AM 1: Lipid Imaging

Chairs: K. Koch, North Dakota State University, USA; and Z. Guo, Aarhus University, Denmark

Honey Bees, A Status Update. D. Hill, ADM Alliance Nutrition, Inc., Quincy, IL, USA.

In 2007, it was called “Colony Collapse Disorder” or “CCD” because there was no good explanation as to why there was a high incidence of sudden disappearance/death of honey bee colonies. Since that time, governments, universities, industries, and private groups around the world have funded research into bee health. Losses today are much less than 2007, but still high to support agriculture and food production. There are no answers that completely explain these losses, but there is a much better understanding of many of the factors involved. Some factors are well documented and others are not. It is many times difficult to separate fact from fiction and emotion. This presentation will cover the basics of bee production, and review today’s bee health challenges. Bee nutrition is at the top of the list as this affects all other factors. Varroa mites, viruses, pathogenic bacteria, pesticides, and crop production practices are other major factors that will be presented.

Kinetic Phase Diagrams of Crystallizing Trilaurin-trimyristin Mixtures Using Small and Wide Angle X-ray Diffraction. P.K. Batchu and G. Mazzanti, Dalhousie University, Halifax, NS, Canada.

It is very important to have kinetic phase diagrams to predict the solid phase properties during industrial crystallization. The composition and polymorphic form of the solid phases formed affect the physical properties of fat based foods. To study the growth of these solid phases time resolved simultaneous small and wide angle x-ray diffraction experiments were performed at NSLS with three binary mixtures of trilaurin with trimyristin at different undercooled conditions. Four major final crystalline ß’ phases were noticed, but they appeared in sequential pairs depending on the composition of liquid. The composition of the crystalline phases formed was estimated using a correlation between the SAXD d-spacing and composition of crystalline phases developed. Kinetic model proposed by Los et al., is used. An excel solver method is used to calculate the binary interaction parameters and kinetic constant for the instantaneous composition of crystalline phases. The correlation lengths of diagnostic peaks of WAXD patterns showed dependence on the composition of crystalline phases. A novel method to estimate the degree of isomorphism from this dependency is proposed. This degree of isomorphism is used to calculate the binary interaction parameters for the construction of phase diagrams.

The Role of Lipid-protein Interactions on the Textural Properties of Comminuted Meat Products. A.J. Gravelle, A.G. Marangoni, and S. Barbut, Dept. of Food Science, University of Guelph, Guelph, ON, Canada.

Although there has been a large push in the food industry to reduce saturated and *trans*-fats in food products, this fat component often plays a crucial role in providing many desirable properties such as texture and flavor. Our group has recently published work on supplementing traditional fats with structured vegetable oil in frankfurters to improve fatty acid profile, however mimicking texture is a more challenging aspect because the mechanism by which the texture of comminuted meat products is achieved is not yet entirely clear; whether it is simply the size/hardness of the filler particles or the available surface area for lipids and proteins to interact. To investigate this, we have used a model system of finely comminuted poultry meat with filler particles of different chemical nature and distinct size ranges. A large size-dependence was observed even when inert particles, such as glass beads, were used as fillers. Cryo-SEM images confirm that the protein does not adhere to the glass surface, demonstrating that the size of the filler contributes at least in part to the textural properties, with smaller particles producing significantly harder products. This investigation is ongoing and the use of hydrophobic filler particles should help elucidate the role lipid-protein interactions on the textural properties of comminuted meat products.

Investigation of the Tripalmitin/Triolein System via Hot Stage Microscopy. D.I. Stewart[1], A.G.F. Stapley[1], P.S. Chong[2], and Z.K. Nagy[1], [1]Dept. of Chemical Engineering, Loughborough University, Loughborough, Leicestershire, UK, [2]Nestlé Product Technology Centre, York, North Yorkshire, UK.

The isothermal crystallization and subsequent melting behavior of the tripalmitin (PPP)/triolein (OOO) system was investigated using hot stage microscopy (HSM). In blended samples, two distinct polymorphs could be seen as crystals grew, an outer ring of ß' polymorph surrounding an inner circle of ß. Between the two a thin layer of liquid was observed into which the more soluble ß' form dissolved and from which the less soluble ß form crystallized. Thus a direct observation of the mechanism of a melt-mediated transformation from ß' to ß forms was seen. This transformation to ß was not seen with pure PPP samples, which demonstrates that liquid oil content is an important variable governing polymorphic transformation. Melting points for ß' and ß were determined both by HSM and DSC. Both could show a significant (positive) deviation from ideal behavior as predicted by the Hildebrand equation. However, Solid Fat Content profiles obtained by NMR were consistent with ideal behavior. The discrepancy may be due to mass transfer limitations within the microscope slides. Thus whilst HSM is shown to be an excellent technique for visualizing crystal growth and polymorphic transformation it is not yet a reliable method for providing precise melting point determinations.

The Effect of Hazelnut Oil on the Crystallization of Cocoa Butter Observed via Hot Stage Microscopy.

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The crystallization and melting behavior of cocoa butter (CB) and an 80:20 mixture of CB in hazelnut (HZ) oil was investigated using hot stage microscopy (HSM). Samples were melted at 60°C, cooled at various rates to 0°C, and then re-melted at various rates. Images were taken in order to ascertain induction temperatures and observe polymorphic and melting behavior, which were also studied by DSC. Crystals first appeared when temperatures were in the range 18-23°C, with more rapid cooling rates giving lower induction temperatures. In pure CB samples, very few high-melting (ß) crystals were apparent upon re-melting. However, in CB-HZ samples the ß form was much more prevalent, particularly when faster cooling rates had been used. This shows that liquid oil content is an important variable for polymorphic transformation, aiding the transition to the ß form. Fast cooling rates are more likely to produce lower polymorphic forms and these appear to transform relatively easily into the ß form. Slower cooling rates generally produced the ß‘ form, which were less likely to then transform to ß. HSM is shown to be an excellent technique for visualizing crystal growth and polymorphic transformation.

AM 2: Lipid Structure

Chair: K. Koch, North Dakota State University, USA

Microscopy as a Tool in Particle Technology Applications. E. Stensrud, Archer Daniels Midland Company, Decatur, IL, USA.

Understanding the physical and structural properties of particles is important for optimization of downstream processes as well as achieving the desired functionality of finished products. Sieve analysis and laser diffraction exemplify standard methods for determining the particle size distribution of a sample. However, these techniques are often limited in scope, failing to provide, in certain circumstances, pertinent information regarding particle shape and morphology. Microscopy embodies an analytical tool that allows for the finely-tuned evaluation of particle parameters including size, shape, morphology, and surface properties. Case studies will be presented, in which light and scanning electron microscopy methods were employed to ascertain particle attributes.

Identification of Sucrose-ethylcellulose Interactions in a Chocolate System. T.A. Stortz and A.G. Marangoni, University of Guelph, Guelph, ON, Canada.

Ethylcellulose (EC) can provide heat resistance to chocolate. Texture analyses and atomic scale molecular dynamics simulations have revealed an interaction between EC and sucrose. The current work will further validate this interaction. Fourier transform infrared spectroscopy was used to study EC-coated sucrose made via two different methods and analysed using transmission or attenuated total reflectance techniques. Results for both techniques revealed a peak shift at 3335 cm^{-1} corresponding to the stretching of the hydroxyl group on carbon two of the glucose ring of sucrose. A system was also studied with lecithin coating the sucrose prior to addition of EC to mimic what is found in a conventional chocolate. The lecithin prevented the EC from interacting with the sucrose. However, when ethanol was used during sample preparation the peak shift at 3335 cm^{-1} was observed despite the presence of lecithin. Microscopy using a fluorescent labelled phospholipid of lecithin revealed that ethanol was able to solubilise the lecithin, freeing the sucrose surface to interact with EC. Furthermore, the sucrose-EC network of a defatted chocolate sample was imaged using scanning electron microscopy. This work has confirmed an interaction between EC and sucrose which is responsible for heat resistance in ethylcellulose-stabilized chocolate.

Synthesis and Chemo-physical Characterization of Novel Surface Active Cationic, Anionic and Nonionic Phytosteryl Derivatives. Z. Guo, W. Panpipat, and X. Xu, Dept. of Engineering, Aarhus University, Aarhus, Denmark.

Three new kinds of *ß*-sitosteryl amphiphiles including anionic *?*-((*b*-sitosteryl)oxy)-propane-1-sulfonate (Sito-sulfonate), cationic *b*-sitosteryl oxy carbonyl-N,N-dimethylethanaminium (Sito-aminium), *b*-sitosterol-glucuronic acid conjugate (Sito-glucuronic) were successfully synthesized, and nonionic *b*-sitosteryl oxy succinyl PEG (Sito-PEG) was also synthesized for property comparison. The chemical structure of *ß*-sitosterol amphiphiles were identified by ^{1}H-NMR, time-of-flight mass spectrometry and FTIR spectroscopy. All these compounds are found to be surface-active and their critical micelle concentrations were determined by the pyrene fluorescence method. The amphiphillic *ß*-sitosteryl derivatives self-aggregated nanoparticles were prepared by probe sonication technique in water and analyzed by dynamic light scattering for size distribution and zeta potential. This study also compared the interfacial property and film morphology of amphiphillic *ß*-sitosteryl derivatives by using Langmuir Blodgett (LB) technique.