2013 Annual Meeting Abstracts

Edible Applications Technology

MONDAY

AFTERNOON

EAT 1: Functional Lipids
Chair(s): N. Garti, The Hebrew University of Jerusalem, Israel; B. Kickle, ADM Oils Research, USA; H.-S. Hwang, USDA, ARS, NCAUR, USA

Synergistic Solubilization of dha and Curcumin in Nano-sized Delivery Liquid Vehicles

N. Garti[(1)]
[(1)]The Hebrew University of Jerusalem, Israel

Recently we developed novel nano-sized delivery vehicles known as NSSL (nano-sized self assembled liquid vehicles) that are fully dilutable with any amount of water. The NSSL vehicles have very high Solubilization capacity at their interface and thus are capable of solubilizing both water-insoluble and oil-soluble bioactives and nutrraceuticals. In the last year we managed to solubilize together (co-Solubilization) different and various types of nutraceuticals. Of special interest are the omega fatty acids in their triglyceride forms (both DHA and EPA) to be used in beverages and also other anti-inflammatory agents. In this presentation we will demonstrate solubilization of DHA along with curcumin to form clear solution-like structured , non-viscous fluid fully dilutable in water. The physical and chemical characteristics of this novel formulation based on friendly emulsifiers and good ability to cross the human guts-blood membrane will be demonstrated.

Microstructure of Gels Made With Monoglycerides and Canola Oil

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Organogels have viscoelastic properties useful for the manufacture of margarines, shortenings, and edible emulsions. This work investigates the structure and physical properties of organogels statically and under shear, using blends of canola oil and saturated monoglycerides [80:20 monostearate: monopalmitate (SKB) or 50:50 (w/w) monostearate: monopalmitate (PKB)]. Some blends included of 6% ethyl cellulose to evaluate viscosity effect on organogel stability. Through powder X-ray diffraction experiments, we established that under static conditions, SKB at a total monoglyceride concentration of 8%, forms gels where ?´ is the predominant polymorph, while for PKB, the predominant form was ?. At a total monoglyceride concentration of 2%, SBK gels underwent a ?´ to ? polymorphic transition after 4 days of storage at 15°C. In contrast, in 8% SBK gels set while shearing, the predominant polymorph was ?. Under static conditions, all blends with and without ethyl cellulose, developed needle-like crystals that aggregate over time. These results suggest that the oil phase separation observed during storage is not associated with a ?´ to ? polymorphic transition, but due to the development of large crystal aggregates, which lead to an increase in the

porosity of the three-dimensional crystal network.

Thermodynamic Calculation of Multicomponent Phase Compositions

R. Liu[(1)], A. Marangoni[(2)], G. Mazzanti[(3)]
[(1)]Dalhousie University, Canada [(2)]University of Guelph, Canada [(3)]Dalhousie University, Canada

Mixed fat crystals play a key role in food flavor, texture and physical properties. The fat crystallization behavior depends on its composition and crystallization conditions. Therefore, it is important to predict multicomponent phase composition in food industry. A database that includes melting temperature, interaction parameters and enthalpy of crystallization of over 200 triaclylgcerols for three kinds of polymorphs was digitized. Wesdorp?s equilibrium model, along with modifications from Los et al., was used to calculate the equilibrium temperature and compositions of two and three phase systems. The model was implemented as a MATLAB program. The program can be used also to estimate equilibrium SFC and iso-solid curves. The graphical user interface (GUI) of the program allows the user to select the composition of the mixture and the generation of SFC and compositional diagrams. We present as an example results for two ternary systems, LLL-PPP-SSS and SOS-POS-POP, and for two shortening blends. The model?s predictions were compared to data from differential scanning calorimetry, x-ray diffraction and nuclear magnetic resonance. The comparison produced mixed results, since the model, at this stage, is not including kinetic distortions, which are unavoidable in real experiments with these materials. This thermodynamic calculation program, with a user-friendly GUI, is a step forward to disseminate the very important advances in crystallization science that have so far remained mostly in the academic world.

CANCELLED - Crystallisation and Polymorphic Behaviour of Shea Stearin and Effect of Diacylglycerols

J. Ray[(1)], K. Smith[(2)], K. Bhaggan[(3)], Z. Nagy[(4)], A. Stapley[(5)]
[(1)]Loughborough University, United Kingdom (Great Britain) [(2)]Fat Science Consulting Ltd, United Kingdom (Great Britain) [(3)]IOI Loders Croklaan Europe, Netherlands [(4)]Purdue University, United States of America [(5)]Loughborough University, United Kingdom (Great Britain)

Multi-Length-Scale Structural Elucidation of Mechanism Responsible for Inhibiting FAME Crystallization

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Unsaturated triacylglycerols (TAGs), particularly those with cis unsaturated fatty acids at the sn-1 and sn-3 positions and a trans/saturated fatty acid at the sn-2 position, have been found to significantly reduce the crystallization onset of saturated fatty acid methyl esters (FAMES) at low loading. Detailed microstructure and crystal structure analyses by PLM and XRD of a model binary system made of 1,3-dioleoyl-2-palmitoyl glycerol (OPO) and methyl palmitate (MeP) were conducted in order to elucidate the mechanism of crystallization inhibition at drastically different length scales. Both the crystal structure and the microstructure of crystallized MeP were found to be profoundly disrupted by the TAG. The mechanism is proposed to be a limitation to growth of the FAME crystal lattice or a nucleus being formed in the melt due to the participation of the saturated fatty acid of the TAG in the crystal lattice or in the lamellae of a forming nucleus of the FAME, and the highly kinked cis unsaturated fatty acids also present on the TAG preventing any further packing of a similar nature. This both results in a disruption of the growth of the crystal as well

as limitation of nucleation in the liquid melt due to a disruption of the growth of a forming nucleus into a size which is thermodynamically favourable for growth.

Rheological Behaviour of Suspensions of Lipid Nanoplatelets

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Shortenings, margarines and many other lipid based foods are industrially crystallized under shear flow. Knowledge of the rheological behaviour of these suspensions of crystals in oil is very limited. It has been recently proven that the crystals are nanoplatelets, and they can aggregate into larger clusters. To study the effect of shear rate on the aggregation of the nanoplatelets and its effect on the rheological properties of the suspension, we used a mixture of fully hydrogenated soybean oil (FHSO) in soybean oil (SO) at nominal solids levels of 5, 10, 15 and 20 % by weight of FHSO. The crystallization was performed at temperatures between 40 and 60 °C under shear rates between 500 and 800 s-1, using an Anton Paar DSR301 rheometer. A ?small variation method? was employed to test the rheological response of the suspension to changes in shear rate. The suspensions displayed shear thinning behaviour. Comparing with literature reports on the orientation of the nanocrystals under shear flow, we conclude that the shear-thinning behaviour is related to the orientation of the platelets, and to their aggregation behaviour. A generalized Cross-Carreau model with a modified Williams-Landel-Ferry temperature dependency was used to successfully describe the rheological behaviour of the suspensions.

Pre-shearing of Candelilla Wax-vegetable oil Solutions Does Determine the Rheology of the Organogels

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The gelation of 3% candelilla wax (CW) safflower oil solutions was done statically, or applying a shear rate (30 to 600 1/s) constantly during cooling (CS), or just during cooling from 90°C to 52°C, to then continuing the cooling under static conditions (S52). We measured the elastic (G?) and loss (G?) modulus, and yield stress (?*) of the CW organogels as a function of time at 5°C. Compared with the gels formed statically the use of CS resulted in organogels poorly structured with decreasing G? as shear rate increased. Under quiescent conditions the gels showed microplatelets with a meshing organization, while CS produced smaller microplatelets with less extent of meshing as shear rate increased. In contrast, at all shear rates investigated S52 conditions formed organogels with larger microplatelets, a more apparent meshing organization with higher G? and ?* than gels developed statically or with CS ($P < 0.10$). At 300 1/s, where S52 organogels showed the highest solid phase content (SPC), G? showed a maximum ($P < 0.002$). However, the SPC did not explain the G? behavior fully. The behavior of the micro-structure or gel development rate [i.e., d(G?)/d(time)] as a function of T°, suggested that flow produced by S52 conditions induced the molecular alignment of CW components at T° above the onset for CW crystallization and even above its melting T°. We concluded that shearing and the extent of its application as T° decreases, determine crystal size and the microplatelet-microplatelet interaction throughout the three-dimensional crystal network.

Investigating the Eutectic Behavior of Certain Structured TAGs and FAMEs

S. Narine[(1)], L. Bouzidi[(2)]

[(1)]Trent University, Canada [(2)]Trent University, Canada

The binary phase behavior of a number of chemically pure structured triacylglycerols (TAGs) and TAG oligomers with chemically pure saturated fatty acid methyl esters (FAMEs) were studied. Dramatic eutectic behavior was noted in many instances, and a simple packing model will be presented to explain the colligative effect of the structured TAG and TAG oligomers on the crystallization behavior of the saturated FAMEs. X Ray Diffraction, Differential Scanning Calorimetry and Polarized Light Microscopy were used to highlight the colligative effect, which affected both the melting behavior as well as grain sizes of the resulting crystals. The model and experimental studies have profound implications for mitigating the crystallization of saturated FAMEs in biodiesel.

Acylglycerol Polymorphism: a Stereochemical Perspective

R. Craven[(1)], R. Lencki[(2)]
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The physical properties of a food product often depend on the polymorphism of the constituent fat phase. This is illustrated by the favorable physical and sensory properties associated with the beta prime form for margarine and butter and the beta (V) form for chocolate. It is the non-covalent interactions within and between acylglycerol molecules that determine the polymorphism of lipid-containing materials. These interactions are influenced by two main factors: the nature of substituents on, and the stereochemistry of, the glycerol backbone. Recently, we demonstrated that stereochemistry plays a key role in the polymorphism of triacylglycerols by compiling and analyzing enantiomeric phase diagram and crystal structure data. We showed that polymorphism in triacylglycerols occurs due to differences in unit-cell stereochemistry and that these observations, made for chiral systems, also apply to achiral systems. Interestingly, the role stereochemistry plays in the function of proteins and nucleic acids is widely-recognized, but, a similar understanding for lipids has yet to be established. In this presentation, we will demonstrate that stereochemistry plays a key role in the polymorphism of monoacylglycerols, diacylglycerols, and triacylglycerols, and in the physical properties of membrane lipids (e.g. phospholipids) and other glycerol-derived molecules.

TUESDAY

MORNING

EAT 2: Novel Lipid Technologies
Chair(s): G. Mazzanti, Dalhousie University, Canada; M. Rogers, The State University of New Jersey, USA

Formation of Vegetable Oil-based Ethylcellulose Oleogels at the Macro- and Micro-scale

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The development of techniques to reduce levels of saturated and trans-fatty acids in food products has been a very active area of study in recent years. The structuring of edible oils for direct replacement of fats has proven to be a promising strategy and many ?organogelators? have now been identified. Of these, ethylcellulose organogels have been shown to have excellent oil structuring potential and these gels have also been successfully incorporated into

several food products, including cream fillings, and finely comminuted meat products. Moving to a commercial scale production of such products would require the production of large-scale batches of these gels. However, we have recently observed that the combination of larger sample volumes, addition of certain types of surfactants, and cooling rate during gel setting can have a severe impact on the resulting gel structure. When cooled in bulk, certain formulations of these gels ?fractionate? and form a firmer exterior surrounding a much softer core. Independent investigation of these two distinct regions has demonstrated they are chemically indistinct, indicating the mechanics during gel formation cause the observed fractionation. The stark contrast between the two phases can be lessened through quench cooling, however slow cooling results in complete homogeneity. In the coming months we intend to further investigate the structural arrangement and/or conformational state of ethylcellulose responsible for the fractionation effect, and will add to the growing knowledgebase on vegetable oil-based ethylcellulose organogels.

Imaging the Polymer Network Structure of Ethylcellulose Oleogels Using Cryo-scanning Electron Microscopy

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Oleogels made using the polymer ethylcellulose have recently been shown to have a wide variety of food applications. Their potential use in cookies, chocolate, or finely comminuted meat products have all been demonstrated with great success. Though great insight has been uncovered in regards to the mechanical properties of these oleogels, little is known about their microstructure. Imaging these gels has proved to be a great challenge, with several previous attempts providing little details about network structure. Finally, after removing a layer of surface oil using a solvent, the polymer network structure was exposed and could be imaged using cryo-scanning electron microscopy. By measuring the average pore sizes, previously filled with vegetable oil, an insight could be attained as to how the network changed for different oil types, polymer molecular weights, polymer concentrations, and surfactant (sorbitan monostearate) concentrations. By using this microstructure analysis, it was possible to establish a relationship between microstructure and mechanical properties (texture). This information allows for a targeted modification of gel properties for the design of specific functionalities in food products.

Mechanism of Heat Resistance in Ethylcellulose-stabilized Heat Resistant Chocolate

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Heat resistant chocolate (HRC) was developed by addition of ethylcellulose (EC) dissolved in ethanol (EtOH) to conventional chocolate. Upon removal of the EtOH a milk chocolate containing 2.17% EC had a hardness at 40°C of 18 N. The mechanism of heat resistance in this chocolate was studied. Model chocolate systems based on the ingredients in the HRC were prepared and the hardness was tested at 40°C using a texture analyser. It was found that the hardness increased dramatically with increasing concentration of sugar. Control samples containing no EC or no sugar had a hardness of 0.5 N and 2 N respectively; a sample with both EC and sucrose had hardness of 18 N. This shows that interactions between sucrose and EC may be responsible for providing heat resistance. Atomic scale molecular dynamics simulations using GROMACS 4.5.5 software were performed on a system with EC and sucrose in a triacylglycerol medium. The results indicated that hydrogen bonding is possible between EC and sucrose. The role of lecithin at the sucrose surface was also studied and it was found that lecithin provides a physical barrier shielding the EC from the sucrose reducing interactions and heat resistance. These results have shown that interactions between EC and sucrose are likely important to achieving heat resistance in EC-stabilized chocolate.

A new Group Contribution Method to Describe the Enthalpy of Fusion and Melting Temperature of Triglycerdies

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To allow for modelling the crystallization of TAG's still the work from Wesdorp in the early nineties remains the gold standard. This work is due to thh fact that it practically delivers the only comprehensve set of physical properties data for the modelling of fat crysatllization from first principles bases for nearly all SLE calculations. This work is however based on rather arbitrary correlations of the available experimental data and does practically not allow to model the physical properties of TAG's in polymorphs they only appear in when crystallized as mixed solid phases. This limitaton is particualrly true for the experimantal determintion of the physical properties. In our contribution we present an attempt to formulate a new model for the physical properties which is primarily build on the different contributions from fatty acid - fatty acids neighbours, glycerol conformation and methyl end plane structure. This approach allows due to the nature of the fatty acid - fatty acid interaction to limit the number of fitting parameters substantially. Additionally this could eleminate the limitation to pure systems and consequently allow for example to predict the formation of compound crystals.

In Situ Observation of Transformation Pathways of Polymorphic Forms of 1,3-dipalmitoyl-2-oleoyl Glycerol (pop) Examined With Synchrotron Radiation X-ray Diffraction and Dsc

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We studied the influence of the rates of cooling and heating on the polymorphic crystallization and transformation of POP (1,3-dipalmitoyl-2-oleoyl glycerol) with DSC and Synchrotron Radiation X-Ray Diffraction (SR-XRD). The rate of cooling (heating) was changed from 15 to 2, 1, and 0.5ºC/min (15 to 2, 1, 0.5, and 0.1ºC/min). The results indicated that more stable forms were formed in a higher quantity when POP was slowly cooled and heated, whereas less stable forms occurred at higher rates of cooling and heating. Specifically, less stable ? and ? forms were directly obtained at cooling rates of 15 to 0.5ºC/min. The more stable forms of ?? or ? did not occur even at a rate of cooling of 0.5ºC/min, whereas ? or ?? transformed to ?? or ??at heating rates of 0.5 and 0.1ºC/min. The polymorphic transformations occurred either in solid-state or melt-mediation and were largely influenced by the heating rates. We discuss the present results by considering the differences in activation free energies for the transformations from ? or ? to more stable forms, which may determine the heating-rate-dependent transformation pathways.

Effects of fat Composition on Microscopic Observations of Arrested (partial) Coalescence

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Arrested (Partial) coalescence describes the incomplete coalescence of emulsified fat that occurs in aerated dairy products. Because this phenomenon influences the rheology and structure of these systems, most research in the area focuses on macroscopic analytical methods. The following study takes a unique microscopy-based approach by using micromanipulation techniques to move and initiate coalescence in two individual fat globules. The extent of coalescence is quantified by measuring globule diameters prior to coalescence and comparing their added lengths to the total length of the mass after coalescence. A series of emulsions is made with varying levels of solid fat in both a model system consisting of tristearin (SSS) in triolein (OOO) and a natural fat system. When the solid fat content

(SFC) of the SSS/OOO droplets approaches 25% (wt./wt.), the globules behave as perfectly elastic spheres and remain isolated. At 5% SFC near-complete coalescence is observed, and at 15% SFC an intermediate level of deformation produces the classic ?peanut? shape commonly associated with arrested coalescence. Disparities between fat systems are rationalized by differences in the elastic moduli of their crystalline matrices.

X-ray Scattering Study of Undercooled Liquid Saturated Monoacid Triglycerides

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[(1)]Dalhousie University, Canada [(2)]Dalhousie University, Canada

The difference between the melting temperature and the actual temperature of a liquid is called undercooling. The undercooled liquid is the material state that precedes and determines the onset of crystallization. To develop predictive models for fat crystallization it is necessary to understand how temperature affects the distribution of molecules in undercooled liquid triglycerides (TAGs). X-ray scattering data for pure samples and binary mixtures of different compositions were recorded. These data were gathered at temperatures above and below the melting point. Experiments were conducted at beamline X10A of the National Synchrotron Light Source at Brookhaven National Laboratory in Upton, NY, USA. The average intermolecular distance and type of distributions were determined as a function of undercooling. The distance between the hydrocarbon chains was found by analysing wide angle scattering patterns. The average intermolecular distances between two triglyceride molecules were determined by studying the small angle scattering patterns. Standard liquid behaviour for asymmetric molecules was observed above the melting point. The intensity below the melting temperature changes due to variations in average intermolecular distance between molecules as they form nuclei. These data sets are now available for the development of adequate models to predict undercooled behaviour.

A Glimpse Into the Ternary Phase Diagram of Beta-sitosterol, Gamma Oryzanol and Canola Oil

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Numerous novel phases have been identified utilizing the ternary phase diagram for beta-sitosterol, gamma oryzanol and canola oil including nano crystals, liquid crystals, ad macroscopic crystals. These very distinct phases have very different rheological properties ranging from viscous solutions to viscoelastic gels to elastic solids. These structures will be outlined with a focus on potentinal application in new foods systems.

Impact of Sucrose Octa-esters of Fatty Acids on the Crystallization and Solidification Properties of Confectionery Fats

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Olestra fat substitutes developed by Procter and Gamble, can provide a significant reduction in calories and/or saturated fats when used as a full or partial replacement of fats in many food formulas. A variety of sucrose octa-esters of fatty acids, Olestra fat substitutes, with varying melting profiles, were blended with traditional confectionery coatings to evaluate the impact on the crystallization and solidification properties of the confectionery fat system.

Physical properties, determined by drop point, solid fat content, rate of solification, differential scanning calorimetry and polarized light microscopy were examined at blend levels having a significant impact on nutritional content of a confectionery coatings. Analysis indicates blends can provide physical properties required to deliver acceptable coating attributes, although interactions between the Olestra bases and confectionery fats behave similar to blends of triaclyglycerols with different fatty acid compositions.

AFTERNOON

EAT 3/H&N 3: Algal Oil - Food Applications and Nutritional Aspects
Chair(s): W. Rakitsky, Solazyme, Inc., USA; E. Bailey-Hall, DSM Nutritional Products, USA

Microalgae Triglyceride Oils: a new Source of oil for Food Industry Applications

W. Rakitsky[(1)], R. Bond[(2)]
[(1)]Solazyme, Inc., United States of America [(2)]Solazyme, United States of America

Solazyme, Inc. is a renewable oil and bioproducts company that transforms a range of low-cost plant-based sugars into high-value tailored oils. Headquartered in South San Francisco, Solazyme?s renewable products can replace or enhance the properties of triglyceride oils derived from the world?s three dominant sources: petroleum, plants and animals. Harnessing the oil-producing capabilities of microalgae, Solazyme?s biotechnology platform utilizes industrial standard fermentation equipment to efficiently scale and accelerate microalgae?s natural oil production time from weeks to merely a few days. By feeding simple plant sugars to proprietary microalgae strains in industrial fermentation vessels, the company is in effect taking advantage of ?indirect photosynthesis?, in contrast to the traditional open-pond approaches most often associated with microalgae. Through Solazyme?s unique tailoring technology ability, the company has been able to optimize specific oil profiles ideal for various food applications. These profiles have superior performance characteristics when compared to currently available food oils and provide unprecedented opportunities for optimizing the balance of health and wellness with flavor and texture delivery. Throughout this presentation, Dr. Walt Rakitsky will discuss the innovative benefits that Solazyme?s algal oils provide the food industry, including providing alternatives to partially hydrogenated vegetable oils, animal fats, oils and palm oil fractions, and beyond the possibilities of traditional plant and seed oils. He will also explore the impact of Solazyme?s tailoring on important oil characteristics such as viscosity, oxidative stability, solid fat content profiles and pour points, among many others.

Functionality Matching of two Algal Oils With Vastly Different Molecular Compositions

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The nutritional and functional properties of edible fats have been traditionally associated with specific chemical compositions and crystallization conditions. Switching from one oil source to another is usually a difficult task since both the melting behavior and structure of the fat changes dramatically, leading to adverse changes in functionality. In recent history, we can recall the painful period when partially hydrogenated fats were replaced with palm oil and palm oil fractions. In this work we demonstrate how the yield stress, elastic modulus, polymorphism, microstructure and melting profile of two fats with vastly different chemical compositions can be matched. Solazyme oil A contains greater than 62% (w/w) medium chain fatty acids, or MCT (C8:0-C14:0), 23% (C16:0+C18:0) and 9% C18:1, while Solazyme oil B contains less than 2% C8:0-C14:0, 54% (C16:0+C18:0) and 29% C18:1. Oil A is a medium chain

triglyceride rich fat, while Oil B resembles palm oil. Both oils had a solid fat content of ~45% at 20oC, and very similar SFC versus temperature profiles. DSC melting profiles showed two major peaks centered around ~12-13oC and ~28-35oC. Both fats were in the beta-prime polymorphic form and displayed asymmetric, elongated crystallite morphology with characteristic features. The yield stresses and storage moduli (G?) of Solazyme A and B oils were 520-550 Pa, and 7x106Pa-1.8x107Pa, respectively. A yield stress and G' in this range suggests a satisfactory functionality as a roll-in shortening. Using algal biotechnology, it was possible to alter the chemical composition of a food while retaining its lamination functionality.

Evaluation of the performance of a range of algal oils in food frying applications

M. Matlock[(1)], T. Tiffany[(2)], M. Pietz[(3)], R. Bond[(4)]
[(1)]ADM, United States of America [(2)]ADM, United States of America [(3)]ADM, United States of America [(4)]Solazyme, United States of America

Results generated in ADM?s R&D laboratory will be presented from 10-day frying tests exploring the properties of Solazyme?s tailored algal oils versus commercially available high-stability vegetable frying oils. Quantitative measurements of quality and fry life such as development of total polar materials, free fatty acid levels, para-anisidine values, and oxidative stability index (OSI) over time will be discussed. Other parameters measured include color stability and GC/MS headspace analysis of volatile products, as well as sensory properties by a trained internal panel. Variables explored include the impact of natural and synthetic antioxidants and frying with and without defoamers. The three different algal triglyceride oils tested had fatty acid compositions ranging from a mid-oleic (60%) to an oil composed of >85% oleic with near-zero polyunsaturates. Results indicated that all three algal oils evaluated in this frying procedure exhibited similar or improved oxidative, hydrolytic stability and color stability to that of a commercial premium vegetable frying oil. One algal oil showed a higher OSI at the end of ten days frying ? without antioxidant additives ? than the control oil, a high oleic/low linolenic canola oil, had at the beginning of testing. Remarkably, this same algal oil, without dimethylpolysiloxane antifoamer additive, did not show foaming even after ten days of frying. Throughout this presentation, a thorough analysis of frying characteristics will be used to demonstrate how the compositions of algal oils derived from Solazyme?s technology platform affected performance under different experimental conditions, as seen through ADM?s experienced laboratory frying protocols.

Challenges of PUFA Fortifications in Food and Beverages

W. Wang-Nolan[(1)], X. Tang[(2)], M. Stefanski[(3)], O. Pena[(4)], G. Su[(5)]
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Fortifications of algal oil in food, even at 32 mg DHA/serving of food, can be meaningful based on daily intake of long-chain omega-3 polyunsaturated fatty acids from a typical American diet. To make the food and beverage products successful in maintaining product shelf life, both algal oil stability as well as its stability after incorporation into foods are important. The types of measures to maintain the product stability largely depend on the oxidation mechanisms; thus they are functions of food matrices, flavors, storage conditions, packaging and shelf life requirements.

Algal DHA , Nutrition and Cognitive Activity

E. Nelson[(1)]

[(1)]DSM Nutritional Lipids, United States of America

The reason for studying algal DHA as a bioactive for improving cognitive ability is based on several lines of evidence, including 1. Elevated prenatal DHA levels are associated with improved infant IQ, 2.Breast feeding data suggesting benefits and 3.Consumption of DHA (and other LCPUFA) from fish is linked to a lower incidence of Alzheimer's Disease (AD). We conducted, sponsored or were associated with several studies which demonstrated the bioactivity of algal DHA in benefiting cognitive behavior in some subject populations. These studies included nursing infants, preschool and school age children, and older adults with or without AD. They were carried out in the US and UK. All were double blind placebo controlled trials. The overall conclusion from these studies is that a cognitive benefit of DHA can be shown in certain subject populations, when the correct subject population is selected, the correct measurements are used, a proper amount of DHA is selected and a reasonable time frame of use is allowed. I will review these trials and place them in context with literature associated with this field.

Long-Chain Polyunsaturated Fatty Acid (LCPUFA) Nutrition for Athletes

E. Barrett[(1)]
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DHA and EPA are long-chain polyunsaturated fatty acids (LCPUFAs) that are important for serious athletes as well as weekend warriors. LCPUFAs support a healthy heart which is essential for athletic performance. LCPUFAs reduce inflammation, muscle damage, and muscle soreness induced by exercise. LCPUFAs are also being investigated as a therapy for concussions. Although concussions are recognized as a major public health concern, an effective therapy for concussions is not available. DHA is the primary structural LCPUFA in the brain and a nutrient critical for brain development and cognitive functions throughout life. As such, DHA is being evaluated as a therapy for concussions. In animal studies, DHA supplementation before or after injury protects the brain by reducing axonal damage, reducing inflammation and cell death, and limiting injury-induced brain dysfunction. Exercise places increased demands on the cardiovascular system, making heart health essential for athletic performance. Many components of the diet affect heart health, and LCPUFAs in particular are recognized as essential for normal heart function. In clinical trials LCPUFA supplementation reduces heart rate at rest and during exercise. LCPUFAs also increase stroke volume, cardiac output, and blood flow and oxygen delivery to exercising muscles. Inflammation is a normal response to prolonged and intense exercise. Unresolved inflammation, however, results in prolonged muscle soreness and reduced physical performance. In clinical studies, LCPUFAs counteract exercise-induced inflammation, reducing blood markers for inflammation and muscle damage. They also reduce levels of perceived pain, improve range of motion, and reduce arm/thigh circumference (swelling).

The effect of phytosterols and omega 3 fatty acids on fatty streak in LDLr-knockout mice

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Atherosclerotic process begins early in life and is progressive. As drug therapy is not recommended for healthy children, supplementation with bioactive compounds may be an alternative approach by which to prevent atherosclerosis. To evaluate this hypothesis, LDLr knockout mice were supplemented by gavage with omega 3 fatty acids (n-3 FA) (stearidonic acid - SDA from Echium oil and docosahexaenoic acid - DHA from algae oil) with or without phytosterols during the first 2 months of life. Subsequently, dyslipidemia and oxidative stress were induced by a high-fat diet intake for 2 months. Instead of being reduced, an increase was observed in fatty streaks lesion area in

the aorta artery following isolated phytosterol supplementation. This effect was fully reversed by co-supplementation with both forms of n-3 FA. The mechanisms by which n-3 FA reversed the phytosterol-induced increase in fatty streaks area involved the activation of fatty acid oxidation by Peroxisome Proliferator Activated Receptor ? (PPAR-?) and a reduction in fatty acid synthesis by Liver X Receptor ? LXR-?). Moreover, supplementation with Echium oil exhibited a clear trend (p=0.048) to reduce polyunsaturated fatty acid oxidation in the liver, by a mechanism that did not involve the modulation of antioxidant enzyme activity or expression. We conclude that to reduce the risk of atherosclerosis, the most desirable food supplementation for children was conferred by n-3 FAs, especially SDA from Echium oil. More studies are necessary to clarify the phytosterol effect as a promoter of fatty streak lesion when associated with a high-fat diet.

WEDNESDAY

MORNING

EAT 4/S&D 4.1: Emulsions, Dispersions, and Foams
Chair(s): C. Rojas, AMCOL International Corp., USA; A. Wright, University of Guelph, Canada

Capillary Video Microscopy as a Tool for Developing Double-Emulsion Creams

K. Papadopoulos[(1)]
[(1)]Tulane University, United States of America

Optical/fluorescent microscopy inside narrow capillaries provides micromanipulation of observed microscopic objects to degrees that are not possible without a restriction such as that imposed by the capillary geometry. The reason is a simple one: an observable object that has dimensions comparable to a host-capillary?s diameter are stripped of two degrees of freedom in their movement, while the third degree can be manipulated by flow or the movement of microneedles. The talk will visually summarize a series of phenomena we have observed in our lab, that include coalescence of droplets, swimming of bacteria, multiphase transport in porous media, reaction of overbased lubricants with acid drops. The main topic of the talk will focus on our efforts to make cream-vaccines for immunization through the skin. We are part of a research group that uses several approaches for the achievement of skin vaccination, and our lab?s objective is the making of double emulsions as vehicles of vaccine antigens. Antigens can be simply suspended in the ?internal aqueous phase? of double-emulsion globules, or they may be hosted within liposomes, which in turn are suspended in the double emulsions? ?internal aqueous phase,? thus providing a double-protection system for the antigen.

The HLB System ? A Time-Saving Guide to Emulsifier Selection

A. Kaziska[(1)]
[(1)]Croda Inc., United States of America

The HLB (Hydrophile-Lipophile Balance) system provides a means to narrow down the hundreds of emulsifiers available today to a small, manageable list. The system can help save countless hours wasted on the bench by using a ? trial and error? approach. This presentation will: ? define HLB for nonionic surfactants and demonstrate how to calculate HLB values ? explain required HLB for oils to be emulsified and demonstrate a required HLB test ? provide tools for quick implementation of the system back in your lab so you can use the HLB system to optimize both type

and concentration of emulsifiers

Nutraceutical Nanoemulsions: Influence of Carrier Lipid Composition and Location on ??carotene Bioaccessibility

?-carotene is used in aqueous-based foods and beverages as a natural color and nutraceutical. We investigated the influence of lipid carrier composition and location on the physical stability, microstructure, and bioaccessibility of nanoemulsions using an in vitro digestion model. ??carotene enriched nanoemulsions (d< 150 nm) were formed using sucrose monoester and lysolecithin as emulsifiers, and corn oil (digestible) and/or lemon oil (indigestible) as oils. The influence of carrier oil composition and location on lipid digestion and ??carotene bioaccessibility was examined by mixing digestible and indigestible oils before homogenization (?oil mixture?), or by preparing digestible and indigestible nanoemulsions separately and then mixing them together (?emulsion mixture?). Lipase induced free fatty acid (FFA) production in the small intestine was more dependent on oil composition than on oil location. The rate and extent of FFA production increased as the amount of corn oil present increased. ??carotene bioaccessibility decreased in the order corn oil (?76%) > oil mixture (?56%) > emulsion mixture (?34%) > lemon oil (?5%), which was attributed to differences in the formation of mixed micelles capable of solubilizing ??carotene. This study provides important information for encapsulating and delivering functional lipids in food and beverage applications.

Physico-chemical Properties, Oxidative Stability and Non-enzymatic Browning Reactions in Marine Phospholipids Emulsions and Their Applications for Food Enrichment

L. FungSieng (Henna)[(1)], C. Jacobsen[(2)], N. Skall Nielsen[(3)], C. P. Baron[(4)]
[(1)]Technical University of Denmark, Denmark [(2)]Technical university of Denmark, Denmark [(3)]Technical University of Denmark, Denmark
[(4)]Technical University of Denmark, Denmark

Marine phospholipids (PL) are more advantageous than fish oil. They seem to have better bioavailability, better resistance and higher content of eicosapentaenoic acids and docosahexaenoic acids than fish oil. The main objective of this study was to explore the possibilities of using marine PL for food enrichment. The secondary objective was to investigate the different aspects of marine PL emulsions including: physico-chemical properties, oxidative stability and non-enzymatic browning reactions while identifying the important factors affecting their stability. The physical and oxidative stability of marine PL emulsions was significantly influenced by the chemical composition of marine PL used. Emulsions with a high oxidative stability could be obtained when using marine PL of high purity with a high content of PL, cholesterol and ?-tocopherol. Non-enzymatic browning reactions (Strecker degradation and pyrrolization) seemed to influence the oxidative stability of marine PL emulsions. Similar to marine PL emulsions, the oxidative stability and sensory acceptability of marine PL enriched products varied depending on the quality and chemical composition of marine PL used. Overall, this study provided new insights into the oxidative stability of marine PL and preliminary knowledge on the quality of marine PL fortified foods.

Location and Reactivity of Model Ingredients in Emulsions: Effect of Interface Properties and Ingredient Lipophilicity

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[(1)]The Pennsylvania State University, United States of America [(2)]The Pennsylvania State University, United States of America [(3)]The Pennsylvania State University, United States of America

Functional ingredients (e.g., flavors, vitamins, bioactive peptides, drugs) with various properties (e.g., molecular weights, lipophilicities) are often encapsulated in emulsions to enhance their solubility and stability. The performance of oil-in-water (O/W) emulsions as encapsulation systems is controlled to a large extent by the properties of both the emulsion and the ingredient. The objective of this work was to investigate the effect of the interface properties, the ingredient properties and the oil physical state on the location and reactivity of model ingredients in emulsions. Spin probes with various molecular structures and lipophilicities were selected as model compounds and incorporated in nanoscale emulsions, prepared by homogenizing n-tetradecane or n-eicosane into emulsifier aqueous solutions. Emulsifiers with various physical properties were chosen, including proteins and ionic surfactants. The distribution of paramagnetic spin probes between the different phases of emulsions was measured using electron paramagnetic resonance (EPR). The probe molecules partitioned between aqueous, micellar, interfacial and lipid environments, depending on the probe lipophilicity, the fraction of unadsorbed emulsifier and the oil physical state (i.e., liquid or solid). The reactivity of spin probes was measured after addition of water-soluble reactants, and was found to be strongly affected by their location, mobility and by the droplet surface charge. In particular, probe immobilization at the interface resulted in the greatest protection against aqueous reactants.

Structural Impact of Partial Coalescence on ice Cream

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[(1)]University of WIsconsin, United States of America [(2)]University of Wisconsin, United States of America [(3)]University of Wisconsin, United States of America

Partially-coalesced fat globules are important to the structural attributes, texture properties, and stand-up behaviors of ice cream. Commercial vanilla ice cream products with different fat content were analyzed to determine size and amount of partially-coalesced fat globules in the ice cream and their drip-through rates. Partial coalescence was confirmed using light optical microscopy and quantified by laser light scattering . Drip-through rates and height after complete melting were determined by the conventional drip-through test, where the ice cream melts on a mesh screen. Ice cream products containing large partially-coalesced clusters had slower drip-through rates and greater height after melting, whereas those containing smaller globules or clusters collapsed to flow rapidly and completely through the screen. Fat destabilization level, as determined by the relative number of clusters to initial emulsion droplets, did not predict the drip-through or stand-up properties of the ice cream products. A cluster density parameter is being developed to empirically model the relationship between the partially-coalesced fat globules and drip-through rates in ice cream products.

Cancelled - Localization and Stability of ?-tocopherols in Emulsion-based Delivery Systems

Impact of water cut and continuous phase wax crystals on water-in-oil emulsion rheology

D. Rousseau[(1)], S. Ghosh[(2)], S. Haj-shaifiei[(3)]
[(1)]Ryerson University, Canada [(2)]University of Saskatchewan, Canada [(3)]Ryerson University, Canada

The isothermal rheological behaviour of wax-stabilized water-in-oil (W/O) emulsions consisting of light mineral oil, paraffin wax and glycerol monooleate in the oil phase and a dispersed aqueous phase at different water cuts (10-50 wt %) was evaluated. All emulsions were prepared via high-pressure valve homogenization and consisted of the same average water droplet diameter (~30 ?m). Rotational viscometry, oscillatory rheology and creep compliance and

recovery were performed on emulsions aged up to 28 days. Freshly-prepared emulsions with a higher water cut had a higher viscosity and storage modulus that those at a lower water cut. With ageing, however, the viscosity and storage modulus of all emulsions increased due to the development of a more pronounced wax crystal network. Supporting results for these findings were acquired with light microscopy, solid wax content, and aqueous droplet size analysis. Overall, this study clearly established that both water cut and continuous phase wax solidification play a significant role in W/O emulsion rheology, with the former conferring a greater influence to emulsion viscosity in the systems studied. Such findings may be used to better understand and tailor emulsion properties in fields of application such as the petrochemical, cosmetics, food and pharmaceutical industries.

Food Grade Water-in-oil Nanoemulsions From a High-pressure Valve Homogenizer and a Microfluidizer

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[(1)]The University of Birmingham, United Kingdom (Great Britain) [(2)]The University of Birmingham, United Kingdom (Great Britain)
[(3)]PepsiCo Intl, United Kingdom (Great Britain) [(4)]The University of Birmingham, United Kingdom (Great Britain)

The purpose of this work was to compare the production of sunflower oil continuous nanoemulsions using a Microfluidizer (high pressure impinging jet) and a high pressure valve homogeniser (HPH). The work investigates the affect of homogenising pressure, pass numbers, viscosity ratio, PGPR concentration and electrolyte addition on the droplet size; and complements previous studies that have explored droplet break-up mechanisms for O/W nanoemulsions [1]. Comparing the energy dissipation in the high pressure devices indicates that the smallest eddies in the system should be of the order of 1 ? 3 ?m. The droplet sizes achieved are from 100 nm after the first pass, reducing to 50 nm after the fifth pass. The continued droplet size reduction and the size of the droplets in comparison to the expected turbulent length scale indicate turbulent viscous flow. Processing at this oil viscosity (0.01 Pa.s) has matched the performance of the HPH and Microfluidizer; this is explained to be a result of minimal coalescence and negligible effects from the impinging jet. The continuous phase viscosity was increased by an order of magnitude, however this did not affect the change in droplet size. Whereas, an increase in the dispersed phase viscosity to the same extent has led to a droplet size increase. This highlights the change in droplet break-up mechanism with flow regime. 1. Lee, L. and I.T. Norton, Comparing droplet breakup for a high-pressure valve homogeniser and a Microfluidizer for the potential production of food-grade nanoemulsions. Journal of Food Engineering, 2012.

Microencapsulated Self-emulsifying Delivery Systems.

E. Acosta[(1)], M. Nouraei[(2)], L. Diosady[(3)]
[(1)]University of Toronto, Department of Chemical Eng. and Appl. Chemistry, Canada [(2)]University of Toronto, Canada [(3)]University of Toronto, Canada

This presentation describes self-emulsifying and self-microemulsifying delivery systems for food ingredients. The presentation will describe the formulation of the food-grade self-emulsifying systems produced with lecithin-linker systems.

AFTERNOON

EAT 5: General Edible Applications Technology
Chair(s): B. Farhang, University of Guelph, Canada; G. List, Retired, Consultant, USA

Microalgae lipid and protein fractionation

T. Wang[(1)]
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Extraction of total lipids with alcoholic solvents, particularly Isopropyl alcohol (IPA), was conducted using several microalgae pastes. Depend on the composition neutral and polar lipid classes and cell wall structure, the extraction performance is different for different algae. Oil may be conveniently recovered by lowering the temperature of the crude lipid extract. Full lipid characterization indicates significant difference in class composition among the five algae lipids studied. Certain lipid components may not be desirable as biofuel and others may be highly wanted as health promoting lipids. From the defatted biomass of Nannochloropsis, we explored algae protein extraction using a modified conventional procedure that led to an improved extraction yield. However, the presence of significant amount of non-protein components limits our ability to obtain high purity protein.

Microalgal Oils Rich in Omega-3 Lc-pufa: Effect of Extraction Solvent on oil Composition

E. Ryckebosch[(1)], C. Bruneel[(2)], K. Muylaert[(3)], I. Foubert[(4)]
[(1)]KU Leuven University Kulak, Belgium [(2)]KU Leuven University Kulak, Belgium [(3)]KU Leuven University Kulak, Belgium [(4)]KU Leuven University Kulak, Belgium

It has become clear that the long chain omega-3 polyunsaturated fatty acids (LC-PUFA) EPA and DHA are effective in preventing or treating several diseases, such as cardiovascular disorders and cancers, and that they play a role in brain and nerve development of growing foetuses and infants. However, worldwide, the current intake of omega-3 LC-PUFA is too low. Furthermore, the main commercial source of omega-3 LC-PUFA is fish oil. Several problems are still associated with this source: unpleasant odor, low oxidative stability, geographical and seasonal variation in quality, as well as increasingly stringent regulation of fisheries. Previous research already showed that the oil obtained with total lipid extraction (chloroform/methanol) had a composition that might be interesting for use in human nutrition. Unfortunately, these solvents are not tolerated in food industry. Therefore, the aim of this research was to investigate two extraction solvent systems allowed for food purposes (hexane and hexane/isopropanol 3:2). They were tested on 5 species: Isochrysis galbana, Nannochloropsis gaditana, Nannochloropsis sp., Phaeodactylum tricornutum and Pavlova sp. The oil composition (fatty acid composition, omega-3 LC-PUFA content, lipid class content, sterol content, carotenoid content and composition) of these microalgal oils was shown to be quite similar to the total lipid extract. This means that all oils extracted from the microalgae can be a potential alternative for fish oil, but the large difference in extraction yield will feed the search for maximum lipid yield with ?food grade? solvents.

Differentiation in Triacylglicerol Composition and Thermal Profiles of the fat From Cow, Goat and Sheep Milk Cheeses

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Determination of triacylglycerols (TG) composition and thermal properties in milk fat is important because of their influence on technology, rheology, physiology, and sensorial and nutritional properties. However, the composition of individual TG of dairy fat is extremely complex because the number of possible TG could be over 1300 considering only those fatty acids present in amounts higher than 1%. The aim of this work was to study the differences in

triglyceride composition (by HPLC) and thermal properties (by DSC) of the fat extracted from cow, goat and sheep cheeses. Results show that there are differences in the composition of triglycerides and thermal behavior. Minor differences were found among the fat from goat and sheep but the behavior was different for the fat of cow cheeses. Fat from cow cheeses have mostly triglycerides with partition numbers (PN) of 46, 48 and 50 (maximum PN=48), while fat from sheep and goat have a maximum PN=42 and major triglycerides have PN between 36 and 44. Their composition is of interest, because it can be used to verify the origin of milk fat. Thermograms for fat from goat and sheep show three endothermic peaks, while cow cheeses only show two peaks at higher temperature.

Structuring Food With Sodium Caseinate/sunflower oil Gels

M. Herrera[(1)], C. Huck Iriart[(2)], R. Candal[(3)]
[(1)]University of Buenos Aires, Argentina [(2)]University of Buenos Aires, Argentina [(3)]University of San Martin, Argentina

Present regulations in United States, Europe, in MERCOSUR, and other regions and the scientific evidences related to the effect of trans and saturated fats in human health have forced food industries to reformulate the existing products. Nowadays new fats from different origin are being incorporated in foods. These new products include oils containing a high proportion of unsaturated fatty acids. Structuring liquid oils has become an active area of research in the past decade, mainly due to pressures to reduce saturated fat intake and eliminate trans fats from our diets. However, replacing hard fats with liquid oil can lead to major changes in the quality of food products. Recent strategies to impart solid-fat functionality to liquid oils include gelification of protein emulsions. The aim of this work was to study the effect of sucrose addition on physical properties of acidified sodium caseinate/sunflower oil gels. Gels were prepared from sodium caseinate emulsions with the following composition: 5 wt.% sodium caseinate, 10 wt.% sunflower oil, and 0, 5, 10, 15, 20, and 30 wt.% of sucrose. Emulsions were acidified with glucono-delta-lactone (GDL) acid added in a ratio of GDL/protein 1:5 (1 g of protein and 0.2 g of GDL). Particle size of emulsions was studied by dynamic light scattering. Formation of gels was followed by Turbiscan and nuclear magnetic resonance. Gel structure was described by confocal laser scanning microscopy. Addition of sucrose cause reduction in average particle size in the emulsions, delayed gelification kinetics, and gave gels with a more uniform structure.

Formulation of two Different Types of Trans Free (tf) and low Saturated Fatty Acid (sfa) Butter oil Substitutes Using Modified Palm Oil, Canola and Beef Tallow, Canola. Application: in Cookies and Muffin.

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[(1)]Independant Researcher-Industry Consultant, Canada [(2)]Agri-Industry &Veg. Oil Mahidasht Kermanshah, Iran [(3)]Karami Trading Company, Iran [(4)]Karami Trading Company, Canada

In continuation of long term research on Trans fat free formulation using applied research we incorporated new advances in formulation of new products. Our frame work was trans fat free, low SFA, high oleic and linolenic. Two different types of solid fat products were formulated. In first phase of the study modified palm oils with 14 and 2 IV, canola and monoglyceride were used. Different ratios were selected and blended and crystallized after adding beta carotene and butter flavor. Using modified palm oil with 2 IV showed better result achieving lower SFA and better homogenicity. In second study we choose beef fat from in Toronto and Vancouver area. In a pilot scale beef fat rendered and fat extracted. To achieve similar physical property compared to the first study, different ratio of beef tallow were blended with canola and monoglyceride . Beta carotene was added to the blend and crystallized. Both products were used in preparing Muffins. Texture, taste and shelf life was evaluated by sensory panel. Muffin with palm oil was preferred. Fatty acid profile of products with palm oil: SFA 12%, 18:1 62%, 18:3 8% and 18:2 18 % Fatty acid profile of products with beef tallow: SFA 17 %, MUFA60%, 18:3 7% and 18:2 16 %

CANCELLED-Using the Baking Process to Solubilize Ethylcellulose into Unsaturated Oil to Replace Hard Fat

J. Derhammer[(1)]
[(1)]Ashland, United States of America

Effect of Extraction Methods on Quality and Healthy Minor Components of Canola Oil

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[(1)]University of Guelph, Canada [(2)]University of Valencia, Spain [(3)]University of Guelph, Canada

Canola oil contains low amounts ofof saturated fatty acids, is a good source of omega-3 fatty acids (?-linolenic acid), and, after olive oil, has the highest amount of monounsaturated fatty acids (oleic acid) compared to other common vegetable oils. Also, canola oil contains significant amount of micronutrients such as phytosterols, tocopherols, and phenolic components. In this study, oil quality parameters such as free fatty acids (FFA), phosphatides, peroxide value, p-anisidine value and chlorophyll content in industrially extracted canola oils (cold pressed, mechanically extracted and solvent extracted) were evaluated. The amount of free phytosterols (Brassicasterol, Campesterol, Stigmasterol and ?-sitosterol) and phytosterol esters, tocopherols (alpha and gama), polyphenols and fatty acid composition were also determined and compared between the samples. Results showed that although cold pressed canola oils had the lowest amount of undesirable components (FFA, phosphatides, p-anisidine value and chlorophyll content), the amount of phytosterols and tocopherols were significantly ($p<0.05$) lower compared to solvent extracted and mechanically extracted canola oils. Solvent extracted canola oil was richer in polyphenols than cold pressed canola oils. The total amount of saturated fatty acids in cold-pressed oils were lower while the total polyunsaturated fatty acids in the cold-pressed oil was higher than either solvent extracted and mechanically extracted canola oils. Our results suggest that although there is an increased demand for cold pressed canola oil, nutraceutical content is lower for cold pressed canola oil than canola oil extracted by solvent or mechanical pressing.

EAT 5.1: Lipid Foods Imaging
Chair(s): D. Kalnin, PHILOLAO, Sweden

Effect of sorbitan-based surfactants on the early-stage crystallization kinetics of coconut oil

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[(1)]Ryerson University, Canada [(2)]Silpakornn University, Thailand [(3)]Silpakorn University, Thailand

The purpose of this research was to investigate the early-stage crystallization kinetics and microstructure of coconut oil (CO) in the presence of 5 wt% sorbitan esters (monolaurate, monopalmitate, monostearate and tristearate). Microstructure was investigated via polarized light microscopy and crystallization kinetics studied with pulsed-NMR and DSC. Sorbitan monolaurate had the largest effect on CO early-stage crystallization, greatly retarding its initial crystallization, due to the molecular complementarity between the lauric acids present in the CO and the surfactant. Contrary to sorbitan monolaurate, sorbitan tristearate accelerated early-stage CO crystallization. There was a lesser effect of sorbitan monopalmitate and monostearate. Based on light microscopy, all surfactants reduced CO crystal size and presence of sorbitan tristearate displayed the strongest effect by leading to the smallest CO crystal size. Overall, it was shown that sorbitan esters can significantly impact CO crystallization, however, this was highly-dependent on

surfactant structure.

Fat crystals in puff pastry

S. Breau[(1)], P. Saguez[(2)], F. Sobolewski[(3)], D. Kalnin[(4)]
[(1)]ENILIA-ENSMIC/PHILOLAO, France [(2)]PHILOLAO, France [(3)]PHILOLAO, France [(4)]PHILOLAO, Sweden

Nowadays in France, the majority of butter production is used in industrial bakery, biscuit pastry production. The largest volumes are consumed to produce pastries where the butter is represented up to 30% of the product. Butter as a functional ingredient, must meet specific requirements including texture. As of today measurement tools such as textureanalysis is sufficient for sorting butters to allow thier use on a production lines, but this is only one aspect of functionality that is taken into account. The purpose of this study named ?ANAXAGOR? is to understand the functionality of butter through more accurate analytical techniques (crystallization state by optical microscopy, differential scanning calorimetry, NMR ...) and making puff pastry models. The optical microscopy technique used to date allows not only to understand the density of crysatal network installed in the butter but also to determine a profile of crystal sizes in the form of "Maltese cross". Previous studies have shown the relationship between the size and profile of the ability of butter to perform as a function ingredient in puff pastry. The purpose of this work is to identify polymorphic forms composing these crystals in the form of "Maltese cross" in relation to the sizes distribution observed. We have carried out fabrication of puff pastry models to establish the relationship between the behavior of butters in manufacturing, the puffinf og pastries without yeast and the fat crystalisation in puff pastries.

Microstructure Variations of Milk fat Globule Membrane Related to Chemical Composition

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The lateral segregation of polar lipids in liquid-ordered phase occurred on milk fat globule membrane (MFGM). Microstructure of human MFGM at different temperatures stained by Rh-DOPE fluorescent probe observed by confocal laser scanning microscopy (CLSM) showed the segregated domains became larger as the temperature was decreased to 4 °C and smaller when increased to 37 °C, which indicated these domains were highly temperature-dependent. Further investigation of the correlation between the chemical composition and microstructure variations carried out on two kinds of bovine MFGM with significant membrane chemical composition implied the heterogeneities on the MFGM were largely due to the lateral segregation of sphingomyelin under the room and physiological temperature, and under low temperature, the glyerophospholipids with saturated fatty acids had great influence on the formation of these domains. These segregated domains in liquid-ordered phase on the MFGM, similar to the ?lipid raft? on the cell membrane, may have some special functions, which need to be further investigated.

Monitoring the translational diffusion of emulsion droplets in dairy gels with particle tracking microrheology

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[(1)]University of Guelph, Canada, Canada [(2)]University of Guelph, Canada

Particle tracking microrheology is a method utilized in the monitoring of the diffusion characteristics of particles in sol or gel media and has the capabilities of generating novel information on structural properties of complex matrices.

This technique is commonly used for the tracking of uniformly sized, synthetic particles. In this study, microrheology was employed to track, in situ, the diffusion of oil droplets within a gel matrix, in the attempt to study a more realistic model system. The emulsion droplets were dyed with Nile red and visualized using confocal laser scanning microscopy (CLSM) and tracked using image analysis routines. A 15% oil-in-water emulsion stabilized with 2% whey protein isolate (WPI) was prepared using high pressure homogenization. The droplets, with a broad size distribution (between 1-20 um), were dispersed in a milk protein concentrate (MPC) medium, gelled in situ using rennet. The diffusivity of the emulsion droplets were a function of MPC concentration and particle size. Gel rearrangements during storage were noted. This methodology shows great potential to be used to better define structural changes in complex matrices such as food and biological systems.

Edible Applications Technology Poster Session

Chair(s): G. List, Retired, Consultant, USA; G. Cherian, Kelloggs North America Co., USA

Cancelled-Papaya Seed oil From two Malaysian Varieties: Comparison of Solvent Extraction and Ultrasound Technique

H. Mirhosseini[(1)]

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[(1)]University Putra malaysia, Malaysia [(2)]University Putra malaysia, Malaysia [(3)]University Putra malaysia, Malaysia [(4)]University Putra malaysia, Malaysia

Oxidative stability of wax ester containing n-3 PUFA synthesized by lipase-catalyzed esterification

M. Kim[(1)], T. Zhao[(2)], S. Yoon[(3)], I. Kim[(4)]

[(1)]Korea University, Korea, Republic of [(2)]Korea University, Korea, Republic of [(3)]Korea University, Korea, Republic of [(4)]korea University, Korea, Republic of

Oxidative stability of the wax ester synthesized by enzymatic method was compared to tuna oil, and a mixture prepared by physical blending with tuna oil and policosanol. It was determined by peroxide value (POV), p-anisidine value (p-AV), and conjugated trienoic acid value (CTV) during storage at 25oC for 21 days. POV determination was used to measure the primary products of lipid oxidation, and p-AV was used for the determination of the secondary products of lipid oxidation. Conjugated dienoic (absorption at 235nm), trienoic (268nm), tetraenoic (315nm), pentaenoic (345nm), and hexaenoic (375nm) acid value was evaluated and CTV showed remarkable correlation coefficient with POV. CTV is an indicator of oxidation as nonconjugated triene arrangement of unsaturation is changed to conjugated triene. The wax ester containing n-3 PUFA was synthesized via lipase-catalyzed esterification of policosanols with fatty acid from tuna oil using Novozyme 435 lipase from Candida antartica as a biocatalyst. Wax ester showed the highest oxidative stability over tuna oil, and mixture of tuna oil and policosanol. This indicates that enzymatic esterification with policosanol enhanced the oxidative stability of polyunsaturated fatty acid.

Effects of Addition of Emulsifiers in the Crystalline Properties of Palm Olein and Coconut Oil

R. Silva[(1)], J. Maruyama[(2)], N. Roque[(3)], Y. Silva[(4)], L. Gioielli[(5)]

[(1)]São Paulo University, Brazil [(2)]São Paulo University, Brazil [(3)]São Paulo University, Brazil [(4)]São Paulo University, Brazil [(5)]São Paulo University, Brazil

The crystallization behavior of lipids has important implications in the industrial processing of food products whose physical characteristics depend largely of fat crystals. Recent scientific studies show that lipids minority (LM) affect the crystallization and can promote or inhibit it by adding or removing them. This work aims to propose the study of changes in the crystallization of palm olein and coconut oil after the addition of commercial emulsifiers containing predominantly MAGs. To this objective were prepared mixtures between palm olein and coconut oil with two

commercial emulsifiers (EM1 and EM2) in different proportions (1 and 3%). The fatty acid composition of coconut oil and palm olein have demonstrated that these oils have distinct profiles, since the first is highly saturated while the palm olein has unsaturation of about 57%. The same was observed with emulsifiers, once EM1 is higly unsaturated and EM2 shows high level of saturation. The addition of emulsifiers effectively alter the thermal characteristics of melting and crystallization of oils. The regiospecific distribution of coconut oil and palm olein is significant different from literature values, however results are coherent, as the values obtained are in agreement with the fatty acid composition obtained by gas chromatography

Microemulsions Containing Riboflavin as Potential Delivery Systems

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Riboflavin (vitamin B2) plays an important role in biochemical redox reactions in humans and animals. It works as an antioxidant and is essential for the health of skin, hair, eyes, and liver. Microemulsions are clear, stable, isotropic mixtures of oil, water, and surfactant, which are capable of solubilizing different active matter. In the present work we are solubilizing riboflavin in various unique dilutable selected microemulsions of oil-in-water. We intend to study the permeation and target delivery of these formulations into human organs and across the blood-brain barrier (BBB). Structural aspects of the empty system in comparison to those loaded with the riboflavin are studied using advanced analytical tools, such as cryo-TEM, PFGS-NMR, SAXS, and macro-techniques such as DSC, viscosity and electrical conductivity. Guest molecule loading capacity (up to 1.5 wt%), structural changes (unique microemulsion transformation) and release profiles (within minutes to hours) of the riboflavin, in three different formulations (zero to 10 wt% oil) to aqueous phase are studied. The results are showing very interesting characteristics and behavior that will be discussed in the presentation.

Selective Enrichment of Trans-10,Cis-12 Isomers from Commercial Conjugated Linoleic Acid Mixtures in a Recirculating Packed Bed Reactor via Lipase-catalyzed Esterification

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The aim of this study was to enrich trans-10,cis-12 (t10,c12)-conjugated linoleic acid (CLA) from commercial CLA mixtures via a selective esterification using a immobilized lipase from Candida rugosa as a biocatalyst. Commercial CLA mixtures, containing 34.4% t10,c12-CLA and 33.2% cis-9,trans-11(c9,t11)-CLA was esterified with dodecan-1-ol in the presence of water in a recirculating packed bed reactor (RPBR). Free fatty acid fraction enriched in t10,c12-CLA was obtained by removing the c9,t11 isomers in the form of dodecyl esters. The effects of temperature, substrate molar ratio (CLA mixtures to dodecan-1-ol), water content of the substrates, and residence time of the substrates in RPBR on the content of t10,c12-CLA in the fraction were investigated, as a function of reaction time. Optimal reaction conditions for maximizing the content of t10,c12-CLA were: temperature, 40°C, substrate molar ratio, 1:1; water content, 10%; residence time, 5 min. Under these conditions free fatty acid fraction containing 63.1% t10,c12-CLA was obtained with the yield of 29.8% during the initial 36 h of reaction.

Do Biopolymer-based Multilayered Emulsions Protect Encapsulated Lipophilic Ingredients Against Chemical Degradation Through Electrostatic Interactions?

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Lipophilic ingredients such as flavors or vitamins are often added to food products to produce a desired functionality. Most of these ingredients are chemically labile. Therefore, there is a need to use protective strategies such as encapsulation in oil-in-water (O/W) emulsions. Among other formulation strategies, multilayered emulsions have been

used increasingly for the past few years to protect polyunsaturated fatty acids against oxidation. Promising results have been obtained, but the mechanisms involved in the protective effect of the multilayer interfaces still remain unclear. The objective of this work was to investigate the effect of the addition of a second interfacial layer onto emulsion droplets on the reactivity of a model lipophilic ingredient, the lipophilic spin probe (4-phenyl-2,2,5,5-tetramethyl-3-imidazoline-1-oxyl, PTMIO). Primary emulsions were prepared by homogenizing n-tetradecane containing PTMIO into sodium caseinate solution at neutral pH. The negatively charged droplets were then coated with a cationic biopolymer (lysozyme or modified dextran) by electrostatic deposition. Electron paramagnetic resonance (EPR) measurements showed that the location and mobility of PTMIO in emulsions were not affected by the addition of the second layer. The reactivity of PTMIO with a water-soluble anionic compound did not increase when the cationic second layer was added, which suggests that other mechanisms than electrostatic interactions presumably contribute to the barrier effect of multilayered interfaces in emulsions.

Superchilling Treatment Alter the Melting Point of fat in Pork

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Superchilling means reducing the temperature of food uniformly to a point slightly above which obtained in freezing point, thereby extend the self-life of food, retaining fresh and high quality food. Further, suppressing growth of harmful microorganisms in food. Food aging under the superchilling resulted in the increased of glucogenic amino acid and glutamic acid contents compared with that aging under the chilling conditions. However, no information is available concerning the properties of fat under the superchilling treatment. This study evaluated the effect of different aging temperature on the properties of fat in porcine meat. The porcine meats just after slaughter which were storage for aging at ?2 ± 0.5°C (superchilling) or 3 ± 0.5°C (chilling) for 0, 1, 3, 5, 7, and 14 days. After the aging periods, the melting point of fat, fatty acid composition and structure of fat in porcine meat were examined. The melting point of fat in superchilling was decreased by 3.0°C from 0 to 1 day, and then maintained to approximately 38°C. On the other hand, the melting point of fat in chilling maintained a constant temperature about 41°C. At present, the cause of the decreased melting point of fat is not known.

Effect of Undercooling on the Phase Behavior of Trilaurin and Trimyristin Binary Mixtures

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The type and composition of crystalline phases of triglycerides affect the physical properties of fat-based foods. The undercooling of liquid triglycerides determines the formation of these phases. The growth of phases was studied under different undercooled conditions for binary mixtures of trilaurin and trimyristin. During crystallization, time-resolved small (SAXD) and wide angle (WAXD) x-ray diffraction patterns were captured at National Synchrotron Light Source, Brookhaven National Laboratory, NY. The composition of the phases formed was estimated from the SAXD d-spacings using a methodology developed by Mazzanti et al. (2010). Interestingly, only four d-spacings and therefore only four phase compositions of trilaurin were consistently observed for all different samples at different holding temperatures. The analysis of WAXD data showed that samples rich in trilaurin formed ??1 polymorphs, whereas samples rich in trimyristin tended to form ??2 polymorphs. These ??1 patterns have sharper peaks than ??2 patterns. Consequently, ??1 displayed high correlation lengths in their WAXD patterns compared to ??2 and had lesser defects than crystals from mixtures poor in trilaurin. These WAXD patterns were also estimated to be either from mixtures of pure ??1 and ??2 polymorphs, or ??2 polymorphs transforming into ??1. The area under the liquid peak in the WAXD patterns was used as a tool to estimate the solid fraction in the system with respect to time. This knowledge of phase formation as a function of the degree of undercooling is necessary for improving predictive models that control product formation during industrial processing.

Influence of Guar gum on Emulsion Lipid Digestion and Carotenoid Bioaccessibility.

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We need to better understand the influence of dietary fibre on the bioavailability of other molecules present in foods, including fat soluble vitamins and nutraceuticals. The purpose of this study was to determine the influence of guar gum (GG) on the transfer processes impacting beta carotene (BC) bioaccessibility (i.e. transfer to the aqueous phase) from an oil in water emulsion using an in vitro model simulating gastric and upper intestinal digestion. Canola oil emulsions (1.5% soy protein isolate, 10% canola oil with 0.1% all trans BC) were prepared by microfluidization (M110-EH, 40 MPa, 3 passes, D4,3~270nm) and exposed, in the presence of 0 - 4% GG, to conditions representative of the upper gastrointestinal tract (GIT). Gastric conditions: pepsin=3.2 mg/mL, pH=2, time=1h, temp= 37ºC. Duodenal conditions: pancreatin=5 mg/mL, bile salts=8 mg/mL, phospholipids=5mM, pH=6.5, time=2h, temp=37ºC. Lipolysis (enzyme kit for free fatty acids), BC bioaccessibility (aqueous phase extraction, A450nm), digestate apparent viscosities (at 48 & 98 s-1) changes in droplet size (Mastersizer) were determined at set intervals. Addition of digestive juices led to increases in particle size, especially at higher GG concentrations. Viscosity increases with GG led to decreased lipolysis and BC bioaccessibility. Peak lipolysis was 55% vs. 10% for emulsions containing 0% and 4% GG, respectively. BC bioaccessibility was also lower in the presence of GG (i.e. 28 vs 8% for 0 vs 4% GG). Therefore, the presence of GG impacts digestive processes central to BC absorption. Further research is needed and fortification strategies should consider this potential.

Tocopherol Composition of Brazil nut oil Varies According to Extraction Method

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The aim of the present study was to investigate the influence of varied methods of extraction of Brazil nut oil on tocopherol composition of the oil. Four samples of Brazil nut oil were analyzed: one commercial (cold-pressed, industrial-scale), and three obtained experimentally (laboratory-scale), two by solvent extraction (ethanol or petroleum ether), and one by cold-pressing. The contents of tocopherols (?, ?, ? and ?) were determined by normal-phase HPLC, with fluorescence detection. Oil yield (g of oil/100 g of Brazil nut; mean +/- SD) was highest after extraction with petroleum ether (50.5 +/- 0.45), followed by cold-pressing (48.3 +/- 0.31) and ethanol (35.7 +/- 0.16). ?-Tocopherol was the major tocol, followed by ?-tocopherol, in all samples of Brazil nut oils. Tocopherol composition varied significantly ($p < 0.01$) between oil samples, and the sample obtained by ethanol extraction showed the highest contents (mg/100 g; mean +/- SD) of ?-tocopherol (31.5 +/- 1,42), ?-tocopherol (49.2 +/- 2.72) and total tocopherols (83.6 +/- 2.51). The commercial oil (cold-pressed), and the oil extracted by petroleum ether showed the two lowest contents of ?-tocopherol (0.68 +/- 0,59 and 2.70 +/- 0,12, respectively). Additionally, the oil extracted with petroleum ether showed the lowest contents of total tocopherols (17.6 +/- 0.35). Although extraction of Brazil nut oil with ethanol promoted relatively low yields, it uses a low-toxicity solvent and results in tocopherol contents several-fold higher than the other methods. Financial Support: FAPERJ, CNPq, CAPES.

Quantification of Energy Parameters During Crystallization of tag Binary Mixtures

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Triacyglycerols (TAGs) crystallize in many nano and micro entities with specific thermal and structural characteristics. These crystalline entities (phases) often exist as solid solutions with different proportions of polymorphs and compositions. Determining these proportions is an urgent need for both the industry and for researchers. This, however, remains a big challenge. To tackle the challenge, the energies that determine how TAG molecules interact with each other to form a crystalline phase must be determined. To develop and implement the methodology used by Wesdorp et. al. (2005) we estimated the excess energies of large numbers of mixed binary mixtures (mole %) of trilaurin and trimyristin by combining accurate determination of enthalpy of crystallization with x-ray data. Our results suggest that the enthalpic deviation from ideality for the crystalline phases formed at cooling rates between 15 and 1 °C/min is due to the presence of two different sub-forms of the same polymorphic type ß?. These sub-forms appear only in mixed systems and treating them as one miscible phase (i.e ß? polymorph) and not as two distinctive states is erroneous. Multi-TAG fats follow the same behaviour and the same problem arises. This requires combining both reliable experimental and theoretical approaches to be solved.

Physicochemical Properties of the Principal Ingredients in Dark Chocolate and Their Effects in the Final Product Quality

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The functionality and quality of dark chocolate bars is dependent of several factors. For example, the tempered process generates desirable product quality features such as brightness, fracture, soft texture, color and stability during storage in which the presence of crystals ? (V) form plays an important role. In this work, we focused on the physicochemical characterization of the main ingredients of dark chocolate and of stored chocolate, especially fatty acids and triacylglycerides composition by GC and HPLC respectively, melting profile by DSC, and polymorphic state by powder X-ray diffraction. The compositional results in the chocolate confirmed the high content of POS, SOS and POP. Calorimetric results showed melting temperatures of ?32 ° C for tempered chocolate and 33 ° C for chocolates without temper, melting that corresponded to the presence of crystals of the forms ? (V-VI) that did not change according to the storage time, information obtained from the interplanar distance d and the intensity in the diffraction patterns. Textural analysis showed an increase in hardness while the visual analysis of chocolates during storage reflected the presence of a white coating on the surface associated with both, sugar and fat bloom. In this last event, the migrated fat proved to be rich in palmitic fatty acid.

Crystallization and polymorphism behavior of pure triacylglycerol?s added with monoacylglycerols

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Minority lipids (ML) include more polar lipids and with amphiphilic structure, as diacylglycerols (DAGs), monoacylglycerols (MAGs), free fatty acids, phospholipids and sterols. These constituents have been considered molecular agents that affect crystallization. The MAGs are present in minor amounts in fats, and studies on the effect of these compounds on the crystallization behavior of these are less numerous. This project aims to study these effects in crystallization and polymorphism of mixtures were obtained from the addition of 5% of MAGs in pure triacylglycerols (TAGs). The MAGs used were: monopalmitin (P), monolaurin (L) and monoolein (O), and pure TAGs were: tristearin (SSS), tripalmitin (PPP) and triolein (OOO). The effects of the addition of MAGs could be observed through analysis by polarized light microscopy and differential scanning calorimetry (DSC). Results showed that the additions of saturated MAGs (P and L) tended to co-crystallize with saturated TAGs (PPP and SSS), slowing the polymorphic transition. Whereas the additions of O promoted polymorphic transition in all TAGs pure.

Thermal and Structural Behaviour of Four Industrial Lauric Fats

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Up to now, limited data are available in the literature comparing the thermal and structural behaviour of lauric fats, especially concerning their polymorphism. The objective of this work is to contribute to an establishment of these basic informations on lauric fats by analysing four industrial lauric fats, which are sold under the same commercial description, by using pulsed nuclear magnetic resonance, differential scanning calorimetry, and X-ray diffraction. The four fats have been classified into two groups based on their compositions: group 1 was characterized by its higher concentration in stearic acid and group 2 by its higher concentrations in lauric and myristic acids. After cooling and 24 h tempering at 4°C, group 1 and 2 crystallized in the ?'2 and ?'1 forms, respectively. These crystalline varieties corresponded to double-chain-length organizations (2L); both groups exhibited great ?' polymorph stability. The four fats were also submitted to various tempering programs (4, 20 and/or 25°C for several weeks) and to a temperature cycling (crystallization at 4°C followed by a tempering at 20 or 25°C). The tempering at 25°C favoured a better organization of lipid crystals; however it increased and accelerated the polymorphic transitions from ?' form to a mixture of ?' and ? polymorphs.

Liquid Oil Margarine with Ultramicro-starch-filaments & Oil Leakage Prevention from Oily-fruits for

Beverage- and- food Manufacture

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Any liquid oils, i.e. EVOO, ice cream, etc. have shape retention properties by mixing them with a few% of microfilaments of starch. These hold the shape even at 200 degrees Centigrade, where these become brown-black by baking. When these are eaten into the mouth, these rapidly liquefy by salivary amylase. These liquid oils have convenient easy-to-use hardness at any temperatures from minus 20 to plus 200 degrees C. This has no harm for health because of no trans-fatty acid, no saturated fat, no waxy substances of high melting points etc. The filaments are different from ordinary starch which works only in water but never in oil. These filaments can be made any methods, i.e, thin-solution lyophilization, flush freeze, magnetic freeze, etc. Margarine etc. are becoming great problem for health. But these can be solved by this. USA patent 2011-125301,Yamada. Oil and bitter leakage from oily bitter fruits are prevented in order to make non-oily delicious and beautiful red beverages and foods, i.e. olive red wine, vinegar, alcoholic dishes, chocolate, etc. Oil-containing endoplasmic reticulum and reactive parts of bitter molecules are coagulated with saturated Ca(OH)2 and CO2, and covered by CaCO3. After they are eaten and swallowed into the stomach, the gastric acid immediately dissolves the cover. Then the covered molecules returns to original ones to be absorbed. Traditional NaOH and salt for olives destroys nutrition. But these have polyphenol content 40mg/dl. Patent pendWO2012/036080A1,Yamada.

Retardation of crystallization of diacylglycerol oils using polyglycerol fatty acid esters

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Diacylglycerol (DAG) has beneficial effects on obesity and obesity-related diseases, therefore widespread application of DAG to food products has been expected. In general, for use of fatty materials in food products, it is important to know and control the crystallization behavior of them, because it greatly affects the physical properties of the final product. In the previous study, we investigated crystallizing process of DAG made from vegetable oil (DAG-rich oil), in which 1,3-disaturated DAG (1,3-SS), 1,3-saturated-unsaturated DAG (1,3-SU), and 1,3-diunsaturated DAG (1,3-UU) separately crystallized in a sequential manner at chilled temperatures (Saito et al., JAOCS, 89.1231, 2012). In this study, we examined retardation of the precipitation in the DAG-rich oils by adding food emulsifiers, polyglycerine fatty acid esters (PGFEs) containing different fatty acid moieties. The results were discussed in terms of the effects of the PGFE additive on pre-nucleation processes of the high-melting fractions in the DAG-rich oil. We also report on unique structural properties of PGFEs in DAG-rich oils, which indicated the formation of self-assembled mesophases by the PGFE additives during cooling processes near crystallization temperature.

Promising Cultivar of Soybean for the Yield of Oil and Protein in Khyber Pakhtunkhwa-Pakistan

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Research work conducted on the yield of oil and protein consisted of two varietal trials with 8 promising varieties of Soybean during Kharif 2009 in KPK-Pakistan in order to select the most promising, high and stable yielding cultivar for the yield of oil and protein on hectare basis. The seed was inoculated with a commercial strain of TAL-379. The data revealed that variety Kharif-93 gave the highest seed yield of 2540kg/ha, followed by Wahab-93 (1925kg/ha)and Ajmeeri (1655kg/ha), however, the lowest yield of 650kg/ha was obtained from variety Weber. The maximum oil and protein content were found in Weber (21.6%)and Kharif-93 (44.9%) respectively but due to increase in seed yield, a progressive increase in the yield of oil (510.5 kg/ha) and protein (1140.5kg/ha) were found in Kharif-93, followed by variety Wahab-93 (392.3kg/ha) and (854.7 kg/ha), variety Ajmeri- (334.3kg/ha) and (715.8kg/ha). Being leguminous crops, it was observed that soybean improves the fertility and productivity of soil and the ultimate yield of oil and protein increased on hectare basis. Furthermore, it will help the growers on the one hand to avoid the indiscriminate use of fertilizer and on the other hand, this will save a large amount of foreign exchange on the import of edible oils and fertilizer i.e about 2 billion dollars (Rs 198 million) and Rs 14 billion respectively.It is, therefore, suggested that soybean varieties Kharif -93 and Wahab-93 are recommended for commercial cultivation in Khbyer Pakhtunkhwa-Pakistan with regard to the yield of oil and protein on hectare basis.

Determination of trans fatty acid levels by Gas Chromatography in processed foods in India

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The results obtained from the present study would be aiding to an increase in consumer awareness about presence of trans fatty acids in food items and better appraisal by the companies and thus improving the current scenario. The fatty acid composition, fats percentage and trans fatty acid (TFA) contents of samples of 18 different Indian food items and milk products were determined by gas?liquid chromatography, using a polar 100 m capillary column CP Sil-88 coated with highly polar stationary phase (Cyanopolysiloxane) and flame ionization detector. Total TFA ranged from 0.83 % to 8.42 % of total fatty acid. The highest TFA found in Samosa which is 8.42 % and lowest TFA found in Curd which is 0.83 %. Total SFA ranged from 32.88 % to 57.6 % of total fatty acids. The highest SFA found in Pastry which is 57.6 % and lowest found in Burger which is 32.8 %. Total MUFA ranged from 25.65 % to 41.14 % of total fatty acids. The highest MUFA found in Biscuit which is 41.14 % and lowest found in Pizza which is 25.65 %. Total PUFA ranged from 8.88 % to 21.12 % of total fatty acids. The highest PUFA found in Pizza which is 21.12 % and lowest found in Pastry which is 8.88 %. Experimental results suggested that Indian food items contain significant amount of trans fatty acids, both monounsaturated and polyunsaturated.

Modeling and Analysis of segmented data from lipid studies: Straight Line Analysis Tool (SLAT) Software

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The problem of modelling segmented data is ubiquitous in many branches of science and engineering including the particular area of lipid studies such as lipid crystallization and oil binding capacity of structurants. We have developed a software tool with a Graphical User Interface (GUI), so-called Straight Line Analysis Tool (SLAT), to model piecewise data containing linear and non-linear segments. The test for linearity uses a polynomial approach supplemented with a deviation criterion. The regression equations of the polynomials are calculated with the least squares method and the significance of the parameters is determined using statistical t-test and non-central F-test. A test for the stability of the regression coefficients is also employed. The segmentation procedure uses a combinatorial approach and is implemented in a recursive manner. It starts with a ?seed? and involves forward as well as backward nested search processes. A requirement based on a priori knowledge of the system, akin to a penalization criterion, establishes the trade-off between a good quality of fit and a reasonable number of segments. The program is objective and automated. It is practical and simple and provides very impressive results for both synthetic and lipid studies data and is quicker than existing larger software packages.

Puff pastry margarines performances related to their physicochemical properties

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The functionality of margarines and shortenings as bakery ingredients depends on several factors. Formulation and processing are both key factors affecting the performances of the final products. Specifically, in puff pastry margarines, the fats must present some special technical functionalities, such as plasticity for buildup of fine layers without rupture in the dough. In the past, high TFA fats were used to ensure those requirements. In this work, fully palm-based puff pastry margarines have been made on a laboratory scale. The low-trans fat blends used in these formulations have been characterized both physico-chemically and chemically (texture, dropping point, polymorphism stability, melting profile, fatty acids composition, ?). The bakery aptitudes of the produced margarines have also been determined and compared with commercial standard puff pastry margarines. For this purpose, puff pastries were prepared, their heights were measured and compared to the commercial references, as well as their global appearance. According to these results, the functionality of the palm-based blends was similar or even better compared to the commercial references. However, it was shown that the storage temperature of the palm-based margarines strongly modifies their bakery performances. The control of the temperature before and during dough preparation is of crucial importance for such products.

Morphology and physical properties of high melting fractions of milk fat

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Milk fat (MF) is the fatty portion of milk and is a complex mixture of triacylglycerols (TAGs). It can be separated into two components, high- and low-melting fractions depending on the melting point of triacylglycerols. To separate high- and low-melting fraction, in general, dry fractionation is performed on milk fat. In this process, the solid fraction is separated from liquid by a filtration or centrifugation. In this filtration process, the morphology and the size of fat crystals influence on the filtration efficiency. The purpose of this study is to investigate the morphology and physical properties of HMF of MF by using polarized light microscopy and synchrotron radiation X-ray diffraction. In addition, the effects of additives on crystallization of HMF of MF are reported. The main results are as follows; (i) HMF of MF crystallizes into two shapes, ?spherulite? and ?aggregation? under slow cooling, and both crystals showed same lamellar distance, (ii) Growth rates, melting points and crystal orientations were different, (iii) addition of 0.1% of SSS increases lamellar distance and the melting point of milk fat crystal.

Development of astaxanthin microcapsules as a functional ingredient for foods

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Astaxanthin, a lipohilic bioactive compound, has shown to have beneficial effects on human health. However, it is hydrophobic and susceptibility to light, heat and oxygen, therefore having limited application in most food systems. The objective of this work is to study the development of astaxanthin microcapsules as a functional ingredient for food using microencapsulation technology. Astaxanthin emulsions were prepared by a two-stage homogenizer using dairy proteins i.e. whey protein isolate (WPI) or sodium caseinate (SC) and carbohydrate (soluble corn fiber, SCF70) as emulsifiers. The droplet size and distribution, ?-potential, and viscosity of the emulsion were measured. The emulsions were then spray-dried into powders at air temperatures of 160°C (inlet) and 70°C (outlet). The powders were characterized including water activity, microencapsulation efficiency, surface properties and oxidative stability. The interaction between wall materials was studied using Fourier Transform Infrared Spectroscopy (FTIR) while the bioaccessibility was investigated in an in vitro digestion experiment. Current results showed that astaxanthin microcapsules with good properties, including water activity, surface morphology and oxidative stability could be produced through spray drying. The reconstituted emulsions showed good stability similar to the parent emulsions. The microencapsulation efficiency was high (~90%) for the wall systems, indicating the suitability of the wall materials for encapsulating the hydrophobic astaxanthin. The FTIR results indicated the possibility of Maillard reaction products formation, which may influence the oxidative stability of the microcapsules. The in vitro digestion results suggested that the WPI/SCF70 wall systems could be digested more easily than those of the SC/SCF70.

Development of In-House Laser Absorbance Setup to Prepare X-Ray Diffraction Experiments at a Synchrotron Facility

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Due to the limited time availability to perform experiments in synchrotron facilities, it is essential to run in-house experiments to test the experimental. It is also important to determine the onset of crystallisation at the final holding temperatures. The in-house laser absorbance setup that has been developed consists of a Level 3b helium-neon laser (623nm), capillary cell, flow switch, temperature controller, photo diode detector, water bath and a computer to run a Labview program. The capillary cell is a custom built component which is used to heat-up or cool down the sample at controlled rates. The heating or cooling of the capillary cell is effected by a set of special high temperature Peltier elements, that receive a DC voltage input from the power controller which is in-turn driven by a compiled Labview program. A Flow switch which is installed between the water bath and the capillary cell ensure that the power is delivered to the Peltier elements only when there is a flow of water in the capillary cell. The amount of power sent to the temperature controller is governed by a PID algorithm. A Photo diode detector senses the laser intensity and converts it into voltage which is further sent to the Labview program through DAQ. Isothermal experiments of various binary mixtures like trimyristin-trilaurin etc. were conducted using this setup and onsets of crystallisation times were

determined. Optimum PID parameters were found out for minimum overshooting at different temperatures by testing with a wide range of PID constants.

Study of Microstructure and Onset of Crystallization of pure triglycerides and their binary mixtures by Polarized Light Microscopy

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Fats and oils are the chief constituents of food products. Triacylglycerols (TAGS) are one of the most abundant types of fats. A large number of properties of foods are dependent upon the type of TAGS, their composition and the polymorphic form. The structural function of fat in food is to provide sensory satiety, give taste, texture and mouth feel. The microstructure of the crystalized fat has a great effect on the melting behavior of fat-based foods. Hence to correlate the type of triglycerides, composition and the processing conditions with the melting behavior, the microstructure formed at these conditions is required to be understood. Polarized Light Microscopy (PLM) is the analytical technique that has been employed to study the microstructure of fat crystal network. PLM exploits the difference in the optical property of triglycerides crystals and liquid triglycerides. The triglycerides crystals are birefringent i.e. they have varying refractive index w.r.t angle of incident light whereas the background (liquid triglycerides) is non birefringent. Micrographs of pure triglycerides and their binary mixtures were obtained using PLM. The image analyzing software ?ImageJ? was used to improve the visibility of microstructure from the micrographs. So far, onset of crystallization was calculated for different triglycerides and their binary mixtures at different conditions. Onset obtained from the PLM was compared with the data from DSC and XRD. A proportionality factor was estimated by comparing the change in intensity obtained from PLM with the rate of change of area of a phase obtained from XRD at similar conditions.

CANCELLED-Observation in the liquid state of TAGs - Laser and synchrotron x-ray

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Effect of temperature on the wide angle x-ray diffraction of nanocrystalline triglycerides

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Triacyglycerols (TAG), the main component of edible fats, have a rich and complex polymorphism. The phase behavior of TAG is strongly influenced by many factors during crystallization, such as temperature, shear rate, cooling rate. Often the best texture of specific foods is obtained by forming a particular polymorph rather than others. Due to the peculiar size of intermolecular distances in nanocrystalline triglycerides, their diffraction patterns are naturally divided into two groups ? Small angle x-ray diffraction patterns (SAXD) and wide angle x-ray diffraction patterns (WAXD). SAXD patterns give information about the number of phases formed and the amount of each phase formed as crystallization proceeds. WAXD patterns give information about the lateral distances between two hydrocarbon chains in a crystal, which are characteristic of a particular polymorph. It was noticed in previous studies that the peak position of WAXD patterns is affected by the temperature. In order to observe this effect quantitatively, trilaurin was melted at 95°C and was tempered to crystallize in the ? polymorph. This crystallized trilaurin was kept at different constant temperatures for 8 minutes and its detailed WAXD patterns were obtained at the National Synchrotron Light Source, NY, US. This poster describes how different WAXD peaks change their position as the temperature changes. It is particularly interesting that the anisotropy of the nanocrystals is put in evidence by these changes.

Presence of two distinct wide angle liquid phases in partially crystallized binary mixtures of trilaurin and trimyristin

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Triacylglycerols (TAGs) are the chief constituents of all fat based foods. The physical properties of fat based foods depend on the composition of triglycerides and the form in which they crystallize. Thus, it has become extremely important to study the kinetics of crystallization and the effect of processing conditions on the final type of polymorph formed. Binary mixtures of trilaurin and trimyristin are melted at 75°C for 10 min and were cooled down rapidly to different final temperatures and allowed to crystallize. Time resolved small and wide angle x-ray diffraction (SAXD and WAXD) patterns were obtained at National Synchrotron Light Source, NY, US during crystallization. These patterns were analyzed using imageJ and a statistical analysis package igorPro6. Peak fitting of liquid scattering patterns at high temperatures revealed the presence of only one liquid phase, while the analysis of patterns obtained during the stages of crystallization and melting showed the presence of two distinct liquid phases. This could be either due to phase separation of liquid before it crystallizes into two distinct phases which were observed from SAXD patterns or possibly that this liquid corresponds to the triglycerides building up in one particular direction of the growing crystal. This poster summarizes the presence of these dual scattering patterns for liquid at different temperatures and for different compositions of trilaurin and trimyristin. More detailed investigation and analysis is required to understand the reason behind the formation of these patterns.

Program