylinaltan@yahoo.com

Keywords: food structure, characterization, imaging technique

Abstract

Understanding the relation between processing conditions and food structure can be helpful for designing appropriate processes or defining the proper conditions for retaining the quality of the product. During processing of foods, existing structures are destroyed and new ones are formed. The structure of foods can have a significant effect on its nutritional value, rheology and textural attributes. Therefore, it is required to measure food structure and how it changes during processing operations. A number of techniques can be applied to measure the structure of foods either directly such as confocal microscopy, magnetic resonance imaging or scanning electron microscopy or indirectly from measurements of the mechanical response. This presentation will present the application of different imaging techniques to characterize food structure. Confocal microscopy has been used for imaging of changes in microstructure of almonds as a function of different thermal processing. It has been observed that oil roasting processes had a significant impact on cell structure of parenchyma cells and oil bodies of almond tissue as compared to the hot air roasting and blanching processes. Oil migration from 2-layer model system of chocolate and almond confection has been quantified using magnetic resonance imaging. Scanning electron microscopy was used to analyse the changes in microstructure of barley grains after pretreatments and microwave expansion. It was concluded that the pretreatment methods depending on the initial moisture content of grains caused significant changes in starch structure. These changes had different impacts on the degree of gelatinization of starch molecules and expansion of grains during the microwave heating.

References:

Altan, A. (2014). Effects of Pretreatments and Moisture Content on Microstructure and Physical Properties of Microwave Expanded Hull-less Barley, Food Research International, 56, 126-135.

Altan, A. McCarthy, K.L. Tikekar, R. McCarthy, M.J. and Nitin, N. (2011). Image Analysis of Microstructural Changes in Almond Cotyledon as a Result of Processing; Journal of Food Science, 76, E212-E221.

Altan, A. Lavenson, D., McCarthy, K.L., McCarthy M.J. (2011). Oil Migration in Chocolate and Almond Product Confectionery Systems, Journal of Food Science, 76, E489-494.

Ref: 3272

The nanostructure of pectin, hemicellulose and cellulose in the cell walls of pears of different texture and firmness

Zdunek, Artur[1]; Cybulska, Justyna[1]; Kozioł, Arkadiusz[1]; Pieczywek, Piotr M.[1]

[1]Institute of Agrophysics PAS, Poland

E-mail: a.zdunek@ipan.lublin.pl

Keywords: fruit, firmness, cell walls, pectin, hemicellulose, cellulose

Abstract

The nanostructure of polysaccharides is supposed to determine properties like stiffness or diffusivity of cell walls and their functionality for various tailored properties of food. Sensory texture and firmness are some of the main quality attributes of fruits which, in addition to turgor and cell spatial distribution, are determined by cell wall elasticity. However, at present, both the nanostructure of polysaccharides in cell walls and their function in mechanical properties remain to some degree unknown. The goal of this work was to evaluate the nanostructure of pectin (water, chelator and diluted alkali soluble), hemicellulose and cellulose macromolecules in terms of their diameter and branching using an atomic force microscope and image analysis, and relating them to macroscopic sensory texture and firmness. Two pear cultivars 'Xenia' (firmer) and 'Conference' (softer) were studied at their harvest times. Nanostructure evaluation showed that macroscopic texture and firmness of pears were related to the nanostructural features of polysaccharides in cell walls, particularly pectins and hemicellulose. Less degraded, thicker and more branched pectin molecules were associated with higher firmness and more favourable texture. Hemicellulose provided a positive contribution to texture when they were thinner and more flexible, which makes possible cellulose cross-linking.

Acknowledgements: The study was supported by the National Science Centre, Poland, DEC-2011/01/B/NZ9/00787.

Ref: 3275

Nanomechanics of cell walls in relation to firmness during pre- and postharvest maturation of pears

Kozioł, Arkadiusz[1]; Cybulska, Justyna[1]; Kruk, Beata[1]; Sysa, Dorota[1]; Lekka, Małgorzata[2]; Zdunek, Artur[1]

[1]Institute of Agrophysics PAS, Poland;
[2]The Henryk Niewodniczanski Institute of Nuclear Physics PAS, Poland.

E-mail: a.zdunek@ipan.lublin.pl

Keywords: cell walls, Young's modulus, stiffness, firmness, AFM, pears

Abstract

Cell walls proprieties determine many properties, including texture and water-related shrinkage of fruits. Since cell wall composition is very dynamic, an actual value of the Young's modulus of cell walls is necessary to interpret macromechanical properties. The goal of this work was to determine the Young's modulus of cell walls during pre- and postharvest maturation of pears. Atomic force microscope (AFM) was used for determination of Young's modulus of cell walls. Pear fruits (cv. 'Xenia'- firmness 86 N, and cv. 'Conference'- firmness 74N at the harvest time) were studied at various development stages, including: pre-harvest period, the harvest time and postharvest storage in a cold room (2 °C, and normal atmosphere), and seven days of shelf life. Cell wall material (CWM) was isolated using the modified phenol buffer method. CWM fragments were adsorbed on a glass substrate. The Young's modulus, using the Hertz-Sneddon model fitted to the force-indentation curves, was measured on CWM fully hydrated in water. The study was completed with measurements of: firmness, sensory texture, acoustic emission, pectolytic enzyme activities and pectin content. Young's modulus of CWM reflected macroscopic texture characteristics of cultivars. Before harvest, similar to firmness of the whole fruit, the Young's modulus of CMW decreased during fruit development. Then during postharvest period, cell wall stiffness constantly increased with very significant effect for the samples stored in shelf life. Enzymatic activity and galacturonic acid content showed that pectins were depolymerized during storage which resulted in cell wall stiffening as it was evidenced by comparison for model composites made of bacterial cellulose with pectins vs pure cellulose.

Acknowledgements: The study was supported by the National Science Centre, Poland, DEC-2011/01/B/NZ9/00787.

Ref: 3276

Influence of fat crystal network structure on the oxidation rate of lipophilic bioactive molecules

Calligaris, Sonia[2]; Valoppi, Fabio[2]; Barba, Luisa[1]; Anese, Monica[2]; Nicoli, Maria Cristina[2]

[1]Institut of Crystallography, National Council of Research, Italy;
[2]Department of Food Science, University of Udine, Italy.

E-mail: sonia.calligaris@uniud.it

Keywords: bioactive compounds, oxidation, structure, polymorphism

Abstract

In recent years, bioactive lipophilic substances have received an increasing interest due to their health protecting capacity. Unfortunately, these molecules are known to be highly prone to degradation through the development of oxidative reactions. Different strategies have been proposed to delivery and protect lipophilic molecules from oxidation in foods. The design of lipid-based delivery systems appears the most promising approach since the incorporation of these compounds in lipid media is facilitated due to their hydrophobicity. Moreover, the presence of lipids is known to enhance bioavailability of lipophilic bioactive compounds. Today, one open issue on this topic is the understanding of the effect of the lipid carrier physical state on the stability of bioactive molecules. Conflicting results can be found in literature, probably due to the complexity of lipid crystallization and polymorphism.
This research was addressed to study the effect of fat crystal network structure on bleaching kinetics of β-carotene and curcumin, chosen as target bioactive molecules. To this aim, β-carotene and curcumin were added to tristearin, tripalmitin and saturated monoglycerides. Phase transition properties of fats with and without bioactive molecules were studied by differential scanning calorimetry, synchrotron XRD and polarized light microscopy. The oxidation kinetics at 25 °C were followed by measuring color changes.
Results evidenced that the structure of fat crystal network played a critical role in determining bioactive molecule stability. The location of β-carotene and curcumin resulted different depending on the fat type. These results appear of considerable interest in the attempt to improve the stability of lipophilic bioactive compounds in lipid containing foods as well as to design efficient delivery systems, for which the choice of the lipid carrier could be crucial.

Acknowledgements: Research supported by the project “From nutrigenetics to nutraceutics: development of synergic and integrated actions for the development of tests, diets and foods able to improve the public well-being and prevent food related diseases”. Art. 13, D.M. 593, August 8th, 2000.

Ref: 3277

Novel edible films containing thyme polyphenols

Trifković, Kata[1]; Talón, Emma[2]; Vargas, Maria[2]; Djordjević, Verica[1]; Nedović, Viktor[3]; Bugarski, Branko[1]; González-Martínez, Chelo[2]

[1]University of Belgrade – Faculty of Technology and Metallurgy, Department of Chemical Engineering, Karnegijeva 4, 11000 Belgrade, Serbia;
[2]Universidad Politécnica de Valencia – Department of Food Technology, Camino de Vera s/n, 46022 Valencia, Spain;
[3]University of Belgrade – Faculty of Agriculture, Department of Food Technology and Biochemistry, Nemanjina 6, 11080 Belgrade, Serbia

E-mail: ktrifkovic@tmf.bg.ac.rs

Keywords: Edible films, chitosan, thyme polyphenols, antioxidant activity, release

Abstract

The utilization of edible films containing antioxidants has gain growing interest in the last years. The role of these films, beside increasing the shelf-life of food products (and substituting the packaging plastics) is to act as carriers for antioxidants. The aim of the study was to develop chitosan-based edible films with antioxidant properties by adding polyphenols from thyme (*Thymus serpyllum L*) aqueous extracts. Chitosan films were prepared with the thyme aqueous extract in the form of lyophilized powder or encapsulated with liposomes. The polyphenol content in the film was 61.4 mg GAE per gram of polymer. Liposomes were produced from a commercial mixture of phosphatidylcholine lipids by proliposome method suitable for food applications. The thickness of the films was 0.091±0.008 µm. SEM micrographs of the cross-sections of the films showed that addition of polyphenols did not promoted relevant changes in the microstructure of the films. The presence of the liposomes particles was confirmed on the micrographs. The kinetics of polyphenols release from the films, as well as their antioxidant activity was studied during 24h in four different food simulants: water, 3% acetic acid, 10% and 20% ethanol. The highest amount of polyphenols was released in the acetic medium, while antioxidant activity amounted up to 80% of free radicals inhibition. The release tests confirmed that liposomes-in-film formulations were suitable for controlled release of polyphenols. The results obtained in this study provided valuable information for further developments in polyphenols-rich edible coatings.

Acknowledgements: The authors are grateful to COST Action FA1001 for STSM Grant (STSM applicant Kata T. Trifković) through which these results were obtained, as well as Ministry of Education, Science and Technological Development of the Republic of Serbia (Project No. III 46010, 2011-2014).

Ref: 3278

Electrosprayed vs. spray-dried gelatin microparticles as edible carriers for polyphenols in functional foods

***G. Gómez-Mascaraque, Laura*[1]; *Lagarón, José María*[1]; *López-Rubio, Amparo*[1]**

[1]Instituto de Agroquímica y Tecnología de Alimentos (IATA-CSIC), Spain

E-mail: lggm@iata.csic.es

Keywords: Encapsulation, Spray-drying, Electrospraying, gelatin, polyphenols, catechins

Abstract

Green tea polyphenols are powerful antioxidants which have attracted great interest in the field of functional foods due to their numerous attributed health benefits. However, their poor stability in solution limits their direct addition to food products. One approach to protect their activity and bioavailability is to develop edible microencapsulation matrices capable of stabilizing them. Among the different encapsulation techniques, electrospraying of polymeric solutions is a versatile technology to obtain polymeric particles without the need of employing high temperatures or toxic solvents, by subjecting the polymer solution to an external electric field. Another commonly used technique to produce encapsulates for the food industry is spray-drying, which exploits a hot air stream to dry small droplets of a polymeric solution. In this work, gelatin microparticles have been produced from acidic aqueous solutions of gelatin A employing both techniques, and they have been used as encapsulation matrices for (–)-epigallocatechin gallate (EGCG), the most abundant polyphenol in green tea. The conditions required to obtain microparticles by both techniques were optimized.

The morphology of the materials, analyzed by scanning electron microscopy, showed pseudo-spherical shapes in the submicro- and microscopic range. The electrosprayed particles were characterized by the presence of residual nanofibrils, while their spray-dried counterparts were bigger in size. Infrared spectra corroborated the encapsulation of the antioxidant in the microparticles and evidenced the presence of intermolecular interactions with the biopolymeric matrix.

The thermal stability of the materials, studied by means of thermogravimetric analysis, varied depending on the processing technique used (electrospraying or spray-drying). Similarly, the EGCG release profiles from the encapsulation matrices in solution, obtained from UV-vis absorption measurements, were different depending on the encapsulation method used. Also, $ABTS^{+\cdot}$ radical scavenging assays were conducted to corroborate that, indeed, the extracts released from the EGCG-loaded microcapsules retained the antioxidant activity of pristine EGCG.

Acknowledgements: L. G. Gómez-Mascaraque is recipient of a predoctoral contract from the Spanish Ministry of Economy and Competitiveness (MINECO). The authors would like to thank the Spanish MINECO project AGL2012-30647 for financial support.

Ref: 3285

β-carotene encapsulation in microbeads via ionotropic gelation: structural characterisation and chemical stability during storage

***Christos, Soukoulis*[1]; *Hoffmann, Lucien*[1]; *Bohn, Torsten*[1]**

[1]Public Research Centre Gabriel Lippmann, Environmental and Agro-Biotechnologies Department, rue du Brill 41, Belvaux, L-4422, LUXEMBOURG

E-mail: soukouli@lippmann.lu

Keywords: Extrusion, microbeads, encapsulation efficiency, physicochemical stability, lipophilic bioactive compounds

Abstract

Carotenoids are natural organic pigments synthesized by all plants and many microorganisms, but not by animals including humans. Carotenoids as bioactive substances for developing functional foods have gained attention due to their attributed health benefits, i.e. reduced risk of degenerative diseases such as cardiovascular disease, cataract formation, and some types of cancer. In addition, some carotenoids exhibit pro-vitamin A activity.

However, carotenoids may easily isomerise and oxidise when exposed to heat, light or oxygen. This does not only restrict their chemical stability throughout food processing and storage, but also adversely affects their biological activity and conferred health benefits. Furthermore, their lipophilic character and low water solubility reduce their bioaccessibility and intestinal cellular uptake.

Encapsulation, i.e. the development of a properly structural designed carrier that entraps (physically or chemically) an active substance and protects it when exposed to deleterious (heat, oxygen, light, acid, enzymes) conditions, has found several applications in the field of functional foods. Moreover, encapsulation in many cases may also achieve a sustained release of the active compound, facilitating its absorption.

In the present work, single-extrusion based on ionotropic gelation of divalent cation reactive biopolymers (pectin/sodium alginate and their mixtures with κ-carrageenan) is investigated. Emulsification of the lipid phase β-carotene in canola oil) was achieved by either Tween 20 or sodium caseinate. A Büchi B-395 Pro encapsulator equipped with a nozzle of a nominal size of 150 μm was employed for producing gelled microbeads. The microbeads were freeze-dried and stored at controlled temperature and humidity conditions for 8 weeks. The encapsulation efficiency and physical state of the dried microbeads was determined by DSC and XRD; microcapsule structural features were visualised by light and scanning electron microscopy. The oxidation rates of β-carotene during storage were associated with the structural collapse and light and oxygen permeability of the produced capsules.

Ref: 3287

Physicochemical properties of pectin-based nanoemulsion containing lycopene-enriched corn oil

Gasa-Falcón, Ariadna[1]; Odriozola-Serrano, Isabel[1]; Oms-Oliu, Gemma[1]; Martín-Belloso, Olga[1]

[1]Department of Food Technology, UTPV-CeRTA, University of Lleida. Av.Rovira Roure 191, 25198 Lleida, Spain

E-mail: iodriozola@tecal.udl.es

Keywords: nanoemulsions, lycopene, dropet size, colour, viscosity, pectin

Abstract

The interest of incorporating carotenoids, such as lycopene, into food and beverages is growing due to their potential health-benefits. However, the poor water solubility of carotenoids is currently a challenge to their incorporation into many foods. Nanoemulsions may be used as delivery systems to encapsulate lipophilic bioactive compounds in food to optimize their functionality. Thus, the aim of this work was to characterize nanoemulsions with lycopene-enriched corn oil, incorporated into an aqueous phase with different concentration of pectin as stabilizing agent in terms of droplet size, polydispersity index, ζ-potential, viscosity and color in comparison with conventional emulsions. Nanoemulsions presented improved physical and chemical properties compared to conventional emulsions. Droplet size of conventional emulsions (6117.6 nm) was higher than nanoemulsions (168.54 nm). Additionally, the droplet size increased with pectin addition in nanoemulsions. Polidispersity index was greater in conventional emulsions, which indicates bad homogeneity. All samples had a negative zeta potential, being the conventional emulsion the sample that presented the most negative values (-16.5 mV). In general, the higher the amount of pectin, the lower the negatively of the nanoemulsions. The conventional emulsion presented more viscosity and less luminosity than nanoemulsions. The highest viscosity (202.7 mPa.s) was obtained in nanoemulsions containing 2% of pectin. Unexpectedly, colour parameters were not affected by pectin addition, which could be an interesting result since color is the first quality factor that consumers appreciate and has a remarkable influence on acceptance. In conclusion, nanotechnology could be a good choice for food industry to innovate on food production and other fields.

Acknowledgements: This study was supported by the Ministerio de Ciencias e Innovación (Spain) throughout the project AGL2012-35635.

Ref: 3297

Elderberry extract encapsulation process into liposomes

***Bryla, Anna*[1]*; Juzwa, Wojciech*[1]*; Lewandowicz, Grazyna*[1]

[1]Department of Biotechnology and Food Microbiology, Poznań University of Life Sciences, Poland

E-mail: anna.bryla@up.poznan.pl

Keywords: elderberry extract, liposomes, nanocapsules, nanoparticles

Abstract

Elderberry (*Sambucus nigra*) belongs to the *Caprifoliacea* family. *Fructus Sambuci* (elderberry fruits) have been used for generations in both home therapy and supplementation. High content of flavonoids and lipophilic factors justifies the use of elderberries in treatment of colds, asthma, arthritis, sinusitis and in cancer prevention processes. However, application of fresh fruits may be questionable due to the presence of toxic sambunigrin and high susceptibility to degradation of bioactive compounds. Moreover, antioxidants, especially flavonoids, are not efficiently absorbed from the gastrointestinal tract. The use of fruits extracts encapsulated in liposomes may be the solution. Liposomes are microspheres made of surfactant bilayers both filled with and suspended in an aqueous solution. The unique structure of the vesicle provides the necessary barrier properties and allows the inner solution to be released in specific locations and conditions.

The aim of the study was to develop a method for elderberry extract encapsulation into liposomes and to characterize the obtained nanoparticles population.

Nanocapsules core material was elderberry extract and consisted of egg yolk, soy or sunflower lecithin. Liposomes were prepared by thin lipid film hydration method. Nanoparticles population were characterized by ζ-potential and size determination by Dynamic Light Scattering technique. The structure was investigated by flow cytometry. Finally, encapsulation efficiency was calculated.

As a result of given research, one has proved that an elderberry extract be encapsulated into liposomes. It was revealed, that the most suitable among tested lecithin is a soy one. Vesicles obtained from soy lecithin were relatively stable and homogenous. The encapsulation process itself was characterized by satisfactory efficiency level. For all the above mentioned reasons, it can be assumed, that liposomes are an adequate carrier for elderberry extract. Additionally, nanoencapsulation can, potentially, increase both stability and intestine absorption rate of bioactive compounds.

Acknowledgements: The work was financially supported by the grant POIG 01.01.02-00-061/09 “Bioactive food” implemented within the Programme Innovative Economy 2007-2013.

Ref: 3301

Influence of resveratrol on membrane fluidity of proliposomes

Isailović, Bojana[1]; Ota, Ajda[2]; Djordjević, Verica[1]; Šentjurc, Marjeta[3]; Nedović, Viktor[4]; Bugarski, Branko[1]; Poklar Ulrih, Nataša[2]

[1]Department of Chemical Engineering, Faculty of Technology and Metallurgy, University of Belgrade, Karnegijeva 4, 11000 Belgrade, Serbia;
[2]University of Ljubljana, Biotechnical Faculty, Jamnikarjeva 101, SI-1000 Ljubljana, Slovenia;
[3]Institute J. Stefan, Jamova 39, SI-1000 Ljubljana, Slovenia;
[4]Department of Food Technology and Biochemistry, Faculty of Agriculture, University of Belgrade, Nemanjina 6, 11080 Belgrade, Serbia

E-mail: bisailovic@tmf.bg.ac.rs

Keywords: Proliposomes, resveratrol, membrane fluidity

Abstract

Resveratrol is a phenolic compound found in a variety of plants, red wine and dark chocolate. It shows a wide range of positive effects on health and attracts a significant attention for its strong antioxidant activity. Still, resveratrol is photosensitive and easily oxidizable; thus, its long-term application in food products requires a protection in the form of encapsulation. It has been already shown that resveratrol could be encapsulated in liposomes prepared by proliposome method, but the influence of resveratrol on the structural properties of the liposome membrane has not been considered yet. In this work two methods were applied to identify changes in the structural properties of proliposome membrane caused by resveratrol presence: fluorescence spectroscopy and lectron paramagnetic resonance spectroscopy (EPR). Two probes were used for each method in order to monitor changes in the membrane both close to water-lipid interface and in the middle of the bilayer. The polarisation values measured at 25 ^{o}C using 1,6-diphenyl-1,3,5-hexatriene (DPH) probe increased for 20 % with an increase of resveratrol-to-lipids ration. The encapsulation of resveratrol also caused the increase in empirical correlation time (compared with the empty proliposomes), indicating that membrane fluidity is reduced in the presence of resveratrol. The increase was more distinct in the inner part of the proliposome bilayer and it amounted about 10% throughout the entire temperature range. Based on the results it can be concluded that resveratrol is positioned rather in the inner part of liposome membrane than in the outer region. This information is important for better understanding of the antioxidant activity of resveratrol incorporated in liposome biomembranes.

Acknowledgements: The authors are grateful to COST Action FA1001 for STSM Grant (STSM applicant Bojana Isailović) through which these results were obtained, as well as Ministry of Education, Science and Technological Development of the Republic of Serbia (Project No. III 46010, 2011-2014).

Ref: 3304

Oil droplet size distribution in the emulsion systems generated in the course of microencapsulation process

***Biegaj, Malwina*[1]*; Zander, Lidia*[1]*; Banaszczyk, Paweł*[1]*; Dajnowiec, Fabian*[1]

[1]University of Warmia and Mazury in Olsztyn, Faculty of Food Science, Department of Process Engineering and Equipment, Poland

E-mail: malwina.biegaj@uwm.edu.pl

Keywords: oil droplet size distribution, emulsions

Abstract

Emulsion homogenization is an important step preceding the spray drying, because the efficiency of microencapsulation depends on the size of oil droplets. Therefore, the uniform droplet size distribution should be produced. Moreover, droplet sizes may influence the bioaccessibility of the bioactive compounds being encapsulated.

The objective of this study was to elucidate the effect of homogenization pressure and protein content on the particle size distribution (PSD) in the primary and homogenized o/w emulsions of plant oils.

The experiments were carried out using three kinds of bioactive oils: amaranth (*Amaranthus caudatus*), evening-primrose (*Oenothera biennis L.*) and seabucthorn (*Hippophae rhamnoides*) as the dispersed phase. The mass fraction of the oil in the emulsion was equal to 0.3. The water phase was the solution of maltodextrin (DE = 7÷13%) and whey protein concentrate (WPC 80), milk protein concentrate (MPC 75) and/or WPC/MPC mixture (1:1) as emulsifiers. The composition of the continuous phase varied according to experiment design type 2 (3-1).

The primary emulsions were prepared in the baffled vessel (D = H = 120 mm) with toothed-disk, high-speed (3500 rpm) impeller (d/D = 0.3). Next the emulsions were subjected to two-stage pressure homogenization at 14/5, 21/5 or 28/5 MPa using high-pressure homogenizer Niro Soavi Panda. PSD in the both primary and homogenized emulsion systems was obtained by the laser diffraction method using Mastersizer 2000 analyzer (*Malvern Instruments Ltd*).

It was stated that average droplet size was varied within the wide range of sizes from 0.3 to 38 mm depending on water phase composition and treatment mode. In emulsions subjected to homogenization the PSD span was smaller, however this magnitude was related to the span of primary emulsions.

Acknowledgements: Research project No N N312 214539 was supported by the National Science Centre (Poland) and the co-author (M. Biegaj) is supported by the European Union within the European Social Fund.

Ref: 3315

Steady and time dependent rheological properties of Salvia gum

***Yılmaz, Mustafa Tahsin*[1]; *Sagdic, Osman*[1]; *Özçelik, Gözde*[1]; *Toker, Ömer Said*[1]; *Karaman, Safa*[2]; *Tulukçu, Eray*[3]**

[1]Yıldız Technical University, Chemical and Metallurgical Engineering Faculty, Food Engineering Department, İstanbul, Turkey;
[2]Erciyes University, Engineering Faculty, Food Engineering Department, Kayseri, Turkey;
[3]Selcuk University, Cumra Vocational School, Plant and Animal Production Department, Konya, Turkey

E-mail: mtyilmaz13@gmail.com

Keywords: Salvia, steady, time dependent, hysteresis

Abstract

In the present study, salvia plant as a new gum source was used to produce a gum. Steady and time-dependent rheological characteristics of the Salvia gum in concentration of 1% was determined at 25 ^{o}C. Apparent viscosity of the gum solution decreased with increase in shear rate applied, indicating that the gum solution showed shear thinning behavior. Ostwald de Waele model best described flow behavior of the gum solution (R^2 = 0.9972). Consistency coefficient (*K*) and flow behavior index (*n*) value of the Salvia solution was found to be 3.02 Pa sn and 0.2921, respectively. Temperature sweep test was also performed to determine temperature dependency of apparent viscosity value at 50 s^{-1} (η50) within temperature range of 10 and 60 ^{o}C. η50 value of the Salvia gum decreased with increasing temperature. Moreover, time dependent viscosity of the gum solution was also determined at constant shear rate of 50 s^{-1}. η50 value of the solution decreased with time. Obtained time versus η50 data was fitted to the second order structural kinetic model. Hysteresis loop area of the sample was also determined if the Salvia gum solution had time dependent characteristic. Hysteresis loop area was found as 0.51 and the sample had structural degradation.

Acknowledgements: This project was funded by TUBİTAK

Ref: 3323

Study of the effects of High Hydrostatic Pressure (HHP) and Pulsed Light (PL) on BSA structure and hydrolysis

De Maria, Serena[1]; Ferrari, Giovanna[1,2]; Maresca, Paola[2]; Oliveira, Carla[3]

[1]Department of Industrial Engineering, University of Salerno, Via Giovanni Paolo II, 84084 Fisciano (SA), ITALY;
[2]ProdAl Scarl, Via Ponte Don Melillo, 84084 Fisciano (SA), ITALY;
[3]Department of Biological Engineering, University of Minho, Largo do Paço, 4704-553 Braga, PORTUGAL

E-mail: sdemaria@unisa.it

Keywords: Pulsed Light, High Pressure Processing, hydrolysis, BSA

Abstract

Non-thermal technologies, such as High Hydrostatic Pressure (HHP) and Pulsed light (PL), affect protein inducing modifications in its conformational structure. For this reason the hydrolysis reaction of the protein can be modulated if it is conducted in combination with these technologies which are able to change the availability of peptide bonds exposed to the enzymatic action.

The aim is to study the effects of HHP and PL on the structure and the extent of hydrolysis reaction of a target protein: the Bovine Serum Albumin (BSA). BSA protein (5 mg/mL) in sodium phosphate buffer (50 mM, pH = 8) were treated with PL and HHP at different processing conditions, namely pressure level and treatment time in the case of HHP and treatment time and energy input in the case of PL. Structural modification of the protein solutions were analyzed by determining the sulphidrilic groups and the changes of the secondary structure.

The effect of the two treatments on the hydrolysis degree (HD) at 37 °C was also evaluated by OPA method. Chymotrypsin and trypsin (E/S ratio = 1/10) were used to hydrolyze the BSA protein solutions. The hydrolysis was carried out in HHP assisted or PL assisted conditions or the protein solutions were treated with HHP or PL processes and immediately after hydrolyzed with the enzymes.

Results obtained so far demonstrated that the two technologies tested are able to induce protein modifications and the occurrence and importance of this phenomenon depends on processing parameters causing protein unfolding, namely pressure level and number of pulses. When the maximum protein unfolding is obtained, higher HD values are detected. The highest HD value is obtained in HHP assisted hydrolysis with longer treatment time, and when, before undergoing hydrolysis, the PL treatment is applied to the solution placed at the higher distance from the lamp.

Ref: 3325

HOMOGENIZATION TECHNIQUE Ultra-Turrax for encapsulation of Spirulina LEB 18 - nanometer in size

***Machado, Adriana*[1]; *Assis, Leticia*[3]; *Machado, Maria Inês*[2]; *Toledo, Antônio Matias*[1]; *Souza-Soares, Leonor*[1]**

[1]Federal University of Rio Grande – FURG, Brasil;
[2]Federal University of PELOTAS – UFPEL, Brasil;
[3]SOUTH FEDERAL INSTITUTE-RS, Brasil.

E-mail: adririso@hotmail.com

Keywords: Microalgae, Hydration, Nanoparticles, Lipospheres

Abstract

The objective of this study was to develop a method for encapsulation of Spirulina LEB - 18 in nanosized particles. The dried microalgae biomass, grown and produced in southern Brazil, was received in pellets and then were crushed in a ball mill and sieved to achieve a micrometer-size (SM) with particles size of 88 µm (Tyler 170). Spirulina LEB -18 nanoparticles were obtained by homogenization in Ultra-Turrax 10.000 rpm for 20 min. and homogenized 1:100 (w/v) in steps with phosphate buffer (0.2 M, pH 7.0) by ultrasound at 60 °C for 40 min. Subsequently, through this homogenization process the nanoparticles were obtained. The encapsulation process was carried out by the method of lipid film hydration and some parameters were analysed: average size and morphology of particles, using techniques of dynamic light scattering and scanning electron microscopy (microscope Shimadzu, model SSX – 550 with vacuum and EDS coupled). The pH of the samples was measured to check the materials stability. The average size and polydispersity of nanometer Spirulina LEB-18 (NS), nano-encapsulated Spirulina (SNE), prepared by the method of homogenization in Ultra-Turrax, were 223.53a and 0.290a for NS; and 199.10b and 0.223b for SNE. The morphology of nano-encapsulated Spirulina showed visually spherical shape. The evaluation of stability samples showed: SN 6.89a ± 0.029, SNE 6.53 b ± 0.080 and SM 6.87a ± 0.059. The method of lipid film hydration by homogenization with Ultra-Turrax proved to be an efficient method for obtaining Spirulina nanometric lipospheres.

Acknowledgements: UFPEL, FURG, UFRGS, CAPES

Ref: 3335

Potato starch gelatinization by video microscopy

***Aguilera, Jose M.*[1]**

[1]Dept. of Chemical and Bioprocess Engineering, Pontificia Universidad Católica de Chile, Chile

E-mail: jmaguile@ing.puc.cl

Keywords: Starch, gelatinization, image analysis

Abstract

Starch is the most important source of energy for humans and it is present in many products derived from cereals, legumes and tubers. Gelatinization is the main structural transformation of starch granules when a food is heat processed or cooked (above 65 to 70 °C) in the presence of water The phenomenon, involving imbibition of water and expansion of the starch granule, eventually leading to its obliteration, has consequences in cooking and in the glycemic response after digestion. The objective of this work was to study the early stages of starch swelling by hot-stage videomicroscopy. Drops of a diluted aqueous suspension (e.g., 2-3% w/w) of potato starch were sandwiched between two glass slides and the sample holder was positioned over a Linkham hot-stage mounted under the lens of a light microscope equipped with a polarizer. The heating rate (set at 5 ^{o}C/min) was controlled with a Linkham temperature programmer. Heating experiments were done at a temperature similar to that of the gelatinization threshold (Tgel = 60 ^{o}C), and at higher temperatures (between 70 and 80 °C). Images of the gelatinization process were captured with a videocamera connected to the video port of a PC computer. Delineation and binarization of the contour of granules was done with the software Paint Shop Pro while geometric features (projected area and circularity) were obtained with the software UTHSCSA Image Tool. Changes in projected area (PA) due to swelling) and loss of birefringence (LB) of individual granules were determined as a function of time by image analysis. At temperatures close to the gelatinization point (e.g. <63 ^{o}C) PA and LB were synchronous processes proceeding at similar rates. However, at higher temperature (e.g. >70 ^{o}C) LB occurred much faster than swelling and it was completed while swelling continued. The area of the gelatinization endotherm increased at higher temperatures revealing that the effects of the thermal process proceeded to a larger extent. Thus, different structures of starch granules may be obtained by controlled heating at constant temperatures with possible applications to tailor-make foods with specific glycemic responses.

Ref: 3336

Ferulic acid as a cross-linking agent in soy protein- based coatings for fresh-cut apples

Alves, Maria Manuela[1,2]; Gonçalves, Maria do Pilar[1]; Rocha, Cristina M.R.[1]

[1]REQUIMTE- Faculdade de Engenharia da Universidade do Porto, Porto, Portugal;
[2]ERCR - European Research Centre for Recycling, Matosinhos, Portugal

E-mail: cmrocha@fe.up.pt

Keywords: Edible coatings, Ferilic acid, Soy protein

Abstract

The application of edible coatings on fresh fruits and vegetables can provide an alternative to modified atmosphere storage while also allowing encapsulation of health-related bioactive compounds. Cross-linking has been explored as a viable method to improve the mechanical strength and barrier properties of protein-based films. Ferulic acid is known for its antioxidant properties but it has also potential for cross-linking with both polysaccharides and proteins. Besides its low toxicity it has been also reported to have many physiological/bioactive functions. Thus, the objective of this work was to assess the potential of incorporating ferulic in soy protein-based edible coating formulations in order to increase the quality and shelf life of fresh-cut apples (Golden).

Ferulic acid was incorporated in soy protein isolate (SPI) coating formulations, plasticized with glycerol, in four concentrations between 0.10 and 0.40% (w/v). The coated fresh-cut apples were stored during 7 days at 10 ^{o}C and were periodically analysed for weight loss, colour, firmness, pH and soluble solids content (^{o}Brix). Formulations incorporating sodium and calcium ascorbates (common commercial antioxidants) at 1.0% w/v were also tested, for comparison. Uncoated apples and apples dipped into solutions of the three antioxidants were used as controls. Preliminarily, the water vapour permeability of films (WVP), with same coating formulations, was investigated.

The formulation with ferulic acid at 0.40% w/v and pH 7.0 (sufficiently away from the isoelectric point of protein) has demonstrated potential application to extend the shelf life of fresh-cut apples. This formulation was the best for controlling the weight loss, firmness and ^{o}Brix of apples, during the storage period, and demonstrated a satisfactory result in terms of the colour of apples. It also led to a 20% decrease in the WVP of the SPI film. This result can be attributed to the ferulic acid cross-linking properties with SPI and its hydrophobic character.

Acknowledgements: This work was financed by the European Community's Seventh Framework Programme, through SusFoFlex, collaborative project number 289829, KBBE.2011.2.3-03). This work was also supported by the European Union (FEDER funds through COMPETE) and National funds (Fundação para a Ciência e Tecnologia, FCT), through

project PEst-C-EQB-LA0006/2013, and by QREN (European Union, FEDER funds), through Project NORTE-07-0124-FEDER-000069.

Ref: 3338

Biopolymeric microbeads for incorporation of lipophilic and hydrophilic compounds

***Sato, Ana Carla*[1]; *Perrechil, Fabiana*[2]; *Michelon, Mariano*[1]; *Cunha, Rosiane*[1]**

[1]University of Campinas, Brazil;
[2]Federal University of São Paulo, Brazil.

E-mail: acksato@yahoo.com.br

Keywords: biopolymer, protein, polysaccharide

Abstract

The development of encapsulation systems from natural compounds was studied in order to provide alternatives to the use of synthetic materials as encapsulating systems. In this work, microbeads composed of caseinate and k-carrageenan were produced using the extrusion technique. The biopolymer solutions were prepared in a pH condition in which the electrical charges of protein and polysaccharide were similar (pH 7) and opposite (pH 3.5) in order to verify the effect of the biopolymer interaction on the structure of the beads. These microspheres were tested in order to assess their applicability as encapsulating matrix for compounds with higher affinity for lipid or aqueous compounds. In the first case, a caseinate stabilized emulsion was previously produced by high-pressure homogenization prior the addition of the k-carrageenan solution. On the other hand, for the production of the aqueous beads, the model compound was directly added to the caseinate solution, prior its mixture to the polysaccharide solution. In both cases, after the addition of the k-carrageenan, the mixture was extruded through an atomizer nozzle in a potassium chloride solution in order to induce ionotropic gelation of microbeads. Confocal microscopy showed that structure of microgels depended on the pH in which they were produced. At the pH 3.5, the particles were enfolded by the polysaccharide, with the protein distributed within the gel network. On the other hand, at pH 7, the electrostatic repulsion between the biopolymers resulted in a different structure, with the protein located in the edge of the particles. However, the different structures did not influence on the amount of bioactive compound retained in the matrix, neither for a lipophilic compound (tryptophan) nor for a hydrophilic compound (*Lactobacillus rhamnosus*). In these cases, the encapsulated amount of both tryptophan and probiotic were the same for the capsules produced at the different pH.

Acknowledgements: Authors would like to thank CAPES, FAPESP and CNPq for financial support.

Ref: 4337

Comparative evaluation of different natural biopolymers and proteins for encapsulation of green tea (*Camellia sinensis* L.) bioactive compounds

Belščak-Cvitanović, Ana[1]; Nedović, Viktor[2]; Đorđević, Verica[3]; Pravilović, Radoslava[3]; Karlović, Sven[1]; Komes, Draženka[1]; Bugarski, Branko[3]

[1]Faculty of Food Technology and Biotechnology, University of Zagreb, Pierottijeva 6, 10 000 Zagreb, Croatia;
[2]Faculty of Agriculture, University of Belgrade, Nemanjina 6, 11081 Belgrade-Zemun, Serbia;
[3]Faculty of Technology and Metallurgy, University of Belgrade, Karnegijeva 4, 11120 Belgrade, Serbia

E-mail: abelscak@pbf.hr

Keywords: caffeine, complex coacervation, electrostatic extrusion, green tea, ionic gelling, polyphenols

Abstract

Since the production of nutritively highly valuable food products is one of the major current demands of the global food industry, encapsulation of various bioactive phytochemicals is of great interest and should conform to the large-scale and economic production of food products. In this study various biomaterials, naturally derived polysaccharides and proteins were studied as matrices for the encapsulation of bioactive compounds from aqueous extract of green tea. Different formulations of biopolymers such as alginate, carageenan, pectin, chitosan, agar, starch, xanthan, locust bean gum and whey proteins, as plain compounds or blends, were compared in terms of encapsulation attributes and delivery properties of polyphenols, textural and sensory properties. The delivery systems were produced in the form of micro-sized particles by applying either electrostatic extrusion technique or emulsification method and by employing either ionic gellation or complex coacervation (depending on the formulation) as the mechanisms responsible for microparticles formation. Among the evaluated delivery systems, alginate hydrogels blended with whey proteins, modified starch, xanthan or locust bean gum provided the highest encapsulation efficiency of polyphenolic antioxidants and the most retarded release in water. Alginate-xanthan microparticles exhibited the largest particle size (<1300 µm) and the poorest textural properties, while alginate-whey proteins microbeads were characterized with the smallest particle size (700 µm) but the best textural properties. Alginate and whey proteins formulation resulted with the highest encapsulation efficiency of total polyphenolic compounds and caffeine and the lowest bitterness and astringency intensity of the suspended microparticles in water. For the sake of controlled release of green tea polyphenols, the selected matrix-type encapsulates were additionally coated with chitosan or pectin; the coating led to an extention of polyphenols

release to 30 min for chitosan-coated and 80 min for pectin-coated microparticles. As the end-result of this study, optimized dosage form of green tea bioactives were produced.

Acknowledgements: This study is a contribution to the project "The application of innovative fundamental food-structure-property relationships to the design of foods for health, wellness and pleasure", which is funded as a EU COST Action FA 1001.

Ref: 4338

An Atlas for food structures and the Free Open International Journal of Molecular Gastronomy

Aguilera, José M.[1]; This, Hervé[2]

[1]Department of Chemical and Bioprocess Engineering, Pontificia Universidad Católica de Chile, Chile;
[2]Groupe de Gastronomie Moléculaire, AgroParisTech, Paris, France.

E-mail: jmaguile@ing.puc.cl

Keywords: Molecular gastronomy

Abstract

The structure of food can be described at various scales (from the molecular level to the macroscopic scale), as it changes during processing as well as in the culinary practice (Aguilera, 2012). In order to better describe food structures at the various scales according to their "degree of complexity", the Disperse System Formalism (DSF) scheme has been proposed (This, 2007). For example, custard which is made of oil droplets O (from milk), air bubbles G (introduced during the initial whipping of sugar and egg yolks) and small solid particles S (due to egg coagulation during thermal processing) all dispersed in an aqueous phase (W), may be described as $[D_0(O) + D_0(G) + D_0(S)]/D_3(W)$. When the DSF was applied to French classical sauces compiled from culinary books, 23 categories of products were found. To make this nomenclature describing food structures more comprehensible and didactic, an Atlas of Food Structures is under construction for each DSF formula, which includes also a drawing illustrating the phases or elements involved and their interrelationships (described through operators), as well as photomicrographs at different relevant scales.

Almost simultaneously, a Free Open International Journal of Molecular Gastronomy has been recently launched to communicate the scientific activity which looks for the mechanisms of phenomena occurring during culinary processes ("cooking"). Though this electronic journal will keep the same standards of anonymity in the review process and scientific rigor of more traditional food science and technology journals, it will include a more diverse kind of articles while allowing for the flexibility afforded by modern communication technologies (e.g., ex-post reviewing, graphical displays, educational tools, etc.). This presentation will elaborate on the specifics of these two initiatives.

References:

Aguilera, J.M. 2012. Edible Food Structures. CRC Press/Taylor and Francis, NY.

This, H. 2007. Formal descriptions for formulation. International Journal of Pharmaceutics, 4-8.

Ref: 4340

Production of liposomes using different lecithins aiming food applications

***Michelon, Mariano*[2]*; de la Torre, Lucimara Gaziola*[1]*; Cunha, Rosiane Lopes*[2]**

[1]Faculty of Chemical Engineering, University of Campinas, Brazil;
[2]Faculty of Food Engineering, University of Campinas, Brazil.

E-mail: michelonmariano@gmail.com

Keywords: phospholipids, lecithin, liposomes

Abstract

Liposomes are spherical vesicles consisting of concentric phospholipid bilayers which isolate one internal aqueous compartment from the external environment. Initially, the phospholipids have the capacity of self-assembling in bilayers in aqueous medium, exposing their hydrophilic heads and hiding their hydrophobic tails and thus the liposomes are formed. Liposomes are under intensive research and development by the food industries as nanocarrier systems for the protection and delivery of bioactive compounds. However, one of the challenges for application of liposomes in the food industries as nanocarrier is the utilization of the natural materials of low cost such as soybean lecithin. The aim of this work was to produce conventional liposomes aiming food applications using different soybean lecithin and evaluating their properties. Three soybean lecithins with different phospholipids composition and amount of triglycerides were used for the liposomes production by ethanol injection method at 40 °C with flow rate injection of 10 mL/min. Different concentrations of lecithin were studied in the range of 5 to 200 mM. Particles with a lower polydispersity index and average hydrodynamic diameter of 238.1±2.25 nm were obtained using a soybean lecithin with 46% (w/w) phospholipids and 37% (w/w) triglycerides. These results were similar to those obtained using a fat-free lecithin with 67% (w/w) phospholipids, showing it that would be possible to produce liposomes with low polydispersity index employing raw lecithin with reduced phospholipids content for food applications.

Acknowledgements: Authors would like to thank CNPq for financial support.

Ref: 4346

Microcapsules formed by emulsion gelation: Design and application as vehicle for *Lactobacillus Rhamnosus*

Bueno, Andressa C.[1]; Picone, Carolina S. F.[2]; Michelon, Mariano[1]; Cunha, Rosiane L.[1]

[1]School of Food Engineering, University of Campinas, Brazil;
[2]School of Technology, University of Campinas, Brazil.

E-mail: rosiane@fea.unicamp.br

Keywords: emulsion gelation, microcapsules, probiotics

Abstract

The emulsion gelation is a promising technique for the production of tunable microparticles to encapsulate beneficial microorganisms and protect them from the adverse environmental and stomach conditions. These conditions can seriously decrease the number of living cells during the consumption of probiotic products. However, the successful of microcapsules production based on water in oil emulsion gelation lies on the balance between the gelation of aqueous phase and droplets coalescence. Therefore, this work aimed to develop microgels using gellan acidified by glucono-α-lactone (GDL) dispersed in soybean oil and polyglycerol polyricionoleate (PGPR) through a high pressure homogenizer. Initially, the kinetic of gelation and emulsification were studied by testing different ratios of GDL/gellan (R_{GDL}= 1.2 to 3.0) and PGPR concentration (0.5 to 2% w/v) in order to determine an adequate composition of the emulsion to produce microparticles. The gelation time and mechanical properties of gellan gels were previously analyzed by uniaxial compression and oscillatory rheological tests, respectively. The emulsion stability to digestion was evaluated by *in vitro* assay. The rheological profile obtained through the oscillatory rheological tests showed that the gellan gels were formed after 7 minutes, approximately, what means the kinetic of phase separation should be later than this period to prevent droplets coalescence. This condition was obtained in the emulsion formed by gellan 0.5% (w/w) acidified by R_{GDL} = 1.2 and 2% (w/v) of PGPR in the oil phase (ratio of aqueous to oil phase = 40%), which resulted in the formation of spherical microcapsules with a rigid and deformable gel structure measuring around 2 µm. In addition, the *in vitro* digestion tests confirmed that this system guarantees the controlled lyses of the microcapsules during the enteric digestion. Finally, the predetermined emulsion composition was used to encapsulate *Lactobacillus rhamnosus* which resulted in encapsulation viability of 98%. On balance, the emulsion gelation showed to be a potential technique to the encapsulation of functional ingredients with health benefits.

Acknowledgements: The authors are grateful to FAPESP (2012/14003-9) and CNPq (122634/2013-6) for the financial support.

Ref: 4348

Viscoelasticity in microfluidic devices: effect of dispersed phase composition in droplets production

***Rocha Bernardes de Oliveira, Davi*[1]; *Yumi Ushikubo, Fernanda*[1]; *Lopes da Cunha, Rosiane*[1]**

[1]University of Campinas, Brazil

E-mail: davi.rochab@gmail.com

Keywords: Microfluidic, Viscoelasticity, Extensional rheology, Monodispersity

Abstract

Emulsification in microfluidic devices is distinguished by its ability to generate droplets in a controlled and individual way, in which it is possible to obtain emulsions with polydispersity lower than 5%. Glycerol solutions (Newtonian fluids) at concentrations ranging from 10 to 75% (w/w) were used as dispersed phase in order to obtain water in oil emulsions, using Y - and T - junction microchannels. As continuous phase, soybean oil containing 5% (w/w) of emulsifier polyglycerol polyricinoleate was used. Similarly, four xanthan gum solutions (non-Newtonian fluids) with concentrations ranging from 0.05 to 0.50% (w/w) were evaluated as dispersed phase in a Y – junction microchannel. In all systems, the ratio of the flow rates of the phases was the most important factor on droplets size. Regarding Newtonian fluids, the T – junction microchannel was less sensitive to the fluids physical properties, while in Y – junction geometry it was noted that the interfacial tension played the main role in droplet size, overcoming viscous forces. Regarding the non-Newtonian fluids, droplets with high polydispersity were obtained, especially with more concentrated xanthan gum solutions. Extensional rheology confirmed that elongational viscosity of xanthan gum solutions increased at higher concentrations and also with the rate of elongational deformation, which would explain the formation of the jet at droplet detachment and emulsion polidispersity. Thus, it was verified that in dripping regime, typical for Newtonian fluids, the monodispersity was a well-defined characteristic. On the other hand, when using viscoelastic fluids as dispersed phase, obtaining monodispersed droplets is still a challenge. In this way, it becomes necessary evaluate new process conditions and microchannel geometries in order to reach emulsions with low polydispersity.

Acknowledgements: The authors appreciate the technical support given by Professor Angelo Gobbi and Maria Helena de Oliveira Piazzeto of the Microfabrication Laboratory at the Brazilian Center for Research in Energy and Materials (CNPEM). The authors also would like to thank São Paulo Foundation (FAPESP 2011/06.083-0) and National Council for Scientific and Technological Development (CNPq 131351/2012-5) for supporting this research.

Ref: 4357

Physico-chemical properties of sodium alginate and chitosan in aqueous solutions: Effect of pH and biopolymer concentration

***Acevedo-Fani, Alejandra*[1]; *Salvia-Trujillo, Laura*[1]; *Rojas-Graü, María Alejandra*[1]; *Martín-Belloso, Olga*[1]**

[1]Department of Food Technology, University of Lleida. Av. Rovira Roure 191, 25198 Lleida, Spain

E-mail: omartin@tecal.udl.es

Keywords: sodium alginate, chitosan, ζ-potential, viscosity, whiteness index

Abstract

Recently much attention has been focused on designing nanostructures based on polysaccharides as food delivery systems, since they are edible and biodegradable. The adsorption of ionic polysaccharides at liquid-liquid or solid-liquid interfaces is an important process in the formation of nanostructures by the layer-by-layer assembly. However, the proper control of biopolymer adsorption requires the understanding of its electrical and physical behavior in aqueous solution. The pH and the biopolymer concentration are parameters that might influence their overall properties. The aim of this study was to evaluate the physico-chemical characteristics of ionic biopolymers to obtain crucial insights for the subsequent design of food nanostructures involving electrostatic interactions. Aqueous-based sodium alginate and chitosan solutions were prepared at different pH (3-11) and biopolymer concentrations (0.1, 0.5 and 1% w/v). Solutions were analyzed by measuring ζ-potential, viscosity and whiteness index (WI). The electrical charge of sodium alginate was negative at all pH values, and decreased in magnitude at pH 3 due to the partial protonation of carboxyl groups. The electrical charge of chitosan was positive, and ζ-potentials diminished as the pH increased due to the neutralization of amino groups. The greater the alginate or chitosan concentration was, the more negative or positive the ζ-potential, respectively. Viscosity of alginate decreased at pH 3 regardless of biopolymer concentration, which might be explained by the weaker electrostatic interactions at that pH. As expected, the higher the alginate concentration the higher the viscosity. Viscosity of chitosan decreased gradually at increasing pH, regardless of the biopolymer concentration. The pH did not affect WI of alginate solutions but WI did increase with concentration. At pH 7-11, WI of chitosan increased and this effect was more pronounced at a concentration 0.5 %, suggesting the formation of aggregates and colloidal instability. Results obtained in this work are useful for the rational design of functional nanostructures based on electrostatic attractions.

Acknowledgements: We thank to the Ministerio de Ciencia e Innovación (Spain), to the University of Lleida and to the Institució Catalana de Recerca I Estudis Avançats (ICREA) for supporting this research.

Ref: 4358

Novel biopolymer particles for the encapsulation of poorly soluble phenolic compounds

***Sessa, Mariarenata*[1]; *Ferrari, Giovanna*[2]; *Donsì, Francesco*[1]**

[1]Università degli studi di Salerno, Italy;
[2]ProdAl scarl, Competence Center on Agro-Food Productions, Italy.

E-mail: msessa@unisa.it

Keywords: biopolymer particles, lactoferrin, phenolic compounds, high pressure homogenization, *in vitro* digestion

Abstract

The development of biopolymeric nanoparticles to deliver bioactive compounds gathered a significant interest in scientists and manufacturers seeking to produce healthier and safer foods.
In this study, different poorly soluble phenolic compounds, such as resveratrol, curcumin and quercetin, were encapsulated into biopolymer nanoparticles, fabricated by electrostatic complexation of lactoferrin (LF) with anionic polysaccharides (alginate, carrageenan, or pectin). Initially, a lactoferrin core was formed by inducing conformational changes in the protein structure by heat treatments at different temperature (70, 75, 80, 85 and 90°C, 20 min) or by high pressure homogenization. The effectiness of these treatments was assessed by turbidity, dynamic light scattering and z-potential measurements, together with interfacial tension measurements, which gave information on the interactions of lactoferrin with polyphenol compounds, and the impact on its conformational and functional properties.
The lactoferrin biopolymeric nanoparticles were then coated with an additional biopolymeric layer through their direct mixing with anionic polysaccharides. The obtained systems exibited a relatively stable behaviour on a wide pH range (2-11), with a measurable growth in size occurring only at low pH, probably due to charge neutralization and bridging effects.
The physicochemical stability of the coated biopolymeric nanoparticles also exhibited a significant stability upon simulated gastrointestinal digestion, preserving most of the bioactive compounds until the gastrointestinal tract, where they are released and can be absorbed through the intestinal wall in active form.
The proposed approach can easily increase the aqueous dispersibility of polyphenols, exploiting their interactions with lactoferrin in the fabrication of coated nanoparticles, which offers the advantages of high food compatibility and controlled release in the gastrointestinal tract.

Ref: 4359

Study of the kinetics of formation of α-lactalbumin nanotubes in presence of manganese

***Fuciños, Clara*[1,2]; *Martins, Artur*[1]; *Rúa, María-Luísa*[2]; *Pastrana, Lorenzo*[2]; *Vicente, António*[1]**

[1]CEB - Centre of Biological Engineering, University of Minho, Campus de Gualtar, Braga, Portugal; [2]Biotechnology Group, Department of Analytical Chemistry and Food Science, University of Vigo, Ourense, Spain

E-mail: clarafg@gmail.com

Keywords: α-lactalbumin, nanotubes, whey proteins, self-assembly, light scattering, hydrolysis

Abstract

Partial hydrolysis of α-lactalbumin (α-La) induced by a serine endoprotease from *Bacillus licheniformis* (BLP) will result in the formation of nanotubes in the presence of a divalent ion, which acts as salt-bridge between two negatively charged carboxylic groups. Because of the GRAS status, this type of nanostructures will be very useful in food applications, which could involve their use as thickener agents and as a vehicle for controlled release of bioactive molecules.

In this work we studied the influence of temperature and the relation of Mn^{2+} (*R*) on the α-La nanotubes formation in presence of BLP, following the kinetics of formation by dynamic light scattering (DLS), reverse phase liquid chromatography (RP-HPLC) and spectrophotometry.

The hydrolysis of α-La and the self-assembly kinetics are both temperature dependent. The ion concentration (*R*) had no effect on the hydrolysis kinetics, but greatly influenced the effect of temperature on self-assembly kinetics. The lag time previous to nanotube elongation was related with both hydrolysis and self-assembly. In general, by increasing the temperature, the formation of nanotubes was faster and the lag time became shorter.

At 45 ^{o}C as *R*-values increased α-La was less degraded; when this happened the nanostructures formed by the partially hydrolyzed α-La started incorporating the hydrolysis products, which then became hardly accessible to the protease and, consequently the protein hydrolysis stopped earlier. However by increasing *R*-values at 50 and 55 ^{o}C the degree of hydrolysis was not substantially modified. Increasing both *R*-values and temperature, building blocks production and nanotube elongation were increased, and therefore the differences were reduced.

Finally, gels obtained at higher temperatures and higher *R*-values were the strongest and most transparent, which would be optimal to enhance the structure and functionality of foods.

Acknowledgements: Clara Fuciños gratefully acknowledge her Pos-Doctoral grant (SFRH/BPD/87910/2012) to the Fundação para a Ciência e Tecnologia (FCT, Portugal). The authors thank the FCT Strategic Project PEst-OE/EQB/LA0023/2013 and the project "BioInd-

Biotechnology and Bioengineering for improved Industrial and Agro-Food processes", REF. NORTE-07-0124-FEDER-000028 Co-funded by the Programa Operacional Regional do Norte (ON.2 – O Novo Norte), QREN, FEDER.

Ref: 4360

Lactoferrin-based nanohydrogel as a vehicle for iron delivery – preparation and release profile

Martins, Joana T.[1]; Bourbon, Ana I.[1]; Pinheiro, Ana C.[1]; Santos, Susana F.[1]; Cerqueira, Miguel A.[1]; González-Fernández, África[2]; Vicente, António A.[1]

[1]Centre of Biological Engineering, University of Minho, Campus de Gualtar, 4710-057 Braga, Portugal;
[2]Immunology, Biomedical Research Center (CINBIO) and Institute of Biomedical Research of Vigo (IBIV), University of Vigo, Campus Lagoas Marcosende, 36310 Vigo, Pontevedra, Spain.

E-mail: joanamartins@deb.uminho.pt

Keywords: nanohydrogel, protein, delivery, controlled release

Abstract

Lactoferrin is a milk protein involved in numerous biological functions, such as regulation and transport of free iron levels, antioxidant and antimicrobial activities.
Nanosystems, such as nanohydrogels, may be a vehicle to enrich foods with essential nutrients. Once iron deficit is a major nutritional problem, its inclusion in lactoferrin nanohydrogels could be one of the approaches to improve their stability, protection and subsequent absorption. Moreover, understanding the release mechanisms involved during human consumption, recurring to mathematical modeling, is important for the design of nanohydrogels carriers allowing foreseeing if the developed systems are appropriated to food products.
The research conducted aims at developing bovine lactoferrin-based nanohydrogel, and understanding the transport mechanisms of the nanosystem used as iron vehicle.
Nanohydrogel were formed by thermal gelation of lactoferrin (0.2 % (w/v)) at 75 °C for 20 minutes. After heat treatment, 35 mM (w/v) of ferric chloride was added. Nanohydrogels were characterized in terms of size distribution, polydispersity index (PDI) and morphology. Release experiments were conducted at different pH (2.0 or 7.0) at 37 ^{o}C (simulation of human digestive system conditions). Mathematical models were used to discuss the transport mechanism. Results showed that nanohydrogels with size of 110.0±0.4 nm and PDI of 0.218±0.005 were produced, and were stable during 76 weeks. Data from release experiments at pH 2 were successfully described by linear superimposition model which accounts for both Fick and Case II (polymer relaxation phenomenon) transport; in contrast, transport mechanism at pH 7 cannot be described by either Fick or Case II transport.
These results suggest that lactoferrin nanohydrogel system can be used in the food industry as a carrier to facilitate the release of essential nutrients, such as iron, in the human body. Additionally, the approach presented in this work allows interpretation of the phenomena involved in mass transport at the nano-scale.

Acknowledgements: Joana T. Martins, Ana I. Bourbon and Miguel A. Cerqueira acknowledge the Fundação para a Ciência e Tecnologia (FCT, Portugal) for their fellowships (SFRH/BPD/89992/2012, SFRH/BD/73178/2010, SFRH/BPD/72753/2010, respectively). The authors thank the FCT Strategic Project PEst-OE/EQB/LA0023/2013 and the project "BioInd - Biotechnology and Bioengineering for improved Industrial and Agro-Food processes", REF. NORTE-07-0124-FEDER-000028 Co-funded by the Programa Operacional Regional do Norte (ON.2 – O Novo Norte), QREN, FEDER.

Ref: 4364

Design of nanostructures, obtained from assembling of α-lactalbumin and lysozyme upon heat treatment and selective environmental conditions

Monteiro, Adenilson A.[1,2,3]; Monteiro, Marcia R.[3,4]; Ramos, Óscar L.[3,5]; Pereira, Ricardo N.[3]; Diniz, Renata[6]; Costa, Angélica R.[1]; Malcata, F. Xavier[5,7]; Teixeira, José A.[3]; Teixeira, Álvaro V.[1]; Oliveira, Eduardo B.[1]; Vicente, António A.[3]; Coimbra, Jane S.[1,6]

[1]Department of Food Technology, Universidade Federal de Viçosa, Viçosa, Minas Gerais, Brasil; [2]COLUNI – Colégio de Aplicação da Universidade Federal de Viçosa, Viçosa, Brasil;
[3] CEB - Centre of Biological Engineering, University of Minho, Braga, Portugal;
[4]Department of Nutrition, School of Nursing, Universidade Federal de Minas Gerais, Belo Horizonte, Brasil;
[5]LEPABE - Laboratory for Process Engineering, Environment, Biotechnology and Energy University of Porto, Porto, Portugal;
[6]UFPA - Universidade Federal do Pará, Belém, Pará, Brasil;
[7]Department of Chemical Engineering, University of Porto, Porto, Portugal

E-mail: os.silva.ramos@gmail.com

Keywords: Nanostructures, α-lactalbumin and lysozyme, food applications, bio-based materials

Abstract

Protein assembly into supramolecular structures (e.g. aggregates, fibrils and nanotubes) is a widespread phenomenon in biological sciences. Nowadays, it is well documented that the amphiphilic properties of proteins is a driving force to their self-assembling into innovative micro- and nanostructures of high interest in the food and pharmaceutical fields. Formation of such structures is strongly dependent on physicochemical conditions and protein conformation.

In this study, bio-based nanostructures were produced from assembly of hen egg white lysozyme (Lys) and bovine α-lactalbumin (α-La) – i.e. two homologous globular proteins with opposite charge), under various processing conditions: heating treatment (55 °C and 75 °C), holding time (25 and 35 min) and pH (3 and 11). The nano-scale structures prepared by solubilization of 2 mg mL^{-1} of Lys and α-La powders in water, at a molar ratio of 1:0.54, were characterized via dynamic light scattering (in terms of particle size, polydispersity and zeta potential), and further analyzed by transmission electron microscopy (TEM). Smaller sized particles (75 nm) and low podydispersity values (0.24) were produced at pH 11 after heating at 75 °C for 25 min, whereas at pH 3 (and similar conditions) the average mean particle size was ca. 402 nm with polydispersity of 0.45. The nanostructure stability was also assessed; higher stability was obtained at pH 11 than 3, with zeta potentials of -35 and +27 mV, respectively, by 60 d. The nanostructure entities prepared at pH 11 were shown by TEM to possess a well-

defined spherical shape. Protein assembly mechanisms and intermolecular interactions involved appear to be controlled by the environmental conditions applied; therefore, an understanding of the quantitative effects of these conditions are crucial for rational design of new protein assemblies with tailor-made functionalities

Acknowledgements: A.A.M and M.R.M gratefully acknowledge their grants to CNPqz and CAPES (Brazil), and their support to FAPEMIG and CNPEM-LNBio, both from Brazil. O.L.R and R.N.P gratefully acknowledge their Post-Doctoral grants (SFRH/BPD/80766/2011 and SFRH/BPD/81887/2011, respectively) to Fundação para a Ciência e Tecnologia (FCT, Portugal). The authors thank FCT Strategic Project PEst-OE/EQB/LA0023/2013 and project “BioInd - Biotechnology and Bioengineering for improved Industrial and Agro-Food processes", REF. NORTE-07-0124-FEDER-000028, co-funded by the Programa Operacional Regional do Norte (ON.2 – O Novo Norte), QREN, FEDER.

Ref: 4365

Nanoencapsulation of quercetin into bio-based nanostructures obtained from assembling of α-lactalbumin and lysozyme

Monteiro, Adenilson A.[1,2,3]; Monteiro, Marcia R.[3,4]; Ramos, Óscar L.[3,5]; Pereira, Ricardo N.[3]; Malcata, F. Xavier[5,6]; Teixeira, José A.[3]; Teixeira, Álvaro V.[1]; Oliveira, Eduardo B.[1]; Coimbra, Jane S.[1]; Vicente, António A.[3]

[1]Department of Food Technology, Universidade Federal de Viçosa, Viçosa, Minas Gerais, Brasil; [2]COLUNI – Colégio de Aplicação da Universidade Federal de Viçosa, Viçosa, Brasil;
[3]CEB - Centre of Biological Engineering, University of Minho, Braga, Portugal;
[4]Department of Nutrition, School of Nursing, Universidade Federal de Minas Gerais, Belo Horizonte, Brasil;
[5]LEPABE – Laboratpry for Process Engineering, Environment, Biotechnology and Energy University of Porto, Porto, Portugal;
[6]Department of Chemical Engineering, University of Porto, Porto, Portugal

E-mail: os.silva.ramos@gmail.com

Keywords: Nanoencapsulation, bio-based materials, quercetin, functional foods, health benefits

Abstract

Nanotechnology possesses an intrinsic potential to produce new food ingredients and innovative products, with considerable benefits to human health. This can be attained via development of innovative structures for application in functional foods. In recent years, consumption of foods providing health benefits has risen chiefly as a result of significant investments from the food industry and widening consumer awareness in this field. Polyphenols constitute one such functional ingredient: it entails a large group of plant metabolites with a large spectrum of recognized biological activities in humans. Quercetin is, in particular, one of the most representative compounds of the flavonoid family; it has been assigned a wide range of health benefits, including anti-inflammatory agent, cancer prevention, DNA protection agent, antioxidant and cardio-protective agent. However, its bioavailability is low, so limited biological effects may be noticed arising from its poor solubility, gastrointestinal instability and low uptake rate through the gastrointestinal tract. A possible solution to overcome such limitations is nanoencapsulation of quercetin. Therefore, our study was aimed at encapsulating quercetin into bio-based nanostructures obtained from assembling of α-lactalbumin (α-La) and lysozyme (Lys), as promoted by heating at 75 ^{o}C for 15 min, at pH 11; evaluation of their association efficiency was performed. Such nanostructures were prepared via solubilization of 2 mg mL^{-1} of Lys and α-La powders in water, at a molar ratio of 1:0.54, and were extensively characterized by dynamic light scattering (for particle size, polydispersity and zeta potential) and transmission electron microscopy (for microstructure and morphology).

Quercetin has been successfully encapsulated into protein nanostructures above 50% efficiency. These nanostructures exhibited spherical morphology, with average size below 100 nm and zeta potential around -35 mV. Our results suggest that quercetin encapsulated in such proteinaceous nanostructures may be used for manufacture of functional foods.

Acknowledgements: A.A.M and M.R.M gratefully acknowledge their grants to CNPqz and CAPES (Brazil), and their support to FAPEMIG and CNPEM-LNBio, both from Brazil. O.L.R and R.N.P gratefully acknowledge their Post-Doctoral grants (SFRH/BPD/80766/2011 and SFRH/BPD/81887/2011, respectively) to Fundação para a Ciência e Tecnologia (FCT, Portugal). The authors thank FCT Strategic Project PEst-OE/EQB/LA0023/2013 and project “BioInd - Biotechnology and Bioengineering for improved Industrial and Agro-Food processes", REF. NORTE-07-0124-FEDER-000028, co-funded by the Programa Operacional Regional do Norte (ON.2 – O Novo Norte), QREN, FEDER.

Ref: 4368

Steady state rheological behavior of cocoa (*Theobroma cacao L.*) nectar thickened with mixtures of xantan, guar and locust bean gums

S. Conceição, Robson[2]; Cruz, Rui[1]; C. Vieira, Margarida[1]

[1]Universidade do Algarve, Portugal;
[2]University Federal de Campina Grande, Brazil

E-mail: mvieira@ualg.pt

Keywords: rheology, shear rate shear stress, gums, *Theobroma cacao*, mathematical modeling, mixture designs

Abstract

The addition of gums in the production of nectars is very common in the beverage industry in Brazil therefore it is crucial to know the rheology of these products for sensory purposes as well as for equipment dimensioning. The effect of a mixture of three different gums, [xanthan gum (XG), guar gum (GG) and locust bean gum (LBG) and their combinations on the rheological properties of a nectar of cacao (*Theobroma cacao*) was studied for temperatures ranging from 23-60 ^{o}C. A simplex centroid mixture design was used where the three components varied from 0 to 0.5 %. The temperature dependence of the rheological parameters (consistency index (*K*) and flow behavior index (*n*) followed the Arrhenius law for all mixtures where LBG was not present or was present in very low percentage and through non-linear regression a prediction mathematical model based on the Ostwald Waele model was able to fit the experimental data in the range of temperatures studied.
K40.6 ^{o}C and Eak ranged from 5.89 Pa.sn for mixture 1 (0.5, 0.0, 0.0) to 0.06 Pa.sn for mixture 3 (0.0, 0.0, 0.5) and *n*40.6 ^{o}C varied from 0,17 for mixture 1 and up to 0.75 for mixture 3. Through response surface methodology, polynomial prediction models were obtained for *K*, *Eak*, *n* and *Ean* allowing prediction of the rheological parameters for any composition in the mixtures range studied.

Ref: 4372

Production of high added value products from eggshells

Castro, Inês[2]; Pinto, Daniel[2]; Maciel, Filipe[3]; Araújo, Ana[3]; Vicente, António[3]; Rocha, Cristina[1]

[1]REQUIMTE, Department of Chemical Engineering, Faculty of Engineering, University of Porto, Porto, Portugal;
[2]CPC - Castro Pinto & Costa, Porto, Portugal;
[3]IBB - Institute for Biotechnology and Bioengineering, Centre of Biological Engineering, University of Minho, Braga, Portugal

E-mail: jfilipemaciel@gmail.com

Keywords: Eggshell, eggshell membranes, collagen, bioactive peptides

Abstract

There are an increasing number of food companies addressing sustainable-manufacturing practices as part of social responsibility reporting. The egg processing industry produces several tons of eggshell residues which are a major environmental problem and represent a significant cost for these industries (ca. 0.6 % of sales). The main goal of this work is to produce high added value products, namely collagen and bioactive peptides, using the remnant of collagen extraction from the eggshell membrane. The target market of the products obtained is the biomedical, pharmaceutical, cosmetics and food industry.

The separation of the shell and the membrane was optimized and a chemical-physical process was performed having a yield of 9 % (w membrane/w shell). Times and yields for different separation methods were calculated and the economic viability of the process was studied.

In order to optimize collagen extraction from the eggshell membranes several variables were studied (e.g. temperature, enzyme concentration and time). The collagen obtained was separated using saline precipitation steps and different collagen types were identified. The collagen types were visualized using SDS-electrophoresis and total quantification of collagen was made by hydroxyproline method.

Moreover, the residue after collagen extraction was further digested with different enzymes, namely pancreatin, tripsin and lysin and the peptides profile was determined by HPLC-UV method.

The results showed promising strategies for using this technology at industrial scale as an economic viable technology for producing high added value products from eggshells membranes. This technology will equally contribute to reducing the environmental problem associated with these residues.

Ref: 4377

Preparation of Ca-alginate encapsulates with liquid aroma

Lević, Steva[1]; Kalušević, Ana[1]; Đorđević, Verica[2]; Rac, Vladislav[1]; Rakić, Vesna[1]; Pavlović, Vladimir[1]; Šolević Knudsen, Tatjana[3]; Bugarski, Branko[2]; Nedović, Viktor[1]

[1]University of Belgrade-Faculty of Agriculture, Nemanjina 6, 11081 Belgrade-Zemun, Serbia;
[2]University of Belgrade-Faculty of Technology and Metallurgy, Karnegijeva 4, 11000 Belgrade, Serbia;
[3]Department of Chemistry, Institute of Chemistry, Technology and Metallurgy, 11001 Belgrade, Njegoševa 12, P.O. Box 473, Serbia.

E-mail: anakalusevic@gmail.com

Keywords: alginate, electrostatic extrusion, encapsulation, aroma

Abstract

Encapsulation is technology that may provide barriers between sensitive active components such as aroma, and the environment, and consequently to allow taste and aroma differentiation. Additional benefit of encapsulation of aroma is less degradation and evaporation of volatile and odorous organic molecules. Aromas are usually expensive and therefore food manufacturers are usually concerned about the preservation of aromatic components. Finally, since the flavour is one of the most important characteristics of food, the main aim of encapsulation is controlling aroma release and improving aroma stability during processing and consumption.

The aim of this study was to produce Ca-alginate encapsulates of liquid aroma in different concentration in order to improve thermal properties of this sensitive ingredient.

Electrostatic extrusion as encapsulation technique and sodium alginate as a carrier material for aroma were used. Commercially available coconut aroma in concentration of 5 and 10 %w/w served as an active component in encapsulates.

Prior to the electrostatic extrusion, preparation of emulsion of aroma and Na-alginate mixture was carried out, with testing primarily rheological properties of emulsions. The final form of the particles was obtained by gelation of Na-alginate in the presence of a Ca^{2+} ions, and thus coconut aroma was entrapped within the structure of the Ca-alginate gel.

After encapsulation, the particles were dried at room temperature and the analysis of their morphological characteristics, the content of aroma, and thermal properties were done. The obtained results showed that Ca-alginate particles are suitable as carriers for the encapsulation of liquid aroma. Statistically significant improvement of the thermal properties of encapsulated aroma compared to the free one was observed.

Thanks to encapsulation, a food compound such as coconut aroma could be covered with a protective wall material of alginate and by that way could be protected against evaporation, chemical reactions and migration in a food matrix.

Acknowledgements: This research was supported by the Ministry of Education, Science and Technological development, Republic of Serbia (Projects No III 46010 and III 46001) and European Commission, Seventh Framework Programme, (Project AREA No 316004).

Ref: 4379

Emulsion-based microgels: influence of production technique on the digestibility profile

***Perrechil, Fabiana*[1]*; Sato, Ana Carla*[2]*; Cunha, Rosiane*[2]

[1]Federal University of São Paulo, Brazil
[2]University of Campinas, Brazil

E-mail: rosiane@fea.unicamp.br

Keywords: microgels, digestibility, microstructure

Abstract

Emulsion-based microgels were produced by atomization of emulsions produced using the same biopolymers but different techniques: the mixed microgels (MM) and the double-layered microgels (DLM). In the first case, prior to atomization, a mixture of gelatin and alginate was prepared, and the biopolymer solution was high-pressure homogenized with oil in order to produce an O/W emulsion. The double-layered microgels, on the other hand, were prepared by homogenizing a gelatin solution with the oil (primary O/W emulsion) and mixing this emulsion with an alginate solution, resulting in a secondary emulsion, before atomization. The emulsions were atomized in a $CaCl_2$ solution. Microgels were characterized using confocal microcopy and *in vitro* digestibility was performed in order to simulate the gastric (pepsin; pH 2) and enteric (pancreatin and bile extract; pH 7) digestion. Particle size distribution and morphology of the emulsion-based microcapsules were evaluated during the digestion assay. Confocal microscopy indicated that both biopolymers were homogeneously distributed along the MM, while, in the DLM the colocalization was concentrated in the center of the particle. Both gastric and enteric steps led to reduction on the size of the particles. A higher reduction of particles diameter after the gastric step was observed for the DLM microgels (~ 13% of the initial size, in comparison to ~6% of the MM), while the MM showed smaller diameters after the enteric step (~ 94% of the initial size, in comparison to ~64% of the DLM). Microscopy showed that along the enteric step, the MM gel network was loosened, releasing the entrapped oil droplets, which was not observed at the DLM systems. Results indicated that, although being produced with the same biopolymers, the microgels showed different digestibility profiles indicating that the technique used in their production is determinant for their morphologic characteristics and release properties.

Acknowledgements: Authors would like to thank CAPES, FAPESP and CNPq for financial support.

Ref: 4383

The effect of the addition of potato juice on the structure and quality of finely comminuted sausages

***Kowalczewski, Przemysław*[1]; Lewandowicz, Grażyna[1]; Krzywdzińska-Bartkowiak, Mirosława[2]; Piątek, Michał[2]; Jeziorna, Magdalena[1]; Białas, Wojciech[1]; Baranowska, Hanna Maria[3]**

[1]Department of Biotechnology and Food Microbiology, Poznań University of Life Sciences, Poznań, Poland; [2]Institute of Meat Technology, Poznań University of Life Sciences, Poznań, Poland;
[3]Department of Physics, Poznań University of Life Sciences, Poznań, Poland

E-mail: przemyslaw.kowalczewski@up.poznan.pl

Keywords: sausages, potato juice, microstructure, low-field NMR, texture, functional food

Abstract

Potato juice is a liquid waste product separated in modern starch plants from the potato pulp. It contains protein of high nutritional value, minerals, vitamins and other bioactive substances. For this reason it could be used as a functional component in novel food designs. The aim of this study was to assess the effect of potato juice addition on the quality, structure, physicochemical properties and consumer acceptance of finely comminuted sausages.

Finely comminuted sausages were enriched with freshly squeezed or dried potato juice. Free water, protein, fat and salt content were determined in all the investigated sausages. Consumer acceptance tests were conducted using the linear scaling method. The microstructure of investigated sausages was assessed using a computer image analysis system (CIA). Texture profile was analysed with TA.XT2i apparatus equipped with a single Warner-Bratzler knife for cutting tests. Single compression tests up to 50% of the sample height were also performed. The dynamics properties of water was analysed by using low-field NMR method.

It was found that the addition of potato juice to sausages did not cause any changes in the free water, protein, fat and salt content of the sausages. Moreover, the results of consumer acceptance showed that sausage fortification with potato juice did not affect the taste negatively. The addition of fresh potato juice did not change the texture of the enriched sausages in comparison to the control samples. However, the hardness of sausages enriched with dried potato juice was higher. The results of computer image analysis showed that fat emulsification was the best in sausages containing dried potato juice. These differences are reflected in the results of the molecular dynamics of water.

Acknowledgements: The work was financially supported by the grant POIG 01.01.02-00-061/09 “Bioactive food” implemented within the Programme Innovative Economy 2007-2013

Ref: 4387

Particle tracking microrheology in a phase separated system of sodium caseinate and locust bean gum

***Biliaderis, Costas G.*[1]; *Chantzos, Nickolaos*[1]; *Moschakis, Thomas*[1]**

[1]Department of Food Science and Technology, School of Agriculture, Aristotle University of Thessaloniki, GR-541 24, Thessaloniki, Greece

E-mail: biliader@agro.auth.gr

Keywords: Particle tracking microrheology, w/w emulsions, phase separation

Abstract

Most of the food products contain polysaccharides and proteins, for example dairy products such as ice cream. However, under certain circumstances proteins and polysaccharides are thermodynamically incompatible and therefore phase separation is observed. Many studies investigate the mechanism and kinetics of phase separation between proteins and polysaccharides, but mostly on macroscopic level. In the present study, particle tracking microrheology using confocal laser scanning microscopy was employed to investigate on micro-level the mechanical response of the phase separated regions of mixed solutions containing sodium caseinate (SC) and locust bean gum (LBG) and determine the effect of each phase on the overall viscosity.

Polystyrene carboxylated fluorescent tracer particles of various sizes were added and images/videos were captured by using an inverted confocal microscope (Leica TCS SP5II). In additional, bulk rheology, and macroscopic observation were employed to probe the phase separation phenomena. W/w emulsions were formed with the phase separated regions (continuous or dispersed phase) enriched in proteins or polysaccharides dependent on the ratio of the two biopolymers. That is, when the concentration of SC is significantly larger than LBG the continuous phase was enriched with the SC. By decreasing the ratio of SC/LBG phase inversion was observed. Moreover, the addition of NaCl or GDL accelerated the phase separation and the formation of a detectable microstructure of the w/w emulsions. The presence of NaCl resulted in the accumulation of particles at the liquid – liquid interface. Particle tracking microrheology has revealed that the viscosity of the SC-rich phase was considerably lower than the viscosity of the LBG-rich phase. The actual concentration of the biopolymers in the two phases was also calculated with particle tracking microrheology, assuming that the phase separated regions contain only the enriched biopolymer.

Ref: 4388

Complex coacervation as a potential microencapsulation technique of probiotics

***Biliaderis, Costas G.*[1]; *Bosnea, Loulouda A.*[1]; *Moschakis, Thomas*[1]**

[1]Department of Food Science and Technology, School of Agriculture, Aristotle University of Thessaloniki, GR-541 24 Thessaloniki, Greece

E-mail: biliader@agro.auth.gr

Keywords: complex coacervation, microencapsulation, probiotics

Abstract

Two probiotic strains of *Lactobacillus paracasei subsp. paracasei* and *Lactobacillus paraplantarum* were microencapsulated by complex coacervation using whey protein isolate (WPI) and gum arabic (GA) interacting by ionic forces. Several parameters were examined for optimization of the microcapsule formation and cell viability, such as total biopolymer concentration, inoculum concentration and the effect of ionic strength. The viability of the bacterial cells during processing (heat treatment, high salt concentrations) under simulated gut conditions (low pH and high bile concentrations) and upon storage was also evaluated.

Among different WPI/GA weight ratios tested (1:1, 2:1 and 4:1), the highest survival rate was observed for the coacervate structures made with the ratio of 2:1. The protection efficiency at low pH values is influenced by both concentration and ratio of the added biopolymers. The inoculum level also seems to affect the efficiency of microcapsules to entrap the bacterial cells, with an optimum content at less than 8 log cfu/ml. Both encapsulated strains retained high viability in simulated gastric juice (>73%), compared to non-encapsulated (free) cells (<19%). Moreover, after 60 days of refrigerated storage at pH 4.0, the cell viability for the encapsulated cells was more than 86%, in comparison with the free cells (< 59 %). The encapsulated lactobacilli also exhibited enhanced viability after 10 – 30 min of heat treatment at 65^{o}C as well as at different NaCl concentrations (pH 4.0). Overall, the results of this study suggest that ionotropic complex coacervation with WPI/GA has a potential to improve the viability of live probiotics in low pH food systems and fermented dairy products. It is also worth noting, that the complexes dissolve at pH 7.0, releasing the microbial cells and therefore they might act as targeted delivery systems of live probiotics in the gut environment.

Ref: 4391

Layer-by-layer microcarrier production and characterization as a model to probiotics microencapsulation

Ramos, Phillippe E.[1]; Cerqueira, Miguel A.[1]; Cook, Michael [2]; Charalampopoulos, Dimitris[3]; Khutoryanskiy, Vitaliy V.[2]; Teixeira, José A.[1]; Vicente, António A:[1]

[1]CEB - Centre of Biological Engineering, University of Minho, Campus de Gualtar, 4710-057 Braga, Portugal
[2]School of Pharmacy, University of Reading, Reading, RG6 6AD, UK
[3]Food and Nutritional Science, University of Reading, Reading, RG6 6AD, UK

E-mail: philippecr18@gmail.com

Keywords: Probiotics; Folate; microencapsulation; layer-by-layer

Abstract

The recommended daily intake of folate (B-complex vitamin) for an adult varies between 200 and 400 µg, being the intake of folate inefficient due its extremely unstable chemical forms. One of the presented solutions is the in situ production using probiotics. However, two concerns exist for this solution: a) probiotic bacteria may need protection towards the gastric medium (encapsulation); and b) microcapsule sizes should be smaller than 100 µm, to avoid modifying food texture.

Alginate-based microcapsules were produced and three layers were added using the layer-by-layer technique: 1st - poly-L-lysine (0.1%); 2nd - sodium alginate (1%); 3rd - chitosan (0.03%). Confocal microscopy was used to confirm the consequent adhesion of the layers, and if they were in the correct position (the layers labelled were the first (Poly-l-lysine/FITC) and the third layer (Chitosan/Rhodamine). After production the particles where put into a 10 mL solution of KCl-HCl (pH 2) during 1 hour, at 100 rpm and then into a PBS solution (pH 7.2), during 3 hours in order to mimic the gastrointestinal tract during digestion.

The average size of the particles was 21.01 ± 0.493 µm and 39.84 ± 0.794 µm during the process at pH 2 and at pH 7.2, respectively. The sizes were smaller than 100 µm and showed a swelling capacity (particles duplicate their size upon passing from pH 2 to pH 7.2). Confocal images showed the adhesion of the different layers, also proving indirectly the existence of the second layer (not labelled). Further, after the contact with the KCl-HCl (pH 2) and PBS (7.2) media, the structure of the capsules with the layers was maintained, thus showing the robustness of this structure at pH values typical of the gastrointestinal system.

Alginate microcapsules production through LbL technique showed potential for encapsulation of probiotics, allowing their protection against harsh conditions in gastrointestinal tract.

Ref: 4395

Isolation and characterisation of lactic acid bacteria from cassava by products

Ayodeji, David[1]; Piccirillo, Clara[2]; Ferraro, Vincenza[2]; Moreira, Patrícia[2]; Obadina, Adewale[1]; Sanni, Lateef [1]; Manuela, Pintado[2]

[1]Food Science and technology Department, Federal University of Agriculture Abeokuta, Nigeria;
[2]CBQF/ESB, Universidade Católica Portuguesa, Porto, Portugal

E-mail: cpiccirillo@porto.ucp.pt

Keywords: lactic acid bacteria isolation

Abstract

Lactic acid bacteria (LAB) are known for their probiotic properties. Literature reports how they can be isolated from both food products and their by-products, in particular from food/by-products which went through a fermentation process.
Cassava is a root crop with high nutritional value, widely consumed in many African, Asian and South American countries. Cassava food items and by-products could be used to isolate probiotic strains.
In this work we report about the isolation of several LAB strains from the effluents of gari and fufu, two cassava-based food items typical of Nigeria.
The isolate were analysed to determine their morphology, Gram-staining, acid and bile salt tolerance; moreover, molecular characterisation was also performed. Indeed some of the strains showed interesting properties.
This study shows the potential of cassava as a source of LAB, which could find numerous applications in the food industry.

Acknowledgements: The work presented here was financially supported by the Gratitude project (FP7/KBBE.2011.2.5-02).

Ref: 4396

Study of the mineral composition of different Nigerian yam flours

***Piccirillo, Clara*[1]; *Ferraro, Vincenza*[1]; *Roriz, Mariana*[1]; *Omohimi, Celstina*[2]; *Abayomi, Louise A*[3]; *Vasconcelos, Marta W*[1]; *Sanni, Lateef*[2]; *Pintado, Manuela*[1]**

[1]CBQF/ESB, Universidade Católica Portuguesa, Porto, Portugal;
[2]Food Science and technology Department, Federal University of Agriculture Abeokuta, Nigeria;
[3]Natural Resources Institute, University of Greenwich, United Kingdom.

E-mail: cpiccirillo@porto.ucp.pt

Keywords: yam flour composition

Abstract

Yam is a root crop essential for the lives of hundreds of millions of people in many African, Asian and South American countries. Yam roots are in fact used to produce a variety of food items, including yam flour.

The flours are consumed mainly as a source of carbohydrate; however, they also supply several minerals which are essential for good state of health.

In this study we report about a systematic investigation on the mineral composition of several Nigerian yam flours. More than 40 flours samples purchased from local market vendors and/or producers were analysed by ICP-OES spectrometry; the concentration of minerals (i.e. potassium, sodium, iron, etc.) was determined.

Results showed variance in the mineral profile across different sources of the flour. This research also highlighted the nutritional potential of yam flours and allowed possible regional variations in the flour compositions to be monitored.

Acknowledgements: The work presented here was financially supported by the Gratitude project (FP7/KBBE.2011.2.5-02).

Ref: 4397

Curcumin-containing nanoparticles for delivery of antimicrobial activity in food systems

***Rodov, Victor*[1]; *Choudhary, Ruplal*[2]; *Dogra, Navneet*[2]; *Kohli, Punit*[2]; *Haddock, John D.*[2]; *Makwana, Sanjaysinh*[2]; *Horev, Batia*[1]; *Vinokur, Yakov*[1]; *Shlar, Ilya*[3]; *Droby, Samir*[1]**

[1]ARO - The Volcani Center, Israel
[2]South Illinois University, United States of America;
[3]Hebrew University of Jerusalem, Israel.

E-mail: vrodov@agri.gov.il

Keywords: Nanoparticles, liposomes, curcumin, phenylpropanoids, methyl-beta-cyclodextrin, polydiacetylene, bactericidal, Esherichia coli, Bacillus cereus, antibacterial surfaces, glass

Abstract

Cross-contamination through food-contact surfaces is one of the common dissemination paths of food-borne diseases. The ultimate goal of this study is developing antimicrobial food-contact materials based on natural phenolic compounds. Promising active principles for the research were chosen from the range including phenylpropanoid acids, aldehydes, alcohols and related natural phenolics. Microencapsulation in methylated β-cyclodextrin (MBCD) was used for testing the activities of the phenolic compounds in aqueous medium in the concentration range of 0.1 – 20 mM. Just a few compounds, all having 4-hydroxy-3-methoxy substituents, demonstrated complete inhibition of *E. coli* growth at concentrations tested: curcumin, coniferaldehyde and ferulic acid. Within the series with the same substituents the antimicrobial activity declined in the order aldehyde > acid >> alcohol. The MBCD-encapsulated phenolic compounds demonstrated scavenging capacity towards stable free radical-cation ABTS+•.

Curcumin possessed by far the highest antimicrobial effect among the compounds tested with half-maximal inhibitory concentration (IC50) of 0.17 mM and minimum inhibitory concentration (MIC) of 0.4 mM, and therefore was chosen as an active principle for preparing antimicrobial nanoparticles. Curcumin was enclosed in liposome-type polydiacetylene/phospholipid nanovesicles additionally supplemented with N-hydroxysuccinimide- (NHS) and glucose-containing monomers. Fluorescence spectrum of curcumin-functionalized nanovesicles (CFN) suggested that curcumin was located in their non-polar bilayer region. When brought in contact with *E. coli*, the nanovesicles tended to bind to the bacterial surface. Free-suspended CFN demonstrated bactericidal activity towards Gram-negative (*E. coli*) and vegetative cells of Gram-positive (*Bacillus cereus*) bacteria reducing their counts in phosphate buffered saline from 5 log CFU/mL to undetectable level within 8 h. To produce antimicrobial surfaces, the nanovesicles were covalently bound to silanized glass. Incubation of *E. coli* and *B. cereus* with CFNbound glass resulted in 2.5 log reduction in their

viable counts. After optimization this approach can be used for controlling microbial growth, cross-contamination and biofilm formation on food-contacting surfaces.

Acknowledgements: This research was supported by the US-Israel Binational Agricultural Research and Development (BARD) Grant US-4471-11F. Nanoparticles, liposomes, curcumin, phenylpropanoids, methyl-beta-cyclodextrin, polydiacetylene, bactericidal, *Esherichia coli, Bacillus cereus*, antibacterial surfaces, glass.

Ref: 4399

Effect of digestion on solid lipid nanoparticles loaded with rosmarinic acid

Campos, Débora[1]; Madureira, Ana Raquel[1]; Gomes, Ana Maria[1]; Sarmento, Bruno[2,3]; Pintado, Manuela[1]

[1]Centro de Biotecnologia e Química Fina, Escola Superior de Biotecnologia, Universidade Católica do Porto, Portugal;
[2]CICS - Health Sciences Reseach Center, Instituto Superior de Ciências da Saúde-Norte, Gandra, Portugal;
[3]INEB - Instituto de Engenharia Biomédica, NewTherapies group, Universidade do Porto, Porto, Portugal.

E-mail: rmadureira@porto.ucp.pt

Keywords: SLN, polyphenols, digestion

Abstract

The incorporation of bioactive nanoparticles in food matrices as a way to improve and diversify functional and nutritional properties has been the aim of several research efforts. Solid lipid nanoparticles (SLNs) loaded with rosmarinic acid (RA) were produced using as lipid matrices the waxes Witepsol H15 and Carnauba (Campos et al., 2013). Since these nanoparticles will be further incorporated in food matrices, the effect of digestion on the stability and bioactivity of such systems was studied. Hence, nanoparticles were subject to simulated digestion conditions. Stomach was simulated by adjusting the pH of each solution to 2.0 (HCl, 1 M), and adding pepsin (25 mg/mL) at a ratio of 0.05 mL/mL of sample. Samples were incubated and digested during 60 min, at 37 ˚C, with continuous homogenization (130 rpm). Duodenum conditions were simulated by increasing pH of the digested samples to 6.0 (NaHCO3, 1M) and adding simulated intestinal juice comprising pancreatin (2 g/L) and bile salts (12 g/L) to a rate of 0.25 mL/mL of sample. All samples were incubated during 2 h, at 37 ˚C with continuous homogenization (45 rpm). Evolution of the physical properties was followed by Dynamic Light Scattering (DLS); polyphenol release % was obtained by High Performance Liquid Chromatography (HPLC). A release of 50% of RA from the SLNs was observed when SLNs were subjected to the duodenum phase. Concentration of free RA decreased along digestion simulation. Particle size was maintained along the simulation of digestion, viz. witepsol SLNs with sizes of ca. 220 nm and carnauba wax
SLNs with ca. 350 nm. The polydispersion indexes of the initial SLNs were indicative of monodispersed solutions (0.150), but after digestion these exhibited an increase (0.300). Zeta potential values, for both types of SLNs, demonstrated the maintenance of a good stability, with values of charges between -20 and -30 mV.

Acknowledgements: Partial funding for this research work was provided via project NANODAIRY (PTDC/AGR-ALI/117808/2010) and project PEstOE/EQB/LA0016/2011, administrated by FCT (Fundação para a Ciência e Tecnologia, Portugal). Author Ana Raquel Madureira acknowledges FCT for the post-doctoral scholarship SFRH / BPD / 71391 / 2010.

Ref: 4400

Production of chitosan nanoparticles with polyphenols for incorporation in bioactive food formulations

Pereira, Adriana[1]; Campos, Débora[1]; Madureira, Ana Raquel[1]; Pintado, Manuela[1]

[1]Centro de Biotecnologia e Química Fina, Escola Superior de Biotecnologia, Universidade Católica do Porto, Portugal.

E-mail: rmadureira@porto.ucp.pt

Keywords: Nanoparticles, chitosan, polyphenols

Abstract

The design of bioactive nanoparticles for food incorporation has been a new challenge for food researchers. Aiming the development of bioactive food formulations with antimicrobial activity against pathogenic intestinal bacteria, the optimization of the production of chitosan nanoparticles loaded with polyphenols was performed. *Bacillus cereus, Escherichia coli O157:H7, Staphylococcus aureus, Salmonella typhimurium, Listeria innocua*, and *Yersinia enterocolitica* strains were the target bacteria. A first study to evaluate the antimicrobial activity of the polyphenols such as rosmarinic acid (RA), protocatechuic acid (PA) and the 2,5-dihydroxybenzoic acid (DHBA) and of chitosan of low (LMWC) and high molecular weights (HMWC) (107 kDa and 624 kDa) was performed. The individual compounds, as well their mixtures were tested using the minimum inhibitory concentration (MIC) determination based on the M07-A8 standard (2009). The effective concentrations of polyphenols and chitosans chosen

for each compound (CS and polyphenols) were the following: for chitosans LMWC 0.2 %, HMWC 0.4 %, RA 0.6 %, PA 0.3 %, and DHBA 0.3 % (m/v), and the nanoparticles were produced by ionic gelation. The physical properties (particle size, polidispersity index and zeta potential) of the nanoparticles were obtained by DLS and the entrapment efficiencies (EE%) were also calculated. The antimicrobial activity of the nanoparticles against the intestinal bacteria was obtained also by MIC determination. The particle sizes of the NP were in the range of 300-800 nm, with zeta potential of ca. 30 mV and EE% of 60-90 %. The nanoparticles also exhibited high % of inhibition especially the ones produced with LMWC and RA and HMWC with DHBA. The highest inhibition observed was against E. coli O157 and B. cereus.

Acknowledgements: Partial funding for this research work was provided via project NANODAIRY (PTDC/AGR-ALI/117808/2010) and project PEstOE/EQB/LA0016/2011, administrated by FCT (Fundação para a Ciência e Tecnologia, Portugal). Author Ana Raquel Madureira acknowledges FCT for the post-doctoral scholarship SFRH / BPD / 71391 / 2010.

Ref: 4405

Whey protein isolate edible film: a carrier for probiotic bacteria

***Odila Pereira, Joana*[1]; *Gomes, Ana*[1]; *Pintado, Manuela*[1]**

[1]CBQF – Centro de Biotecnologia e Química Fina – Laboratório Associado, Escola Superior de Biotecnologia, Universidade Católica Portuguesa/Porto, Rua Dr. António Bernardino de Almeida, 4200-072, Porto, Portugal

E-mail: joanaodila@gmail.com

Keywords: Edible films/coatings, Bifidobacterium, Lacotbacillus, Whey protein isolate

Abstract

The use of edible films formulated with bioactive compounds in food products in order to convey new functionalities or extend shelf-life opens new possibilities as support for functional lactic acid bacteria. Thus, active coatings can be obtained by immobilization of the microorganisms in the film, which when in contact with food, will enable the release of microbial bioactive principles and/or after ingestion can directly exert functionality in the human body. Such action may include specific health benefits, such as modulation of the intestinal microbiota that may provide protection against gastrointestinal disorders. Probiotics, when delivered via food or supplement-like forms may contribute to such modulation if their survival and stability is assured until their reaching of the gastrointestinal tract.

In this work the main objective was to study the stability of probiotic microorganisms, viz. *Bifidobacterium animalis ssp. Lactis* BB-12® and *Lactobacillus casei* 01, in edible films based on whey proteins for coating food products and improving their quality and safety.

The selected probiotics at 109 CFU/g of film were incorporated in whey protein-based films to obtain stable edible films to be later applied in food products to provide them antimicrobial protection or make them carriers of viable probiotic bacteria. Films solutions were produced, dried and stored for 60 days to assess stability through the determination of viable cell numbers and physical properties namely color, aw, thickness and weight.

The results demonstrated the stability of probiotics in edible films for 60 days at 23 and 4 ^{o}C. A loss of viability of ca. 3 log cycles (reaching 106 CFU/g film) was observed until the end of storage at both temperatures. Nevertheless, the final viable cell numbers achieved are still within the minimum threshold necessary for intended biological function in the human body. Physical properties of films did not change throughout storage period.

Acknowledgements: The authors gratefully acknowledged the Fundação para a Ciência e Tecnologia (FCT), Portugal for providing PhD scholarship ref. SFRH/BD/88383/2012 to Joana Odila Pereira. This work was supported by National Funds from FCT through project PEstOE/EQB/LA0016/2013.

Ref: 4408

Antiulcerative and antitumoral properties of spent brewer's yeast peptide extracts for incorporation in foods

***Amorim, Manuela*[1]; *Pereira, Joana*[1]; *Monteiro, Karin*[2]; *Ruiz, Ana*[2]; *Pinheiro, Hélder*[3]; *Carvalho, João*[2]; *Pintado, Manuela*[1]**

[1]CBQF – Centro de Biotecnologia e Química Fina – Laboratório Associado, Escola Superior de Biotecnologia, Universidade Católica Portuguesa/Porto, Rua Dr. António Bernardino de Almeida, 4200-072, Porto, Portugal;
[2]Divisão de Farmacologia e Toxicologia do Centro Pluridisciplinar de Pesquisas Químicas, Biológicas e Agrícolas da Universidade Estadual de Campinas - UNICAMP. Campinas, Brasil;
[3]Departamento de Farmacologia e Terapêutica da Faculdade de Medicina da Universidade do Porto, Al. Hernani Monteiro, 4200-319 Porto, Portugal.

E-mail: mamorim@porto.ucp.pt

Keywords: functional ingredients, peptides, antiulcerogenic activity, tumor cells, Cytoprotection mechanisms

Abstract

Today, the inflammatory bowel diseases such as ulcerative colitis are increasing and have been associated to contemporary people. Additionally, the increasing of cancer in the world is also a current fact. These issues are attracting attention in the search of new ingredients used in the prevention and improvement of these diseases. Particularly, several compounds, when added to foods, are able to positively stimulate certain biological systems leading to health improvement. Thereby, extracts obtained from the combined autolysis and hydrolysis of yeast cells possess compounds such peptides and amino acids, which eventually may control the production of inflammatory cytokines, thus leading to an anti-inflammatory activity and antitumoral properties. Thus, the main objective of the present work is to study the antiulcerative and antitumoral potential of yeast peptide extract for further incorporation in functional foods to prevent or improve symptoms in these chronic diseases. Peptide concentrates obtained by hydrolysis of spent brewer yeast proteins with extracts of *Cynara cardunculus* were studied using animal models to prove possible protection of the stomach mucosa against ulcerative lesions caused by oral administration of absolute ethanol. The peptide fraction below 3 kDa (peptidic extract) from yeast proteins was able to reduce gastric injuries to significant levels ($p < 0.05$). Additionally, the anti-proliferative activity of these extracts in nine cell lines of different human tumor was tested. The results exhibited a promising antiproliferative activity against leukemia cells. These results suggest that this new peptide extract can be used to develop new functional foods, although further studies are required.

Ref: 4409

Effect of food matrix on antimicrobial activity upon food spoilage Lactic Acid Bacteria

Costa, E.M.[1]; Silva, S.[1]; Matias, C.[2]; Matias, O.[2]; Couto, J.A.[1]; Gomes, A. M.[1]; Pintado, M. M.[1]

[1]CBQF - Centro de Biotecnologia e Química Fina – Laboratório Associado, Escola Superior de Biotecnologia, Universidade Católica Portuguesa/Porto, Rua Dr. António Bernardino Almeida, 4200-072 Porto, Portugal; [2]Mendes Gonçalves S.A., Zona Industrial, Lote 6, 2154-909 Golegã, Portugal.

E-mail: emcosta@porto.ucp.pt

Keywords: chitosan derivative, Maillard Reaction, Structural Characterization

Abstract

Lactic acid bacteria (LAB) have been used in foodstuffs due to the desirable effects on the organoleptic and functional characteristics; however they can also cause food spoilage by producing off-flavours, carbon dioxide and textural changes. In such circumstances, their intrinsic high resistance to acidic conditions and antimicrobials poses a problem to the food industry. So it is important to select amongst the food additives those that assure LAB inhibition in acid and complex food matrices assuring safety and quality preservation. In this work we describe the antimicrobial efficiency of sodium diacetate in two prototypes of mayonnaise and ketchup. To that end both matrices (ketchup and mayonnaise) formulated with the selected antimicrobial agent were inoculated with a LAB isolated from previously spoiled sauces and the capability to reduce their initial viable cell numbers was evaluated.
The results obtained showed that the inclusion of this antimicrobial into both matrices was not completely successful. While in the ketchup prototype revealed high antimicrobial activity reducing, in 24 h, LAB viable counts by 5.37 log CFU/g, in the mayonnaise only 1 log CFU/g reduction was observed in the same time frame. A probable cause for this discrepancy is the higher fat content of mayonnaise that may be blocking the antimicrobial activity.
In conclusion the results obtained show the need to adapt the antimicrobial solution to different complex matrices, since several interactions between food matrix and antimicrobial components may occur.

Acknowledgements: The author hereby gratefully acknowledges the Agency of Innovation (Agência de Inovação, ADI, Portugal) and Quadro de Referência Estratégico Nacional (QREN, Portugal) which through the project “Saucealth – Desenvolvimento de novos e inovadores molhos mais saudáveis e seguros” (QREN-ADI 30230) and the National Funds from FCT – Fundação para a Ciência e a Tecnologia through project PEst-OE/EQB/LA0016/2013 provided funding for the realization of this work.

Ref: 4411

Synthesis optimization and structural characterization of chitosan-glucose derivative obtained by the Maillard reaction

Montenegro, M. I.[1]; Cardelle-Cobas, A.[1]; Gullón, B.[1]; Ruiz-Matute, A.[2]; Corzo, N.[2]; Pintado, M. M.[1]

[1]CBQF - Centro de Biotecnologia e Química Fina – Laboratório Associado, Escola Superior de Biotecnologia, Universidade Católica Portuguesa/Porto, Rua Dr. António Bernardino Almeida, 4200-072 Porto, Portugal;
[2]Departamento de Bioactividad y Análisis de Alimentos. Instituto de Investigación en Ciencias de la Alimentación. CIAL (CSIC-UAM). Nicolás Cabrera 9, Campus de la Universidad Autónoma de Madrid, 28049 Madrid, Spain

E-mail: mpintado@porto.ucp.pt

Keywords: chitosan derivative, Maillard Reaction, Structural Characterization

Abstract

Several strategies have been applied in order to expand the functional properties of chitosan and its applicability. One of the most successful is the introduction of hydrophilic residues in the chitosan molecule via formation of covalent bonds with the reactive amino groups that may provide it higher solubility (allowing application in more diverse food matrices) and more functional properties, namely prebiotic activity (allowing the development of new functional foods). The Maillard reaction is one of the most important used reactions. Several authors have carried out this kind of chitosan modification obtaining new derivatives with better functional properties. For that, the aim of this work was to optimize the synthesis of a chitosan (Chit)-glucose (Glc) derivative by the Maillard reaction as well as to carry out a complete structural characterization of the obtained derivative.

Reaction conditions, evaluating the extent of the Maillard reaction, were optimized by varying temperature (40-80 °C), Glc concentration, and reaction time (0-72 h). Assessment of the reaction extent was carried out by measurements of absorbance and fluorescence. Structural characterization of the derivative was performed by different methodologies in order to determine the molecular weight (Mw) of the derivative, the degree of substitution (DS) and, to confirm the structure of the new derivative, a colloid titration method, High-Performance Liquid Chromatography-Size Exclusion Chromatography (HPLC-SEC), Fourier Transform Infrared Spectroscopy (FT-IR) and Proton Nuclear Magnetic Resonance (1H-NMR) were used.

The results obtained, regarding the extent of the reaction, allowed to determine the optimal conditions being: 2% (w/v) of chitosan, 2% (w/v) of Glc, 60 °C and 32 h of reaction time. Structural characterization confirmed the successful introduction of the glucose into the chitosan molecule obtaining a Chit-Glc derivative with a Mw of 76 ±4.25 and a DS of 64.76 ±4.40 %.

Acknowledgements: The authors B. Gullón and A. Cardelle-Cobas acknowledge the Fundação para a Ciência e Tecnologia. (FCT) for financial support provided by postdoctoral fellowships (refs. SFRH/BPD/79942/2011 and SFRH/BDP/90069/2012), respectively.

Ref: 4416

Microbiological safety of yam chips, flakes and flour from selected markets in Southwest Nigeria

Celestina Ibitayo, Omohimi[1]; LO, Sanni[1]; OA, Obadina[1]; AM, Omemu[2]; LA, Abayomi[3]

[1]Food Science and Technology Department, Federal University of Agriculture, Abeokuta, Nigeria;
[2]Hospitality and Toursim Management, Federal University of Agriculture, Abeokuta, Nigeria;
[3]Natural Resources Institute, Greenwich University, Kent, UK

E-mail: get2tina2@yahoo.com

Keywords: Food safety, yam chips, yam flakes, yam flour, pathogenic microorganisms

Abstract

Food quality and safety is an increasingly important public health issue. The aim of this study was to assess the microbial contamination of traditional yam chips (gbodo), flakes (kunube) and flour (elubo) sold in some selected markets in Southwest Nigeria. Samples were procured in three batches of sixteen (16) samples per batch between the months of May, 2013 to Jan., 2014. Analysis on the microbial load of the samples was carried out and further morphological characterization of the fungi isolates with the use of standard procedures. The standard plate count revealed that for Total viable bacteria, Coliform, Staphylococcus and Fungi, the summary of the average microbial loads for yam chips range from $2x10^7$ to $7.5x10^7$ $cfug^{-1}$, $6x10^5$ to $1x10^7$ $cfug^{-1}$, $5x10^5$ to $1x10^7$ $cfug^{-1}$, and $2.5x10^5$ to $4x10^7$ $cfug^{-1}$, respectively. For the yam flakes, values ranging between $2x10^7$ and $1.1x10^8$ $cfug^{-1}$, $8x10^5$ and $3.3x10^7$ $cfug^{-1}$, $3x10^5$ and $1x10^7$ $cfug^{-1}$, and $3x10^5$ and $8.5x10^7$ $cfug^{-1}$, while $1.1x10^6$ to $1.2x10^8$ $cfug^{-1}$, $1.1x10^6$ to $6.5x10^7$ $cfug^{-1}$, $3.5x10^5$ to $2.5x10^7$ $cfug^{-1}$ and $3x10^5$ to $6x10^7$ $cfug^{-1}$ were obtained for yam flour respectively. However, colonies of *Salmonella* and *Shigela* were not detected in any of the samples. Further examination revealed the isolation of *Aspergillus flavus*, *Aspergillus niger*, *Aspergillus fumigatus, Penicillum vericosum, Penicilum marneffei, Mucor species, Fusarium species and Alternaria*, with the predominance of *Aspergillus niger* and *flavus* which are possible mycotoxin producing organisms.

Acknowledgements: The work presented here was financially supported by the Gratitude project (FP7/KBBE.2011.2.5-02).

Ref: 4417

Effect of different processing methods on the functional properties, pasting characteristics and hydrogen cyanide content of high quality cassava flour

K. F, Owolabi[1]; LO, Sanni[1]; OP, Sobukola[1]; MO, Adegunwa[2]

[1]Food Science and Technology Department, Federal University of Agriculture, Abeokuta, Nigeria; [2]Hospitality and Toursim Department, Federal University of Agriculture, Abeokuta, Nigeria

E-mail: sannilateef5@gmail.com

Keywords: High quality cassava flour, chipping, grating, drying methods

Abstract

It was hypothesized that the functional and pasting properties of high quality cassava flour (HQCF) in any food system is a function of the size reduction process and drying methods used. To this end, fresh cassava roots were subjected to two-size reduction process (chipping and grating) and five drying methods viz. sun, oven, cabinet, hybrid-solar and flash drying for the production of HQCF, although the chipped cassava samples were not flash dried. The effects of size reduction processes and drying methods on the functional properties, pasting characteristics and hydrogen cyanide (HCN) content of HQCF were investigated. The result showed that the drying methods have significant effect ($p>0.05$) on all the functional properties except water absorption capacity (WAC) and wettability. Wettability is also the only parameter that is not significantly affected ($p>0.05$) by the size reduction process. Cabinet drying after grating produced HQCF of higher dispersibility; oven drying after chipping and grating gave HQCF of higher WAC and bulk density respectively while hybrid solar and sun drying after chipping had higher wettability and oil absorption capacity correspondingly. Grated oven dried HQCF had higher trough viscosity; grated solar dried HQCF had higher peak and final viscosities while that of the control sample had higher breakdown viscosity. However, all the HQCF could be cooked into paste below the temperature of water for less than 5 min. Values obtained for HCN of all the HQCF samples ranged between 0.24 mg HCN/ kg and 5.88 mg HCN/ kg; which are lower than the WHO recommended permitted level of 10 mg HCN/ kg for floury foods. Therefore, the functional and pasting behaviour of HQCF depends on the type of size reduction process and drying methods used during production.

Acknowledgements: The work presented here was financially supported by the Gratitude project (FP7/KBBE.2011.2.5-02).

Ref: 4418

Varietal effect on the functional and chemical properties of cassava starch-based custard powder supplemented with whole egg powder

W, Awoyale[1]; TA, Shittu[2]; MO, Adegunwa[3]; LO, Sanni[2]

[1]Food, Agriculture and BioEngineering Department, Kwara State University, Nigeria;
[2]Food Science and Technology Department, Federal University of Agriculture, Abeokuta, Nigeria;
[3]Hospitality and Tourism Management Department, Federal University of Agriculture, Abeokuta, Nigeria

E-mail: sannilateef5@gmail.com

Keywords: Functional; chemical; cassava starch; whole egg powder; supplementation; custard powder

Abstract

The functional and chemical properties of cassava starch-based custard powder (CbCP) produced from different yellow-fleshed cassava root starch (YfCRS) (90-98%) supplemented with whole egg powder (WEP) (2-10%) were investigated. The blends were determined using response surface methodology, and separately packaged in a polyethylene bag prior to analyses. The result revealed that the functional, pasting and chemical properties of the CbCP were significantly (P≤0.001) affected by the cassava varieties (except solubility index), blend ratios and the interactions between the cassava varieties and blend ratios (except for amylose, starch and hydrogen cyanide contents). The CbCP produced from TMS06/1630 YfCRS had higher setback viscosity, pasting temperature and all the functional properties except for water absorption capacity (WAC), which was highest in TMS01/1371 YfCRS custard powder. The peak, trough and final viscosities were also higher in TMS01/1371 YfCRS custard powder, while the breakdown viscosity was higher in that of TMS01/1368 YfCRS. The WAC, swelling power (SWP) and solubility index (SI) of the CbCP increased with WEP supplementation, while the dispersibility, bulk density and all the pasting properties decreased. The custard powder produced from TMS01/1371 YfCRS had higher protein, carbohydrate and total energy contents; TMS01/1368 YfCRS had higher moisture, starch, hydrogen cyanide and β-carotene contents while that of TMS06/1630 YfCRS had higher pH value, ash, fat and, iron and zinc contents. In addition, the WAC, swelling power, solubility index, protein, ash, fat and, the iron and zinc contents of the CbCP increased with WEP supplementation, while the dispersibility, bulk density, pasting properties, carbohydrate, total energy and β-carotene contents decreased. Therefore, the quality of any CbCP depends on the cassava variety used and the level of WEP supplementation.

Ref: 6484

Microencapsulation of propolis by spray drying using chitosan, arabic gum and inulin as wall materials

Penim, D.; Beijoca,M.; Moldão-Martins, M.; Januário, I.; Beirão da Costa, L.; Alves, V. D.

CEER-Centro de Engenharia dos Biossistemas, Instituto Superior de Agronomia, Universidade de Lisboa, Lisboa, Portugal, vitoralves@isa.ulisboa.pt

E-mail: vitoralves@isa.utl.pt

Abstract

Propolis, a resinous material produced by bees, has been referred to present a wide range of bioactive properties, such as antioxidant, antibacterial, antifungal, antiviral, anti-inflammatory and antitumor activities. As such. propolis has the potential to be used in the food industry [1]. However, it presents a strong and unpleasant taste. As so, it is expected that propolis encapsulation will enable its incorporation in food systems taking advantage of its bioactivity, without affecting negatively the products sensory properties.

In the present work, the encapsulation of propolis was performed by spray drying using chitosan, arabic gum and inulin as encapsulating matrices. The polymers concentration in water and the drying temperatures were selected based in previous studies [2-4] as follows: chitosan (2% w/w), T = 170^{o}C; arabic gum (20% w/w), T= 170^{o}C and inulin (10% w/w), T= 190^{o}C. In the case of chitosan, the encapsulation was also carried out using citric acid or tripolyphosphate as crosslinkers. In all cases, the mass ratio of propolis/encapsulating material was 20%.

The loading of propolis in the microparticles was expressed as total phenolic content (TPC) and had an average value of 5% (mass of TPC/mass of particles). The release studies were carried in aqueous acidic (pH=1.2) and neutral (pH=6.8) media. It was observed that the different matrices studied presented different releasing properties. Except for chitosan with citric acid, there was a release of the overall TPC encapsulated at pH=6.8, and a substancial retention of those compounds at pH=1.2. The release profile from arabic gum was very differentiated from the other matrices: it was higher at neutral conditions and much lower at pH=1.2.

Further studies are envisaged in terms of sensory analysis of model food systems with added microencapsulates, in order determine the maximum amount accepted, and evaluate the correspondent antioxidant and antimicrobial activities.

Acknowledgements: This work was supported by Fundação para a Ciência e Tecnologia (FC&T), Portugal, through project PTDC/AGR-ALI/114706/2009 – “New edible bioactive coatings for the improvement of food products quality”.

References:

[1] Moreira, L., Dias, L., Pereira, J., Estevinho, L., Food and Chemical Toxicology, 2008, 46, 3482.
[2] He, P., Davis, S., Illum, L., International Journal of Pharmaceutics, 1999, 187, 53 – 65.
[3] Ribeiro C., Encapsulamento de Aromas alimentares, Tese de Doutoramento, ISA/UTL, 2007
[4] Costa, S., et al, Journal of Food Engineering, 2012, 110, 190 – 199

Ref: 6485

Using FucoPol as encapsulation matrix of antioxidants by spray drying

Lourenço, S.[1], Torres, C. A. V.[2]; Freitas, F.[2] ; Reis, M. A. M[2]; Fortunato, E.[3]; Nunes, D.[3]; Duarte, P[3]; Beirão da Costa, L.[1]; Alves, V. D.[1]

[1]CEER-Centro de Engenharia dos Biossistemas, Instituto Superior de Agronomia, Universidade de Lisboa, Lisboa, Portugal;
[2]REQUIMTE/CQFB, Chemistry Department, FCT/Universidade Nova de Lisboa, Caparica, Portugal;
[3]CENIMAT/I3N, Departamento de Ciência dos Materiais, Faculdade de Ciências e Tecnologia, FCT, Universidade Nova de Lisboa and CEMOP/UNINOVA, 2829-516 Caparica, Portugal.

E-mail: vitoralves@isa.utl.pt

Abstract

Some bioactive compounds used in the food industry are unstable when subjected to industrial processing and to conditions of transport and storage with negative impact. The encapsulation process has been studied as a way of protecting such compounds. The most widely applied process for microencapsulation of food bioactives is spray drying, using a wide range of encapsulating matrices such as polysaccharides (e.g. starch, arabic gum and acacia gum) and proteins (e.g. gelatine and milk proteins). These materials were used to encapsulate a variety of food ingredients, such as antioxidants, lipids, essential oils and vitamins [1, 2].
The present study is focused in assessing the potential of a microbial exopolysaccharide named FucoPol to function as encapsulation matrix. This biopolymer is produced by the bacterium *Enterobacter* A47 *(*DSM 23139*)* using glycerol as the sole carbon source. It is a high molecular weight ($4.19 \times 10^6 - 5.80 \times 10^6$) heteropolysaccharide composed of sugar residues (fucose, galactose, glucose and glucuronic acid) and acyl groups (pyruvate, succinate and acetate) [3].
In order to select the best conditions to produce microparticles by the spray drying process, a central composite design with three independent variables was applied: FucoPol concentration (1% - 2% w/w), drying temperature (150°C - 200°C) and feed temperature (20°C - 70°C). The particles were characterized in terms of morphology, size distribution (Scanning Electron Microscopy), and crystallinity (X-Ray diffraction).
Selected operating conditions were applied to encapsulate two model compounds (gallic acid and oregano essential oil), and their release kinetics was evaluated in aqueous media with different pH values. The results have shown that FucoPol is able to produce microcapsules and act as wall material to encapsulate the antioxidant compounds tested. FucoPol has a good potential to be explored to produce microparticles with designed properties presenting specific release rates of the microencapsulated materials.

Acknowledgements: This work was supported by Fundação para a Ciência e Tecnologia (FC&T), Portugal, through projects PEst-C/EQB/LA0006/2013 and PTDC/AGR-ALI/114706/2009

– “New edible bioactive coatings for the improvement of food products quality”. Cristiana A. V. Torres and Filomena Freitas acknowledge FCT&T for Post-Doctoral fellowships SFRH/BPD/87774/2012 and SFRH/BPD/72280/2010.

References:

[1] A. Gharsallaoui, G. Roudaut, O. Chambin, A. Voilley, R. Saurel, Food Research International, 2007, 40, 1107-1121.

[2] S. Beirão da Costa, C. Duarte, A.I. Bourbon, A.C. Pinheiro, A.T. Serra, M. Moldão Martins, M.I.N. Januário, A.A. Vicente, I Delgadillo, C. Duarte, M.L. Beirão da Costa, Journal of Food Engineering, 2012, 110, 190–199

[3] F. Freitas, V.D. Alves, C.A.V. Torres, M. Cruz, I. Sousa, M.J. Melo, A.M. Ramos, M.A.M. Reis, Carbohydrate Polymers, 2011, 83, 159-165.

Ref: 6487

Bioencapsulaton of *Lactobacillus Casei* Shirota using different wall materials and capsule properties

Osman GUL[1], Muhammet DERVISOGLU[2]

[1] Program of Food Technology, Yesilyurt Demir Çelik Vocational School, Ondokuz Mayis University, Samsun 55330, Turkey
[2] Department of Food Engineering, Engineering Faculty, Ondokuz Mayis University, 55319 Samsun, Turkey

E-mail: osman.gul@omu.edu.tr; mderviso@omu.edu.tr

Keywords: Bioencapsulation, Alginate, Starch, Gelatin, *L. casei* Shirota (LCS), Survival

Abstract

This study was conducted to evaluate the physical properties of probiotic *Lactobacillus lactis* strain Shirota (LCS) bioencapsulated by extrusion technique using wall materials included alginate (1.5%, w/v), alginate – starch (1.5% – 0.5%, w/v) or alginate – gelatin (1.5% – 0.5%, w/v) mixtureand to determine the resistant of free and encapsulated probiotic to simulated gastrointestinal conditions. Initial cells were adjusted to ~10^{10} CFU/mL and capsules were prepared using a peristaltic pump with a 22S syringe needle (0.16 mm) at 6 mL/min flow rate. The size of capsules were changed significantly used different wall materials which alginate – starch capsule size (1.35 mm) was found smaller than the others ($p<0.05$). The release of viable cells from capsules in phosphate buffer solution for 2 h were significantly increased when used starch or gelatin together with alginate ($p<0.05$). While viable cell entrapped alginate – gelatin was completely released after 2 h, however, 98.15% for alginate – starch and 92.73% for alginate of entrapped viable cells were released under same conditions. The free cells were completely destroyed in simulated gastric juice at pH 2 after 2 h whereas encapsulated cells using alginate, alginate – starch, and alginate – gelatin registered 4.73, 2.09 and 1.93 log cycle reduction, respectively. When encapsulated probiotic with different wall materials was subjected to simulated intestinal juice (pH 7.2) for 2 h, there was significant increase ($p<0.05$) in viable cell counts compared to the free cells. Bioencapsulation using starch or gelatin with alginate provided greater protection than using only alginate against intestinal juice ($p>0.05$). In general, bioencapsulationof LCS using alginate with starch was found the most effective when considered capsule size, controlled releaseand protecting cells in simulated gastrointestinal conditions.

Session 2: Process and product engineering

Session 2 (Part I): Process and product engineering: Food properties generation/preservation/delivery

Session 2 (Part I): Keynote lectures

Ref: 3320

Human digestion: a processing perspective

***Boland, Mike*[1]**

[1]Riddet Institute, New Zealand

E-mail: m.boland@massey.ac.nz

Keywords: Digestion, *in vitro* models, gastric digestion, intestinal digestion, microbiota, colon, oral processing

Abstract

The design of foods to ensure the proper release of nutrients and bioactive components during digestion requires first that we understand the processing the food will undergo after it is consumed. Processing of food through the gastrointestinal tract exposes it to a range of mechanical, chemical and enzymatic processes in a sequential range of processing environments as it passes through the tract. This presentation will give an overview of these processing environments in the oral, gastric, small intestinal and colon compartments. It will discuss ways of modelling the different parts of the gastrointestinal tract and will describe ways of investigating the physicochemical biological and microstructural changes in food substances as a consequence of this processing, both *in vitro* and *in vivo*.

Acknowledgements: I would like acknowledge support from COST FA1001, the Dumont d'Urville NZ-France Science & Technology Support Programme (PHC DUMONT D'URVILLE 2014 PROJET N° 29817SB), INRA de Thiex, CoRE Funding from the New Zealand Tertiary Education Commission and funding from the New Zealand Ministry of Business Innovation and Employment.

Session 2 (Part I): Oral Presentations

Ref: 4367

Oxidation of encapsulated camelina oil

Adal, Eda[1]; Moilanen, Henna[2]; Rocchi, Elisa[3]; Damerau, Annelie[2]; Lampi, Anna-Maija[2]; Piironen, Vieno[2]; Piazza, Laura[3]; Jouppila, Kirsi[2]

[1]University of Gaziantep, Turkey;
[2]University of Helsinki, Finland;
[3]University of Milan, Italy

E-mail: adal@gantep.edu.tr

Keywords: oxidation, encapsulation, spray drying, emulsion

Abstract

Omega-3 rich oils are gaining increased attention because of the health benefits related to cardiovascular diseases prevention. Camelina (*Camelina sativa*) oil is polyunsaturated oil that contains high levels of α-linolenic acids (C18:3ω3). These fatty acids are easily oxidized upon exposure to air, light, transition metals, or heat during food processing. Such easily oxidized oils can be protected using microencapsulation. The aim of this study was to evaluate the potential of different mixtures of maltodextrin (MD; DE 19.2) and whey protein isolate (WPI) as wall material in microencapsulation of camelina oil by spray drying. The WPIMD ratios of 1:1, 1:3 and 1:9 were used. The oil-wall material ratio used was 1:2.5. Emulsions were prepared using high pressure homogenisator and characterized for stability and viscosity. Emulsions were spray-dried and the powders obtained were rehumidified at relative humidities (RH) of 11 and 44% at room temperature. Rehumidified samples were stored at 40 °C for 2, 4, 6, 8 and 10 weeks before analysis of the volatile profile by HS-SPME-GC-MS. Production of hexanal was found to increase as content of MD increased in wall material. Similar trend was observed with production of hexanoic acid. RH used in rehumidification did not affect the production of hexanal or hexanoic acid. The best protection of camelina oil was achieved with the mixture containing 50% WPI and 50% MD. The results of the present study showed that composition of wall material used in microencapsulation of easily oxidized oil affects storage stability of encapsulated oil.

Acknowledgements: COST Action FA1001 is acknowledged for funding this research through a STSM.

Ref: 5482

Nanoemulsions obtained via bubble-bursting at a compound interface

Feng, Jie[1]; Roché, Matthieu[1]; Vigolo, Daniele[1]; Arnaudov, Luben N.[2]; Stoyanov, Simeon D.[2,3,4]; Gurkov, Theodor D.[5]; Tsutsumanova, Gichka G.[6]; Stone, Howard A.[1]

[1] Department of Mechanical and Aerospace Engineering, Princeton University, Princeton, USA;
[2]Unilever Research and Development, Vlaardingen, The Netherlands;
[3]Laboratory of Physical Chemistry and Colloid Science, Wageningen Uni, The Netherlands;
[4]Department of Mechanical Engineering, University College London, UK;
[5]Department of Chemical Engineering, Faculty of Chemistry, University of Sofia, Bulgaria;
[6]Department of Solid State Physics, Faculty of Physics, University of Sofia, Bulgaria

E-mail: Simeon.Stoyanov@unilever.com

Abstract

Bursting of bubbles at an air/liquid interface is a familiar occurrence relevant to foam stability, cell cultures in bioreactors and ocean–atmosphere mass transfer. In the latter case, bubble-bursting leads to the dispersal of sea-water aerosols in the surrounding air. Here we show that bubbles bursting at a compound air/oil/water-with-surfactant interface can disperse submicrometre oil droplets in water.

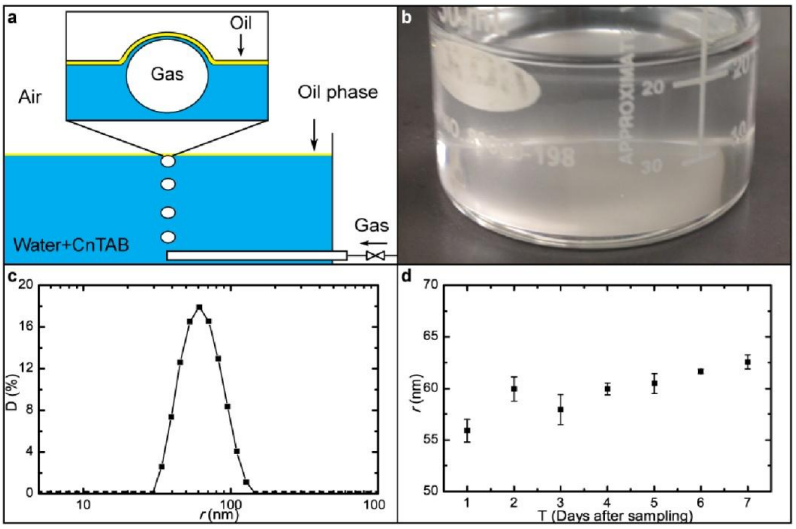

Figure 1. (a) Sketch of the experimental system. Inset: close-up of the deformed compound interface; (b) Image of the translucent aqueous phase after bubbling for 48; (c) Size distribution of the oil; (d) Time evolution of nano droplets size in the same sample shown in Fig. 1c over a week.

Dispersal results from the detachment of an oil spray from the bottom of the bubble towards water during bubble collapse. We provide evidence that droplet size is selected by physicochemical interactions between oil molecules and the surfactants rather than by hydrodynamics. We demonstrate the unrecognized role that this dispersal mechanism may play in the fate of the sea surface microlayer and of pollutant spills by dispersing petroleum in the water column. Finally, our system provides an energy-e cient route, with potential upscalability, for applications in drug delivery, food production and materials science.

References:

Jie Feng, Matthieu Roché, Daniele Vigolo, Luben N. Arnaudov, Simeon D. Stoyanov, Theodor D. Gurkov, Gichka G. Tsutsumanova and Howard A. Stone. 2014. “Nanoemulsions obtained via bubble bursting at a compound interface", Nature Physics, 10, 606–612.

Jens Eggers. 2014. “Getting the drops in", Nature Physics, 10, 548–549.

Luben N. Arnaudov, Simeon D. Stoyanov, Martien A. Cohen Stuart. 2008. “Colloid fabrication by co-extrusion”, Colloids and Surfaces A: Physicochem. Eng. Aspects, 323, 94–98.

Ref: 3274

Design of bread structure and its influence on human oral processing

Gao, Jing[1]; Henry, Jeyakumar[2]; Wong, Jocelyn Xueyan[1]; Zhou, Weibiao[1]

[1]Food Science and Technology Programme, c/o Department of Chemistry, National University of Singapore;
[2]Clinical Nutrition Research Center, Singapore Institute of Clinical Science

E-mail: chmzwb@nus.edu.sg

Keywords: bread, micro structure, oral processing, digestion

Abstract

There is an increasing awareness of the link between food structure and human digestion. Bread, one of the most commonly consumed staple foods, is a good example of food product with a complex micro structure and in general, also a high glycemic index (GI). Many studies have been conducted trying to reduce the glycemic impact of bread by incorporating low GI ingredients; however limit attention has been drawn to the possibility of achieving it through manipulating bread micro structure. This study aimed to understand the relationship between bread structure and human oral processing which is the first interaction between food and human digestive tract. Three types of bread were produced, namely baguette, baked bread and steamed bread. Baguette was proofed and baked for longest duration, while steamed bread was subjected to the shortest proofing time and the mildest thermal treatment. 2D image analysis and 3D micro-tomography analysis showed that baguette had the most porous crumb with largest pore size among the three. There was a good correlation between crumb grain structure and bread texture. The results suggest that distinctly different crumb grain structures can be designed by varying processing conditions only. Oral processing of 14 trained panelists was monitored using surface electromyography (sEMG). All the panelists adapted their chewing behavior according to bread type. Despite of its most porous and softest crumb, baguette required the highest muscle activity and longest masticatory cycles. The greater chewing effort resulted in a higher level of saliva impregnation and smaller particle size in baguette bolus as compared to baked bread and steamed bread. This may be explained by the large portion of dry and hard crust of baguette sample. Therefore, two important factors should be taken into consideration when designing bread structure, i.e. the porosity of its crumb and the relative ratio of its crust. In this study, crust was identified as a predominant factor in determining the masticatory performance of human subjects.

Acknowledgements: A*STAR grant SERC 112 177 0033 is gratefully acknowledged.

Ref: 3284

Protein enriched pasta: impact of protein network structure on the *in-vitro* protein digestibility

Laleg, Karima[1]; Barron, Cécile[2]; Cassan, Denis[2]; Walrand, Stéphane[3]; Micard, Valérie[1]

[1]SupAgro - INRA - IATE – Montpellier, France;
[2]INRA – IATE, France;
[3]INRA, France

E-mail: micard@supagro.inra.fr

Keywords: Pasta structure, amino acid profile, egg white, faba bean, gluten, protein network, rheology, microstructure, SE-HPLC, FTIR, *in vitro* protein digestibility

Abstract

Pasta, a traditional and highly popular cereal-based food, is produced with durum wheat semolina. It contains 13% (db) of proteins, but is deficient in some amino acids.
Protein enriched (17%) pasta with better amino acid profile were produced using 35% faba bean flour or 5% egg white powder. The impact of pasta enrichment on the structuration of their protein network was studied from the macro to the supramolecular scales against two pasta controls: classical 100% durum wheat pasta (13% protein) and wheat gluten enriched pasta (17% protein). Pasta is traditionally obtained after kneading, extruding and drying steps. Different temperature barrels can be used in industry. The effect of such drying temperature on the protein network structuration was studied using low (55 °C) or very high temperature (90 °C) on all enriched and control pasta. Changes in dried and cooked pasta structure were monitored by rheological, microscopic, SE-HPLC and FTIR methods and linked to *in vitro* protein digestibility of cooked pasta
Different structural changes were detected in pasta especially at the macroscopic and supramolecular scales, related to the nature of the protein source used for the enrichment. The gluten and egg white enriched pasta presented a strengthened structure due to their high covalently linked protein network, unlike faba bean enriched pasta which presented a weakly bounded protein network. This variability in pasta matrix structure may impact the protein digestibility of cooked pasta. Protein conformation (β-sheet and β-turns) was highly related to the amino acid content of the raw mater used for enrichment. Rising temperature induced a fortification of pasta structure, notably for gluten and egg pasta, by increasing the level of covalently bounded proteins and induced a higher β-sheet proportion, while decreasing α-helix structures in dried pasta. Despite these structural high temperature-induced changes, no effect on protein digestion after cooking pasta was observed.

Acknowledgements: K. Laleg funding was provided by the « Région Auvergne ». This study was undertaken with the financial support of the « Institut Carnot Qualiment » as part of the Vegage project, entitled « Rate of digestion and nutritional value of vegetable protein sources on nitrogen retention and protein metabolism during aging ». Gemef and Syral industries are thanked for kindly providing faba bean flour and wheat gluten. The authors thank J. Bonicel (UMR IATE-Montpellier) for skilfultechnical assistance.

Session 2 (Part II): Process and product engineering: Designing innovative everyday foods

Session 2 (Part II): Keynote lectures

Ref: 5431

Process innovations in designing foods with enhanced nutritional properties

***Martín-Belloso, Olga*[1]**

[1]University of Lleida, Spain

E-mail: omartin@tecal.udl.cat

Abstract

Non thermal food processing technologies are gaining relevance in the food industrial sector, since they allow attaining shelf life stability while better keeping, or even enhancing, the nutritional value of raw materials, in comparison with foods processed by using conventional thermal treatments.

This presentation will focus on different aspects dealing with the design of food products through the implementation of innovative approaches. First, principles of the application of emerging non thermal processing technologies for obtaining nutritious food products will be introduced and selected examples will be presented. On the other hand, innovative packaging strategies with a positive impact on the nutritious value of food products will be highlighted. Namely, the potential of edible coatings as a mean of incorporating and deliver bioactive ingredients to food matrices will be analyzed. Examples of nanoemulsion-based coating applications developed for different food products, as well as, the beneficial effects of their use on the bioactive composition of foods and their bioaccessibility will be presented and discussed.

Integration of these technologies is critical for the development of healthy novel food products that capture the interest of consumers. However, issues related to the harmonization of food regulations and the overcoming of technical challenges for each key technology will have to be addressed in due course.

Ref: 5435

Structure-sensory properties relationship and consumer perception as a criterion for process design

***Iordachescu, Gabriela*[1]**

[1]Dunărea de Jos University, Faculty of Food Science and Engineering, Romania

E-mail: gabriela.iordachescu@ugal.ro

Keywords: Structure, sensory, consumer, process design

Abstract

The food quality must adapt to consumers' demands. This is especially true when talking about the development of new raw material use, the new processing and traceability techniques and the investigation methods which are increasingly accurate, reaching to the nano level. Some years ago the consumer was guided mostly by sensorial component of food quality. Now the consumers are more informed about food safety, nutrition sensory and convineince aspects. They can access information about the cheese, ice cream, sparkling water, dressing or cookies that they eat in every moment of the day. And of course they start to think of needs, acceptance and pleasure. As part of sensorial food quality the structure is linked to the consumer's age, gender, religion, diet, allergies, intollerances (gluten free products, lactose free products) etc. The food structure regardless of the level (macro, micro, nano) plays an important role being imparted by nature and/or by processing. The food technology, research and development must offer the products smooth, foamy, crunchy, and palatable for all the consumers' types and linked to the image created by the product. The portion size, texture tolerance, contrast, combinations, texture for foodies, picky/fussy eaters are challanges for the product and process design.

Acknowledgements: The support of COST through Action FA 1001 is gratefully acknowledged.

Session 2 (Part II): Oral Presentations

Ref: 3310

Unidirectional ice growth for preparation of porous structures

Yasunsky, Victor[2]; Roth, Sigal[1]; Lapidot, Shaul[1]; Shoseyov, Oded[2]; Braslavsky, Ido[2]

[1]Melodea Ltd., Israel;
[2]Robert H. Smith Faculty of Agriculture, Food and Environment, The Hebrew University of Jerusalm, Israel

E-mail: ido.braslavsky@mail.huji.ac.il

Keywords: Unidirectional growth, porous structures, ice templating

Abstract

Ice templating, which is also known as freeze-casting, takes advantage over controlled ice growth to introduce microstructure into second material that dispersed/dissolved in water. This method allows fine control of the porous microstructure and in principle can be replicated over several length scales. Here we focus on cellulose, the primary structural component of plants, eco-friendly and most widespread bio-material on the planet. Using acid hydrolysis we extract nano-crystalline cellulose particles from the raw cellulose. Cooling of nano-crystalline water solution at constant rate and with unidirectional temperature gradient results in formation of ice platelets oriented in parallel to temperature gradient direction with nano-crystalline cellulose particles entrapped in between. Followed by ice removal by sublimation or exchange we obtain an inverse ice-replica of self-assembled nano-crystalline cellulose porous scaffold. We show that control of freezing rate allows controlling the microstructure of the scaffold and makes this approach very attractive for various applications such as material and food engineering.

Acknowledgements: We acknowledge support from European Community Seventh Framework Program, grant number FP7/604003, http://www.ncc-foam.eu/.

Ref: 3289

Crystallisation of high concentrated sucrose systems

Wang, R.[1]; Gouseti, O.[1]; Lopez-Quiroga, E.[1]; Fryer, P.J.[1]; Bakalis, S.[1]

[1]University of Birmingham, United Kingdom

E-mail: s.bakalis@bham.ac.uk

Keywords: crystallisation, high concentrated sucrose

Abstract

Controlling crystallisation phenomena during processes such as freezing or freeze-drying is critical for the determination of microstructure and final quality of food products. As food manufacturing increasingly demands handling of highly concentrated systems, crystallisation control becomes increasingly difficult. The upcoming challenges therefore rely not only in developing successful processing protocols but also in understanding the insights of these systems.

In the present work, ice crystal formation has been experimentally studied for sucrose solutions at a range of concentrations (20-70% wt/wt) and cooling conditions using DSC and cryo-XRD. The degree of crystallisation showed significant reduction (up to 75%) on increasing sucrose content from 20 to 50%. At high solids content (>60%) homogeneous crystallisation was not observed during freezing and crystal formation (XRD peaks characteristic of ice crystals) only occurred during subsequent heating of the systems at temperatures close to the melting temperature (-35 °C). Seeding with ice crystals was further studied using optical microscopy and showed enhancement of crystallisation processes in concentrated systems (70%).

In order to provide a better comprehension of the process behaviour, a first principles-based model coupling crystallization kinetics (nucleation and growth) together with a PDE-phase-change heat transfer problem has been developed. This multiscale model will be employed as the core of a control scheme to be employed in the design of targeted product microstructure and optimisation (minimisation of energy consumption) of food industry standards for processes carried out at higher solids fractions than conventionally used (solids concentration above 60%).

Overall, results demonstrate the difficulties associated with crystallisation of industrially relevant, highly concentrated systems and the need for different approaches.

Acknowledgements: This work forms part of the National Centre for Sustainable Energy Use in Food Chains (CSEF), a new RCUK involving the Universities of Brunel, Manchester and Birmingham, together with a wide range of retailers and manufacturers.

Ref: 3246

Development of model particles representing relevant textural properties of soft food

***Schmitt, Christian*[1]*; Hensel, Oliver*[2]*; Grupa, Uwe*[1]

[1]University of Applied Science Fulda, Germany;
[2]University Kassel, Germany

E-mail: christian.schmitt@lt.hs-fulda.de

Keywords: texture model, particle in gels, agar pectin gel, pendulum test, uniaxial compression test

Abstract

The determination of changes of food properties simply by observing their behavior in processing plants is not sufficient for research purposes because of high variation of relevant textural characteristics and the limited transfer of results to other food. By using models for food these problems are solved. In production plants processing of soft food (e.g. cooked vegetables, fruits) is critical because of their sensibility to damages, especially breaking. The aim of this study is the development of model particles representing the texture of soft food to enable the testing of their behavior in processing plants.
The desired texture is defined based on a cluster analysis. Textural parameters are a derived value of breaking energy (high peed pendulum test) and breaking strength/strain (low speed uniaxial compression test). Hydrocolloid gels are used for creating the model particles. Based on literature-review and preliminary trials three approaches are tested: a) mixtures of gelatin and agar by using the miscibility gap, b) particles in a gel matrix and c) combinations of agar and pectin.
Getting closer to the miscibility gap for mixtures of gelatin and agar, gels are too elastic and are not suitable as model particles. Small amount of hydrophilic particles (cellulose, starch, silica) in agar gels result in increasing breaking strength. However, higher concentrations reduce the breaking strength despite constant breaking strain and energy. Furthermore, hydrophobic particles (coffee powder) yield in similar results except for decreasing elasticity with increasing concentration. Although hydrophobic particles in agar gels show low potential, gels with particles are not recommendable as model particles. Higher concentrations of pectin in agar gels decrease all measured textural values. Additionally sodium chloride in pectin agar gels further reduces the textural parameters and results in the desired texture.
With the combination of agar, pectin and sodium chloride a model for soft food for testing in processing plants can be created.

Ref: 3233

Encapsulation of catechins in different delivery systems

Istenic, Katja[1]; Skrt, Mihaela[1]; Bele, Marjan[2]; Poklar Ulrih, Natasa[1]

[1]Biotechnical Faculty, University of Ljubljana, Slovenia;
[2]National Chemical Institute, Slovenia

E-mail: natasa.poklar@bf.uni-lj.si

Keywords: delivery systems, microcapsules, catechins

Abstract

Catechins are the main group of flavonoids found in green tea. Due to their antioxidant, antimicrobial, cardioprotective and anticancerogenic activity their consumption has numerous positive effects on human health. Furthermore as food additives they have a potential to replace synthetic antioxidants and preservatives. Activity and beneficial effects of catechins strongly depend on their bioavailability and stability at different environmental conditions during food processing (temperature, oxygen and light) and during digestion in gastrointestinal tract (pH, enzymes and other nutrients). Microencapsulation has shown to be an effective protection system for bioactive compounds. One of the most widely used method for preparation of microcapsules is extrusion of matrix polymer through vibrating nozzle. The vibration causes the liquid jet to break up into equally sized droplets that fall into a gelling bath where they polymerize. Using this technique epigallocatechin gallate (EGCG) was encapsulated into alginate and chitosan microbeads reinforced by additional chitosan or alginate membrane respectively. Due to the high porosity of the polysaccharide matrices the systems were not efficient for encapsulation of EGCG. In order to improve the encapsulation efficiency EGCG was encapsulated in lecithin proliposomes prior the encapsulation in polysaccharide matrix. Chitosan and alginate microbeads entrapping EGCG loaded proliposomes were prepared by extrusion technique and the morphology and size of the particles were characterized using light microscopy. The encapsulation efficiency was determined by measuring the concentration of EGCG in the gelling bath using HPLC and was found to be >70%. Release rate of EGCG was tested at different pH values for prolonged time period and the stability of the entrapped EGCG was determined by disrupting the microbeads by sonication and subsequently dissolving the proliposomes in methanol:chloroform mixture. The efficiency of the microcapsules in protecting EGCG from adverse environmental conditions was estimated by measuring the concentration of encapsulated and non-encapsulated EGCG overtime.

Acknowledgements: We would like to thank the COST action FA1001 and Ministry of Education, Science and Sport, Republic of Slovenia (Program P4-0121) for financial support.

Session 2: Poster Presentations

Ref: 3209

Addition of canola oil, selenium and vitamin in cattle ration and quality of meat and their effects on human health and nutrition

***Zanetti, Marcus*[1]; *Correa, Lisia*[1]; *Saran Netto, Arlindo*[1]; *Cunha, José Aparecido*[1]; *Santana, Roberta*[1]**

[1]University of São Paulo (USP), Faculdade de Zootecnia e Engenharia de Alimentos da, Departamento de Zootecnia, Campus Pirassununga, Brazil

E-mail: mzanetti@usp.br

Keywords: cholesterol, human nutrition, healthy meat

Abstract

In many areas of world and in Brazil, there is selenium deficiency and one of the ways of supplementing the human diet is enriching the products of animal origin, such as meat and milk. With respect to the meat, there is a concern about the saturated fat and cholesterol. This study was done with the objective to study the effect of canola oil as a source of unsaturated fatty acids, combined with the effects of antioxidants selenium and vitamin E added to the diet of cattle in feedlot. It was verified the effect on meat quality and its nutritional value, and the biochemical and physiological parameters of blood from elderly fed with this modified meat. Two experiments were carried out. One of animal science, using 48 Nellore bulls, during 12 weeks in the Faculty of Animal Science and Food Engineering (FZEA) of the University of São Paulo, Brazil, Campus Pirassununga. The animals received the following treatments: control diet; control diet + vitamin E + selenium; control diet with canola oil and control diet with canola oil + Se + vit E. In the second experiment of human nutrition and health, the meat produced in the first experiment was given to 80 elderly. As a result, the selenium and vitamin E supplementation increased the levels of these antioxidants and decreased significantly the level of cholesterol in the blood and in the meat of the animals ($P < 0.05$). After three months supplying the meat for the elderly, it was observed an increase in the selenium and vitamin E and a decrease in serum cholesterol ($P < 0.05$). The production of a beef with a better profile in fatty acids, vitamins and minerals and less cholesterol content is of fundamental importance not only for the producer but also for the human healthy.

Acknowledgements: To the FAPESP for the financial support.

Ref: 3211

Comparison of batch and continuous ultrasonic emulsification

***O'Sullivan, Jonathan*[1]; *Norton, Ian*[1]**

[1]Center for Formulation Engineering, School of Chemical Engineering, University of Birmingham, Edgbaston, B15 2TT, United Kingdom

E-mail: JJO023@bham.ac.uk

Keywords: Ultrasound processing, emulsification, O/W emulsions, Tween 80, milk protein isolate, pea protein isolate

Abstract

Ultrasound processing has many applications in a wide range of sectors, yet the fundamentals of the effect of ultrasound in emulsification processes are to be fully understood. Little research has been conducted on the development of novel continuous acoustic emulsification processes, and a subsequent comparison to batch processing. O/W emulsions presented in our study were prepared using batch and continuous ultrasonic configurations.

10% rapeseed oil-in-90% water emulsions were prepared with one surfactant, Tween 80, and two proteins, milk protein isolate (MPI) and pea protein isolate (PPI), at a range of concentrations, 0.1%, 0.5%, 0.75%, 1.5% and 3%. Emulsification process conditions were varied by changing the processing time, flowrate for the continuous setup, the mass of emulsion being processed, batch size or chamber volume, and the acoustic power, and a comparison was drawn between batch and continuous processes.

Sonication of pre-emulsions reduces the droplet size due to hydrodynamic shear imparted by ultrasonic cavitations. Increasing the processing time increases the time the pre-emulsion is within the shear field further reducing the droplet size. Smaller masses of pre-emulsion being processed yield an increase in the rate of emulsion droplet breakup as the acoustic energy is dissipated more intensely through the smaller masses. The smaller volume present in the continuous setup yielded smaller droplets more efficiently by comparison to the batch configuration. Increasing the acoustic power increases the rate of droplet size reduction for both configurations presented.

In conclusion, sonication has been shown to be effective for the formation of submicron emulsions. Decreasing the mass of pre-emulsion reduces the time required to achieve the submicron droplets. Given the smaller volumes of the chambers for the continuous configuration by comparison to the masses allowed for batch processing, continuous processing allows for the generation of smaller droplets more rapidly.

Acknowledgements: The authors acknowledge Kerry Group for their sponsorship and permission to present this work. The authors also would like to acknowledge the financial support from EPRSC.

Ref: 3221

Lipid stability of rye bran extrudates during storage

***Damerau, Annelie*[1]; Lampi, Anna-Maija[1]; Piironen, Vieno[1]; Moisio, Timo[2]; Nyström, Laura[3]**

[1]University of Helsinki, P.O. Box 27, 00014 University of Helsinki, Finland;
[2]VTT Technical Research Centre of Finland, P.O. Box 1000, 02044 VTT, Finland;
[3]ETH Zurich, Schmelzbergstrasse 9, 8092 Zurich, Switzerland

E-mail: annelie.damerau@helsinki.fi

Keywords: extrusion, rye bran, lipid stability, storage

Abstract

Rye bran, a by-product in rye flour production, contains bioactive compounds and is rich in dietary fibre. Although its nutritional value is high, it has not been widely utilized in foods, because of its impact on flavour and texture. Extrusion was shown be an effective processing technique in masking intense rye flavour and creating different textured products (Heiniö et al., 2003). In extrusion a wide variety of chemical reactions, like Maillard reaction or lipid oxidation, may occur affecting the flavour and storage stability.

The aim of this study was to determine the effect of bran size and extrusion parameters on the stability of lipids in rye bran extrudates during storage. Therefore five extrudates produced either from coarse or fine rye bran at different temperatures (120 and 140 °C) and water contents (13% and 22%) were produced and stored for 8 weeks at 40 °C. The lipid stability was determined by measuring tocopherols and tocotrienols (tocols) losses by NP-HPLC, volatile formation by HS-SPME-GC-MS, and radical content by EPR.

No significant differences in radical, tocol and, volatile content and expansion rates were found for extrudates produced at different temperatures. While low water content during extrusion and smaller particle size of the rye bran were shown to facilitate expansion, and formation of volatile Maillard reaction products (mainly pyrazines and furals) and radicals. However, based on the calculated g-values (2.0113 - 2.0123) the types of radicals were similar in all extrudates. On basis of tocol degradation during storage the extrudates produced at low water content were most stable. These extrudates also showed the lowest formation of volatile lipid oxidation products. In conclusion low water content in extrusion was most beneficial for the flavour formation and expansion, and for the lipid stability of extrudates during storage.

Reference:

Heiniö et al., Lebensm.-Wiss. u. -Technol 36 (2003) 533-545.

Acknowledgements: The presenting author would like to thank the COST Action FA 1001 for funding a STSM at ETH Zurich for performing the radical measurements. Further the authors would like to thank Léa Varion for technical assistance with the tocols measurements.

Ref: 3224

Viscoelastic properties of reduced milk-fat stirred yogurt: effect of native and chemically modified starches addition as fat replacers

***Lobato-Calleros, Consuelo*[1]; *Ramírez-Santiago, César*[2]; *Vernon-Carter, E. Jaime*[3]; *Alvarez-Ramirez, José*[3]**

[1]Departamento de Preparatoria Agrícola, Universidad Autónoma Chapingo, Km 38.5 Carretera México-Texcoco, 56227 Texcoco, México;
[2]Departamento de Ingeniería Agroindustrial, Universidad Autónoma Chapingo, Km 38.5 Carretera México-Texcoco, Texcoco, 56230 México;
[3]Departamento de Ingeniería de Procesos e Hidráulica, Universidad Autónoma Metropolitana-Iztapalapa, San Rafael Atlixco 186, Vicentina, México, D.F. 09340, México.

E-mail: consuelobato@yahoo.com

Keywords: reduced milk-fat yogurt, starch

Abstract

An interesting simple alternative for formulating reduced milk-fat yogurts is to create physical building blocks (structural elements) within the continuous phase that may substitute the functionality of the removed milk-fat. The use of native and modified starches as fillers, or as bulking o texturizing agents in low-fat food formulations has been suggested for a long time. In this sense, the chemical composition, syneresis, and viscoelastic properties of reduced milk-fat yogurts, in which milk-fat was partially replaced by commercial starches were evaluated. A full-fat control yogurt (YC, 25.0 $g.L^{-1}$ of milk-fat) without starch was manufactured from reconstituted milk. Three reduced milk-fat yogurts (12.5 $g.L^{-1}$ of milk-fat) containing 10 $g.L^{-1}$ of native maize (YNMS), chemically modified maize (YMS) or tapioca (YTS) starches were made from partially skimmed reconstituted milk. It was found that starches can induce positive impact in syneresis and viscoelastic properties as compared with YC. While the apparent viscosity (happ) of YC diminished markedly after 15 days of storage, the happ of the yogurts containing starches remained practically constant during the whole storage period. After 15 days of storage all the reduced-fat yogurts containing starches showed higher maximum viscosity values than that presented by the YC.

Ref:3225

Stability and rheological properties of oil-in-water micro and nanoemulsions made with whey protein hydrolysate-haw pectin soluble complexes

Trujillo-Ramírez, Daniel[1]; Aguirre-Mandujano, Eleazar[2]; Valle-Guadarrama, Salvador[2]; Lobato-Calleros, Consuelo[1]

[1]Departamento de Ingeniería Agroindustrial, Universidad Autónoma Chapingo, Km 38.5 Carretera México-Texcoco, Texcoco, 56230 México;
[2]Departamento de Preparatoria Agrícola, Universidad Autónoma Chapingo, Km 38.5 Carretera México-Texcoco, 56227 Texcoco, México

E-mail: eleagman@yahoo.com

Keywords: micro and nanoemulsions, stability and rheological properties, biopolymer soluble complexes

Abstract

Actual development of food emulsions usually includes the use of two or more biopolymers for enhancing their individual functional properties. For instance, the combined use of proteins and polysaccharides would be expected to bring together the emulsifying role of the protein with the stabilizing role of the polysaccharide. Also, improved functional properties are resulting in protein–polysaccharide complexes in comparison to those of the proteins and polysaccharides alone. In this work, the stability and rheological properties of oil-in-water micro and nanoemulsions stabilized by whey protein hydrolysate (WPH)-pectin (P) soluble complexes (SCWPH:P) were evaluated. Eighteen emulsions variations were prepared using a weight ratio WPH:P of 6:1, and by varying the droplet size (~ 4000, 3000, 2500, 200, 100, and 30 nm) and the pectin type. Pectins from 26 and 50 haw accessions (PT26 and PT50, respectively), and citrus pectin (PC) were used as forming part of the soluble complexes. The interaction pH values to generate CSWPH:P were established through zeta potential and turbidity determinations. Both pectin type and the droplet size influenced the stability and rheological properties of the emulsions. All of the emulsions were stable, but those with volume-surface average diameter (d3,2) ≤ 100 nm suffered the smallest droplet size variation during the storage. The emulsions stabilized with the WPH-PT26 and WPH-PT50 soluble complexes displayed higher viscoelastic properties and apparent viscosities, which increased as the d3,2 values decreased, in comparison with those presented by the emulsions stabilized with the WPH-PTC soluble complex.

Ref: 3226

Influence of the interfacial properties of milk fat globule membrane on the stability of water-in-oil-in-water multiple emulsions

Dzul-Cauich, Jorge Gustavo[1]; Lobato-Calleros, Consuelo[2]; Pérez-Orozco, Juan Pablo[3]; Alvarez-Ramirez, José[4]; Vernon-Carter, E. Jaime[4]

[1]Departamento de Biotecnología, Universidad Autónoma Metropolitana-Iztapalapa, San Rafael Atlixco 186, Vicentina, México, D.F. 09340, México;
[2]Departamento de Preparatoria Agrícola, Universidad Autónoma Chapingo, Km 38.5 Carretera México-Texcoco, 56227 Texcoco, México;
[3]Instituto Tecnológico de Zacatepec, Departamento de Ingeniería Química y Bioquímica, Calzada Tecnológico No.27, Col. Centro, Zacatepec, Morelos 62780, México;
[4]Departamento de Ingeniería de Procesos e Hidráulica, Universidad Autónoma Metropolitana-Iztapalapa, San Rafael Atlixco 186, Vicentina, México, D.F. 09340, México

E-mail: consuelobato@yahoo.com

Keywords: milk fat globule membrane, multiple emulsions, stability and rheological properties

Abstract

The health-enhancing functions and excellent emulsification properties of the milk fat globule membrane (MFGM) have led to research into developing technologies for the isolation and separation of MFGM-enriched material from milk, which could potentially be incorporated into food emulsions, and could result in new functional foods and nutraceuticals. On the other hand the droplets in water-in-oil-in-water multiple emulsions used in the food and pharmaceutical industries as edible delivery systems of bioactive compounds may be stabilized by a variety of different emulsifiers, including small molecule surfactants, biopolymers and phospholipids. In particular, it is important that these delivery systems can be fabricated from food-grade ingredients using economically viable processing operations, and that they are robust enough to remain stable throughout their application in foods. In this sense, in this work the interfacial shear viscosity (ηint) and the creep compliance-time (J(t)) behavior of MFGM films (4, 5 and 6% w/w) formed at the water-oil interface were evaluated. Films with higher MFGM concentration displayed higher ηint and interfacial viscoelastic properties. When esters of polyglycerol and polyriciniolate fatty acids (PGPR) were added to the oil phase, a competitive adsorption at the interface took place between PGPR and MFGM which caused a decrease in the interfacial viscoelastic properties of the films. The change in the rheological behavior of the films suggests that their interfacial structure was determined by complex interactions between the MFGM and PGPR molecules. Multiple emulsions stabilized by MFGM displayed smaller surface-volume droplet size (d3,2), greater stability, and higher storage (G')

and loss (G'') moduli when higher MFGM concentrations were used in the outer aqueous phase.

Ref: 3227

A new method to obtain the honey powder containing a reduced amount of the carrier material

***Samborska, Katarzyna*[1]*; Śledź, Magdalena*[1]*; Kamińska-Dwórznicka, Anna*[1]*; Witrowa-Rajchert, Dorota*[1]

[1]Faculty of Food Sciences, Warsaw University of Life Sciences (WULS-SGGW), Warsaw, Poland

E-mail: katarzyna_samborska@sggw.pl

Keywords: spray drying, glucose oxidase, powder recovery, particle size

Abstract

The production of honey powder with a composition close to natural honey and with good physical properties is still a challenge. The main problem during honey drying is stickiness related to the high content of glucose and fructose, which have low glass transition temperature *T*g. The addition of carrier substance of high *T*g (maltodextrin or Arabic gum) solves this problem. However, large amounts of carrier (>50% w/w) are required to obtain honey in a powder form.

The aim of work was to validate the possibility of honey enzymatic modification as a method to decrease the amount of carrier needed for spray drying. Honey solutions were treated by glucose oxidase (Gluzyme MONO 10000BG, Novozymes) for 72 h at 40 °C. After incubation Arabic gum was added and the spray drying was performed at inlet air temperature 180 °C, feed ratio speed 1 mL/s, speed of a rotary disk 39,000 rpm. Three variants were tested: H50, H75, H83, in which honey solids content in dried material was respectively 50, 75 and 83% w/w. Powders were evaluated in terms of moisture content, color, hygroscopicity, bulk density, flowability (as the angle of repose), particle size and morphology.

Enzymatic pretreatment by glucose oxidase let to reduce the amount of carrier added before spray drying and to obtain honey powder containing 83% w/w of honey solids in total solids (variant H83). The powder recovery Rp of enzymatically-treated material H50 was significantly higher (*R*p 78%) than non-treated H50 (*R*p 47%). Powders H50 obtained from enzymaticallytreated material had better flowability and solubility, but higher hygroscopicity than non-treated H50. Increasing the amount of honey solids in total powders solids from 50 to 75 and 83% w/w led to: 1) the reduction of moisture content, bulk density and solubility; 2) the increase of particle size and hygroscopicity; 3) flowability deterioration.

Acknowledgements: This research was funded by The National Science Centre (Poland) under Grant No. N 312 267 140.

Ref: 3228

The influence of kappa carrageenan and its hydrolystaes on recrystallization process in sorbets

***Kamińska-Dwórznicka, Anna*[1]; *Matusiak, Magdalena*[1]; *Samborska, Katarzyna*[1]; *Witrowa-Rajchert, Dorota*[1]**

[1]Faculty of Food Sciences, Warsaw University of Life Sciences (WULS-SGGW), Warsaw, Poland

E-mail: anna_kaminska1@sggw.pl

Keywords: sorbet, kappa carrageenan, recrystallization

Abstract

Ice crystallization is an important factor that determines sorbet final quality. Recrystallization during storage is influenced by various factors: total solids, initial freezing temperature, unfrozen water, stabilizer type and storage temperature. Consequently, there is current interest in the possible use of new substances to control ice crystal growth during freezing of food. Kappa form of carrageenan can bring positive results as a substance strongly retarding recrystallization, during storage of some kinds of frozen food or desserts. Very little information about the physicochemical properties of oligosaccharides gained by the way of hydrolysis of carrageenan, especially kappa formation, is available.

The aim of this research study was to investigate recrystallization process during freezing and storage of strawberry sorbet with the addition of new "poligeenan" as a final product of κ-carrageenan acid and enzymatic hydrolysis. Sorbets were prepared using freezer Gelato Pro 1700. The recrystallization process was analyzed based on the images of ice crystals taken after one hour, one week and one month of sorbets storage at the temperature of -18 °C and using a microscope (Nikon Alpha Phot-2) and camera (Nikon DS-Fi1) adapted to work at the temperatures below zero. Those images were then analyzed using an NIS Elements D program.

Based on the experiments performed it was found that the addition of new "poligeenan" to sorbets had a stronger effect on inhibiting the recrystallization process then the addition of κ-carrageenan. After one month of storage in sorbet with the addition of κ-carrageenan ice crystals diameter was at the range of 25.04 µm while in sorbet with the addition of the new "poligeenan" wasn't higher than 12 µm. At the same time, it was proved that the recrystallization process was most effectively inhibited in sorbet with the addition of the hydrolysates after acid then after enzymatic hydrolysis.

Acknowledgements: This research was funded by The National Science Centre (Poland) under Grant No. N N312 0777238, year 2010-2014.

Ref: 3229

Hazelnut “milk” as a probiotic food carrier

Bernat, Neus[1]; Cháfer, Maite[1]; Chiralt, Amparo[1]; González-Martínez, Chelo[1]

[1]Universitat Politècnica de València, Spain

E-mail: neuberpe@upvnet.upv.es

Keywords: Hazelnut "milk", confocal, physical stability, fermentation, probiotic, survivals

Abstract

Some dairy fermented products provide consumers the possibility to benefit from probiotics in which, among others, lactoseintolerants and vegetarians are excluded. Following the demand of functional vegetable products and owing to the nutritional and sensory acceptance, hazelnut “milk” was considered a possible alternative to dairy milks for developing probiotic foods. Firstly, the effect of high pressure homogenization (HPH) and heat treatments on physical stability of hazelnut “milk” was studied. The beverage was homogenized by applying 62, 103 and 172 MPa (MF1, MF2 and MF3 respectively); the last treatment was also combined with two different heat treatments (85 °C-30 min (LH) and 121 °C-15 min (HH)). Both microstructure and colloidal stability were analyzed in all “milk”-samples processed with the different treatments. The optimized hazelnut “milk” was then fermented using the probiotic *Lactobacillus rhamnosus* GG mixed with *Streptococcus thermophilus*. The fermented product obtained was characterized throughout cold storage time (28 days) as to pH, acidity, rheological behavior, colloidal stability, probiotic viability before and after an *in vitro* digestion and sensorily. Results showed that physical and structural properties of hazelnut “milk” were greatly affected by both HPH and heat treatments, obtaining greatest stability in samples submitted to the combined treatment MF3 and LH. The fermented “milk” allowed high probiotic survivals (≈ 8 log cfu/mL) and >60% survived to the *in vitro* digestion process. This viability was maintained during all the time controlled. The product was highly appreciated by the sensory panel during its shelf life despite the formation of a weak gel, which presented syneresis at the last storage time. Hence, the obtained product might be considered a new functional food suitable for many different sensitized groups (celiac, lactose-intolerant, allergic to cow-milk proteins, etc.).

Acknowledgements: This work was supported with the Universitat Politècnica de València (PAID-05-09 n°4244) and also the Conselleria de Eduació of the Valencian government, which awarded a grant to the author N. Bernat (Val i+ D ACIF/2011).

Ref: 3231

The use of encapsulated phosphates designed with two different melting temperatures to inhibit lipid oxidation in cooked ground meat

***Kılıç, Birol*[1]; Şimşek, Azim[1]; Claus, James[2]; Atılgan, Esra[1]**

[1]Suleyman Demirel University, Faculty of Engineering, Department of Food Engineering, Isparta, Turkey;
[2]University of Wisconsin-Madison, Department of Animal Sciences, Muscle Biology Laboratory, Madison, WI, U.S.A.

E-mail: birolkilic@sdu.edu.tr

Keywords: Phosphate, encapsulation, oxidation, beef, chicken

Abstract

Effects of encapsulated (e) phosphates (sodium tripolyphosphate, STP; sodium hexameta phosphate, HMP; sodium pyrophosphate, SPP) with different melting temperatures (MT; 60, 68 °C) on lipid oxidation in ground chicken meat and beef cooked at two different heating rate (fast, slow) during storage were investigated. Cooking loss (CL), TBARS, lipid hydroperoxides (LPO), soluble orthophosphate (OP), color and pH were determined. Study results indicated that fast heating rate and eSTP resulted in lower CL in both chicken and beef ($P<0.01$). Hovewer, MT did not affect CL. The use of eSTP resulted in an increase in pH, whereas eSPP decreased pH values in both meat species ($P<0.01$). pH values were not affected by MT. In both meat species, the highest OP levels were determined in the samples contained eSTP followed by eSPP and eHMP ($P<0.01$). Higher OP was determined in beef samples that underwent slow heating rate ($P<0.01$), dissimilar to chicken samples, where heating rate did not affect OP level. The application of 68 °C MT in beef samples and that of 60 °C in chicken samples resulted in higher OP ($P<0.01$). The use of eSTP or eSPP enhanced reduction in TBARS and LPO during storage of both cooked ground chicken and beef compared to that of eHMP ($P<0.01$). In addition, 68 °C MT resulted in lower TBARS and LPO in both meat species compared with 60 °C MT ($P<0.01$). Heating rate had no observable effect on TBARS values of both chicken and beef samples. Hovewer, higher LPO values were observed in both chicken and beef samples that underwent fast heating rate ($P<0.01$). This study proved that better oxidation inhibition in pre-cooked ready-to-eat chicken meat and beef products can be achieved by eSTP and eSPP and antioxidant effect of eSTP or eSPP can be enhanced with higher MT of encapsulation.

Acknowledgements: Appreciation is expressed to The Scientific and Technological Research Council of Turkey (TUBITAK) for providing financial support for this work (Project no: 111O261).

Ref: 3236

Effect of device surface condition and operation period on production of oil-in-water emulsions by microchannel emulsification

***Zhang, Yanru*[1,2]; *Kobayashi, Isao*[1]; *Neves, Marcos A.*[1,2]; *Uemura, Kunihiko*[1]; *Nakajima, Mitsutoshi*[1,2]**

[1]Food Engineering Division, National Food Research Institute, NARO, Tsukuba, Japan;
[2]Graduate School of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

E-mail: zyr1103@gmail.com

Keywords: Microchannel emulsification, long-term continuous production, oil-in-water emulsion, monodisperse emulsion, emulsifier, hydrophilic surface

Abstract

Microchannel (MC) emulsification is capable of producing monodisperse emulsions by simply forcing a dispersed phase through an MC array into a continuous phase. Long-term continuous MC emulsification as well as scaling up MC emulsification systems must be achieved for practica-scale production of monodisperse emulsions. An earlier study reported successful short -term continuous production of the monodisperse O/W emulsions, for up to several hours [1], while the droplet generation behavior during long-term continuous MC emulsification is unclear. In this study, we first investigated the effect of the hydrophilicity of silicon dead-end MC array plates (model MSX11) on the generation of soybean oil droplets stabilized by a hydrophilic surfactant by MC emulsification. We also investigated continuous MC emulsification using a silicon cross-flow MC array plate (model CMS6-2) with sufficient hydrophilicity. Monodisperse O/W emulsions were produced using a silicon dead-end MC plate with a static water contact angle below a critical value. During continuous MC emulsification, monodisperse O/W emulsions with an average droplet diameter (*d*av) of about 21 mm and a coefficient of variation (CV) below 2% were produced using the CMS6-2 plate on day 1. In the presence of nonionic Tween 20 as the surfactant, CV of the generated oil droplets began to increase on day 4, reaching >30% on day 7. By contract, in the presence of anionic sodium dodecyl sulfate (SDS), the *d*av and CV values hardly changed during 7 days of MC emulsification. Our results indicate that the appropriate surface control of silicon MC array plates as well as emulsion composition is essential to achieve successful long-term continuous MC emulsification.

References:

[1] Tong J., M. Nakajima and H. Nabetani (2002). Preparation of phospholipid oil-in-water microspheres by microchannel emulsification technique. Eur. J. Lipid Sci. Technol., 104, 216-221.

Ref: 3237

Production characteristics of food grade monodisperse O/W emulsions by microchannel emulsification using asymmetric metal micro-through-holes

***Zhang, Yanru*[1,2]; Kobayashi, Isao[1]; Wada, Yoshihiro[3]; Neves, Marcos A.[1,2]; Uemura, Kunihiko[1]; Nakajima, Mitsutoshi[1,2]**

[1]Food Engineering Division, National Food Research Institute, NARO, Tsukuba, Japan;
[2]Graduate School of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan;
[3]EP Tech. Co., Ltd., Hitachi, Japan

E-mail: zyr1103@gmail.com

Keywords: Microchannel emulsification, monodisperse emulsion, microchannel arrays, metal device, oil-in-water emulsion

Abstract

Microchannel (MC) emulsification is a robust and promising technique to produce monodisperse emulsions [1]. In MC emulsification, silicon-based materials are normally used for manufacturing MC array chips by its potential of precisely fabricating the unique geometry of MC arrays. However, silicon MC emulsification chips have a few disadvantages, such as shock fragility and intolerance against alkali cleaning. From a practical viewpoint, aluminum is suitable metallic materials because of its chemical-proof surface and superior mechanical strength. To our knowledge, there is no asymmetric aluminum micro-through-holes on a chip. Therefore, in this study, we investigated the production of monodisperse oil-in-water (O/W) emulsions using newly designed asymmetric aluminum micro-through-holes. Asymmetric metal micro-through-holes were obtained by microdrilling for fabricating circular MCs with a diameter of 50 or 100 mm and subsequent electric discharge machining for fabricating microslots. Refined soybean oil was used as the dispersed phase, and 1 wt% Tween 20 aqueous solution was used as the continuous phase. The dispersed phase was injected via MCs into the flow channel for the continuous phase to generate emulsion droplets. The use of asymmetric aluminum micro-through-holes with a diameter of 100 mm led to the production of monodisperse O/W emulsion droplets with average diameters (*d*av) of about 300 mm and coefficients of variation (CVs) below 4%. In the case of asymmetric through-holes with through-holes diameter of 50 mm was used, monodisperse O/W emulsion droplets with *d*av of about 150 mm and CV below 4% were stably generated. Food grade m onodisperse O/W emulsions were also successfully generated below the critical flow rate of the dispersed phase, with slight variation in *d*av and CV values. These findings are expected to provide useful information on the versatile use of MC emulsification.

References:

[1] Vladisavljević, G.T., I. Kobayashi and M. Nakajima (2012) Production of uniform droplets using membrane emulsification, microchannel emulsification and microfluidic emulsification devices; Microfluid. Nanofluid, 13, 151-178.

Ref: 3243

Investigation into the effect of low frequency ultrasonication on cheese texture

Lemos, Adilia[1]; Greer, Lauren[1]; Tziboula-Clarke, Athina[1]

[1]Abertay University of Dundee, United Kingdom

E-mail: a.lemos@abertay.ac.uk

Keywords: Ultrasonication

Abstract

Application of Ultrasound has many potential applications in the dairy industry such as homogenization or milk fat separation enhancement, defoaming and crystalisation depending on the sonication frequency used. This work aimed to explore the potential to utilize ultrasonication to modify cheese texture.

Response surface methodology (Minitab version 14) was employed to study the effect of sonication on the cheese making properties of skim milk at a constant frequency of 20 KHz and amplitudes ranging from 22-78% at varying duration of treatment ranging from 2-20 minutes under controlled temperature conditions. The various sonication combinations resulted in different energy outputs in milk which were calculated using differential scanning colorimetry ranging from 8.78 kJ to 75.26 kJ. The ultrasonicated milk was subsequently used to prepare model cheeses. The texture of the cheese was assessed using a compression test (Texture analyser TA.XT2, Sable Microsystems, equipped with a cylindrical probe 20mm diameter and a 5 kg load cell).

The results showed that at low amplitudes and short ultrasonication times soft cheese textures were obtained. As the amplitude and duration treatment increased there was an increase in cheese strength reaching a maximum at 30% amplitude for 20 minutes sonication. However at amplitutdes above 40% increasing the duration of sonication resulted in a decrease in cheese strength whilst at amplitudes below 40% longer treatments produced harder cheese textures. No correlation was found between energy levels and cheese strength. Whilst appreciating the limitations of this study it is possible that ultrasonication impacts the casein micellar structure which subsequently affects the organisation of casein coagulum obtained after renneting which requires further investigation. Nevertheless, in principle ultrasonication of raw milk could potentially be used to prepare novel cheese structures.

Ref: 3247

Development of soapwort extract for improving structural properties of Tahini halvah

***Cam, Ihsan Burak*[1]*; Topuz, Ayhan*[1]**

[1]Akdeniz University Food Engineering Department, Antalya, Turkey

E-mail: burakcam@akdeniz.edu.tr

Keywords: Soapwort extract, Tahini halvah, stuctural properties, sensorial properties

Abstract

Soapwort extract which contains high amount of saponin, is an additive used in tahini halvah production to improve consistency and color of Tahini halvah and prevents oozing of sesame oil from the halvah in time due to its bioactive saponin content by acting as emulsifier. This additive has been produced traditionally in food industry by extracting soapwort roots (*Gypsophila bicolor* (Freyn et Sint.) Grossh) in boiling water for a long time.

In this study, optimum process conditions of soapwort extract has been determined by using response-surface method. This extract has been enriched with saponin via reverse osmosis. Soapwort powder, includes 4% moisture, produced from the obtained soapwort concentrate by using the spray dryer. Processing steps optimization and saponin content enrichment of soapwort extract has been tested on tahini halvah production. The main components of Tahini halvah are tahini, sugar and soapwort extract. The other ingredients and processing steps were identical for all samples. The samples were compared in hardness, color and sensorial characteristics.

Results showed that; Halvah samples produced with the soapwort extract reconstituted from powder had the highest rate in sensorial characteristics. Hardness of the samples was determined as 2.68 *g* for commercial extract, 2.13 *g* for reconstitute soapwort concentrate and 6.19 *g* for reconstitute soapwort powder. Interestingly, the lowest oil ooze was observed in the samples produced with soapwort extract reconstituted from powder. In addition soapwort extract reconstituted from powder increased *b* color value which is corresponding to more yellowish product in comparison to other soapwort extracts.

Acknowledgements: This study has been supported by The Scientific and Technological Research Council of Turkey, project # 109 O 839.

Ref: 3250

Hazelnut skin powder: a new brown colored functional ingredient

Özdemir, Kübra Sultan[1]; Yılmaz, Cemile[1]; Gökmen, Vural[1]

[1] Food Engineering Department, Hacettepe University, 06800 Beytepe, Ankara, Turkey.

E-mail: cemileyilmaz@hacettepe.edu.tr

Keywords: Hazelnut skin, brown powder, dietary fiber, phenolic compounds, high-shear homogenization

Abstract

Hazelnut skin is an important by-product in the roasting process of hazelnuts. With its natural brown color, it offers a potential for utilization as a coloring agent in foods. However, its use for this purpose needs further modification of this fiber-rich material. Ground hazelnut skin contains approximately 15% of lipids that should be removed prior to use. Large particles of ground hazelnut skin is not useful for direct utilization in food formulation. In this study, sub-micron sized particles from hazelnut skins defatted by hexane were obtained by means of high shear homogenizer. Half grams of defatted ground skin material was suspended in 100 mL of water. The suspension was pre-homogenized using a low shear mixer (Heidolph, Silent M Crusher) at 25,000 rpm for 8 minutes. Then, pre-homogenized suspension was passed through a high shear microfluidizier (M110P, Microfluidics, Newton, MA, USA). High shear homogenization treatment was performed under various processing conditions applying different pressures (10000 or 30000 psi) and cycle times (1, 3, 5 and 10). Homogenized suspensions were then lyophilized to obtain sub-micron sized solid particles.

The powder samples were analyzed for particle size distribution, color, individual phenolic compounds, total phenolic content, and total antioxidant capacity. The results indicated that a desirable low micron particle sizes for the hazelnut skin for incorporation into food formulations was achieved by means of high shear homogenization, meanwhile there was no significant change in phenolic composition and antioxidant capacity. Moreover, brown color intensity of hazelnut skin could be improved by high shear homogenization process.

Ref: 3252

Limiting the reactivity of ascorbic acid, vanillin and sodium chloride by microencapsulation

***Özdemir, Kübra Sultan*[1]*; Gökmen, Vural*[1]**

[1]Food Engineering Department, Hacettepe University, 06800 Beytepe, Ankara, Turkey.

E-mail: kubrasoz@gmail.com

Keywords: Ascorbic acid, vanillin, sodium chloride, microencapsulation, HMF, acrylamide, furan

Abstract

Microencapsulation technique has been widely used to protect labile food ingredients against deterioration, volatile losses, or interactions with other ingredients.
Ascorbic acid is sensitive to oxidation reactions and can be easily degraded during processing. It was found to be responsible for the formation of furan, a cooking carcinogen, in foods during heating. Being a reactive carbonyl, it may involve in nonenzymatic browning reactions in foods during processing and storage. Latest research findings indicate that freely available ingredients like sodium chloride and vanillin may influence the Maillard reaction and sugar decomposition pathways, respectively, boosting certain known food safety risks. Vanillin is a bioactive carbonyl and play role in the conversion of asparagine to acrylamide at elevated temperatures. NaCl significantly accelerates the decomposition of mono- and disaccharides leading to the formation of HMF in foods during thermal processing.
This study aimed to restrict the reactivity of ascorbic acid, vanillin and sodium chloride by microencapsulation using freezedrying technique. Carnauba wax, maltodextrin, arabic gum and beta-cyclodextrin were used as coating materials. The complexes' stability was evaluated with DSC and release properties of capsules determined in aqueous systems. Formations of HMF, acrylamide and furan in model systems with encapsulated ingredients were also investigated.

Ref: 3253

A study regarding senzorial and technological properties of a dietetic meat product

***Tudose, Cristian*[1]*; Iordachescu, Gabriela*[1]*; Alexe, Petru*[1]*; Stan, Felicia*[2]

[1]Dunarea de Jos University, Faculty of Food Science and Engineering, Romania;
[2]Dunarea de Jos University, Mechanical Faculty, Romania

E-mail: gabriela.iordachescu@ugal.ro

Keywords: Extra virgin olive oil, palm oil, meat product, animal fat, sensorial analysis

Abstract

Nowadays more and more consumers are trying to eat healthier food. These products must be nutritient rich and balanced and have many health beneficial compounds such as high quality protein, unsaturated fatty acids, vitamins and antioxidants.
From all the major compounds of a food, fats have the most important role in terms of energy and taste. Even partial elimination of fats from foods have a negative impact in the sensory qualities. Fat consumption in large quantity and unbalance of fatty acids intake (especially saturated) lead to cardiovascular diseases. Studies recommend eating mainly vegetable fats which have a high content of unsaturated fatty acids (omega3 and Omega6 especially).
In this study, we designed a new meat product diet with total replacement of animal fats. A mixture of extra virgin olive oil and palm oil was used. These two oils are known worldwide and have an important content of unsaturated fatty acids as well as vitamins and antioxidants.
New product obtained was checked if corresponds to the sensory point of view compared with a classic product that has animal fat in the recipe.
Our main objective is to obtain a dietetic meat product with the same sensory and textural qualities and improved nutritional properties by total replacement of animal fat with a vegetable oil mixture. For the new meat product one of the most important tasks should be maintaining or improving sensory qualities.
The results demonstrated that there are no significant difference between the classic meat product with fat animal and the new product with vegetable oils mixture.

Ref: 3260

Wet grinding and microfluidization of wheat bran preparations: improvement of dispersion stability by structural disintegration

Rosa-Sibakov, Natalia[1]; Sibakov, Juhani[1]; Lahtinen, Panu[1]; Poutanen, Kaisa[1]

[1]VTT Technical Research Centre of Finland

E-mail: natalia.rosa-sibakov@vtt.fi

Keywords: Wheat bran, sedimentation, beverage, wet grinding, microfluidization

Abstract

Cereal brans are rich in nutritionally valuable compounds, such as dietary fibre, protein and bioactive compounds. However, they are underutilised in human nutrition due to difficult addition into food systems. They often cause sandy mouthfeel, slightly bitter taste and changes in the structure of food matrices. The enrichment of cereal-based solid foods such as bread, snacks and biscuits with wheat bran has been studied over several years, but the use of wheat bran in liquid food matrix is a new and interesting application which has not been explored yet. The objective of this study was to investigate how processing affected the structure and composition of wheat bran preparations, and their stability in high-moisture conditions, providing thus new insights of the usability of wheat bran in liquid food products. Three wheat bran preparations – standard bran, peeled bran and aleurone-rich fraction – were modified by enzymatic degradation, wet grinding and/or microfluidization. The phase-stability of processed wheat brans in water (5% of dry matter) was analysed by measuring the sedimentation of particles. When untreated wheat bran preparations were mixed in water, most of their particles sediment already in 5 min. Wet grinding drastically destroyed the physical structure of wheat bran preparations. An efficient particle size reduction (down to 10 µm) was needed to improve the dispersion stability of particles. Enzymatic treatment solubilised part of the components (from the initial 3% up to 45% solubilisation), but the increased solubility did not improve the dispersion stability of particles. Microfluidization of bran preparations enhanced the homogenization of particles, increasing viscosity and stability of dispersions. In conclusion, it was demonstrated that wheat bran preparations, when disintegrated and homogenised, possess high potential for use in beverage applications.

Acknowledgements: Funding from the Academy of Finland and Tekes – the Finnish Funding Agency for Innovation are gratefully acknowledged.

Ref: 3261

Optimization of ultrasonic emulsification in flaxseed oil microencapsulation

Tontul, Ismail[1]; Topuz, Ayhan[1]

[1]Akdeniz University, Faculty of Engineering, Department of Food Engineering, 07058, Antalya, Turkey

E-mail: atopuz@akdeniz.edu.tr

Keywords: Flaxseed oil, ultrasonic emulsification, microencapsulation

Abstract

Flaxseed oil is the richest plant based source of the alpha-linolenic acid. However, it is prone to oxidation due to this high content of polyunsaturated fatty acids. In recent years, microencapsulation techniques have been employed to prevent or retard oxidation. Among different microencapsulation techniques, spray drying is the most promising due to it being economical and easily applicable to different core materials. Spray drying is achieved by a series of processing steps, namely emulsification, atomization, drying and separation. Emulsification which can be achieved by different techniques such as ultraturrax, ultrasonic and high pressure homogenization is one the most important phase of the microencapsulation because it affects the physical and chemical stability of the microcapsules during production and shelf life of the product.

In the present study, the ultrasonic emulsification step in the flaxseed oil microencapsulation was optimized using Box-Behnken design of response surface methodology. Whey protein concentrate and maltodextrine mixtures (1/4) were used as wall material. Wall material concentration, oil loading and ultrasonication time were selected as variables of the design and microencapsulation efficiency and product yield were selected as responses.

According to obtained results while microencapsulation efficiency was positively correlated to wall material concentration and ultrasonication time, oil loading had negative effect. On the other hand, product yield was mainly governed by wall material concentration. Increasing the wall material concentration resulted in lower product yield. The calculated optimum conditions to provide maximum MEE and PY was mall material concentration of 20g/100g, oil loading of 20g oil/100g wall material and ultrasonication time of 120 s and this conditions provided 92.4% MEE and 68.7% PY.

Ref: 3263

Enriching cheese products with bioactive milk hydrolysates

Carolan, Anita[1]; McCarron, Paula[1]; Noronha, Nessa[1]; Jacquier, Jean Christophe[1]; O'Sullivan, Michael[1]; O'Riordan, E.Dolores[1]

[1]University College Dublin, Ireland

E-mail: anita.carolan@ucdconnect.ie

Keywords: Sodium caseinate, cheese, bioactive hydrolysates, milk proteins

Abstract

Bioactives derived from hydrolysed sodium caseinate have many health promoting benefits. However, hydrolysed sodium caseinates are very bitter and can alter the textural and sensory quality of foods. The objective of this study was to investigate the effect of sodium caseinate hydrolysates on the functionality and sensory quality of processed cheese. Sodium caseinate hydrolysates with bioactive properties were incorporated into a low fat cheese (4%) at concentrations of 5, 10 and 15% w/w. The hydrolysates were used to replace skimmed-milk curd. These inclusion levels represented dosages expected to have health benefits. The textural, rheological and melt properties of the cheese were assessed. Sensory analysis was conducted using Free Choice Profiling and ranking preference tests.

When the hydrolysate concentration increased from 10 to 15% w/w, there was a significant decrease in cheese hardness from 655 N (control), to 432 N and 302 N, respectively. Cohesiveness, storage modulus and loss modulus were significantly lower than the control ($p < 0.05$). Melt reduced from 120 mm (control) to 100 mm and 97 mm, with 10 and 15% w/w concentration inclusion, respectively. Sensory panellists assessed the aroma, appearance, taste and aftertaste of the cheese samples. Regardless of the hydrolysate inclusion rate, there was no significant difference in the preference for cheese containing the hydrolysates over the control, for both heated and unheated cheese samples.

Sodium caseinate hydrolysates with bioactivity were successfully incorporated into low fat process cheese. Although there were textural changes to the cheeses, the softening effect could be readily overcome by formulation changes. The hydrolysates did not have an adverse effect on the sensory properties of the cheese. The bitter astringent profile of the hydrolysates appeared to be masked by the structure and release properties of the low fat cheese. The research provides good potential for the development of a functional food.

Acknowledgements: I would like to thank all my supervisors for their support and patience. I am also extremely grateful to FHI for funding my research. Finally, I would like to express my gratitude to all the technical staff in the Institute of Food and Health for all their help.

Ref: 3267

Edible lactoferrin bacterial cellulose films as an effective and low-cost antimicrobial active packaging

Padrão, Jorge[1]; Gonçalves, Sara[1]; P. Silva, João[1]; Sencadas, Vitor[2,3]; Lanceros-Méndez, Senentxu[2]; C. Pinheiro, Ana[1]; Vicente, António[1]; R. Rodrigues, Lígia[1]; Dourado, Fernando[1]

[1]Centro de Engenharia Biológica, Universidade do Minho, Campus Gualtar, 4710-057 Braga, Portugal;
[2]Centro/Departamento de Física da Universidade do Minho, Campus de Gualtar, 4710-057 Braga, Portugal;
[3]Escola Superior de Tecnologia, Instituto Politécnico do Cávado e do Ave, Campus do IPCA, 4750-810, Barcelos, Portugal

E-mail: padraoj@deb.uminho.pt

Keywords: Bacterial cellulose, lactoferrin, active packaging, antimicrobial, artificial digestive system, functional food

Abstract

Active packaging is an increasingly reliable technology for assuring the safety and maintenance/improvement of the organoleptic traits of the enclosed food products. Bio-based materials with a wide set of highly impressive characteristics were assembled through a simple and effective methodology to produce affordable edible antibacterial active films. Bacterial cellulose (BC) was used as film scaffold since it is an extremely pure polysaccharide that possesses noteworthy properties for food casing such as high toughness, shape retention and works as a stabilizing agent. Functionalization of BC was achieved through absorption of lactoferrin (LF), a bilobar protein mainly extracted from milk that possess a numerous plethora of activities, such as broad spectrum antibacterial effect, immunoregulatory properties, and also promotes bifidobacteria and intestinal epithelium growth. These films were extensively characterized in terms of their physicochemical characteristics, bactericidal efficiency and cytotoxicity. The LF absorption and de-absorption profiles of the BC films were registered. Surface free energy, water vapour permeability, attenuated total reflection Fourier transform infrared spectroscopy, dynamic mechanical analysis (in water saturated conditions) and swelling profile, and other critical characterization techniques were employed. The antibacterial properties were assessed through the determination of the specific growth rate impact, “live and dead” fluorescence, scanning electron microscopy and colony forming units’ count; using two model microorganisms (*Escherichia coli* and *Staphylococcus aureus*). The contact killing properties were evaluated for standalone films and for a specific case study (fresh sausage). Finally, the films cytotoxicity was determined after digestion in a dynamic mimetic artificial gastrointestinal digestive system. All attained results lead us to conclude that the obtained active edible films display an effective and significant antimicrobial activity

against both Gram – and + and revealed no cytotoxicity, prior and after the gastrointestinal digestion. Thus, these new films present a high potential to safely functionalize the encased foods, while providing prophylactic properties.

Acknowledgements: The authors acknowledge the Portuguese Foundation for Science and Technology (FCT, Portugal) for the financial support provided by the research grants SFRH/BD/64901/2009, SFRH/BD/63578/2009, SFRH/BPD/64958/2009, SFRH/BPD/64958/2009 for Jorge Padrão, Sara Gonçalves, João P. Silva and Vitor Sencadas respectively, and also for FCT Strategic Project PEst-OE/EQB/LA0023/2013

Ref: 3273

Crispness assessment of apple leathers with maltodextrin addition

***Valenzuela, Catalina*[1]*; Aguilera, José Miguel*[1]**

[1]Pontificia Universidad Católica de Chile

E-mail: cf.valenzuela.a@gmail.com

Keywords: Fruit leathers, crispness, maltodextrin, mechanical properties

Abstract

Fruit leathers are snacks consumed in many parts of the world. They are made by drying a layer of fruit puree to produce a pliable sheet. Fruit leathers are mainly composed by low weight carbohydrates, which have low Tg and are highly hygroscopic, so the product becomes softer and sticky at ambient conditions of relative humidity. In this work, apple leather strips (ALS) with addition of maltodextrin were created in order to decrease hygroscopicity and form a crispy material. The crispness of ALS was evaluated by mechanical properties. This work shows the effect of maltodextrin and moisture content on puncture force during rupture. Puncture force and puncture deformation decreased as water content of samples increased. There was a region where as moisture content increased the property also increased. This hardening effect or "moisture toughening" is interpreted by an antiplasticizing mechanism, where the hydration facilitates a molecular rearrangement, responsible for interactions between water and matrix macromolecules. At water contents higher than that of moisture toughening, the softening effect of water became dominant, the particles were totally plasticized, and the puncture force began to decrease again until the mechanical strength was lost. The regression parameters of the Fermi equation would be useful to compare the magnitude of the properties related to crispness, in relation with water content and the maltodextrin concentration. As the maltodextrin content of samples increased, the Fermi parameters also increased. Therefore the crispness of samples increases with the maltodextrin addition. The addition of maltodextrin decreased the puncture force in all cases. It has been proposed that if the ingredient influences the structural organization of the food matrix, then the ingredient will likely control the mechanical properties of the matrix and therefore its crispness.

Acknowledgements: The authors express their sincere appreciation to CONICYT (National Commission for Scientific and Technological Research) for their financial support.

Ref: 3281

Evaluation of wheat flours and their relation with the characteristics of You-tiao

***Zhong, Xiyang*[1]; *Wu, Xin*[2]; *Chen, Li*[2]; *Wang, Hualin*[3]; *Yang, Xuefei*[2]; *Jiang, Shaotong*[2]**

[1]ISchool of Biotechnology and Food Engineering, Hefei University of Technology, China;
[2]School of Biotechnology and Food Engineering, Hefei University of Technology, China;
[3]School of Chemistry and Chemical Technology, Hefei University of Technology, China

E-mail: jiangshaotong@163.com

Keywords: You-tiao, wheat flour, characteristics

Abstract

You-tiao is the most popular traditional breakfast fried food in China, its quality is closely linked to the wheat flour used for making You-tiao, but the relation between wheat flour and the characteristics of You-tiao is still unclear. The objective of this research was to investigate the effect of wheat flour on the quality of You-tiao, and served wheat flour industry to explore the suitable flours for making nutrient, healthy and high quality You-tiao. In this paper, we chose five kinds of commercial wheat flours, assessed their compositions and rheological properties, and used them to make You-tiao. The characteristics of Youtiao, such as appearance, flavor, color, palatability, fat content, organizational structure, hardness and chewiness, were evaluated using the sensory evaluation method, texture profile analysis test and physicochemical analysisanalysis analysis analysis analysis. The results showed that the content of wet wheat gluten and dough stability time of wheat flour were the main factors, and had closely related with the quality of You-tiao.

Acknowledgements: Financial support from National Natural Science Foundation of China (31271931,31171788) are gratefully acknowledged.

Ref: 3292

Colloidal properties and surface activity of oat protein particles with/without transglutaminase treatment

***Ercili-Cura, Dilek*[2]; Miyamoto, Ayaka[1]; Yoshii, Hidefumi[1]; Poutanen, Kaisa[2]; Partanen, Riitta[2]**

[1]Kagawa University, Department of Applied Biological Science, 2393 Ikenobe, Miki-cho, Kita-gun, Kagawa 761-0795 Japan;
[2]VTT Technical Research Centre of Finland, Tietotie 2, 02044 VTT, Finland

E-mail: dilek.ercili@vtt.fi

Keywords: Oats, protein particles, surface activity, transglutaminase

Abstract

There is growing emphasis on the need of utilizing plant-sourced proteins in creating appealing food structures in order to decrease use of animal-sourced proteins as food and ingredients globally. Major plant proteins however, are water insoluble which limits their technological functionality in traditional ways and necessitates understanding of the structure formation by colloidal protein aggregates in aqueous environment. Understanding is needed particularly for development of networks and interfaces controlling molecular mass transfer and macroscopic phase separation in multi-phasic food systems.

Oats (*Avena sativa* L.) is a distinct cereal due to its relatively high protein content and its unique protein composition compared to other cereals. We investigated the size and charge properties of colloidal oat protein particles at different pH environments and after enzymatic modification by transglutaminase. Surface activity of oat proteins was characterized by dynamic surface tension measurements at air-water interface. Oat protein isolate (OPI) prepared from defatted oat flour was used. At the concentrations of 1.5-2.5 mg/mL, the dispersions showed monomodal size distributions; ~70 nm diameter at pH 7.2 and ~30 nm at pH 9.0 and were found to be electrostatically stable (z-potential > -35 mV). When diluted, dissociation and reassociation of the particles occurred resulting in polydispersity at pH 7.2 while at pH 9.0 particle size and z-potential were unchanged after dilution. Dynamic surface tension measurements revealed slower adsorption dynamics and higher final surface tension values at pH 9.0 than those at pH 7.2. Transglutaminase treatment resulted in formation of inter-molecular covalent linkages within the particles. Crosslinked particles showed decreased average particle size and increased stability against dilution when compared with the control. Structuring of naturally existing colloidal oat proteins may lead to design of food grade particles with a controlled size for particle stabilized foams and emulsions.

Ref: 3296

The role of salt form and concentration on the structure and sensory properties of bakery products

Győri, Zoltán[1]; Sipos, Péter[2]

[1] Szent István University, Hungary;
[2] University of Debrecen, Hungary

E-mail: gyori.zoltan@gtk.szie.hu

Keywords: Wheat flour, sodium chloride, dough structure

Abstract

The gluten content of wheat endosperm has unique properties and makes possible to produce a wide range of products. The three dimensional network what it forms after kneeding can be qualified by its strength, elasticity, stability and from several other considerations. This is why its properties have significant role in the classification and valuation of flours. The sodium chloride what is one of our most ancient food additive has important effects on these parameters: it increases the strength of gluten and improves the water absorption capacity of flour, but the main reason why the salt are present in the composition of almost all bakery products is its contribution to the taste. On the other hand, significant connection was found between the sodium intake and the blood pressure and it also was reported that the reduction of sodium intake reduces the risk of cardiovascular diseases. Sodium reducing programs were started in several countries in the last years and the bakery products are the main targets of these programs as about one-third part of consumed sodium are from these products.
The effect of different salt forms and concentrations were evaluated on the rheological properties of dough made from wheat and rye flours. Our aim was to investigate that how does the sodium chloride change the properties of gluten network and therefore the structure of bakery products and what effects can be experienced when it is substituted by other organic and inorganic salts. Different rheological tests were used to monitor the effects on dough (Farinograph, Alveograph and Extensigraph tests) and on the end-product (texture analysis, sensory analysis) and it was found that the most advantageous properties were not measured in the case of the use of sodium chloride in every cases considering physical parameters of gluten structure and the taste of products.

Acknowledgements: This research was supported by the European Union and the State of Hungary, co-financed by the European Social Fund in the framework of TÁMOP-4.2.4.A/ 2-11/1-2012-0001 'National Excellence Program'. This research is a part of COST ActionFA 1001.

Ref: 3302

Functionality of structured emulsions as nutritionally improved fat replacers in cookies

Dapčević Hadnađev, Tamara[1]; Hadnađev, Miroslav[1]; Pojić, Milica[1]; Rakita, Slađana[1]

[1]University of Novi Sad, Institute of Food Technology, Serbia

E-mail: tamara.dapcevic@fins.uns.ac.rs

Keywords: Cookies, structured emulsions, fat reduction, rheology, sensory properties

Abstract

Cookies are traditionally produced using hydrogenated (margarine) or saturated (shortening) fats. Due to the fact that fats comprise up to 20% of cookie dough and that increased consumption of saturated fats is associated with negative cardiovascular and metabolic effects, it is of a great importance to replace traditional fats with cold pressed oils. However, this is mostly associated with negative technological quality and sensory acceptability of cookies.

The aim of this study was to develop novel semi-plastic shortening structures based on starch octenyl succinate stabilized cold pressed oil-in-water emulsions, as well as to investigate their functionality as fat replacers in cookies.

In order to study the effect of incorporating structured 50% oil in water emulsions instead of unstructured oil (50% fat) or margarine (80% fat), cookie dough rheology, cookie texture (cookie break strength and fracturability), cookie spread and sensory attributes were tested.

It was determined that margarine replacement with structured emulsions and unstructured oil led to decreased dough elastic modulus and increased cookie firmness. Cookies containing oil in the form of emulsion expressed better quality in terms of cookie deformation and appearance than cookies containing unstructured oil. Application of oil-structuring method to achieve fat reduction resulted in great sensory acceptability of obtained cookies.

Acknowledgements: This work is a result of COST project FA1001. The financial support of Ministry of Education, Science and Technological Development, Republic of Serbia (project No. 46001) is also greatly acknowledged.

Ref: 3303

Physicochemical and antimicrobial properties of essential oils-high methoxyl pectin nanoemulsions

***Guerra-Rosas, María Inés*[1]; Morales-Castro, Juliana[1]; Ochoa-Martínez, Araceli[1]; Salvia-Trujillo, Laura[2]; Martín-Belloso, Olga[2]**

[1] Instituto Tecnológico de Durango, Mexico;
[2] University of Lleida, Spain

E-mail: mariaines8404@yahoo.com.mx

Keywords: Nanoemulsions, stability, essential oils, antimicrobial properties, food borne pathogens

Abstract

Essential oils (EOs) have been used as antimicrobials against foodborne pathogens and spoilage bacteria yet their utilization is often limited due to their low water solubility. The incorporation of EOs in oil in-water nanoemulsions (diameter <500 nm) as antimicrobial delivery systems can enhance their stability in aqueous media and improve their effectiveness against a range of different microorganisms. The aim of this study was to evaluate the physicochemical stability and the effectiveness of nanoemulsions containing several EOs against *Escherichia coli* and *Listeria innocua.* Nanoemulsions containing oregano, thyme, lemongrass and mandarin EOs stabilized with high methoxyl pectin (1% w/v) and Tween 80 (5% v/v) were obtained by microfluidization (150 MPa and 5 passes). Average droplet size, antimicrobial activity against both bacteria and the concentration of volatile compounds (identified by gas chromatography/mass spectrometry) of EOs-pectin nanoemulsion were evaluated over time (56 days) at room temperature. Transmission Electron Microscopy (TEM) was used to study changes in microbial cells after being contact for 30 min with nanoemulsions. Nanoemulsion droplet size was below 50 nm regardless the EOs used. The droplet size of nanoemulsions with mandarin and lemongrass EOs remained stable during 56 days, while those containing oregano and thyme EOs increased up to 1017.00±198.40 and 924.10±183.80 nm, respectively, over storage time emongrass EO nanoemulsion showed highest antimicrobial activity against *E. coli* followed by oregano, thyme and mandarin EOs as they achieved 5.9, 2.2, 2.1 or 1.9 log-reductions, after 30 min of contact time (0 days), respectively. On the other hand, the antimicrobial activity against *L. innocua* was low regardless the EO used. Moreover, the antimicrobial activity of nanoemulsions decreased during storage time, which was attributed to their loss of volatile compounds over time. TEM images showed significant damage in the cytoplasmic membrane of *E. coli* cells, which lead to cell death, whereas in the case of *L. innocua* the membrane structure was maintained

practically intact after contact with nanoemulsions. The results obtained in this study evidence the advantages of using nanoemulsions as antimicrobial delivery system of EOs to improve microbial stability of foods.

Acknowledgements: The authors thank to Dr. Miguel Ángel Cubero from the University of Lleida, Lleida, Spain for his help in gas chromatography analysis. María Inés Guerra Rosas thanks the Consejo Nacional de Ciencia y Tecnología by the doctoral scholarship granted.

Ref: 3305

In Situ online characterization of microstructural changes of native starch when subjected to a freezing-heating cycle using polarized light video-microscopy

Molina, Teresa[1]; Bouchon, Pedro[2]

[1]Department of Chemical and Bioprocess Engineering, Pontificia Universidad Católica de Chile;
[2]Department of Chemical and Bioprocess Engineering, Pontificia Universidad Católica de Chile.

E-mail: mtmolin1@uc.cl

Keywords: Starch gelatinization, freezing of native starch, hot-stage light microscopy, gradual loss of birefringence, digital image analysis.

Abstract

Syneresis and retrogradation are relevant phenomena that occur in starchy products as a consequence of starch gelatinization. Despite its importance, there are no scientific studies that focus on the effect of freezing on native starch gelatinization during subsequent heating. In order to improve such understanding, the aim of this study was to characterize and analyze the kinetics of native starch gelatinization when subjected to a freezing-heating cycle, through process miniaturization, using hot-stage polarized light video-microscopy.

Samples of native potato starch were either suspended in water or in a kappaI-carrageenan gel (1% w/w), to understand the effect of water accessibility on gelatinization. Suspensions were either frozen during 48 h in a conventional freezer or immediately heated at 15 °C/min in a hot-stage mounted under the lenses of a polarized-light microscope. Frozen samples were defrosted and subsequently heated under the same conditions. The gelatinization process was recorded and frames were processed and analyzed using image analysis. The degree of gelatinization was quantified as the gradual loss of birefringence, considering a starting threshold of 1.5% birefringence-loss.

Results showed that the gelatinization degree was significantly reduced when water accessibility was limited (gel matrix), both in frozen and unfrozen samples. For instance at 68 °C, water and gel suspensions showed a gelatinization degree of 58 and 16%, respectively, which was reduced to 23 and 7%, respectively, in previously-frozen samples. As can be noticed, prefreezing also reduced significantly the gelatinization kinetics, a phenomenon that we are also currently analyzing using differential scanning calorimetry. Overall, these results may contribute to get a better understanding of the effect of freezing on the microstructural changes that a starchy product may suffer when heated and associated quality attributes.

Acknowledgements: This study was carried out with financial support from FONDECYT project number 1131083 and Project Anillo ACT1105/2012 Healthy Food Matrix Design.

Ref: 3312

Effect of vacuum frying on starch gelatinization and associated digestibility in gluten and starch matrices

***Contardo, Ingrid*[1]*; Bouchon, Pedro*[1]**

[1]Department of Chemical and Bioprocess Engineering, Pontificia Universidad Católica de Chile. Avda. Vicuña Mackenna 4869, Macul, Santiago, Chile

E-mail: imcontardo@uc.cl

Keywords: Frying, vacuum frying, starch, gelatinization, *in vitro* digestibility, resistant starch, bioavailability, digestibility

Abstract

Starch is the main source of carbohydrates in human nutrition. Its nutritional quality is markedly dependent on processing conditions, since they may affect its physical state, which in addition to the interaction with other components within the matrix, may alter the accessibility of hydrolytic enzymes during digestion. Even though the effect of different processing conditions on starch gelatinization has been studied, no main reports about the effect of low pressure processing have been informed. In accordance, the objective of this research was to assess the effect of low pressure frying on starch gelatinization and its *in vitro* digestibility after processing.

To do so, thin square-shaped samples (2 mm thickness, 40% moisture) were formulated using a reconstituted blend of gluten (12% d.b.) and wheat starch (88% d.b.), to accurately control ingredients proportion. Samples were deep-fat fried under atmospheric and vacuum conditions (28 inHg vacuum), keeping a thermal driving force of 70 °C (i.e. Toil – Tboiling-point = 70 °C), up to bubble-end point. The degree of starch gelatinization was assessed by differential scanning calorimetry. *In vitro* digestibility of starch was studied using enzymatic methods and rapidly available glucose (RAG), slowly available glucose (SAG), and unavailable glucose (UG, resistant starch) fractions were determined.

Vacuum fried samples showed a low gelatinization degree (34.75±4.5 %) compared to atmospheric fried ones (99.92±0.1 %), and had a lower content of RAG (32.21±0.4 %) and a higher content of UG (54.91±1.0 %), when compared to their atmospheric counterparts (39.53±0.2 % and 46.41±0.7 %, respectively), denoting lower starch bioavailability. These differences were even bigger when the frying time was reduced (before bubble-end point). This behavior may be a consequence of water boiling-point depression and lower water availability within the matrix. Overall, these results show how low pressure processing may be used to control starch gelatinization and associated digestibility.

Acknowledgements: We would like to thank the financial support from CONICYT and project ANILLO ACT1105/2012 Healthy Food Matrix Design

Ref: 3314

Viscoelastic rheological propeties of salvia gum

Yılmaz, Mustafa Tahsin[1]; Toker, Ömer Said[1]; Sagdic, Osman[1]; Özçelik, Gözde[1]; Karaman, Safa[2]; Tulukçu, Eray[3]

[1]Yıldız Technical University, Chemical and Metallurgical Engineering Faculty, Food Engineering Department, İstanbul, Turkey;
[2]Erciyes University, Engineering Faculty, Food Engineering Department, Kayseri, Turkey;
[3]Selcuk University, Cumra Vocational School, Plant and Animal Production Department, Konya, Turkey

E-mail: mtyilmaz13@gmail.com

Keywords: Salvia gum, viscoelastic characteristic, dynamic and creep/recovery

Abstract

Viscoelastic characteristics of the Salvia gum (1%) were determined at 25 °C using dynamic and creep/recovery rheological measurements. Both of the meaurements were carried out at linear viscoelastic region. Storage modulus (*G'*) value of the Salvia gum solution was determined as higher than loss modulus (*G''*) value, which indicates that Salvia gum solution had elastic character rather than liquid character. *G'* and *G''* values of the solution increased with frequency. Creep and recovery measurement was also performed to also determine viscoelastic properties of the gum solution. Compliance value (*J*(t)) increased with time throughout creep phase. Compliance value as a function of time was satisfactorily described by Burger model (R^2 = 0.9999). Instantenous compliance value (*J0*) was found to be 0.22751 1/Pa. After removal of applied stress, magnitude of *J*(t) decreased with time, meaning that gum solution had recoverable properties. Elastic and viscous share of compliance value of the Salvia gum solution was determined as 48.10% and 51.90%, respectively. Compliance value at 300 and 600 s was found to be 1.28 1/Pa and 0.719 1/Pa, respectively, which indicated that gum solution recovered after removal of applied stress. Recovery percentage of the gum solution was found as 56.17%.

Acknowledgements: This project was funded by TUBİTAK, Projject No: 1120533.

Ref: 3322

Characterization of casein peptides produced by High Hydrostatic Pressure

De Maria[1]; Ferrari, Giovanna[1,2]; Maresca, Paola[2]; Burak, Bilen[3]

[1]Department of Industrial Engineering, University of Salerno, Via Giovanni Paolo II, 84084 Fisciano (SA), ITALY;
[2]ProdAl Scarl, Via Ponte Don Melillo, 84084 Fisciano (SA), ITALY;
[3]Abant Izzet Baysal University, Bolu, Turkey

E-mail: sdemaria@unisa.it

Keywords: Casein, High Pressure Processing, hydrolysis

Abstract

Protein hydrolysis reaction is widely used in the food industry to modify proteins structure resulting in an increase of their functional properties or digestibility and/or a reduction of their allergenic power. The proteolysis reaction is influenced by the conformational structure of the protein, affecting the accessibility of the enzymes to peptide bonds. To overcome this problem, treatments based on thermal as well non thermal technologies (mainly High Hydrostatic Pressure) are likely to be used since they are able to induce protein modification, thus leading to an increase of proteolysis.
The aim of this work is to study the effects of process parameters on the formation of casein peptides during and after High Hydrostatic Pressure (HHP) treatments.
Casein solution dissolved in sodium phosphate buffer (5 mg/mL, pH=8) were hydrolyzed utilizing two different enzymes, chymotrypsin and trypsin (with an E/S ratio equal to 1/10) in the pressure range between 100 - 400 MPa and different treatment times (10, 15, 20 and 25 min) at 37 °C. The proteolysis was carried out under pressure (HHP assisted hydrolysis), or on the samples previously treated under pressure (HHP induced hydrolysis). The extent of the hydrolysis was evaluated by determining the hydrolysis degree (HD) by OPA method. The structural changes of the peptides were assessed determining their molecular weight distributions and particle size distributions.
The results obtained so far showed that the HD of samples treated with HHP assisted hydrolysis or HHP induced hydrolysis increases with respect to that occurring at atmospheric pressure. The higher HD was measured in sample hydrolyzed under high pressure at 300 MPa and 25 minutes. The proteolysis level measured when HHP assisted hydrolysis is conducted in more drastic processing conditions is lower due to the enzyme's inactivation induced by high pressure

Ref: 3329

The effect of phytosterols addition on the textural properties of extruded crisp bread

Gondek, Ewa[1]; Jakubczyk, Ewa[1]; Wieczorek, Beata[1]

[1]Warsaw University of Life Sciences, Department of Food Engineering and Process Management, Poland

E-mail: ewa_jakubczyk@sggw.pl

Keywords: Texture, acoustic properties, extruded bread

Abstract

The aim of this work was to determine the effect of sterols addition on the texture of bread. The products (rye crisp bread with and without addition of phytosterols) were made by co-extrusion cooking method using Clextral extruder BC45. The selected physical properties of bread were analysed: water content, water activity, the particle density, the porosity, Water Solubility Index (WSI), Water Adsorption Index (WAI). The mechanical and acoustic properties of breads were examined using of texture analyser with a probe P/36R. The generated sound was recorded during penetration test using the microphone 4189 Bruel&Kjaer and an acoustic envelope detector (AED). The material vibrations were recorded using the sensors 4381 and 4507B Bruel&Kjaer (AE method). The sensory properties of bread were analysed: taste, colour, and texture. The sensory analysis of texture was performed using the scaling method. The selected acoustic parameters were extracted: number of sound peaks, amplitude, energy of single AE event, total number of AE events, total acoustic energy and average spectral characteristic of AE signal. A higher water content and activity as well as a lower apparent and particle densities were observed for the rye bread with phytosterols. The addition of sterols caused the increase of WSI at the same level of WAI of bread. The similar spectral characteristics of sounds were observed for all samples. The maxima of acoustic energy were noted at frequencies from the same ranges 3-4 and 7-8 kHz. The addition of phytosterol leaded to the increase of number of AE events. The energy of single EA event was lower for bread without phytosterols. The sensory analysis showed that bread with plant sterols was perceived more crispy and harder than rye bread. The additions of phytosterols did not affect the bread odour but the negligible deterioration of bread taste was observed by the panellists.

Ref: 3332

Generation of microgels though microfluidics

Ushikubo, Fernanda Yumi[1]; Cunha, Rosiane Lopes[1]

[1]University of Campinas, Brazil

E-mail: yumi.ushikubo@gmail.com

Keywords: Microgel, microfluidics, gellan gum

Abstract

Microfluidic devices can be used to generate microgels with narrow size distribution and high encapsulation efficiency. Although most studies on microfluidics are focused on alginate microgels, there are no reports with gellan gum. Gellan gum is an interesting biopolymer because of its high resistance at low pH conditions, which allows particles to pass intact through the stomach, so that the compound can be released only in the intestine. Thus, this study aimed to study the formation of gellan microgels through two different strategies: external gelation and mixing at the junction. In the former method, a biopolymer droplet is formed at the microchannel junction and the crosslinking agent in the continuous phase diffuses to the droplet. In the latter, the biopolymer and crosslinking agent solutions encounter each other at the microchannel junction, followed by the immediate droplet detachment. In both methods, the biopolymer solution was composed by low acyl gellan gum solution and the continuous phase, by soybean oil with PGPR. In external gelation method, calcium acetate was added to the continuous phase. In the mixing method, calcium chloride solution was used. The device used in the external gelation was designed with two inlet channels, while in the mixing method the chip contained three inlets. As a result, the mixing method generated weak gels, which coalesced after being collected from the chip. This result occurred because of the low final concentration of the gellan gel. On the other hand, in external gelation method, microgels with low polydispersity were successfully obtained. Their size was controlled by the flow rate rate between the phases. Despite that, the confocal microscopy of the microgels showed that the gelling did not occurred homogeneously. This study showed that microfluidic techniques can be successfully used for the generation of highly monodisperse microgels with tunable size.

Acknowledgements: The authors thank the technical support given by Professor Angelo Gobbi and Maria Helena de Oliveira Piazzeto of the Microfabrication Laboratory at the Brazilian Center for Research in Energy and Materials (CNPEM) and the research support by São Paulo Foundation (FAPESP 2010/16.708-4 and 2011/06.083-0).

Ref: 3334

Influence of High Hydrostatic Pressures (HHP) on the fresh cheese texture

Torres, Edwin Fabian Bello[1]; González-Martinez, Gerardo[2]; Klotz, Bernadette[2]; Martinez-López, Antonio[1]

[1]Instituto de Agroquímica y Tecnología de Alimentos (IATA-CSIC) Avenida Agustín Escardino, 7 Parque Científico 46980 Paterna, Valencia, Spain;
[2]Instituto Alpina de Investigación, Edificio Corporativo Alpina Productos Alimenticios S.A, Km 3 vía Briceño-Sopó -(Cundinamarca), Colombia.

E-mail: fabiant20@gmail.com

Keywords: High Hydrostatic pressures, fresh cheese, texture, shelf-life

Abstract

In recent years the world market has introduced a surge in the production of cheese. According to studies by the Food and Agriculture Organization (FAO) and the Organization for Economic Co-operation and Development (OECD) cheese production presented a significant increase exceeding the current rate of 40% of all milk produced worldwide. Due to this growth, the food industry has driven the development of new industrial processes that generate added value to their products. Within these developments is the use of HHP technology belonging to the group of non- thermal food preservation technologies .The high pressure is currently used to inactivate enzymes and microorganisms in food. The aim of this study was to evaluate changes in hardness, adhesiveness and chewiness of fresh cheese treated by HHP and stored 63 days at temperatures of 4 and 10 °C. Fresh cheese was packaged in metallized polypropylene bags and treaty at 400 MPa for 1 minute at 20 °C. The texture measurement was performed every 7 days, following the established methodology. Regarding the influence of the High pressure on fresh cheese at time 0, hardness values (2214.26±101.3 and 2023.71±100.2 g), adhesiveness (-117.81±7.1 g. sec) and chewiness (1325.7± 77.6 g. mm) thus observed that there was no significant difference between the untreated control and treated by HHP. However, in the study of shelf-life for 63 days were generated hardness values (1587.92 ± 29.6 and 1500.8 ± 30.4 g) (P = 0.04), adhesiveness (-111.2 ±3.4 and -139.53±3.5 g.sec) (P = 0.00) and chewiness (1135.1 ± 27.6 and 1111.8 ± 28.0 g.mm) (P = 0.55) respectively for temperatures of 4 and 10 °C.

Acknowledgements: We want to thank Alpina Research Institute (IAI) of Colombia for providing the necessary funds for this work and the Institute of Agrochemistry and Food Technology (IATA-CSIC) for their facilities.

Ref: 3337

Understanding the mechanisms of emulsification in oil-water emulsions stabilized by *Saccharomyces cerevisiae*

***De Figueiredo Furtado, Guilherme*[1]; *Siqueira Franco Picone, Carolina*[1]; *Gouveia Colnaghi, Beatriz*[1]; *Cunha, Rosiane Lopes Da*[1]**

[1]University of Campinas, Brazil

E-mail: furtado.gf@gmail.com

Keywords: Emulsion, stability

Abstract

The emulsion formation is quite common in some fermentative processes and undesired in a number of processes as fuel and chemicals production, bioremediation and microbial desulfurization. The knowledge of emulsion stabilization mechanism is essential for the development of effective de-stabilization process and product recovery. The ability of fresh yeast cells to stabilize oil-in-water emulsions was evaluated and the effect of oil properties on the stabilization mechanisms was studied using different oils: olive oil, silicon and hexadecane. Emulsions were prepared by an aqueous phase of yeast cells (*Saccharomyces cerevisiae*) (0.75, 3.75, 7.47, 14.84 and 22.11 (%, w/w)) in Milli-Q water mixed with oil phase. The ratio between the oil:aqueous phase was kept constant in 30:70 (v/v). The morphology, droplet size distribution and rheology of emulsions were evaluated. In addition, the interfacial tension between the aqueous and oil phases was determined using a drop tensiometer. All the emulsions separated in three phases after preparation, however the volume of each phase was different according to the oil and yeast concentration. The emulsions with silicon oil were more stable which was attributed to its higher viscosity that hindered droplets aggregation and coalescence, whilst the emulsions composed by olive oil presented lower stability. The emulsion morphologies reveal that the yeast adsorbed into the interface acting as a mechanical barrier to droplets coalescence. However, a decrease in the interfacial tension between the phases was observed as the concentration of yeast increased, suggesting an additional stabilization mechanism besides of the possible Pickering-kind stabilization. The yeast affinity by the interface was higher for hexadecane showing that the stabilizing mechanisms depend not only on the surfactant but also the phase composition and properties.

Acknowledgements: CNPq and FAPESP (2011/51707-1)

Ref: 4336

Novel fermented fruit products with functional value

***Coelho, Eduardo*[1]*; Teixeira, José*[1]*; Domingues, Lucília*[1]

[1]Centro de Engenharia Biológica - Universidade do Minho

E-mail: ecoelho87@gmail.com

Keywords: Functional foods, fruits, antioxidant activity, alcoholic fermentation, acetic fermentation

Abstract

Considering a rising demand for novel food products, enriched with functional properties, and fruits as the main source of diversity for food formulations, this work focuses on the application of alcoholic and acetic fermentation processes to obtain novel food products with antioxidant potential. Besides generating differentiated food grade products, fermentation allows an extension of the shelf-life of the raw materials and the use of fruits not suitable for direct sale due to morphological nonconformities or advanced maturation. For this, we used industrially processed concentrates of orange, cherry, mango and banana to produce fruit wines and fruit vinegars. The use of concentrates allowed the production of fruit wines with ethanol yields between 8.66±0.51 % (v/v) and 12.79±0.23 % (v/v), with characteristics close to a wine grade product. From fruit wines, fruit vinegars were produced with total acidities close to 5% as expected for this type of vinegar. Total antioxidant activity was assessed in the fruit wines and vinegars by FRAP, allowing an insight of fermentation impact on the antioxidant potential of the fermented fruit products. Orange and cherry wines and vinegars demonstrated higher antioxidant potential when compared with mango and banana wines and vinegars. Antioxidant activities in fruit wines ranged between 7144.05±770.41 µmol Fe_2SO_4/L for mango wine and 28040.00±1848.10 µmol Fe_2SO_4/L for cherry wine. In fruit vinegars, antioxidant activities ranged from 3700.95±349.41 µmol Fe_2SO_4/L for banana vinegar to 18563.81±2333.94 µmol Fe_2SO_4/L for cherry vinegar. Overall, fruit wines showed 0.5 to 0.9 folds higher antioxidant activities than the one reported as naturally occurring in the given fruits. Fermentation impact on antioxidant activity of fruits was low, being observed a reduction of total antioxidant activity from 0.1 to 0.2 folds during alcoholic fermentation and in a higher range from 0.1 to 0.5 folds in vinegars.

Acknowledgements: Authors would like to aknowledge the FruitVinegarDRINK QREN Project (ref. 23209), Project “BioInd - Biotechnology and Bioengineering for improved Industrial and Agro-Food processes, REF. NORTE-07-0124-FEDER-000028” Co-funded by the Programa Operacional Regional do Norte (ON.2 – O Novo Norte), QREN, FEDER and the FCT Strategic Project PEst-OE/EQB/LA0023/2013.

Ref: 4339

Fresh-cut pear quality during storage: a NMR study of water transverse relaxation time

Fundo, Joana[1]; Carvalho, Alexandra[2]; Feio, Gabriel[2]; Silva, Cristina L. M.[1]; Quintas, Mafalda A. C.[1,3]

[1]CBQF – Centro de Biotecnologia e Química Fina – Laboratório Associado, Escola Superior de Biotecnologia, Centro Regional do Porto da Universidade Católica Portuguesa, Porto;
[2]CENIMAT-I3N, Departamento de Ciência dos Materiais, Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, Caparica, Portugal;
[3]IBB, Centre of Biological Engineering, Universidade do Minho, Braga, Portugal

E-mail: jfundo@porto.ucp.pt

Keywords: Molecular mobility, quality parameters, storage, wounding, fresh-cut pear

Abstract

Fresh-cut fruits have become an important food market segment due to increasing demand for fresh, healthy and convenient foods. However, processing fruits promotes a decrease in its stability with a faster physiological deterioration, biochemical changes and microbial degradation. Recently, food stability is strongly attributed to molecular dynamics and "water availability". Understanding cooperatively changes in location and mobility of water is particularly important, considering that water dynamics profoundly influences physico-chemical and microbiological quality of foods.

The aim of this study was to use nuclear magnetic resonance spectroscopy (NMR) as a tool to evaluate storage fresh-cut fruit quality. Recently, NMR has evolved to become a powerful methodology to probe the molecular dynamics of food constituents, which in turns is a fundamental parameter to determine the dynamic properties of food components and contributes to food degradation reactions comprehension.

In this work fresh-cut pear transverse relaxation time (*T2*) was measured for a period of 7 days of storage at 5 °C. The relationship between the obtained values, microstructure and quality parameters was investigated. In general, results show the existence of one class of water fluidity in the system, the one present in cells after processing. *T2*, a measure of this fluidity, is affected by the processing and storage time. Also, it is possible to find a relationships between *T2* and the quality parameters: total colour difference (TCD), firmness and *aw*. *T2* increases with *aw*, while it decreases with TCD and firmness.

These results highlight the usefulness of NMR methodology application in food science.

Acknowledgements: Author Joana F. Fundo acknowledges Fundacão para a Ciência e a Tecnologia (grant SFRH/ BD / 62176 / 2009). The authors acknowledge the Portuguese NMR

Network and Strategic Project PEst-C/CTM/LA0025/2013-14. This work was supported by National Funds from FCT through project PEst-OE/EQB/LA0016/2013.

Ref: 4341

Effects of different binders on the structure modification and reconstitution behaviour of dairy powders in fluid bed agglomeration

Ji, Junfu[1,2]; Miao, Song[1]; Cronin, Kevin[2]; Fitzpatrick, John[2]; Fenelon, Mark[1]

[1]Teagasc Food Research Centre, Moorepark, Fermoy, Co. Cork, Ireland;
[2]School of Engineering, University College Cork, Cork, Ireland

E-mail: junfu.ji@teagasc.ie

Keywords: Reconstitution properties, agglomerate size, fluid bed agglomeration, binders, density, morphology

Abstract

The type of binder liquid used in the fluid bed agglomeration process significantly influences the structures and reconstitution properties of the aggregates. In this study, milk protein isolate (MPI), as a model system, was agglomerated in a fluid bed granulator with three different binders: water, lactose and sucrose solution (15% w/v). The effect of the binders on the density, morphology and subsequent reconstitution behaviours of the agglomerated MPI was investigated. Morphology was quantified by circularity, convexity and elongation using a Malvern Morphologi G3. Wettability was measured by the modified Washburn dynamic method and dispersibility was quantified by dynamic particle size reduction during dissolution. Solubility was evaluated by three time-dependent indexes, which were turbidity, solid concentration of supernatant and the weight of sediments. The results showed that granules with water as the binder produced the highest particle density and porosity while exhibiting significantly lowest circularity and convexity and highest elongation. Meanwhile, the agglomerate size was related with further agglomerates' reconstitution behaviours. An increase in the size of the agglomerated MPI corresponded with an increase in the wettability but dispersibility and solubility decreased. Granules agglomerated with hydrophilic sugars were found to contribute differently which improved the wettability significantly but negatively influenced the kinetics of dispersion and dissolution.

Acknowledgements: The study was supported financially by the Food Institutional Research Measure (FIRM) of the Department of Agriculture and Food and Fisheries Ireland under the project on 'Formulation and Design for Food Structure and stability'.

Ref: 4342

Effect of cellulose nanocrystals addition on physical and microstructure properties of pea starch: PVA composite films

González, Chelo[1]; Cano Embuena, Amalia Isabel[1]

[1]Insituto Universitario de Ingeniería de Alimentos para el Desarrollo, Universidad Politécnica de Valencia, Spain

E-mail: amcaem@upvnet.upv.es

Keywords: AFM, CNC, FESEM, mechanical, pea starch, reinforcement

Abstract

In the present work, the effect of incorporating the cellulose nanocrystals (CNC) on microstructure, mechanical properties and gloss of pea starch-poly(vinyl alcohol) composite films stored during one and five weeks under controlled conditions (25 °C-53%RH) was studied. To this aim, the mechanical and optical properties were measured following ASTM standard methods in terms of elastic modulus, tensile strength and percentage of elongation at break and the gloss at incidence angle of 60°, respectively. Film microstructure was analyzed by means of FESEM and AFM. The results showed that cellulose nanocrystals influenced the films physical properties. Thus, the CNC incorporation gave rise a slightly more glossy films but these differences were not statistically significant ($p>0.05$). These results are in agreement with the surface FESEM observations, where similar roughness between films was observed. Incorporation of CNC provided films with greater ($p<0.05$) stiffness and stretchability, especially when increasing the CNC content in the films (3% and 5%). The results obtained from AFM (peak force mode) confirmed also the increment of the DMT modulus, due to the presence of CNC. On the other hand, the addition of CNC did not affect the resistance (similar values of tensile strength were obtained) of films. No significant changes were observed in the physical properties of the films due to storage time, thus indicating the polymeric matrix structure is likely to remain largely unchanged throughout time. FESEM micrographs of composite films showed the presence of some irregularities typical from semi-crystalline structures, as a consequence of the arrangement of some segments of the polymer chains. In conclusion, the incorporation of cellulose nanocrystals into starch-PVA matrix led to stiffer and more stretchable films, thus indicating that the cellulose nanocrystals are a good tool to reinforce the mechanical response of these flms.

Acknowledgements: The authors wish to acknowledge the finance support from Spanish Ministerio de Economía y Competitividad throughout the prject AGL2010-20694, con-financed with FEDER founds.

Ref: 4343

Influence of spray drying conditions on the functional properties of blueberry powder

Tatar, Feyza[1]; Tunç, Merve Tuğçe[2]; Cengiz, Alime[1]; Dervisoglu, Muhammed[1]; Kahyaoglu, Talip[1,3]

[1]Department of Food Engineering, Engineering Faculty, Ondokuz Mayıs University, 55139 Samsun, Turkey;
[2]Department of Food Engineering, Engineering Faculty, Gümüşhane University, 29100, Gümüşhane, Turkey;
[3]Department of Food Engineering, Chemistry-Metallurgical Faculty, Yıldız Technical University, 34210, Istanbul, Turkey

E-mail: talipk@yildiz.edu.tr

Keywords: Blueberry, anthocyanins, plackett-burman design, spray drying

Abstract

Blueberry fruit is recognized for their high anthocyanin, flavonoid content and antioxidant activity. The main drawback of the use of blueberries is their short shelf life. Spray drying of blueberry pulp has economical potential and represents an alternative for improved fruit conservation. In this study, a Plackett-Burman experimental design technique was used to investigate the influence of spray drying conditions on the blueberry powder. Inlet air temperature (120 and 180 °C), feed pump rate (20% and 40%), DE of maltodextrin (6 and 15 DE), maltodextrin concentration (10% and 30%) and source of blueberry (Duke and Darrow) were independent variables, tested at high (+1) and low (-1) levels. Anthocyanin content was the dependent variable. In addition, antioxidant activity, total phenolic content, water solubility, water activity and bulk density were measured for blueberry powders. The antioxidant activity of blueberry powders ranged from 352 to 852 mmol Trolox and the total phenolic content was changed from 474 to 880 mg GAE/g. Anthocyanin content were significantly affected ($p<0.05$) by inlet air temperature and maltodextrin concentration. Anthocyanin content increased with decreasing inlet air temperature and maltodextrin concentration. The highest in the content of anthocyanin content could be produced by spray drying at 128 °C inlet air temperature, 37% pump rate, 6 DE of maltodextrin, 11% maltodextrin concentration and source of duke blueberry.

Acknowledgements: This research was supported by TUBİTAK with the project number 112O828 (Ankara, Turkey).

Ref: 4347

The influence of OSA starch on thermo-mechanical properties of wheat dough in the presence of added gluten and salt

***Pojic, Milica*[2]; *Dapcevic Hadnadjev, Tamara*[2]; *Hadnadjev, Miroslav*[2]; *Torbica, Aleksandra*[2]; *Musse, Maja*[1]; *Lucas, Tiphaine*[1]**

[1]Université Européenne de Bretagne, Rennes, France;
[2]Instutute of Food Technology, University of Novi Sad, Novi Sad, Serbia

E-mail: milica.pojic@fins.uns.ac.rs

Keywords: OSA starch, gluten, salt, thermo-mechanical properties, wheat dough

Abstract

Every ingredient used in bread baking (flour, water, salt, yeast and additive) has a very specific function with the ultimate aim – the improvement of bread quality. The improving effect can be claimed to both salt addition, which strengthen gluten and control dough fermentation, and additives with a broad spectrum of improving effects. Recent studies revealed the positive impacts of OSA starches (starches modified with octenyl succinic anhydride) in bread baking. This study was carried out to determine the most influential ingredients commonly used in bread baking (salt, OSA starch, and gluten) on the thermomechanical properties of wheat dough. A screening experimental design - resolution V irregular fraction design - was applied, where the flour quality and gluten addition (in concentration which compensate gluten dilution caused by partial replacement of flour with OSA starch) were treated as categoric factors, while OSA starch content up to 10% and salt content up to 2% were treated as numeric factors. The thermo-mechanical properties of wheat dough were determined using Mixolab, so the treated responses were: water absorption, dough development time, dough stability (C2), starch gelatinization (C3), cooking stability (C4), starch gelling (C5) as well as derived parameters protein weakening rate (C2-C1), starch gelatinization rate (C3-C2), cooking stability rate (C3-C4) and starch retrogradation rate (C5-C4). It was found that water absorption was significantly affected by flour quality and interactions between flour quality and gluten, the presence of OSA starch and salt, respectively. The interactions were also observed between gluten and OSA starch addition and salt, respectively. Dough development time, dough stability and strength (C2), starch gelatinization (C3), cooking stability (C4) and cooking stability rate were not significantly affected. However, starch gelling (C5) and starch retrogradation rate were significantly affected by flour quality, the presence of OSA starch, the interaction between flour quality and gluten, OSA starch and salt, respectively, as well as gluten and salt. The obtained results indicated that the improving effect of OSA starch on the

thermo-mechanical properties of wheat dough is not necessarily implied, but it depends on the applied formulation and flour quality.

Acknowledgements: Financial supported of the Ministry of Education, Science and Technological Development, Serbia (Pr.No.TR31007), scientific bilateral program between Serbia and France and the Provincial Secretariat for Science and Technological Development, The Autonomous Province of Vojvodina, Serbia is highly appreciated.

Ref: 4349

Impact of conventional thermal versus innovative cold atmospheric plasma processing on the techno-functional protein properties from *Pisum sativum*

Bußler, Sara[1]; Ehlbeck, Jörg[2]; Schlüter, Oliver[1]

[1]Leibniz Institute for Agricultural Engineering (ATB), Germany;
[2]Leibniz Institute for Plasma Science and Technology (INP), Germany

E-mail: sbussler@atb-potsdam.de

Keywords: Cold atmospheric pressure plasma, modification, functionalization, dry bulk material

Abstract

Cold atmospheric pressure plasma (CAPP) enables a microbial multi-target inactivation but the available knowledge on product-process interactions is rare. CAPP is assembled of various reactive species interacting with the product surface and thereforehas been applied in diverse research fields to achieve the following purposes: produce special functional groups at the surface, increase surface energy and hydrophobicity, introduce surface cross-linking and remove weak boundary layers or contaminants. Similar to polymer research the modification of surface morphology is of great importance in food science in particular since dry raw materials or intermediate products do not provide required functional properties.
The impact of CAPP treatment on techno-functional properties of high-protein pea flour and pea protein isolate was investigated during storage and compared to conventional thermal treatment in a drying cabinet. CAPP was generated using a dielectric barrier discharge device varying the exposure time from 1 to 10 min. Depending on the extraction conditions the solubility of the protein isolate (purity ≥ 90%) was increased to 185% (dist. Water) or decreased to 75% (buffer ph 9) accompanied by decreasing ph values from 4.1 and 5.6 to 3.4 and 4.6, respectively. Based on the total protein content, the protein yield from high-protein pea flour was slightly decreased from 65 % to 58 % by extending the exposure time to CAPP, whereas fat and water binding capacities rose to 107.7 % and 119.5 %, respectively. Thermal treatment (40 to 100 °C) in contrast led to increasing protein yields of 70 %, whereas fat and water binding capacities were only marginally affected. For both treatments the effects on dry matter contents and particle size distributions were negligible. CAPP treatment led to minor color deviation. Spectrometric analyses of the intrinsic fluorophor tryptophan and gel electrophoresis (SDS-PAGE) were applied in order to study the effects on structure and composition of the recovered proteins.

Acknowledgements: These studies are part of the project 'leguAN' (511-06.01-28-1-54.075-10), which was funded by the Federal Ministry of Food and Agriculture (BMEL) and supported by the Federal Office for Agriculture and Food (BLE) within the innovation program.

Ref: 4350

Development of a lentil based meal substitute produced by extrusion cooking

Pereira, João[1]; Beirão da Costa, Sara[1]; Moldão Martins, Margarida[1]; Beirão da Costa, Maria Luisa[1]

[1]CEER-Biosystems Engineering, ISA, U.Lisboa

E-mail: lbeirao@isa.utl.pt

Keywords: Lentil, extrusion-cooking, partial meal substitute, texture, structure

Abstract

Today lifestyle and concerns about health, changed consumers buying intentions of functional/convenient products. Meal replacements, foods developed to become part of a balanced diet providing the right amount of nutrients, have gained importance. At present those products are associated mainly with specific purposes diets. In the market, meal substitutes are mostly beverages and bars, showing limitations, about the effective suppression of the nutritional needs and on available tastes.

The present study concerns the development, of a lentil-based food, produced by extrusion-cooking in a Brabender single screw extruder that can replace a main dish of a balanced meal, having as consumer target active women (24-54 years old). A differentiated innovative nutritionally and sensory rich final product is expected by introducing in formulations vegetables, fruits, aromatic plants and spices, in a dried state - coriander, parsley, thyme, garlic, oregano, saffron, mushrooms, tomato and green pepper, leek, carrot and mint.

In a first stage, the effects of processing parameters on lentil flour extrudates - conditioning degree (15, 20%) and extrusion temperatures (T1= 100-150-180 °C; T2= 100-170 -200 °C and T3= 100-180 -220 °C) were evaluated on texture, expansion rate, volumetric mass, antioxidant activity , color and structure. The results showed that increasing processing temperature: decreases the colour parameters, the volumetric mass, hardness, antioxidant activity and increases the expansion rate. The conditioning levels didn't lead to significant differences in the expansion rate, although affecting other parameters. Based on results and on organoleptic assessment, 15% conditioning and T=100-170-200 °C were selected conditions. Fiber enriched extrudates were lower in values of expansion rate, higher in density and hardness. Still, hardness values only differ significantly from the base formulation for mixtures with carrots, tomato and leek. Lightness, showed decreases when those materials were introduced. The inclusion of different ingredientes and procesing conditions clearly affected structure properties. All ingredients presented antioxidant activity (AA), in a decreasing order: mint,

mushrooms, oregano, saffron, thyme, coriander, lentils, peppers, carrot, leek, parsley, tomatoes and garlic.
The extrudates still preserved AA and so lentil based products are interesting for the selected food segment.

Ref: 4351

Dissolution of salt microcrystals in artificial saliva

***Quilaqueo, Marcela*[1]*; Aguilera, José Miguel*[1]**

[1]Pontificia Universidad Católica, Chile

E-mail: mcquilaqueo@uc.cl

Keywords: Salt reduction, dissolution, artificial saliva

Abstract

The salt (sodium chloride) added into foods, both as tastant, as to extend its shelf life, leads to increase sodium level in the human body causing health problems. Due to the salt intake is high in several countries, the WHO recommends decrease its level to 5 g per day. In order to forward in development of strategies that permit salt decrease in the foods, is important to know the factors that affect the salt dissolution in the saliva. The aim of this work was to compare the dissolution of different structures of salt crystals. Salt particles as granular crystals (obtained directly of grocery), as spray-dried particles and, as freeze-dryed particles were examined under scanning electronic microscopy in order to know particle structure. Then, the dissolution of salt particles in artificial saliva was measured by conductivity.

It was determined that spray-dried salt and freeze dried salt, are processes that permit obtain microparticles (size lower than 50 µm) while keeping it crystalline condition. The dissolution time of microcrystals was lower that the granular crystals. Spray-dried salt showed dissolution time higher than freeze-dried particles due to agglomeration present in that samples. The agglomeration of salt microcrystal should further investigate due its great influence in dissolution of salt, because can be detrimental when it seeks to dissolve the salt of foods in the mouth, in low time.

Ref: 4352

A layer-by-layer approach for curcumin encapsulation for food applications

Silva, Hélder[2]; Donsì, Francesco[1]; Cerqueira, Miguel[2]; Ferrari, Giovanna[1]; Vicente, António[2]

[1]University of Salerno, Italy;
[2]University of Minho, Braga, Portugal

E-mail: heldersilva@deb.uminho.pt

Keywords: Nanoemulsion, multilayer nanoemulsion, layer by layer, curcumin

Abstract

Driven by the consumers' needs for new, healthier and safer food products, the food industry is seeking for edible systems able to encapsulate, protect and release lipophilic functional compounds. Nanoemulsion-based technology offers the methodologies for encapsulate, protect and control release, while improving the solubility and bioavailability of these compounds.

The present work aimed at preparing stable curcumin nanoemulsions and multilayer nanoemulsions as potential bioactive compounds for food formulations.

Curcumin nanoemulsions and multilayer nanoemulsions were prepared using high-pressure homogenization and the electrostatic layer-by-layer deposition techniques, respectively. Chitosan was used to build the first and third layers, being the second layer formed by alginate. The size stability and zeta potential studies showed that both systems were stable in time, during storage (60 days), obtaining hydrodynamic diameters of 80, 110 and 140 nm for the nanoemulsion, second and third layer, respectively. Size stability against different pH's was also evaluated, being both nanosystems stable between the pH ranges of 2 to 12, where the pKa values of chitosan and alginate can influence the swelling and release of the multilayer nanoemulsions.

Curcumin release studies showed that only curcumin nanoemulsions allowed release of this compound; results clearly showed that the addition of biopolymers layers (multilayer nanoemulsions) reinforced the stability of these structures, avoiding curcumin release.

This work shows that it is possible to prepare multi-layer oil-in-water nanoemulsions through LbL technique using edible biopolymers and that this technology offers the potential to significantly improve solubility and bioavailability of bioactive compounds with different release kinetics profiles.

Acknowledgements: The authors thank the FCT Strategic Project PEst-OE/EQB/LA0023/2013 and the project "BioInd- Biotechnology and Bioengineering for improved Industrial and Agro-

Food processes", REF.NORTE-07-0124-FEDER-000028 Co-funded by the Programa Operacional Regional do Norte (ON.2 – O Novo Norte), QREN, FEDER.

Ref: 4353

Brewers spent yeast in bread dough struture development

Franco, Fátima[1]; Alves, Vitor[1]; Beirão da Costa, Sara[1]; Beirão da, Maria Luisa[1]

[1]CEER-Biosystems Engineering. ISA, U. Lisbon, Portugal

E-mail: lbeirao@isa.utl.pt

Keywords: Enrichment of wheat breads, Spent brewer's yeast, chemical dough development

Abstract

Brewer's spent yeast constitutes a huge amount of by-products generally used in feed production. However its nutritional value may contribute to food products enrichment. Wheat bread is an important staple food around the world, so allowing to be an excellent vehicle to food diet enrichment .However the replacement of wheat flour by other sources generally imparts to dough and bread structure and texture deleterious characteristics imposing adjustments of both formula and process conditions. The present study started having as main objective to evaluate the ability of spray dried spent yeast (SDSY) to add nutritional/functional value to bread (mainly due to β-glucans content). To these purpose the rheological properties of doughs were assesssed at different levels of replacement using both empirical (farinograph and extensograph methods) and fundamental approaches (HAAKE™ MARS III Rotational rheometerr). Those trials were compared to the same level of replacement of wheat flour by regular baker's yeast in both compressed and dried form.

The extensograph results showed a high proteolytic activity of SDSY when compared to baker's yeasts. Besides this yeast still preserves a relatively high fermentative activity.

The previous results lead to a second set of trials aiming to understand whether SDSY may be used in dough structure development as alternative to Chemical Development Method (CDD) of bread production, simultaneously reducing total dough bread fermentation times without increasing baker's yeast level of incorporation.

CDD typically used a reducing agent (cysteine) and an antioxidant (ascorbic acid) to accelerate dough development time. In this regard the traditional CDD method was compared to the use of SDSY.

Results showed that SPSY may be an alternative to CDD method

Acknowledgements: Acknowledge are due to Unicer Bebidas, SA by supliying spent yeast

Ref: 4356

Development of an edible coating for preservation of Serra da Estrela cheese: surface characterization and coating formulation

C. Maciel, Luís[1]; R. Figueiredo, Paulo[2]; B. Rocha, João[2]; M. Nunes, João[2]; A. Teixeira, José[1]; A. Vicente, António[1]

[1]Centro de Engenharia Biológica, Universidade do Minho, Braga, Portugal;
[2]BLC3 Association, Platform for the Development of Central Inner Region, 3400-060 Oliveira do Hospital, Portugal

E-mail: luiscbmaciel@gmail.com

Keywords: Serra da Estrela cheese, edible film, surface energy, spreading coefficient

Abstract

Serra da Estrela cheese is the most prestigious traditional Portuguese cheese, being recognized worldwide. In order to prolong the shelf life of this product, which occurs mostly by external spoilage and growth of fungi and moulds on its surface, the application of an edible coating has been considered. For this purpose, the external surface characterization was performed and the type of surface determined. For this, the sessile drop method was applied, i.e. the contact angle between the surface and the droplet of three pure liquids - bromonaphthalene, formamide and water - was calculated and the surface energy was determined. Polar and apolar components obtained were 7.09 mN/m and 35.53 mN/m, being the cheese surface tension 42.62 mN/m, which means that the cheese has a low surface energy (i.e. <100 mN/m). This value allows using Zisman's method and calculating the critical surface tension (32.68 mN/m). In order to determine the coating formulation with the best composition for application on cheese, the wettability of 27 formulations (three different polymers were used - alginate, guar gum and chitosan - with different concentrations of glycerol and Tween 20, totaling 9 formulations for each polymer) was evaluated. Formulations with 1% (w/v) alginate with 0.1% (w/v) of glycerol and 0.15% (w/v) of Tween 20; 1% (w/v) guar gum with 0.3% (w/v) of glycerol and 0.15% (w/v) of Tween 20; 1% (w/v) chitosan with 0.3% (w/v) of glycerol and 0.15% (w/v) of Tween 20, were the solutions with better wetting capacity on cheese surface. The spreading coefficients were -15.20 mN/m, -21.83 mN/m and -15.07 mN/m for alginate, guar gum and chitosan solutions, respectively. Pareto charts analysis allowed concluding that for alginate-based coatings, the variation of the polymer formulation, together with glycerol and Tween 20 concentrations have significant influence on the values obtained. The same happened in guar gum films. Regarding the coatings containing chitosan, it is only the biopolymer concentration that has significant influence on the values of wettability. These

three alternative compositions for edible coatings can now be tested aiming at valorizing this traditional cheese by improving its shelf-life and marketing potential.

Acknowledgements: The authors thank the FCT Strategic Project PEst-OE/EQB/LA0023/2013 and the project “BioInd - Biotechnology and Bioengineering for improved Industrial and Agro-Food processes", REF. NORTE-07-0124-FEDER-000028 Co-funded by the Programa Operacional Regional do Norte (ON.2 – O Novo Norte), QREN, FEDER.

Ref: 4361

Adsorption properties of chemical modified porous starches

Le Thanh-Blicharz, Joanna[1]; Bryła, Anna[2]; Lewandowicz, Jacek[3]; Walkowski, Aleksander[1]

[1]Department of Food Concentrates and Starch Products in Poznań, Institute of Agricultural and Food Biotechnology, Poznań, Poland;
[2]Department of Biotechnology and Food Microbiology, Poznań University of Life Science, Poznań, Poland;
[3]Department of Natural Science and Quality Assurance, Poznań University of Economics, Poznań, Poland

E-mail: anna.bryla@up.poznan.pl

Keywords: Porous starch, oxidized starch, Fe ions, polyunsaturated fatty acids

Abstract

Biodegradable starch-based porous biomaterials have great potential as a solid dispersion carrier for a wide range of bioactive substances of inorganic and organic origin. Porous starches with abundant micro-sized pores have extensive application on food, pharmaceutics, tissue engineering, agriculture, cosmetics, pulp and paper and other industries.
This work is carried out to synthesis of chemical modified porous potato starches and determination of their adsorption properties for divalent Fe ions and oils soluble biological active substances such as E-vitamin and polyunsaturated fatty acids.
As a starting material oxidized potato starches of two different substitution degrees have been used. Porous starches were prepared by replacing ice water crystals in frozen starch gels with ethanol using a solvent exchange technique. Determination of iron content in starches was performed with Flame Atomic Absorption Spectroscopy (F-AAS) using Varian Spectra A 800 (Australia). Prior to analysis samples were mineralized with nitric acid in microwave digestion system CEM MDS-200 (USA). The polyunsaturated fatty acids contents wer analyzed using gas chromatography (Heweltt-Pacard (Germany) with a flame-ionization detector (FID) and Supelco Nukol fused silica capillary column.
All analyzed porous starches exhibited higher adsorption capacity than their counterparts without the porous structure.

Acknowledgements: The work was financially supported by the grant POIG 01.01.02-00-061/09 “Bioactive food” implemented within the Programme Innovative Economy 2007-2013.

Ref: 4363

Encapsulation and release behaviour of hydrophilic and lipophilic model compounds on lactoferrin-glycomacropetide nanohydrogels

Bourbon, Ana Isabel[1]; Cerqueira, Miguel Ângelo[1]; Vicente, António A.[1]

[1]University of Minho, Centre of Biological Engineering, Braga, Portugal

E-mail: avicente@deb.uminho.pt

Keywords: Protein nanohydrogels, transport mechanisms, curcumin, caffeine

Abstract

Protein-based nanohydrogels have attracted great attention due their non-toxicity, small dimension and large interior network for multivalent bioconjugation, offering several possibilities for the encapsulation of functional compounds. The aim of this work was to evaluate the capacity of protein nanohydrogels to encapsulate two different bioactive model compounds and evaluate their release behaviour under different conditions. Lactoferrin (Lf) and glycomacropetide (GMP) are two natural proteins with isoelectric points of 8.5 and 4.8, respectively. Lf and GMP solutions were mixed at pH 5.5, and then subsequently stirred with a specific bioactive compound concentration and heated at 80 °C, during 20 min for the formation of the nanohydrogels. Two bioactive compounds, curcumin and caffeine have been used as lipophilic and hydrophilic compound model, respectively and were encapsulated into nanydrogels. The resulting nanohydrogels with loaded bioactive compounds were then characterized in terms of morphology, encapsulation capacity and release behaviour. Results showed that nanohydrogels presents a curcumin and caffeine binding capacity of 95.12 % and 90 %, respectively. Bioactive compounds release from nanohydrogels was evaluated by the experimental data of the release kinetics of bioactive compounds under different conditions (i.e. pH 2 and 7). Mathematical models were fitted to the experimental data using non-linear regression. Results showed that transport of bioactive compounds from nanohydrogels followed a Linear Superimposition Model which accounts for both Fickian transport behaviour and polymer relaxation. Depending on the nature of bioactive compound it was observed different release behaviours: lipophilic compound was not released at pH 7, contrarily to hydrophilic compound. At low pH (pH 2) it was observed that the transport mechanism of bioactive compounds from nanohydrogels was driven by the concentration gradient and due the matrix reconfiguration due to contact with a liquid medium. Results showed that is possible to encapsulate two different bioactive compounds in protein nanohydrogels, envisaging great possibilities for food and pharmaceutical applications.

Acknowledgements: The authors Ana I. Bourbon and Miguel A. Cerqueira are recipient of fellowships from the Fundação para a Ciência e Tecnologia, POPH-QREN and FSE (FCT, Portugal) through grants SFRH/BD/73178/2010 and SFRH/BPD/72753/2010, respectively. Also, the authors would like to thank the FCT Strategic Project PEst-OE/EQB/LA0023/2013 and the project "BioInd - Biotechnology and Bioengineering for improved Industrial and Agro-Food processes", REF. NORTE-07-0124-FEDER-000028 Co-funded by the Programa Operacional Regional do Norte (ON.2 – O Novo Norte), QREN, FEDER.

Ref: 4374

Mechanical properties and microstructure of zucchini (*Cucurbita Pepo*, L.) as affected by vacuum impregnation treatments and impregnation solution formulation

Pittia, Paola[1]; Occhino, Elisabetta[1]; Hernando, Isabel[2]; Llorca, E.[2]; Neri, Lilia[1]

[1]Faculty of Bioscience and Technology for Food, Agriculture and Environment, University of Teramo;
[2]Departamento de Tecnología de Alimentos. Universitad Politecnica de Valencia

E-mail: ppittia@unite.it

Keywords: Vacuum impregnation, zucchini, maltodextrines, microstructure, mechanical properties

Abstract

Increasing is the demand for minimally processed vegetables due to their fresh-like character, convenience, and health benefits besides their limited stability and loss of qualities during storage. Vacuum impregnation (VI) is a technology aimed to exchange the internal gas or liquid of a product for an external liquid phase, thereby modifying its original composition, quality and functionality.

This study was aimed to investigate the effect of VI treatments and impregnation solution composition on quality and microstructural properties of zucchini (*Cucurbita pepo,* L.). This vegetable presents a low solutes content and a soft but firm texture that changes meaningfully during storage or due to processing.

VI treatments were carried out on half slices zucchini in a lab scale pilot plant, by varying both process parameters (vacuum and post-vacuum time) and VI solution formulation. In particular, binary solutions made of maltodextrins (DE=7.5-9, 20%), NaCl (1-5%) and $CaCl_2$ (1-100 mM) or mixed solution containing all the solutes at different concentrations were tested. Mass transfer, mechanical and microstructural (by Cryo-SEM) properties were determined.

Results evidenced a main role of the time of post-vacuum in affecting the mass transfer of solutes (gain) and water (loss). The use of binary solutions made of both maltodextrines and NaCl impaired the microstructural properties of the vegetable with turgor loss and cell wall detachment, whilst those of $CaCl_2$ led to a thickening effect with an improvement of the mechanical properties. Mixed solutions (maltodextrines+NaCl+$CaCl_2$) allowed to limit the damage induced by the osmotic dehydration determined by maltodextrines and NaCl along with the achievement of a better preserved microstructure and of an improved mechanical properties.

Results highlight the potential of VI processes in improving the quality of vegetables for minimally processed products. However, an optimisation of the process conditions and in particular of the VI solution to achieve the desired quality attributes is needed.

Acknowledgements: Perez-Munuera I.: in memory

Ref: 4375

Digestibility of organogels produced with medium- and large-chain triacylglycerols

Fasolin, Luiz Henrique[1]; Cerqueira, Miguel Ângelo[2]; Pinheiro, Ana Cristina[2]; Cunha, Rosiane Lopes[1]; Vicente, António Augusto[2]

[1]University of Campinas, Brazil;
[2]University of Minho, Braga, Portugal

E-mail: lh.fasolin@gmail.com

Keywords: Organogel, bioactive, triacylglycerol, release

Abstract

The structure of organogels depends on the organogelator and the type of oil used, exerting influence on the release profiles of bioactives in the gastrointestinal system. So, the aim of this work was to produce gels using medium-chain triacylglycerols (OMCT) or high oleic sunflower oil (large-chain triacylglycerols – OLCT), glycerol monostearate as organogelator and β-carotene as bioactive compound and evaluate its stability in the digestion *in vitro.* The static digestion of the organogels was performed and during the digestion, the gel structure, free-fatty acids (FFA) content and bioaccessibility of β-carotene were evaluated by fluorescent microscopy, NaOH titration and spectrophotometry methods, respectively. In the gastric step the gel structure remains almost intact without bioactive release, but some fluid incorporation was visually observed. In the duoden the bile salts in conjunction with lipase interacted with the organogel, destroying the structure and forming micelles. A great number of small micelles was observed for OLCT, while for OMCT systems fewer and bigger droplets were observed due to the coalescence of the droplets that could indicate loss of structure. This is corroborated by the higher amount of FFA and almost all bioactive bioaccessibility of OMCT systems. In the jejun step the OMCT structure was completely destroyed, while for OLCT the number of micelles decreased but no coalescence was observed. Moreover, for OLCT the FFA content remains the same and decreased for OMCT. At the end (ileum), the OLCT droplets began to coalesce increasing their diameter. Thus, stronger organogel and more resistant to the gastrointestinal system was produced with LCT. However, this resistance did not allow the complete bioaccessibility of the bioactive that was observed for MCT. Results showed that it is possible to use organogels as vehicles for bioactives and the release can be controlled by the modification of the structure.

Ref: 4376

Influence of lipid type and concentration on physical and mechanical properties of breadsticks

Di Mattia, Carla[1]; Pepe, Vito[1]; Sacchetti, Giampiero[1]; Pittia, Paola[1]

[1]Faculty of Bioscience and Technology for Food, Agriculture and Environment, University of Teramo, Italy

E-mail: ppittia@unite.it

Keywords: Breadsticks, mechanical properties, lipids, extra-virgin olive oil

Abstract

Breadsticks are an Italian bakery product whose formulation includes flour, water, yeast, fat/oils, salt and malt. They present peculiar sensory characteristics and textural properties (e.g. crispness and friability) highly dependent on product formulation, process conditions and physical properties. The development of a porous, amorphous and low moisture system is due to the thermal treatment applied during cooking and affected by the initial formulation.

In this study the effect of lipid type and concentration (3 and 6%) on sensory and mechanical properties of breadsticks was investigated. Products were produced according to standard process and recipe based on a 3% oil addition. The following lipids were investigated: sunflower (SO), corn (CO), extra-virgin olive (EVO) oils and pork lard. When the 6% lipid content was studied, a decrease of the flour to compensate the solids in the system was applied.

Moisture, a_w, microstructure, porosity, mechanical and sensory properties evaluations were carried out after the preparation and over storage under different ERH% conditions.

Breadsticks made with CO presented a microstructure characterized by macro-porosity ascribed to coalescence phenomena in the matrix along with high friability and hardness, while SO determined a coarser microstructure and lower stiffness. A fine and well dispersed porosity was found in the breadsticks formulated with lard, which resulted also characterised by higher friability and lower hardness. The use of EVO oil permitted good stabilization properties towards the air/water interfaces and the formation of a well dispersed structure, especially when added in higher amount (6%), while mechanical properties resulted similar to those obtained of the lard-made breadsticks.

Upon storage (14 days, 75% ERH, 20 °C) determined in all products an increase in both water content and a_w that led to an increased hardness and lower friability that impaired the overall acceptability of the product.

Results highlight the important role of lipids on the development of structural and mechanical properties of bakery products.

Ref: 4378

Elaboration of banana muffin with addition of yacon flour

de Souza Mattos, Samanta[1]; de Souza, Thamiris[1]; Lucas dos Santos Ferreira, Raquel[1]; Madeira, Márcia[1]; Duval Barros, Hilda[1]

[1]Institute of Nutrition of University of Rio de Janeiro, Brazil

E-mail: barros-h@hotmail.com

Keywords: Muffin, banana, yacon flour, acceptability test

Abstract

This study evaluated the use of yacon flour of different concentrations in formulation of banana muffin: - analysis of chemistry composition; - microbiological; - sensory evaluation and overall acceptance in 3 products produced. Analyzed samples of muffins: - standard (P); - experimental A (EA) and - experimental B (EB). The physico-chemical analyzes were: - Moisture; - Proteins; - Lipids and - Ash. Carbohydrates were calculated by difference (100 - Sums of other fractions analyzed proximate composition). The fibers were quantified by comparison of formulations with food composition table. The samples were subjected to microbiological analyzes for total coliforms; coliforms; *Bacillus cereus*; *Staphylococcus* coagulase positive; *Salmonella* sp. and total aerobic mesophilic bacteria. The sensory evaluation was carried out in relation to the appearance, texture, flavor and overall acceptability. To assess product acceptance, the acceptance index (AI) was calculated. The test was conducted preference and purchase intent test. The results of physicochemical analyzes were consistent with those found in the literature for each product. Microbiological indicated property to the consumer. It can be concluded that the banana muffins made with flour yacon, both the 40% and 60% showed satisfactory sensory characteristics , a conclusion supported by the acceptability index EA (88.9%) of EB (85 6%) and a preference test between the standard and most accepted (EA) with 67 %. The addition of yacon flour did not cause statistically significant differences in the attributes appearance, texture, flavor and overall acceptability. It was found by the intention of test purchases (83 %) that the product produced would, if sold, would certainly be viable in the consumer market.

Acknowledgements: We would thank the staff of the Internship in Science and Food Technology of the Institute of Nutrition of the University of the State of Rio de Janeiro in 2014-1.

Ref: 4380

Anthocyanins from purple majesty potato – location, extraction and effect of processing and storage

Lemos, M. Adilia[1]; Mane, Shon[1]; M. Aliyu, Maryam[1]; Sarnikova, Katarina[1]; Parsonidis, Pangiotis[1]; Halliday, Adam[1]; Bremner, David[1]; Tziboula-Clarke, Athina[1]; Hungerford, Graham[2]

[1]Abertay University Dundee, United Kingdom;
[2]HORIBA Jobin Yvon IBH Ltd

E-mail: a.lemos@abertay.ac.uk

Keywords: Anthocyanins, ultrasound technology, time-resolved fluorescence techniques

Abstract

Potato (*Solanum tuberosum*) is an important principal food crop. The tubers are a good source of carbohydrates (starch), proteins and vitamin C and as a product of plant origin, they also contain secondary metabolites (phytochemicals), which are proven to have health benefits. Tubers rich in phytochemicals can exhibit a potential health benefit, but these compounds can be destroyed or altered during the cooking and storage process. Pigmented potatoes, such as *Purple Majesty potato*, are a rich source of anthocyanins and there is a great interest in their usage in relation to potential health benefits. This work aims at studying the location of these anthocyanins in the tubers, their extraction and effect of different domestic cooking techniques. The storage under vacuum and using modified atmosphere packaging is also assessed in order to relate to their practical usage. The use of ultrasound as an extraction technique is also employed, and assessed, as it enables this staple food product to be used as a potential source of antioxidants in industry.

Levels of Total Phenolic compounds (TP), total anthocyanins (TA) and anti-oxidant activity (AOA) were monitored. TP, TA and AOA were determined by the Folin-Ciocalteau method, pH shift method and ferric reducing antioxidant potential (FRAP), respectively. As some of the potato components exhibited fluorescence, an investigation was performed using time-resolved fluorescence techniques (which is advantageous as it is concentration independent) to ascertain if the different cooking techniques influenced the observed fluorescence behaviour, thus their composition. Time-resolved emission spectra (TRES) were recorded, as they could give both temporal and spectral information concerning the fluorescence emission. Here this technique is used to show relative differences, between the cooking techniques. Localisation of these compounds was ascertained via fluorescence lifetime imaging (FLIM).

Ref: 4381

Bacterial cellulose as emulsifier for O/W emulsions prepared with different techniques

Paximada, Paraskevi[1]; Kopsahelis, Nikolaos[1]; Koutinas, Apostolis[1]; Scholten, Elke[2]; Mandala, Ioanna[1]

[1]Food Science & Human Nutrition Dept., Agricultural University of Athens, Greece;
[2]Physics and Physical Chemistry of Foods, Wageningen University, Bornse Weilanden 9, 6708 WH, Wageningen, the Netherlands

E-mail: imandala@aua.gr

Keywords: Emulsion, bacterial cellulose, high pressure, ultrasonics

Abstract

Cellulose is the most abundant natural polysaccharide, being the major structural component of plants. Chemically modified cellulose is a food additive mainly used for its gelling and thickening properties. It has been well known that bacteria (*Komagatabacter sucrofermentans* BPR 2001) produce cellulose as pellicle, which has advantages over traditional sources: high water-holding capacity, smooth texture and unique fluid properties. However, not much research has been conducted on its emulsifying ability.

The objective of the present study is the preparation and characterization of olive oil-in-water (o/w) emulsions stabilized by bacterial cellulose (BC) and investigate the factors that influence their properties, such as BC concentration and emulsification method: high shear or ultrasonication. Also, the effect of incorporation of BC in emulsions containing whey protein isolate (WPI) and homogenized by high pressure on the properties of the emulsions will be investigated. O/w emulsions containing 10% wt olive oil and 0.1 -1%wt. BC prepared at pH 3.8. The emulsion characterization was carried out by visual observation, optical microscopy, multiple light scattering and rheology. Then, BC was added in emulsions containing also WPI at various concentrations (3-5%wt.) and the same properties were characterized.

Ultrasonication improved the stability of emulsions, as it reduced the serum index (SI) from 25% (high shear) up to 3% (ultrasounds). Even the BC emulsions showed the largest droplets (D3,2= 26.8μm), showed an extremely stability against coalescence (SI=3%), phenomenon typical for particle-stabilized emulsions. BC emulsions were not affected by changes in pH (3-7), temperature (30-70 °C) or ionic strength (50-200 mM). By the addition of 1%wt. BC, emulsions containing WPI and oil at various concentrations and homogenized by ultrasounds or high pressure, appeared to be extremely stable against coalescence despite the concentration of oil. Viscosity measurements reported that the higher the concentration of oil, the higher the viscosity was.

Acknowledgements: This work is part of the “Nonastru” project (11ΣΥΝ-2-718), implemented within the National Strategic Reference Framework (NSRF) 2007-2013 and co-financed by National (Greek Ministry - General Secretariat of Research and Technology) and Community Funds (E.U.-European Social Fund).

Ref: 4382

Pasta containing potato juice – structure and physicochemical properties

Kowalczewski, Przemysław[1]; Lewandowicz, Grażyna[1]; Makowska, Agnieszka[2]; Knoll, Ismena[1]; Błaszczak, Wioletta[3]; Białas, Wojciech[1]

[1]Department of Biotechnology and Food Microbiology, Poznań University of Life Sciences, Poznań, Poland;
[2]Department of Cereal Science and Technology, Poznań University of Life Sciences, Poznań, Poland;
[3]Department of Chemical and Physical Properties of Food, Institute of Animal Reproduction and Food Research of Polish Academy of Sciences, Olsztyn, Poland

E-mail: przemyslaw.kowalczewski@up.poznan.pl

Keywords: Pasta, potato juice, functional food, microstructure

Abstract

Potato juice is one of the main byproducts in starch industry. It is widely recognized as a waste product but scientific studies show that it can be used in food industry as bio component of new designed food. The necessity to maximize the cost-effectiveness of processes and minimize the amount of waste products has increased an interest in utilization of potato juice. The aim of this work was to demonstrate the effect of addition of potato juice on structure, physicochemical properties and consumer acceptability of pasta.

Three types of pasta was prepared: without addition of potato juice, with freshly squeezed juice and with dried juice. Physicochemical properties was examined by assessing the weight growth coefficient (WGC), loss of dry matter as well as the colour scale L*a*b*. The microstructure of investigated pasta was studied using scanning electron microscope (SEM), and their texture with TA.XT2 Texture Analyzer. Moreover, the consumer acceptance was examined with a ten-point scale.

It was found that the addition of potato juice to pasta did not cause any changes in WGC. However, the addition of fresh juice resulted in a significant reduction in dry matter loss during cooking. On the other hand, the application of the dried potato juice resulted in an increase loss of DM. Addition of potato juice has reduced brightness obtained pasta, and increase red and blue colours saturation. SEM study proved that small air vesicles are present in the structure of all examined pasta samples. The addition of potato juice both in fresh and dried form resulted in increase of the dimension of that pore-like structures and decrease of their number. These phenomena were accompanied by the increase of the firmness of the pasta. Consumer evaluation results showed that the addition of fresh juice and dried juice is acceptable. Fortification of potato juice was caused an increase of firmness obtained pasta.

Acknowledgements: The work was financially supported by the grant POIG 01.01.02-00-061/09 “Bioactive food” implemented within the Programme Innovative Economy 2007-2013.

Ref: 4385

Dielectric spectra of aqueous solutions of some uncharged saccharides

Poklar Ulrih, Nataša[1]; Šegatin, Nataša[1]

[1] Biotechnical Faculty, University of Ljubljana, Ljubljana, Slovenia

E-mail: natasa.segatin@bf.uni-lj.si

Keywords: Dielectric constant, dielectric loss factor, inulin, dextrins, oligofructose

Abstract

Dielectric spectroscopy has emerged as a simple, rapid and non-destructive technique that can provide information about the dielectric response of a material in an electric field. The dielectric parameters (the permittivity or dielectric constant, the dielectric loss) depend on the composition and structure of complex mixtures and also of the food itself. For carbohydrate solutions, the effect of free water on dielectric properties is significant because carbohydrates themselves have small dielectric activities. Monosaccharides are more important electromagnetic absorbing compounds than polysaccharides due to the number and stability of hydrogen bonds formed in water solutions. The purpose of this work was to determine the correlation between the dielectric parameters and the structure of saccharide. Dielectric spectra were determined for aqueous solutions of glucose, fructose, dextrins and fructans. Dielectric constants and dielectric loss factors were determined at frequencies from 500 kHz to 2 MHz by measuring capacitance and resistance while at frequencies from 200 MHz to 8.5 GHz with open end coaxial probe technique. At frequencies from 500 kHz to 2 MHz the dielectric constant was independent on frequency for all saccharides studied. The values of dielectric constants were very similar to that of water and they decreased with increasing temperature and concentration. The values of dielectric losses for aqueous monosaccharides were very low, close to that of water, while those of polysaccharides were much higher. Dielectric loss increased with increasing temperature and concentration. In the region of microwaves (from 200 MHz-8.5 GHz) the dielectric constants were lower than for water and they decreased with increasing frequency. In this part of the spectra the differences between saccharide solutions and water were more explicit. The dielectric losses were higher for saccharide solutions than for water and they increased with increasing frequency. Most pronounced differences in dielectric spectra were found at 8.5 GHz.

Acknowledgements: We are grateful for the financial support from the Slovenian Research Agency through the P4-0121 research programme.

Ref: 4406

Development of a cashew nut coated with bioactive whey peptide extract with antihipertensive

Odila Pereira, Joana[1]; Amorim, Manuela[1]; Silva, L. B.[2]; Ormenese, R.C.S.C.[2]; Pacheco, M.T.B.[2]; Pintado, Manuela[1]

[1]CBQF – Centro de Biotecnologia e Química Fina – Laboratório Associado, Escola Superior de Biotecnologia, Universidade Católica Portuguesa/Porto, Rua Dr. António Bernardino de Almeida, 4200-072, Porto, Portugal;
[2]Instituto de Tecnologia de Alimentos, Av. Brasil, 2880, CP 139, CEP 13070-178, Campinas, SP, Brasil

E-mail: joanaodila@gmail.com

Keywords: Functional foods, whey proteins, biopeptides, antihypertensive activity

Abstract

There is a growing concern in the consumer's habits seeking healthy foods, which has opened new markets for functional foods. This global demand led to the development of functional foods, searching new ingredients to incorporate into conventional foods.
Whey proteins are studied not only from the nutritional and functional properties, but also as a source of peptides that may exert biological functions, particularly antihypertensive activity. These bioactive peptides are released by enzymatic hydrolysis and according the final composition they may exert biological activities.
Cashew nut was used as matrix for incorporation functional ingredients due to its nutritional properties conveyed by the high content of folic acid and essential fatty acids.
The aim of this study was to develop a cashew nut coated with peptide fraction obtained from whey and to evaluate the antihypertensive activity and consumer acceptance of the new functional cashew nuts.
The fraction with MW < 3000 Da was obtained by hydrolysis of whey with *Cynara cardunculus* followed by nanofiltration to obtain low MW fraction, exhibited very high ACE-inhibitory activity, IC50 12.8 µg /mL protein.
The incorporation of peptides (2 %) in cashew nut led to a reduction to values of ACE-inhibitory activity, 532.2 µg/mL. However, this is close the values reported by other products in the market claiming antihypertensive activity. In the formulation there is space to increase concentration and biological activity. Nevertheless, it is important to highlight that the antihypertensive activity was not lost even when high temperatures during coating and processing of the product were used.
The sensory analysis of the functional cashew nut showed high acceptability by the consumers. Our results suggest that the application of these bioactive peptide extracts with

antihypertensive activity in the development of a new snacks with reduce salt content is promising in the improvement of new value-added food products.

Acknowledgements: The authors gratefully acknowledged the Agency of Innovation (Agência de Inovação, ADI, Portugal) and Quadro de Referência Estratégico Nacional (QREN, Portugal) through project ACTIPEP (QREN-ADI 11531) for funding this project. Cereal-Chocotec – ITAL, for all technical assistance in the coating elaboration. Financial support for M. Amorim was provided by the PhD scholarship ref. SFRH/BD/81901/2011 by Fundação para a Ciência e Tecnologia, Portugal. This work was supported by National Funds from FCT through project PEst-OE/EQB/LA0016/2013.

Ref: 4407

Formulation and consumer acceptance of cereal bars with functional properties by the incorporation of peptides and β-glucans from Spent Brewer's Yeast

Amorim, Manuela[1]; Pereira, Joana[1]; Pinheiro, Hélder[3]; Pacheco, Maria Teresa[2]; Pintado, Manuela[1]

[1]CBQF – Centro de Biotecnologia e Química Fina – Laboratório Associado, Escola Superior de Biotecnologia, Universidade Católica Portuguesa/Porto, Rua Dr. António Bernardino de Almeida, 4200-072, Porto, Portugal;
[2]Instituto de Tecnologia de Alimentos, Av. Brasil, 2880, CP 139, CEP 13070-178, Campinas, SP, Brasil;
[3]Departamento de Farmacologia e Terapêutica da Faculdade de Medicina da Universidade do Porto, Al. Hernani Monteiro, 4200-319 Porto, Portugal.

E-mail: mamorim@porto.ucp.pt

Keywords: Functional foods, functional ingredient, biopeptides, beta glucans, brewer spent yeast

Abstract

The market for functional ingredients and foods has a high growth due to increased awareness and promotion of healthy eating and lifestyle of consumers. Food can be used as vehicle to intake bioactive compounds that provide health benefits and increase people well-being. Thus, cereal bars are a popular and convenient food, which is an ideal carrier to incorporate functional ingredients that promote health and prevent diseases. The design and development of functional foods should not be made based solely on nutritional function without taking into account product properties, such as color, texture, flavor and taste. The sensory properties are the most important attributes for the consumer acceptance, as well as other quality issues such as stability and texture. This work was focused on the formulation and sensory analysis of cereal bars obtained by incorporation of peptides and β-glucans extract obtained via autolysis and hydrolysis of spent brewer's and presenting biological activities such as, antihypertensive and prebiotic. However, this ingredient results in particular taste and flavor that may constrain the matrix choice and consumer acceptance. The cereal bar was formulated based on oat, rice and corn and added 2% extract. Consumer acceptance tests were performed to test general acceptability in particular for the appearance, aroma, flavor and texture by hedonic scale of nine points (9 = liked a lot and 1 = dislike very much) and intent to purchase of 5 point scale (5= definitely would buy and 1= definitely would not buy).
The final cereals bars were assessed by 52 consumers and showed positive response since "like" for all attributes were obtained. Regarding the intention to purchase, the sample had an

average between "maybe bought" and "probably would buy". So these results suggest that cereal bar is an adequate matrix to produce a functional food with antihypertensive and prebiotic activity based on spent brewer's yeast bioactive ingredient.

Acknowledgements: The authors gratefully acknowledged the Agência de Inovação, ADI, Portugal and Quadro de Referência Estratégico Nacional (QREN, Portugal) through project ACTIPEP (QREN-ADI 11531) for funding this project. CerealChocotec – ITAL (Campinas, Brasil) for all technical assistance. Financial support for M. Amorim was provided by the PhD scholarship ref. SFRH/BD/81901/2011 by Fundação para a Ciência e Tecnologia, Portugal.

Ref: 4410

Study of antioxidant properties and consumer acceptance of sour cherry based jams

Costa, E.[1]; Silva, S.[1]; Monteiro, M.[2]; Pintado, M.M.[1]

[1]CBQF - Centro de Biotecnologia e Química Fina – Laboratório Associado, Escola Superior de Biotecnologia, Universidade Católica Portuguesa/Porto, Rua Dr. António Bernardino Almeida, 4200-072 Porto, Portugal

E-mail: emcosta@porto.ucp.pt

Keywords: Sour cherry, novel foodstuffs, novel recipes, sensorial analysis

Abstract

In recent years a major market trend has been the design of more natural foodstuffs with chemical constituents being replaced by natural compounds and ingredients. Sour cherry is a phenolic rich fruit that has already been incorporated into the food chain, namely through a Portuguese traditional liquor (Ginjinha), however other food matrices may be the carrier for this antioxidant fruit, but formulation and processing conditions may affect functionality and acceptability. With that in mind the goal of this work was to expand the incorporation of sour cherry into the food chain via development of novel sour cherry based recipes or foodstuffs, with the most promising one being sour cherry jams with reduced sugar content. From this work two formulations resulted, one with whole cherries and other with cherry pulp? These products where characterized in terms of antioxidant activity, phenolic compounds and anthocyanin profile and consumer acceptance.

The results obtained through chemical and sensorial analysis of the two formulations showed that from a chemical standpoint the jams possessed significant antioxidant capacity with a high content of phenolic compounds, namely caffeic acid. Regretfully when considering the anthocyanin content due to the high temperature used during processing they were highly reduced. When considering the sensorial analysis of the two jams through a focus group, results showed that over 77% of the panellists liking both products, with their texture and sweet flavour being remarked as the strong points of both products. Furthermore 72% of the panellists stated their intention to buy the products.

In conclusion the results obtained show that the developed products were market ready and that, despite the thermal treatment involved in their processing, both jams validated for consumption still maintained a significant level of biologically active compounds.

Acknowledgements: The authors would like to acknowledge the Instituto de Apoio às Pequenas e Médias Empresas (IAPMEI) and the National Strategic Reference Board (QREN)

project ‘Desenvolvimento de novas receitas gastronómicas e produtos alimentares com base em extractos/produtos de ginja” which, in addition to the Portuguese Foundation for Science and Technology (FCT) for national fund (PEst-320 OE/EQB/LA0016/2013) provided funding for the realization of this work.

Ref: 4412

Comparison of bioactive compounds in four blueberry cultivars throughout the years: selection of the best cultivars to be used in health promoting foodstuffs

Silva, S.[1]; Costa, E. M.[1]; Coelho, M. C.[1]; Pereira, M. F.[1]; Costa, M. R.[1]; Pintado, M. M.[1]

[1]CBQF - Centro de Biotecnologia e Química Fina – Laboratório Associado, Escola Superior de Biotecnologia, Universidade Católica Portuguesa/Porto, Rua Dr. António Bernardino Almeida, 4200-072 Porto, Portugal

E-mail: mpintado@porto.ucp.pt

Keywords: Blueberry, antioxidant activity, phenolic compounds, anthocyanins

Abstract

Blueberries are known as rich in phenolics and possessing a considerable antioxidant capacity. In recent decades, Portuguese blueberry production has increased greatly with several new blueberry producers appearing every year and, considering the amount of factors that can affect the overall fruit composition it is important to systematically study each matrix in order to understand the phenolic compounds profile, and therefore allow both the industry and consumers to maximize the potential benefits.

Therefore the present work aimed to characterize four blueberry cultivars (representative of Portuguese blueberry production); Duke, Bluecrop, Goldtraube and Ozarkblue throughout a period of 3 years. Antioxidant activity, total phenolic compounds and anthocyanins were assessed.

The results obtained illustrated, as could be expected, significant differences throughout the years studied for all parameters assessed, with values ranging from ca. 205 to 770 g of ascorbic acid equivalents per 100 g of fresh fruit for the total antioxidant capacity, ca. 115 to 630 g of gallic acid equivalents per 100 g of fresh fruit for the total phenolics content and ca. 56 to 263 mg of cianidin-3-glucoside equivalents per 100 g of fresh fruit for the total anthocyanin content. Despite the large variations, the cultivar Goldtraube proved to possess systematically higher contents of anthocyanins and antioxidants than all other cultivars though the same cannot be said for the total phenolics were, despite possessing higher values for 2 years, in both Duke and Bluecrop significantly higher content of phenolic compounds were observed.

In conclusion, as it stands Goldtraube appears to be the better cultivar to be used in the development of blueberry based matrices and foodstuffs with higher potential health benefits.

Acknowledgements: The author hereby gratefully acknowledges the Agency of Innovation (Agência de Inovação, ADI, Portugal) and Quadro de Referência Estratégico Nacional (QREN,

Portugal) which through the project “INNOVATION WITH BLUEBERRY-MYRTILLUS (QREN-ADI 30230) and the National Funds from FCT – Fundação para a Ciência e a Tecnologia through project PEst-OE/EQB/LA0016/2013 provided funding for the realization of this work.

Ref: 4413

Consumers' sensory perception and acceptability of Hibiscus drinks: a cross-cultural study in Europe

Monteiro, M. J.[1]; Costa, A. I. A.[1]; Fliedel[2]; Bechoff, A.[3]; Maraval, I.[2]; Pintado, A. I. E.[1]; Cisse, M.[4]; Pallet, D.[2]; Tomlins, K.[3]; Pintado, M. M.[1]

[1]CBQF - Escola Superior de Biotecnologia. Rua Dr. António Bernardino de Almeida, 4200-072 Porto, Portugal;
[2]CIRAD, TA B-95/16, 73 rue Jean-François Breton, 34398 Montpellier Cedex 5, France;
[3]Natural Resources Institute, University of Greenwich, Central Avenue, Chatham Maritime, Kent, ME7 3RU, United Kingdom;
[4] Ecole Supérieure Polytechnique, Université Cheik Anta Diop, Dakar, Senegal.

E-mail: mjmonteiro@porto.ucp.pt

Keywords: Sensory, Hibiscus, Just-About-Right Scales (JAR), Check-All-That-Apply questions (CATA), consumers' acceptability

Abstract

Important differences can be observed between consumers from different countries due to the strong impact of culture on food preferences and acceptance, while a less important effect is usually expected in sensory perception. In the present study consumer's sensory perception, preference and acceptability of Hibiscus drinks (an African functional drink rich in anthocyanins) were evaluated in three European countries: United Kingdom, France and Portugal. The drinks were developed under the scope of AFTER, an EU FP7-funded research project aiming at the production of improved quality and extended shelf-life products of African tradition for local and European markets. Hibiscus drinks are rich in nutrients and their consumption is widespread in Africa and Asia, but they still are quite unknown amongst European consumers. The sensory quality and acceptability of two Hibiscus drinks developed by AFTER researchers, as well as a traditional infusion prepared from Hibiscus flowers (baseline), were evaluated by 3 independent samples of consumers (France n=143; United Kingdom n=126; Portugal n=124) from March to June 2014. All factors concerning consumers' socio-demographic profiles and materials were maintained as similar as possible. To gather evaluative relevant information and maximize the equivalence between questionnaires, exploratory local focus groups were held.

Consumer profiling techniques based on hedonic acceptance, Just-About-Right intensity evaluation of specific descriptors (JAR) and Check-All-That-Apply questions (CATA) were used to establish sensory profiles and preference maps. Additionally, the chemical composition of the drinks was evaluated and a conjoint analysis was held to determine how consumers valued the composition and African origin of the drinks.

Similar preference profiles for the Hibiscus drinks were obtained for the three countries but significant differences were observed in relation between consumers' acceptance, with French consumers being generally the most appreciative. Importantly, these differences in acceptance were significantly correlated with the drinks sensory profiles and chemical composition.

Acknowledgements: This study was performed within the European Seven Framework program (EU FP7) and fits into the project AFTER (African Food Tradition Revisited by Research) under contract nr. 245025 and the National Funds from FCT – Fundação para a Ciência e a Tecnologia through project PEst-OE/EQB/LA0016/2013 provided funding for the realization of this work. More information about the project can be found on http://www.after-fp7.eu/

Ref: 4414

Acceptability of reengineered Hibiscus drinks by Senegalese consumers

Monteiro, M. J.[1]; Cisse, M.[4]; Fliedel, G.[2], Bechoff[2]; Costa, A. I. A.[1]; Boucher, M.[4]; Ayessou[4]; Pallet, D.[2]; Tomlins, K.[3]; Pintado, M. M.[1]

[1]CBQF - Escola Superior de Biotecnologia. Rua Dr. António Bernardino de Almeida, 4200-072 Porto, Portugal.;
[2]CIRAD, TA B-95/16, 73 rue Jean-François Breton, 34398 Montpellier Cedex 5, France.;
[3]Natural Resources Institute, University of Greenwich, Central Avenue, Chatham Maritime, Kent, ME7 3RU, United Kingdom.;
[4]Ecole Supérieure Polytechnique, Université Cheik Anta Diop, Dakar, Senegal.

E-mail: mjmonteiro@porto.ucp.pt

Keywords: Hibiscus, bissap, Senegalese consumers, consumer acceptance, About-Right Scales (JAR), Check-All-That-Apply questions (CATA)

Abstract

Bissap is a non-alcoholic drink commonly consumed in African countries, particularly in Senegal. It is made from *Hibiscus sabdariffa* L. - an herbaceous plant belonging to the Malvaceae, most often from its Ordinary/Kor (Senegal) and/or Vimto (Sudan) varieties. Past research has shown that Hibiscus drinks are generally rich in vitamins, minerals and bioactive compounds. These drinks are amongst the products investigated by AFTER, an EU FP7-funded research project aiming at the production of good quality (nutritional and sanitary) and extended shelf-life products of African tradition for local and European markets.

A previous AFTER study on the acceptability of four traditional Hibiscus drinks by a sample of Senegalese consumers uncovered significant effects of plant variety and processing method. This highlighted the importance of harmonizing the sensory profile of these drinks as part of the product re-engineering process, and re-assessing their acceptability amongst the Senegalese population.

In view of this, three new Hibiscus (50% Kor and 50% Vinto) drinks – an infusion, a syrup and a vacuum-concentrate – were developed by AFTER researchers. Their sensory quality was evaluated, alongside that of a traditional infusion (baseline), by a sample of 156 Senegalese in Dakar in October-November of 2013. Consumer profiling techniques based on hedonic acceptance, Just-About-Right intensity evaluation of specific descriptors (JAR) and Check-All-That-Apply questions with sensory and emotional descriptors (CATA) were used to establish sensory profiles and preference maps. Descriptors and other relevant evaluative information were obtained through two exploratory focus groups.

Results show that the new Hibiscus drinks all had better acceptability than the baseline. Moreover, three distinct types of Senegalese consumers were identified: baseline dislikers, who liked all drinks except traditional one; overall likers; new Infusion dislikers.
Finally, multiple factor analysis of overall liking scores, JAR ratings and CATA answers yield highly convergent results for all the drinks evaluated.

Acknowledgements: This study was performed within the European Seven Framework program (EU FP7) and fits into the project AFTER (African Food Tradition Revisited by Research) under contract nr. 245025 and the National Funds from FCT – Fundação para a Ciência e a Tecnologia through project PEst-OE/EQB/LA0016/2013 provided funding for the realization of this work. More information about the project can be found on http://www.after-fp7.eu/

Ref: 5469

Improving Health with a Food Biocontrol Technology

Barros, A. B.[1]; Augusto, J.[2]; Bandyopadhyay, R.[2]; Ferrão, J.[1]; Fernandes, T.H.[1]

[1]*Lúrio University, Nampula, Mozambique;*
[2]*IITA – International Institute of Tropical Agriculture, Ibadan, Nigeria*

E-mail: profcattitofernandes@gmail.com

Abstract

The complex challenge of improving food safety and security involving interdependent and interconnected set of issues, such as agriculture and fisheries, energy, environment, government policy and trade, is shortly reviewed. Improving food safety is an essential element for improving food security, which exists when populations have access to sufficient and healthy food. Mycotoxins, especially aflatoxins, are among the most potent mutagenic, teratogenic and carcinogenic substances known. They pose chronic health risks: prolonged exposure to them through diet has been linked to liver cancer, poor nutrient absorption, retarded infant growth and immunosuppression. Human daily exposure to low levels of aflatoxins occurs through consumption of contaminated maize, cassava and peanuts, which are dietary staples in several tropical countries. In some parts of the world, where food supplies are limited, drastic regulatory measures to lower mycotoxin standards would lead to food shortages and higher prices. An innovative biocontrol breakthrough technology solution for reducing aflatoxins during both crop development and postharvest storage, and throughout the value chain is described. Atoxigenic strain-based biological control is a natural technology that uses the ability of native atoxigenic strains of *Aspergillus flavus* (fungus that produces aflatoxin) to naturally outcompete their aflatoxin-producing cousins. This technology is particularly effective in the African context because addresses the source of aflatoxin - fungus in the soil - before it can contaminate the crop prior to harvest. The biocontrol technology has been shown to successfully reduce aflatoxin contamination in maize and groundnut by more than 80% in Nigeria, Senegal, Burkina Faso, Kenya, and The Gambia. Currently, the technology is being developed for Mozambique, Zambia, Tanzania, Rwanda and Ghana. Adopting and applying this solution, with other management practices by farmers, to address aflatoxin contamination in Africa would dramatically improve the health and livelihoods of millions of families while reducing commodity losses due to contamination. It will also increase crop value by at least 5% and improve the health of children and women.

Ref: 6486

Optimization of Spray Drying Process Parameters for Kefir Powder

İlyas ATALAR[1]; Muhammet DERVISOGLU[1]

[1]Department of Food Engineering, Engineering Faculty, Ondokuz Mayis University, 55319 Samsun, Turkey

E-mail: ilyas.atalar@omu.edu.tr, mderviso@omu.edu.tr

Keywords: Kefir Powder, Spray Drying, Freeze Drying, Optimization

Abstract

Response surface methodology (RSM) was used to optimize the spray drying process conditions for production of kefir powder. Influence of inlet air temperature (120–180°C), feed temperature (4–30°C) and pump rate (20–40%) on the survival rates of microorganisms (lactococci, leuconostoc, lactobacilli), outlet temperature, moisture content and water activity were assessed after drying and modeled by RSM. A lab-scale spray dryer (Mini Spray Dryer B–290, Switzerland) was used to carry out the drying experiments which are planned according to Central Composite Rotatable Design (CCRD). Inlet temperature was found as the main factor that effects the all responses statistically significant ($p<0.05$). Effect of pump rate on the responses was found significant for some responses. Feed temperature has no significant effect for any responses. The optimum conditions were found as 135 °C inlet air temperature and 35% pump rate with using Desirability Function. Desired parameters were determined in regard to model fit and lack of fit test analysis results. At the end of this study, optimum conditions of spray drying were matched with freeze drying results. Results showed that at the optimum point, good quality powder can be obtained as freeze dried powder quality.

Session 3: Sharing knowledge and technologies between academia and industry for healthy foods design

Session 3: Keynotes lectures

Ref: 4421

Serving the knowledge and technology need of enterprises to foster innovation in food structure design

***Sebők, András*[1]**

[1]Campden BRI Hungary Ltd, Hungary.

E-mail: a.sebok@campdenkht.com

Keywords: knowledge transfer process, collective research

Abstract

Food structure design can significantly contribute to the success of food products, particularly in the area of the leading drivers of food innovation in Europe such as pleasure and health. For enabling food businesses to implement research results in the product and process development research results have to be converted into practical solutions. Knowledge transfer is a multistep activity, where one bottleneck may compromise the whole process. The majority of food businesses prefer collective research in the preparatory, pre-competitive phase of innovation, when they can understand the principles and the enabling functions of new knowledge for potential innovation, learn from each other, successful practices and how to avoid the typical traps at shared costs, until they can identify their starting ideas for their close to market, confidential in-house innovation projects. The use of transdisciplinary knowledge in food structure design can lead to innovative solutions. Most of the food industry users have limited understanding of the sophisticated knowledge and functions of the techniques provided by food structure design and researchers usually do not know precisely the problems of the industry, which have to be solved. It is recommended that the potential users from food manufacturing should provide clear descriptions of their problem, and the researchers describe the main enablers of the techniques offered. Based on these a dialogue can be developed between the two sides, which can lead to an innovative solution.
Preparation of product and process development briefs and specifications by the company and clear statement of purpose of the method by the solution provider can help these processes.
Examples will be provided on using virtual and augmented reality for mathematical modelling on a macro disperse scale for understanding food properties and functionality, application of 3D printing, hyper-spectral imaging.

Acknowledgements: DREAM FP7 project (Grant agreement no: 222654-2); EcoBioCAP FP7 project (Grant agreement no: 265669); FoodManufuture FP7 project (Grant agreement no: 289327).

Ref: 5430

Knowledge and technologies transfer to traditional food producers

***Braun, Susanne*[1]**

[1]University of Hohenheim

E-mail: s.braun@uni-hohenheim.de

Abstract

In the European Union, Small and Medium Sized Enterprises (SMEs) in the food sector are increasingly under pressure due to the opening of markets, an increasing demand of standardized and price competitive food products by the consumers, the rising importance of large retailers, and the challenges of conforming to governmental regulations. These increased demands put at risk many traditional foods as well as traditional processing techniques still available today. SMEs using locally sourced raw materials and century-old recipes and processing methods are a cornerstone of the cultural identity of European regions. In the urban centers, groups of consumers are increasingly demanding traditional, local and/or organic food productions, as food scandals and the dispute on GMO undermine public confidence in industrial food producing systems. To economically survive and to partake in these modern consumer markets, SMEs producing traditional foods must extend their skills, both in terms of business development and production techniques, to comply with existing European regulations and to promote the aspects of their products related to nutrition and health. To support these traditional SMEs, TRAFOON has set sail in November 2013 to establish a knowledge transfer network with a focus on food products made of grains, fish, fruits, vegetables and mushrooms to support traditional food producing SMEs. The TRAFOON network will interlink researchers, knowledge transfer agents, and SME associations in 14 European countries to foster sustainable innovation and entrepreneurship in the sector of traditional foods for the benefit of the regions of Europe and the European consumer. For further information please visit www.trafoon.eu

Session 3: Oral presentations

Ref: 3132

Protein – polysaccharide complexes for improved emulsification properties

***Andres-Brull, Marina*[1]**

[1]Leatherhead Food Research, United Kingdom.

E-mail: mandres@leatherheadfood.com

Keywords: protein, polysaccharide, electrostatic complexes, conjugates, emulsifiers, enhanced emulsifier

Abstract

The increased demand of natural and non-animal origin ingredients used in food preparations are the current driving forces to find natural and vegan substitutes for chemical additives used in the food and beverage industry. Proteins and polysaccharides are biopolymers extensively used in the food and pharmaceutical industries; they behave not only as emulsifiers and stabilisers but they can greatly affect the properties of food systems such as their rheological properties, texture and in-mouth feel. However, the interactions between proteins and polysaccharides produce more significant influences on the properties of the food system than protein and polysaccharides alone.

In this study, the formation and characterisation of complexes and conjugates were investigated. Several factors affecting the formation of electrostatic complexes, such as pH and protein-polysaccharide ratio, were studied in order to determine the most favourable conditions to achieve electrostatic complexes. Similarly, the effect of pH and protein-polysaccharide ratio on the formation of conjugates by the Maillard reaction, were also investigated. Finally, both protein-polysaccharide complexes and conjugates were incorporated in a simple oil-in-water emulsions in order to assess their emulsification performances. These results were compared to the performance of a chemical emulsifier.

This study suggests that while none of the complexes or conjugates studied presented better emulsification performance than the selected chemical emulsifier, the addition of polysaccharide into the protein solutions greatly improved the protein solubility and emulsification performance at selected pHs. The protein-polysaccharide mixtures have enhanced emulsification performance at the pH region where soluble electrostatic complexes are formed in comparison to the protein alone. The covalent bonding between the protein and polysaccharide allows an enhanced emulsification performance at all pH ranges in comparison to the protein alone.

Ref: 3219

Edible oil structured using water-soluble food polysaccharides

***Patel, Ashok*[1]*; Cludts, Nick*[1]*; Dewettinck, Koen*[1]

[1]Vandemoortele Centre. Ghent University, Belgium.

E-mail: Patel.Ashok@Ugent.be

Keywords: emulsion, food polysaccharides, oleogels, rheology, microstructure studies, cryo-scanning electron microscopy

Abstract

Currently, oil structuring have been receiving increased attention from researchers working in the food domain as an alternative to develop edible products with significant reduction of saturated fats. In the current paper, we report a new approach of preparing oleogels containing a high concentration of liquid oil (> 98 %wt) using only food polysaccharides as structurants. Specifically, physical trapping of a hydrophobic liquid oil in a matrix of watersoluble food polysaccharides was achieved using a facile two-step process by first formulating an emulsifier-free, oil-in-water emulsion stabilized only by food polysaccharides (cellulose ethers and xanthan gum) followed by a complete removal of the water phase, resulting in an oleogel containing a high concentration of liquid oil (~ 98.6 %wt). The unique microstructure of the oleogel (oil droplets packed closely in the matrix of polymers) was revealed by the confocal and cryo scanning electron microscopy imaging and the effect of polymer concentrations on the consistency and flow properties of emulsion as well as the oleogel was evaluated using small amplitude oscillatory shear rheometry. The oleogels showed a high gel strength (elastic modulus > 1000 Pa, independent of the applied frequency) as well as a certain degree of thixotropic recovery (a high % regeneration). The potential application of oleogel as a shortening alternative was further explored through bakery trails and the textural and sensorial results conducted on cakes suggested that the oleogel had comparable functionality to commercial cake margarine & shortening.

Acknowledgements: This research is supported by the Marie Curie Career Integration Grant within the 7th European Community Framework Programme.

Ref: 3330

CONNECT4ACTION: Strategies for improving communication between consumers, consumer scientists and food technology developers

***Knol, Jeroen*[1]; *McKenna, Brian*[1]; *Zimmermann, Karin*[2]**

[1]European Federation of Food Science & Technology;
[2]LEI Wageningen UR, Netherlands.

E-mail: j.knol@effost.org

Keywords: Communication, Food technology developers, Consumer scientist, Product development

Abstract

Despite developments in technology, product design and marketing, most new products are not successfully commercialized. Failure rates for new food products are as high as 70-80%. To improve the success of new product innovations the needs and expectations of consumers must be translated into product characteristics and further to translate the products into appealing marketing messages. These processes require co-operation within innovation networks between food scientists and consumer scientists. The CONNECT4ACTION project emphasizes the need for both external communication between food technology development and the final consumer and internal communication between the scientific disciplines involved in food technology development and commercialization. CONNECT4ACTION aims to engage food technology developers, consumer scientists, consumers and all other stakeholders with interests in food to improve their multidisciplinary dialogue. Stakeholders will be connected with each other and the project via the online CONNECT4ACTION community. Participation of stakeholders delivers to them useful connections, the opportunity to give input during various stages of the project and access to project outcomes. Further success factors and potential barriers from scientific findings and from stakeholders' experiences are identified that underlie improved communication at various stages of the food technology development and commercialization. CONNECT4ACTION has developed a toolbox that enables interested stakeholders at various stages of the food technology development and commercialization process to improve and plan their communication strategies. The toolbox contains various tools for various key players, but the linking pin is connecting consumer wishes to technology development. CONNECT4ACTION improves the dialogue and provide methodologies for identifying potential factors that can lead to acceptance or rejection of new (food) technologies and product innovations by consumers and in order to guarantee that this dialogue will continue after the project is finished, a CONNECT4ACTION Embassy will be established.

Acknowledgements: The Connect4Action project is supported by the European Commission under the Food, agriculture and fisheries, and biotechnology Theme of the 7th Framework Programme for Research and Technological Development.

Session 3: Poster Presentations

Ref: 3220

Chestnut flour in gluten-free bread: An added value during shelf life

Paciulli, Maria[1]; Rinaldi, Massimiliano[1]; Cirlini, Martina[1]; Gasparri, Andrea[2]; Vailati, Alice[2]; Dall'Asta, Chiara[1]; Chiavaro, Emma[1]

[1]Dipartimento di Scienze degli Alimenti, Università degli Studi di Parma, Italy;
[2]Heinz S.p.A, Segrate (Milano), Itlay.

E-mail: emma.chiavaro@unipr.it

Keywords: antioxidant activity; chestnut flour; colour; gluten-free formulation; shelf-life; texture

Abstract

A rising demand for gluten-free breads is today observed in the market trend but the replacement of gluten network in the development of gluten-free cereal products is a challenging task for the cereal technologist due to its unique structure contribute. The absence of gluten in bread could lead to a product with several defects such as crumbling texture, poor colour, low volume, off-flavour and short shelf life.
The nutritional and sensorial quality improvement of gluten-free breads is scarcely addressed in literature but it could be realized including nutritionally valued raw flours as that obtained by chestnut. The effect of chestnut flour addition to rice flour in gluten-free bread-making was already reported in literature but there is a general lack of data about its addition on commercial gluten-free formulations that are prepared also with other flours as well as the description of staling behaviour of these products.
In this work, two commercial gluten-free flour formulations based on potato and rice flours, respectively, were obtained by Heinz Italia S.p.A. and added with 10-20 % of chestnut flour to produce breads to be compared with those used as control. Texture, colour, volume, crumb grain characteristics, water dynamics and antioxidant capacity were evaluated at time 0 and during a short-term storage of three days.
The addition of chestnut flour improve the paler colour of gluten-free breads causing a darkening effect due to its pigmentation also promoting a significant enhancement of antioxidant capacity for both products. Otherwise, a harder crumb texture and lower volumes were observed on both added bread formulations although crust hardness was comparable. During shelf life, the bread formulated with the addition of chestnut flour better maintained the initial characteristics in term of colour, antioxidant capacity, crumb grain and crust hardness. A different water dynamics was observed among control and added breads.

Acknowledgements: The authors gratefully acknowledge Miss Giuseppina Trento for her assistance in running some experiments and Dr Tommaso Ganino for his generous gift of the chestnut flour.

Ref: 3238

Replacing animal fat with salep on quality characteristics of Sucuk - A Turkish dry fermented sausage

GÖK, İsmail[1]; ÖZER, Cem Okan[1,2]; KILIÇ, Birol[1]

[1]Suleyman Demirel University, Turkey;
[2]Nevşehir Hacı Bektaş Veli University, Turkey.

E-mail: okanozer@sdu.edu.tr

Keywords: Sucuk, Salep, TBARS, Texture

Abstract

Salep is flour milled from the dried tubers of certain wild terrestrial orchids and has been used for many years for its nutritive and demulcent properties. Glucomannans, which are most important component in salep, are natural neutral water-soluble fibers, which help to normalize blood sugar, relieve stress on the pancreas, and discourage blood sugar abnormalities. The objective of this study was to investigate the effect of replacing beef fat with salep on the physical, chemical and sensory characteristics of sucuk. Five formulation of sucuk were produced in three replicates by traditional methods as follows; one control (C) using 80% beef and 20% beef fat and four treatments by replacing 2.5, 5, 7.5 and 10% of beef fat with salep, respectively. The results indicated that TBARS values gradually increased during storage period in all treatment groups ($p<0.05$). However, addition of salep decreased TBARS values compared to control group during storage period ($p<0.05$). pH values decreased depending on the amount of salep in the formulation, which shows the addition of salep in sucuks reduces the pH level ($P<0.05$). Higher L* values were observed in sucuk with 10% salep compared to other treatment groups at the end of the fermentation and storage period ($p<0.05$). With the addition of salep, moisture levels in sucuk decreased and fat, ash and protein level in sucuk increased ($p<0.05$). Increasing levels of salep in sucuk formulation resulted in an increased hardness values in sucuk ($p<0.05$). There was no significant difference in the overall acceptability score of samples. It is concluded that replacement of beef fat with salep had no negative effects on quality parameters of sucuk and enhanced reduction of oxidation rate. Additionally, the use of salep in sucuk manufacture may has nutritionally positive effects due to an increased dietary fibre content.

Ref: 3268

Application of innovation in regional and traditional foods

Szczepaniak, Iwona[1]; Wigier, Marek[1]

[1]Institute of Agricultural and Food Economics - National Research Institute, Poland.

E-mail: szczepaniak@ierigz.waw.pl

Keywords: innovation, regional and traditional food, healthy food

Abstract

Introduction

The progresive diversification in consumers's expectations for food, resulting from globalisation processes and the endeavor to maintain national cultural values promotes interest in the traditional and regional food. The exceptional values of these foods are a combination of specific features of raw materials, way of processing and place of origin. These qualities determine the authenticity of this category of food.

Objectives

The aim of the research is to answer the question, whether it is possible to apply innovation in traditional and regional products.

Results and discussion

Results of this study support the assertion that with regard to traditional and regional foods are acceptable innovation, consisting in the use of new technologies to encourage improvements functional values, including the quality of nutrition care and convenience in use. In Poland, as in other EU countries, from year to year is growing interest in regional and traditional products.

This is the consumer answer to the worsening of mass-produced food quality. Many buyers are choosing regional products, produced in the traditional way, with high quality and unique flavor. Increasing consumer interest determines the development of the market for such products, which are increasingly available not only at fairs or festivals, but also on special stands in shopping centers.

For long-term development of the market and increase its competitiveness influence also the decisions of the European Commission, which promotes multifunctional development of rural areas, including the production of regional and traditional products. In Poland, the share of such products in the food market is estimated at 1-3%, whereas e.g. in Austria - about 10%, Sicily - 60%.

Conclusions

The further development of the traditional and regional food requires adaptation its offer to the expectations of today's consumers, who declare willingness to purchase, but do not want to resign the convenience resulting from modern ways of processing, packaging or distribution of food. In order to meet the consumers' expectations, it is necessary to create the innovation on the level of product, method of manufacturing or distributing. It is worth remembering that

the interference in the traditional way of acquiring raw materials or processing could adversely affect the traditional character and perception of traditional food.

Ref: 3294

Chemical and rheological changes in Edam type cheeses during the 20 weeks storage

Veskioja, Andre[1,2]; Jõudu, Ivi[1,2]; Aunapuu, Marina[2]; Järveots, Tõnu[2]; Henno, Merike[2]

[1]Bio-Competence Centre of Healthy Dairy Products, Estonia;
[2]Institute of Veterinary Medicine and Animal Sciences, Estonian University of Life Sciences, Estonia.

E-mail: aveskioja@gmail.com

Keywords: Cheese rheology, Proteolysis, Scanning electron microscopy

Abstract

The rheological and chemical properties of cheese are the key quality attributes for manufacturers, industrial users and consumers as They Affect handling characteristics, texture and eating quality and also the use of the cheese ingredient, its ability to retain given the shape and gas. To date, there is lack of reports on the characterization of dynamical changes que Occur During aging of Edam-type cheeses.
The objectives of this research were to investigate rheological and chemical changes of aging during Edam type cheese.
Six batches were Edam cheese manufactured from cow's milk (standardized to 2.4% of fat) cheese starter with the precultured according to the common production protocol of the producer in the dairy plant in Estonia. Total solids (TS), pH, pH 4.6 soluble nitrogen, and rheological properties were measured on 2, 4, 6, 8, 12, 16 and 20 weeks. The small amplitude oscillatory shear (SAOS) rheometry was used to study the viscoelastic properties of cheese. OSA measurements were made in triplicate using a rheometer (Physica MCR 301, Anton Paar Germany GmbH ®) with a serrated plate measuring system (PP25/P2-SN17951). Scanning electron microscope (LEO 1430VP, now part of Zeiss Inc.) micrographs were made from cheeses 1 and 5 on the 2, 12 and 20 weeks.
Proteolysis of the cheeses was more rapid in the beginning of aging. Extent of the proteolysis ranged from 7:43 (on the second week) to 10.19% (on the week 20). Slight Increase in pH level was measured during the aging - pH level varied from 5:27 to 5:41.
Cheese rheological properties were influenced in TS, protein content and extent of proteolysis. Which one cheese differed from other cheeses in rheological properties, differed also in TS, proteolysis and protein level matrix revealed on scanning electron microscope micrographs.

Acknowledgements: This research was October Carried by the Bio-Competence Centre of Healthy Dairy Products and was co-Financed by the European Community's Regional Development Fund Within the framework of the Competence Center Program of the Enterprise Estonia, project number EU30002.

Ref: 4344

Application of NIR imaging to the study of expanded snacks containing amaranth, quinoa and kañiwa

***Ramos Diaz, Jose Martin*[1]; *Rinnan, Åsmund*[2]; *Jouppila, Kirsi*[1]**

[1]Department of Food and Environmental Sciences, University of Helsinki, Finland;
[2]Department of Food Science, Quality & Technology. University of Copenhagen, Denmark.

E-mail: jose.ramosdiaz@helsinki.fi

Keywords: quinoa, kañiwa, amaranth, NIR imaging, extrusion

Abstract

Amaranth (Amarantus caudatus), quinoa (Chenopodium quinoa) and kañiwa (Chenopodium pallidicaule) are grains that have been cultivated and consumed for centuries in Latin America. These grains are regarded as good gluten-free sources of protein, fibre and bioactive compounds. A co-rotating twin screw extruder was used to obtain corn-based extrudates containing 20, 35 and 50% amaranth, quinoa and kañiwa. The extrusion parameters were: temperature of 6 segments of extruder, ranging from 70 °C to 140 °C; screw speed, 500 rpm; water content of mass, 14%. Extrudates were dehydrated for three days at 52 °C prior to packaging in modified atmosphere (N2). The aim of this investigation was to apply NIR imaging technique to study the homogeneity of the extrudates. How did the selection of grain type and content of grain affect the homogeneity of the sample? What was it that causes the deviation from homogeneity? This study elucidated this lack of homogeneity and gave answers as to why these differences appeared.

From the NIR imaging technique it is possible to observe how the different compounds of the extrudate distributed in the finished food matrix. The effect of the content of grain, and also the type of grain could be observed by NIR imaging coupled with multivariate data analysis. This work showed how NIR imaging technique coupled with multivariate data analysis can unravel the information contained in extrudate samples made from three types of grain, at three different contents. It was possible to get a deeper, chemical understanding with regards to why these extrudates behave differently.

Acknowledgements: COST Action FA1001 is thanked for funding this research through the STSM of Jose Martin Ramos Diaz.

Ref: 4345

Production of probiotic Boza as a functional food for health and wellness, determination of its some properties and investigation of acceptability in public

ARSLAN, Sultan[1]; ERBAS, Mustafa[2]; DURAK, A. Nur[2]

[1]Akdeniz University, Engineering Faculty, Food Engineering Department, 07058, Antalya, Turkey;
[2]Akdeniz University, Engineering Faculty, Food Engineering Department, 07058, Antalya, Turkey.

E-mail: erbas@akdeniz.edu.tr

Keywords: Boza, probiotic, functional food, fermented cereal products, health

Abstract

Fermented cereal products have been consumed since very ancient times at all around the world. Boza is a cereal based traditional food, fermented by lactic acid bacteria and yeasts. In this study; microbiological, chemical and physical properties of boza which was produced with probiotic microorganism (*Saccharomyces boulardii, Lactobacillus acidophilus* LA-5 and *Bifidobacterium bifidum* BB-12), was researched during fermentation and storage.

It was determined that, probiotic *S. boulardii*, *L. acidophilus* LA-5 and *B. bifidum* BB-12 account of boza samples were 3.85, 6.84 and 5.49 log10 cfu/mL, respectively at the end of the fermentation and 4.30, 6.09 and 5.46 log10 cfu/mL respectively at the end of the storage. Lactic, acetic, butyric, succinic and citric acids as organic acids and thiamine, niacin, pantothenic acid and B6 as water soluble vitamins were determined in boza samples. Viscosity values of probiotic boza samples did not change during storage. Also its apparent viscosity, consistency index and flow index were determined as 79.53 Pas, 13.10 Pasn and 0.26, respectively. From a sensorial point of view, probiotic boza samples got 3.44 according to 5 point hedonic scale and 55% of these consumers approved that probiotic boza had acceptance of buying.

As a conclusion, boza was reproduced with certificated probiotic cultures as a new probiotic cereal product. Also it has behaved pseudo-plastic flow property as non-Newtonian. Shelf life of the probiotic boza determined as 12 days at +4°C fridge storage temperature.

Ref: 4366

Natural antimicrobials used to improve the quality traditional Greek Foods

***Tsiraki*[1]**

[1]University of Ioannina, Greece.

E-mail: isavvaid@uoi.gr

Keywords: Traditional Greek Food Products, Natural Antimicrobials

Abstract

As consumer's demand for more healthier meals (free of conventional chemical preservatives) has increased in the last decade, processing technologies employing "Natural Antimicrobials" such as essential oils, natamycin, nisin, citrus extract etc. have been receiving attention. Refrigerated ready to eat (RTE) foods are consumed without additional preparation and cooking by consumers. Examples of RTE foods include: Luncheon meats, deli salads, soft cheeses and pre-packed fresh vegetables, fruits. Tzatziki is a Greek deli salad, served usually as an appetizer, considered as one of the most popular traditional Greek deli salads, consumed locally or also in other counties of Europe, Middle East. Galotyri is considered a traditional Greek PDO (protected designation of origin) soft cheese, produced in Epirus and Thessaly regions of Greece, characterised by a pleasant acid taste and a mild aroma. Two separate experiments were conducted to investigate the effects of (a) citrus extract, natamycin added to Tzatziki, and (b) of nisin, natamycin added to the Galotyri cheese. Results of the 1st experiment showed that Tzatziki's overall flavour was better under vacuum, and of all the treatments examined, the addition of citrus extract, and to a letter extent the combination with natamycin, improved the taste and odor (fruity, pleasant, refreshing with reduced garlic typical flavor) of the Tzatziki deli salad. The shelf-life of the product was extended by more than >10 days (with added citrus extract, or citrus-natamycin) and by and 5-6 days (with added natamycin, citrus and citrus-natamycin) under aerobic or vacuum, respectively, as compared to the control sample's shelf-life. With regard to the 2nd experiment, natamycin, added either singly or in combination with nisin, efficiently suppressed fungal growth in the Galotyri cheese, and the product's shelf-life was doubled (>28 days), maintaining excellent sensorial characteristics, as compared to the control's shelf-life of 14-15 days.

Ref: 4386

Exploring organoleptic and nutritional quality of Portuguese common bean to different food applications

***Carbas, Bruna*[1]; *Mecha, Elsa*[2]; *Serrano, Carmo*[1]; *Manuela, Veloso*[1]; *Bronze, Maria do Rosário*[2]; *Vaz Patto, Maria Carlota*[2]; *Brites, Carla*[1]**

[1]INIAV (instituto Nacional de Investigação Agrária e Veterinária), Portugal;
[2]ITQB (Instituto de Tecnologia Química e Biológica), Portugal.

E-mail: brunainiav@gmail.com

Keywords: Bean (*Phaseolus vulgaris L.*), nutritional, rheological, organoleptic quality, food aplication

Abstract

A broad range (32 samples) of common bean (*Phaseolus vulgaris L.*) portuguese landraces were analysed concerning cooking/rheological behavior as evaluated by seed hydration capacity and flours viscosities profiles. Additionally at the nutritional level, total protein, oil content, α, γ and δ tocopherols and antioxidants content were determined.

Common bean flours showed no breakdown during the holding period at 95°C and this could be due to a lower starch content. The effect of seed soaking and dehulling treatments on viscosity profiles was investigated. This had an important impact on the flour bean pasting properties. However the high correlations obtained suggests that the data collected on whole seeds can be extrapolated to dehulled seeds after soaking.

The protein content of common bean samples ranged from 21.6 to 27.1 g/ 100g. The γ tocopherol appears in a higher content than the other tocopherols (95.9 mg/100g) being α tocopherol the one appearing in lower quantities (0.1 – 3.4 mg/100g). Near Infrared Spectroscopy analysis was performed in these bean flours and quantification models are being developed.

In three traditional common bean varieties *Tarrestre*, *Moleiro* and *Patalar*, we also evaluated total starch and resistant starch content, amylose content and the viscosity profile in different formulations with cereals (maize and rice).

The data collected through the analysis of different quality parameters revealed a high potential of Portuguese common bean flours to be used for supplemented cereal based foods.

Acknowledgements: BeGeQA- Exploiting BEan GEnetics for food Quality and Attractiveness innovation, FCT Research project PTDC/AGRTEC/3555/2012

Ref: 4389

LEGATO (LEGumes for the Agriculture of TOmorrow), adapting to consumers expectations

Carbas, Bruna[1]; Mecha, Elsa[2]; Silva, Andreia[2]; Bronze, Maria do Rosário[2]; Brites, Carla[1]; Vaz Patto, Maria Carlota[2]

[1]INIAV (Instituto Nacional de Investigação Agrária e Veterinária), Portugal;
[2]ITQB (Instituto de Tecnologia Química e Biológica), Portugal.

E-mail: brunainiav@gmail.com

Keywords: Grain, legume, protein

Abstract

The LEGATO (Legumes for the Agriculture of Tomorrow) project (http://legato-fp7.eu/) is aimed at improving the competitiveness of legumes in European agriculture. Grain legumes represent less than 2% of cultivated arable land in Europe, in contrast to >10% in China and the Americas. Despite this, legumes offer major environmental advantages due to their ability to fix atmospheric nitrogen. Thus legumes offer major economies of synthetic nitrogen fertilizer, the incumbent energy cost and greenhouse gas production. Used in a cropping rotation, they supply nitrogen fertilizer to the following crop, increase biodiversity, and can reduce pest and disease transmission. Finally they are an important source of protein for food and feed that can increase Europe's protein autonomy. Animal feed composition is currently dependent on imported soybeans, a commodity showing a steady increase in world market prices.
The LEGATO project brings together 17 research institutions and 10 companies or professional associations from 12 European states to focus on breeding and management methods for the principal grain legumes or pulses grown in Europe.
The Portuguese partners (INIAV and ITQB) will be involved in LEGATO WP4 – Defining traits adapted to consumers' expectations. This work package has several objectives at pre-competitive level or at stakeholders' level. As an example, the phenotypic and genotypic diversity offered by legume collections will be screened and exploited, contributing to the identification of genes conferring desirable seed composition and gustatory qualities, and development of fast and efficient selection tools. Traits relevant to consumers will be prioritized by identifying current and future consumers' food habits and expectations.

Acknowledgements: LEGATO Project "LEGumes for the Agriculture of TOmorrow", project number 613551, is funded by the European Union under the FP7 Programme.

Ref: 5483

Involving stakeholders in the debate on food and health research

***Coutinho, Daniela*[1]**

[1]Sociedade Portuguesa de Inovação, Portugal.

E-mail: danielacoutinho@spi.pt

Keywords: Food and health, Mobilisation and Mutual Learning, Research Programming, Stakeholder Engagement

Abstract

Food and health is a key European challenge due to increases in obesity and diet-related chronic diseases. Innovation is essential to overcoming this challenge. To ensure efforts are directed to the benefit of citizens, innovation requires dialogue and mutual learning between industry, academia and civil society at the programming stage of research processes.

In this context, the European Commission, under its Seventh Framework Programme, is funding Mobilisation and Mutual Learning (MML) Action Plans on Societal Challenges. Under the challenge "A food dilemma: are technological innovations and health concerns reconcilable?", the INPROFOOD project has been exploring, over the course of three years, new ways to establish dialogue and mutual learning between the scientific and civil society community, developing practical guidelines for inclusive, sustainable research designs.

Through the analysis of the current research governance structure, interviews with stakeholders and European Awareness Scenario Workshops the consortium has developed an understanding of the current and desired scenarios in Research Programming in Food and Health over Europe. A "European Open Space Conference" addressed how we can shape the future of food and health research for 2020 covering areas such as education, citizen involvement, and industry-science partnerships. In addition, adolescents were given a voice in policy-making through the PlayDecideGames on Healthy Lifestyle and Diet, organized via 15 science centres.

Through the analysis of the project outcomes, a roadmap to facilitate participatory method take-up has been developed. It outlines a framework to increase the participation of society in health and food research, providing guiding principles to policymakers on how to better incorporate science in society issues into research systems.

Acknowledgements: INPROFOOD (www.inprofood.eu) is comprised of 18 partners from 13 countries, which received funding support from the European Commission's Seventh Framework Programme (Grant agreement no. 289045), and finishes on 31 October 2014.

Special Sessions

Special Session: Action COST TD1104 "European network for development of electroporation-based technologies and treatments" (EP4Bio2Med)

Special Session: Action COST TD1104 - Oral Presentations

Ref: 5484

A European network for development of electroporation-based technologies and treatments

***Ferrari, G.*[1]**

[1]ProdAl Scarl - University of Salerno, via Ponte don Melillo, 84084 Fisciano (SA), Italy

E-mail: gferrari@unisa.it

Abstract

Exposing biological cells to a sufficiently strong external electric field, an increase of the permeability of cell membranes is observed, referred to as electroporation. All types of cells (animal, plant and microorganisms) can be effectively electroporated, thus electroporation can be considered a universal method and a platform technology. Electroporation is nowadays a widely used technology applicable to e.g. cancer treatment, gene transfection, food and biomass processing, and microbial inactivation. However, despite the increasing number of electroporation-based applications, there is a lack of coordination and interdisciplinary exchange of knowledge between researchers from different scientific domains. Thus, critical mass for new major breakthroughs is missing. It was then decided to start an active cooperation between research groups working in different fields of electroporation. Cooperation in Science and Technology (COST) programme through which European Union funds networking and capacity-building activities between researchers working in different research fields seemed the ideal framework to start collaborations between researchers at this stage of electroporation and its applications development. The TD1104 COST Action aimed at: (i) providing necessary steps towards EU cooperation of science and technology to foster basic understanding of electroporation, (ii) improving communication between EU research groups, resulting in streamlining European R&D activities, and (iii) enabling further development of new and existing electroporation-based applications by integrating multidisciplinary research teams, as well as comprehensive training for Early-Stage Researchers (ESRs). Results of the TD1104 COST Action will provide multiple societal, scientific, and technological benefits to improve the existing electroporation-based applications and adding new ones in the field of medicine, biotechnology and environmental preservation.

Ref: 4423

Impact of pulsed electric fields on the textural properties of food materials

***Lebovka, Nikolai*[1]*; Vorobiev, Eugene*[2]**

[1]Institute of Biocolloidal Chemistry named after F.D. Ovcharenko, NAS of Ukraine;
[2]Département de Génie des procédés industriels, Université de Technologie de Compiègne, France

E-mail: lebovka@gmail.com

Keywords: Pulsed electric fields, food plant tissues, electroporation, compression characteristics

Abstract

Control of compression characteristics of fruit and vegetable tissues is very important for optimization of industrial mechanical operations, such as solid/liquid expression, cutting, peeling etc. This work reviews the recent investigations of the impact of pulsed electric fields (PEF) on the texture and compression characteristics of food materials. Detailed textural investigations (stress–deformation and relaxation tests) have shown that plant tissues (carrot, potato and apples, sugar beet etc.) were losing a part of their textural strength after PEF treatment, and both the elasticity modulus and the fracture stress decreased with increase of the damage degree. The PEF-treated tissues generally have compression characteristics intermediate between those of fresh and thermally treated tissues. Moreover, the tissue structure seems to be less affected by the PEF treatment as compared to the freeze-thawing or heating and the tissues treated by PEF generally have compression characteristics intermediate between those of fresh and thermally treated tissues. The PEF-treatment accelerated also the stress relaxation of plant tissues. The PEF-treated tissues demonstrated slower relaxation as compared with freeze-thawed tissues. The evident differences in textural properties of PEF-treated tissues were revealed also in uniaxial and three-dimensional textural tests. The model of PEF assisted solid/liquid expression of agro-food materials was developed on the base of filtration/consolidation theory. The liquid expression mechanisms inside the PEF-treated tissues correspond to the mechanisms, described by the filtration/consolidation theory of compressible porous media. This model was successfully applied for description of the experimental data of expression from different food materials.

Ref: 4420

Application of pulsed electric fields for improving olive oil extraction

Alvarez, Ignacio[1]; Luengo, Elisa[1]; Abenoza, María[1]; Sánchez-Gimeno, Cristina[1]; Raso, Javier[1]

[1]University of Zaragoza, Spain

E-mail: ialvalan@unizar.es

Keywords: Pulsed electric fields, extraction, permeabilization

Abstract

Olive oil is a high-value, edible oil which is appreciated for its flavor and health properties. Olive oil extraction from the cells of olive pulp requires using mechanical procedures including crushing, malaxation and extraction. Increasing malaxation time and/or temperature is the main current approach used for increasing extraction yield. However, these procedures can impair the quality of the olive oil. Pulsed electric fields (PEF) can be an alternative for this objective since it permeabilizes cytoplasmic membranes in plant and animal tissues without a significant temperature increment of the sample. It has been described that PEF improves the extraction yield of juices, and the extraction of intracellular valuable compounds (colorants, polyphenols, etc.).

The objective of this work is to summarize the results obtained by our research group on the application of PEF for the extraction of olive oil at both laboratorial scale and in an olive oil producing company.

The effect of the application of PEF of different intensities (0–2 kV/cm) on Arbequina olive paste in reference to olive oil extraction at different malaxation times (0, 15, and 30 min) and temperatures (15 and 26 °C) was investigated at lab scale. The results were validated at an oil producing company treating 4,000 kg of olive paste at a flow of 3,500 kg/h using a colineal treatment chamber.

At lab scale, the extraction yield improved by 54 % when the olive paste was PEF treated (2 kV/cm) without malaxation. PEF permitted the reduction of the malaxation temperature from 26 to 15 °C without impairing the extraction yield. At the oil producing company, the same extraction yield was obtained after 150 and 80 minutes of malaxation in the control and PEFtreated samples, respectively. After 150 minutes of malaxation the PEF treatment increased the oil extraction yield a 9.5%.

Parameters legally established to measure the level of quality of the virgin olive oil were not affected by the PEF treatments. A sensory analysis revealed that the application of a PEF treatment did not generate any bad flavor or taste in the oil.

Acknowledgements: This study has been carried out with financial support from the Spanish MINCINN, EU-FEDER (CIT020000-2009-40) and Gobierno de Aragón. Authors also thank the support of COST ACTION 1104. European network for the development of electroporation-based technologies and treatments.

Ref: 5432

Pulsed electric field-assisted extraction of aroma and bioactive compounds from dry herbs

Pataro, G.[1]; Tonelli, Isaac[2]; Falcone, Mariangela[3]; Ferrari, G.[1,3]

[1]Department of Industrial Engineering, University of Salerno, via Giovanni Paolo II 132, 84084 Fisciano (SA), Italy;
[2]Kerry Ingredients & Flavours - EMEA Region, Via Capitani di Mozzo, 12/16 I-24030 Mozzo (BG), Italy;
[3]ProdAl Scarl - University of Salerno, via Ponte don Melillo, 84084 Fisciano (SA), Italy

E-mail: gpataro@unisa.it

Keywords: PEF, extraction, dry herbs, aroma, bioactive compounds

Abstract

The influence of pulsed electric field (PEF) treatment on the extraction yield of aroma and bioactive compounds from wormwood, sweet orange peel, green tea, vermouth mixture, cocoa nibs and vanilla beans was investigated. Prior to PEF treatment, the herbs were hydrated by infusion in water for 30 min and then subjected to extraction at different extraction times (2-9 days) and temperatures (5-25 °C) using ethanol (96%), propylen-glycol and water as solvents. Extraction yield of tuione from wormwood, limonene from orange peel, theine from green tea, caffeine from cocoa nibs, linalool from vermouth mixture, and vanillin from vanilla beans was quantified from the extracts obtained after pressing and filtration of the macerated herbs.

Electrical impedance measurements of untreated and PEF treated hydrated samples were used to evaluate the cell disintegration index (Zp), which was used to determine optimal PEF treatment conditions (2.5-4 kV/cm, 5-40 kJ/kg) and optimise extraction yield.

Results revealed a different electrical behavior for the different matrices. The maximum cell disintegration index was detected for cocoa and vanilla (Zp=0.82), followed from green tea (Zp=0.79), vermouth mixture (Zp=0.77), wormwood (Zp=0.70), and orange peel (Zp=0.55). PEF treatment increased the extraction yield of all the compounds of interest, the effect being higher with ethanol as solvent. Increments of extraction yield of 42%, 23%, 12%, 109%, 35%, and 16% were detected for tuione, limonene, theine, linalool, caffeine, and vanillin, respectively.

Overall, the results of this investigation demonstrated the potential of PEF to further improve the extraction yield of valuable compounds from dry herbs.

Ref: 5433

Selected examples of PEF investigations in food processing with particular reference to the acceleration and termination of reactions and extraction of compounds

Lyng, J.[1]; Arroyo-Casabona, C.[1]; Brunton, N.[1]; Apel, C.[1]; O'Sullivan, M.[1]

[1]UCD School of Agriculture, Food Science and Veterinary Medicine, University College Dublin, Ireland

E-mail: james.lyng@ucd.ie

Abstract

The largest proportion of the scientific literature on PEF processing of foodstuffs is in the area of microbial inactivation for preservation purposes. However, there is an increasing trend for publications in other areas of food processing where PEF can be used for non-microbial cell disruption. This presentation will provide a very brief overview of specific examples from this area. It will include synopsised results from investigations on the impact of PEF for the acceleration of meat tenderisation, for termination of chemical reactions for bioactive production and for the extraction of compounds from plant waste streams.

Special Session: “Quafety” Project – Comprehensive approach to enhance quality and safety of ready to eat fresh products

Special Session: “Quafety” Project - Oral presentations

Ref: 4393

Effects of stresses on the regulation of glucosinolates metabolism in rocket (*Diplotaxis tenuifolia* L.)

***Cocetta, Giacomo*[1]*; Cavaiuolo, Marina*[1]*; Ferrante, Antonio*[1]

[1]Department of Agricultural and Environmental Sciences, Università degli Studi di Milano, Italy

E-mail: antonio.ferrante@unimi.it

Keywords: glucosinolates

Abstract

The glucosinolates are important health promoting compounds with proven pharmaceutical and anti-cancer properties. Among the different plant families, the Brassicaceae are particularly rich in glucosinolates. In this work the effects of pre-harvest and postharvest stresses were studied on the transcriptome and genes related to glucosinolates metabolism. Rocket (*Diplotaxis tenuifolia* L.) plants were grown using hydroponic systems in controlled growth chambers for 3 weeks prior to stress treatment. In pre-harvest was imposed salinity (200 mM NaCl), heat radical stress (40 °C), nitrate deficiency, while in post-harvest was imposed chilling (4 °C), wounding, dark and water stress. After 24 h of stress treatment the samples were collected and total RNA was extracted from stressed and control plants and sequenced with a two paired-end Illumina sequencing platform.
The genes involved in the glucosinolates biosynthesis and regulation were identified from the different libraries and the changes in expression in response to different stresses are reported.
From the bioinformatic analysis of transcripts a total of 181 genes involved in the glucosinolate biosynthesis and regulation were identified. The results indicated that the glucosinolate pathways can be regulated by stress applications at both pre- and postharvest stage, enhancing nutritional values of rocket and potentially related species.

Acknowledgements: The research leading to these results has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement n° 289719 – QUAFETY (www.quafety.eu).

Ref: 4392

Composite edible coatings to preserve the quality of fresh cut melons

Poverenov, Elena[1]; Danino, Shani[1]; Rutenberg, Roi[2]; Horev, Batia[1]; Granit, Rina[1]; Vinokur, Yakov[1]; Rodov, Victor[1]

[1]ARO - The Volcani Center, Israel;
[2]The Hebrew University of Jerusalem, Israel

E-mail: vrodov@agri.gov.il

Keywords: Composite coating, edible films, chitosan, alginate, gelatin, layer-by-layer, fresh-cut melon, quality

Abstract

Edible coatings attract interest as promising techniques for controlling food deterioration. The study performed in the framework of the EU FP7 project QUAFETY examined the efficacy of edible coatings for preservation of fresh-cut melons. Different approaches, blending and Layer-by-Layer electrostatic deposition (LbL) were utilized to produce composite coatings comprising amphoteric protein gelatin and cationic polysaccharide chitosan. In parallel, edible films based on these compositions were tested for mechanical, optical and spectroscopic properties. In another series of trials, the LbL approach was used for coating fresh-cut melons using oppositely charged natural polysaccharides, polyanion alginate and polycation chitosan. The effects of the composite coatings on physiological, textural and microbiological parameters of fresh-cut melons were compared with those of single-component coatings and of non-coated control.

All chitosan-containing coatings effectively inhibited microbial growth typically reducing the bacterial, yeast and mold counts on the product by at least 1-2 log CFU/g. Both LbL coatings (gelatin-chitosan and alginate-chitosan) slowed down tissue texture degradation, so that after 14 days of storage only LbL samples maintained an appreciable firmness. All composite coatings did not obstruct fruit gas exchange and did not cause accumulation of fermented off-flavor volatiles observed in melons coated with monolayer alginate. Gelatin-chitosan LBL coating slightly reduced the produce weight loss, while neither blended formulation nor alginate-chitosan LBL coating improved this parameter. The composite coatings proved themselves helpful for extending the product shelf-life.

References:

Poverenov, E., Danino, S., Horev, B., Granit, R., Vinokur, Y., and Rodov, V. (2014). Layer-by-Layer electrostatic deposition of edible coating on fresh cut melon model: anticipated and unexpected effects of alginate-chitosan combination. *Food Bioprocess Technol.*, 7:1424-1432.
Poverenov, E., Rutenberg, R., Danino, S., Horev, B., and Rodov, V. (2014). Gelatin-chitosan composite films and edible coatings to enhance the quality of food products: Layer by Layer vs. blended formulations. *Food Bioprocess Technol.*, DOI 10.1007/s11947-014-1333-7.

Ref: 4394

Smelling shelf life: using volatiles to assess quality and shelf-life

***Spadafora, Natasha*[1]*; Muller, Carsten*[1]*; Bates, Matt*[2]*; Rogers, Hilary J.*[1]

[1]Cardiff University, School of Biosciences, United Kingdom;
[2]Markes International, United Kingdom

E-mail: rogershj@cf.ac.uk

Keywords: volatile organic compounds, melon, rocket salad, shelf-life

Abstract

Ready to eat partially processed fruits and salads are increasingly popular and provide easy access to fresh produce. However, processing of fruit and vegetables induces a number of changes including alterations in colour and texture. In addition respiration rate and ethylene production are affected. Importantly processing also elicits changes in flavour (sweetness) and aroma (production of volatile organic compounds – VOCs), of critical importance to the consumer. Several parameters govern shelf life; temperature is a critical factor and therefore cut fruit and salads are usually stored at low temperatures (around 4 °C). We are using VOC analyses to obtain markers for assessing quality and safety of fresh ready to eat salads and fruits to provide useful tools to the industry.

Several methods are available for capture and analysis of VOCs; we have chosen to collect VOCs from headspace on thermal desorption tubes (TD) and to analyse them after thermal desorption on Gas Chromatography and Time of Flight Mass Spectrometry (TD-GC-TOF-MS) This technique is very sensitive, allows transport of samples collected on site for lab analysis. We are focusing on melons and rocket, two important components of fresh fruit and leafy salads, respectively. We are asking whether temperature affects VOC profiles during storage. We have identified the major volatile compounds associated with melon and rocket aroma and show significant changes in the overall VOC profile during storage. We were also able to separate the VOC profiles from the different temperatures indicating that VOCs may be also useful markers as indicators of the effects of these parameters on quality.

Ref: 4401

Physiological and phytochemical quality of ready-to-eat rocket leaves as affected by processing, modified atmosphere and storage temperature

***Amaro, Ana Luísa*[1]; *Pereira, Maria João*[1]; *Carvalho, Susana*[2]; *Vasconcelos, Marta*[1]; *Pintado, Maria Manuela*[1]**

[1]CBQF/Escola Superior de Biotecnologia, Universidade Católica Portuguesa, 4200-072 Porto, Portugal; [2]Faculdade de Ciências, Universidade do Porto, Departamento de Geociências Ambiente e Ordenamento do Território, Rua do Campo Alegre 697, 4169-007 Porto, Portugal

E-mail: aamaro@porto.ucp.pt

Keywords: ready-to-eat, rocket, quality, processing, preservation

Abstract

Rocket leaves are widely consumed as a ready-to-eat (RTE) leafy vegetable, valued by its wide range of health promoting phytonutrients, including vitamin C and phenolic compounds. Processing and storage conditions are known to affect quality of RTE rocket leaves, with package atmosphere and low temperature as key factors in quality maintenance throughout processing to consumption. However, information on rocket leaves nutritional quality as affected by modified atmosphere and storage temperature is scarce. In order to generate recommendations to optimize phytochemical preservation of rocket leaves during processing, a nutritional audit of the processing line of a fresh-cut vegetables enterprise was performed. Samples were collected at each step of the production flowchart of RTE rocket-leaves: at rocket leaves reception, after washing and decontamination, after centrifugation and after packaging. All samples were analyzed for nutritional characterization. Furthermore, the effect of modified atmosphere and temperature conditions during storage on physiological and phytochemical quality of RTE rocket leaves was evaluated and the relative changes determined. To study modified atmosphere effects on quality, freshly harvested rocket leaves were processed, packaged in low oxygen permeability film bags, flushed with different oxygen concentrations (2.5; 5; 10 and 20% O_2), thermo sealed with a vacuum packing machine and to analyze the effect of temperature on quality, freshly harvested rocket leaves were processed, packaged and stored at different temperatures (0, 5 and 10 °C) for 14 days. All rocket leaves samples were assessed for respiration rate, chlorophyll content and phytochemical composition during storage. Processing, modified atmosphere and storage temperature significantly affected respiration rate, chlorophyll content and phytochemical composition of RTE rocket leaves. The integration of these results contributes to the understanding of the effects of processing and storage conditions on overall quality of RTE vegetables and provide

useful information for developing processes aimed at the modulation of nutritional quality and shelf-life extension.

Acknowledgements: Work was funded by FP7/KBBE2011.2.4-401/289719 – QAFETY- “COMPREHENSIVE APPROACH TO ENHANCE QUALITY AND SAFETY OF READY TO EAT FRESH PRODUCTS”.

Special Session: “Quafety” Project - Poster Presentations

Ref: 4402

Modeling the effect of oxygen availability and storage temperature on fresh-cut strawberry respiration rate

***Amaro, Ana Luísa*[1]; *Pereira, Maria João*[1]; *Carvalho, Susana*[2]; *Vasconcelos, Marta*[1]; *Pintado, Maria Manuela*[1]**

[1]CBQF/Escola Superior de Biotecnologia, Universidade Católica Portuguesa, 4200-072 Porto, Portugal;
[2]Faculdade de Ciências, Universidade do Porto, Departamento de Geociências Ambiente e Ordenamento do Território, Rua do Campo Alegre 697, 4169-007 Porto, Portugal

E-mail: aamaro@porto.ucp.pt

Keywords: fresh-cut strawberry, oxygen availability, temperature, respiration rate

Abstract

Fresh-cut commodities shelf-life is limited by minimal processing operations and storage conditions. Wound damage is sensed by sensors/receptors that recognize increased concentrations of endogenous molecules or their fragments, and tissue response involves an increase in respiration rate. Respiration behavior of fresh-cut strawberries is affected by wounding, storage temperature and oxygen availability. Modified atmosphere packaging and refrigerated storage are frequently used to reduce the respiration rate without negatively affecting the physiology of the fruit and to increase shelf life. Mathematical models have been proposed to correlate the respiration rate with different storage parameters such as gas composition and temperature, but the two factors have rarely been considered simultaneously and the systematic approach to modified atmospheres packaging design involves the knowledge of respiration rate kinetics at different temperatures. The objectives of this study were to determine respiration rate of fresh-cut strawberries as a function of oxygen and temperature conditions during storage and to develop and validate mathematical models for predicting respiration rate. Freshly harvested strawberries were processed into wedges and placed in 750 mL glass jars. The glass jars containing fresh-cut strawberries were then flushed with different oxygen concentrations (2.5; 5; 10 and 20% O_2) and stored in three different temperatures (0, 5 and 10 °C), for 5 days. The experiments were performed in three replicates. Oxygen and carbon dioxide concentrations inside the glass jars were analyzed throughout refrigerated storage with a gas analyzer, measuring at two hours intervals in the first 48 hours and then in 12 hours intervals until the end of the 5 days. Initial oxygen partial pressure and temperature had significant effects on fresh-cut strawberry respiration rate with significant decreases with lower initial oxygen levels and lower temperature. The models developed are useful for supporting decision on fresh-cut strawberry optimal storage conditions based on physiological response.

Acknowledgements: Work was funded by FP7/KBBE2011.2.4-401/289719 – QAFETY- “COMPREHENSIVE APPROACH TO ENHANCE QUALITY AND SAFETY OF READY TO EAT FRESH PRODUCTS”.

Ref: 4403

Fresh-cut melon nutritional and functional quality throughout the production processing line and during storage

Pereira, Maria João[1]; Amaro, Ana Luísa[1]; Carvalho, Susana[2]; Pintado, Maria Manuela[1]

[1]CBQF/Escola Superior de Biotecnologia, Universidade Católica Portuguesa, 4200-072 Porto, Portugal;
[2]Faculdade de Ciências, Universidade do Porto, Departamento de Geociências Ambiente e Ordenamento do Território, Rua do Campo Alegre 697, 4169-007 Porto, Portugal

E-mail: aamaro@porto.ucp.pt

Keywords: fresh-cut cantaloupe, processing, storage, nutritional quality

Abstract

Fruits processing conditions can be described through representative flowcharts with the identification of the process variables. However, integrated information about the effect of each processing step on phytochemical properties of the processed fruits is still lacking. This study aims at development of a system to audit postharvest handling systems and processing lines for the preservation of health-promoting phytochemicals and to optimize processing conditions to maintain fruit quality. A nutritional and functional audit of postharvest handling systems and processing lines of a fresh-cut fruits enterprise was performed and the effects of the production process upon the nutritional and phytochemical composition of melon were determined. Three replicated samples were collected at each step of the production flowchart of fresh-cut cantaloupe melon: at fruit reception, after washing and decontamination and after processing. All samples were frozen with liquid nitrogen and stored at -80 °C until analyzed for nutritional characterization. Total antioxidant activity was assessed by the ABTS method, total phenolics by Folin Ciocalteau´s method and phenolic compounds and carotenoids were analyzed by high performance liquid chromatography (HPLC-DAD). Throughout cantaloupe melon processing, a significant decrease in total phenolic compounds and antioxidant capacity was observed, while total carotenoids levels were relatively maintained. Contrarily, as processing advanced, ascorbic acid concentration increased significantly after decontamination step. After the nutritional audit to the process and to evaluate nutritional quality during storage, simulating the company´s commercial conditions and product´s shelf-life, fresh-cut cantaloupe samples were placed in polypropylene clamshells (236 mL) or in packages heat sealed with a low oxygen transmission rate film (78 mL) and stored at 5 °C for 6 days. Except for ascorbic acid concentration, which was better maintained in filmed packages, overall nutritional quality of fresh-cut melon is better maintained during storage in clamshell packages.

Acknowledgements: Work was funded by FP7/KBBE2011.2.4-401/289719 – QAFETY - “COMPREHENSIVE APPROACH TO ENHANCE QUALITY AND SAFETY OF READY TO EAT FRESH PRODUCTS”.

Ref: 4404

Phenolic compounds content and antioxidant activity of wild strawberries (*Fragaria Vesca* L.)

***Pereira, Maria João*[1]; Amaro, Ana Luísa[1]; Carvalho, Ana[1]; Pintado, Maria Manuela[1]**

[1]CBQF/Escola Superior de Biotecnologia, Universidade Católica Portuguesa, 4200-072 Porto, Portugal

E-mail: aamaro@porto.ucp.pt

Keywords: strawberries, phenolic compounds, anthocyanins, antioxidant activity

Abstract

Strawberries are usually consumed in high quantities and can thus be a valuable source of phenolic compounds, vitamin C and other antioxidant compounds. The main phenolic compounds in strawberries are anthocyanins, responsible for the red color in strawberry flesh, combined with flavonoids, flavanols, and derivatives of hydroxycinnamic and ellagic acid (Aaby *et al*, 2007; Pinto *et al*, 2008). Wild strawberries (*Fragaria Vesca L.*) are usually claimed as more antioxidant and more rich in specific phenolic compounds. So the aim of this work was to characterize the phenolic compounds profile and evaluate the antioxidant capacity of wild strawberries in order to ascribe the relevant nutritional and functional properties of these strawberries. Total phenolics were assessed by Folin Ciocalteau's method, total anthocyanins by spectrophotometric methods, total antioxidant activity by the ABTS method and the phenolic compounds were analyzed by high performance liquid chromatography (HPLCDAD). The results obtained reveal that wild strawberries are indeed a great source of phenolic compounds (catechin, epigallocatechin gallate, rutin and ellagic acid) and anthocyanins (cyanidin-3-*O*-galactoside, cyanidin-3-*O*-glucoside, pelargonidin-3-*O*-glucoside, pelargonidin-3-*O*-rutinoside). All of these compounds have importance for the high antioxidant activity demonstrated by these strawberries. Thus, this study highlights the potential of these wild strawberries as a source of bioactive compounds consumed in human diet.

References:

Aaby, K., Ekeberg, D. & Skrede, G. (2007). Characterization of phenolic compounds in strawberry (*Fragaria x ananassa*) fruits by different HPLC detectors and contribution of individual compounds to total antioxidant capacity. *Journal of Agricultural and Food Chemistry*, *55*, 4395-4406.

Pinto, M. D. S., Kwon, Y. I., Apostolidis, E., Lajolo, F. M., Genovese, M. I., & Shetty, K. (2008). Functionality of bioactive compounds in Brazilian strawberry (*Fragaria x ananassa* Duch.) cultivars: evaluation of hyperglycemia and hypertension potential using *in vitro* models. *Journal of Agricultural and Food Chemistry*, 56(12), 4386-4392.

Acknowledgements: Work was funded by FP7/KBBE2011.2.4-401/289719 – QAFETY- “COMPREHENSIVE APPROACH TO ENHANCE QUALITY AND SAFETY OF READY TO EAT FRESH PRODUCTS”.

Author Index

A

B

C

D

E

F

G

H

I

J

K

L

M

N

O

P

Q

R

S

T

U

V

W

Y

Z