MONDAY

MORNING

PECIG 1: Teaching Lipids Physics and Engineering

Chair(s): R. Verhe, Ghent University, Belgium; and K. Dewettinck, Ghent University, Belgium

Teaching Lipid Crystallization - from Molecules to End Products. K. Sato, Hiroshima University, Japan

Crystallization of lipids has high significances in many research and technological areas of fats and oils, such as fractionation of vegetable and processed oils, production of food lipids (confectionery fats, fat spreads, whipped and ice creams, etc.), cosmetics (cream, lip sticks, etc.) and pharmaceuticals (drug delivery, etc.) It could be true to suppose, however, that most of graduate school students and technologists dealing with lipid crystallization may have some difficulty in learning the concepts and the details of lipid crystallization, even if they had already learned the basics of crystallization. Most probably, this is due to the fact that there are specific complexities in the crystallization processes of lipids which largely differ from those of the other materials, particularly by the occurrence of polymorphism. Furthermore, quite complicated physical states, where the lipid crystallization often occurs in such as emulsion and suspension, may also lead the people to confusion. This talk tries to illustrate a whole road map of lipid crystallization, which begins with getting driving forces for crystallization, and moves on nucleation and crystal growth. Emphasis is paid to the rates of nucleation on polymorphism including driving forces and activation free energies for nucleation, both of which are polymorph-dependent. In addition, heterogeneous nucleation also becomes the key in the emulsion systems, as interfacial nucleation of lipid crystals frequently occurs with the aid of emulsifying reagents. In the end fat, variety of formation processes of crystal network will be presented, as the fat crystal network determines the functionality of the end products of lipids.

Why is Milk Chocolate Softer than Dark Chocolate? A.G. Marangoni, University of Guelph, Guelph, ON, Canada

Knowledge of the physical properties and behavior of fats is key in the development of new formulas with specific functionalities. Fats have a rich hierarchical structure, from molecules to supramolecular assemblies to macroscopic bodies. In this talk, we'll provide an overview of the different structures present in fats at different length scales in the context of the very dramatic softening that takes place when you introduce milkfat into chocolate, as in the manufacture of milk chocolate. This talk will review molecular structure, polymorphism, crystal properties, phase behavior and mechanical testing of fats in order to try to explain why milk chocolate is so much softer than dark chocolate. The aim of this talk is to highlight why it is important to have a basic understanding of fat physical chemistry in order to understand and affect material properties.

The Secrets Behind the Quality and Taste of Belgian Chocolates. Nathalie De Clercq, Cacaolab, Ghent University, Belgium

Worldwide consumers are fond of Belgian chocolates, and this has triggered researchers of Ghent University to explore this scientifically. The superior quality and taste of Belgian chocolate is based on the skills, craftsmanship and devotion of its producers. This lecture will give an overview of the compositional and processing factors that govern the quality and taste of Belgian chocolates. This chocolate journey from the cocoa tree, over cocoa processing and chocolate production to distribution and storage will be illustrated with findings of fundamental and applied work. This lecture will unlock the science behind Belgian chocolates to everybody with a professional interest in this delicacy.

A Superficial Look at Surfaces. J Coupland, Penn State, University Park, PA, USA

Most foods and biological materials contain multiple phases separated by interfaces. The properties of the interfaces differ from the properties of the component phases and can often determine the overall behavior of the system. In this work I will show how mechanical and thermodynamic surface properties arise from the imbalance of intermolecular forces at the surface. Next curved surfaces where the unbalanced forces lead to compression of internal phases or attraction between particles in the form of capillary forces are described. Finally the modification of surface structure by adsorption of amphiphilic material is examined. At all stages I take a qualitative and molecular approach to provide an intuitive understanding of surface properties.

The Use of Inverse Chromatography for Research and Teaching Lipid Technology. J.W. King, University of Arkansas, Department of Chemical Engineering, Fayetteville, AR, 72701, USA

The use of chromatographic methods provide an excellent mechanism for conducting research and teaching students the physicochemical aspects of oil and lipid characterization. Using inexpensive and modified gas and liquid chromatographic instrumentation has allowed us to determine the solvent and surface properties of lipid substrates contained within the chromatography column. Such solution thermodynamic properties as activity coefficients at both infinite dilution and finite concentrations, Henry's Law constants, chi-interaction parameters, and solubility parameters can be determined from ambient conditions to higher temperatures using both IGC and ILC methods. Processing of the chroimatographic retention and peak profile data trains students in the principles of surface chemistry and solution thermodynamics, and provides data for use in process engineering, the physical chemistry of solutions and interfaces, and physicochemical property data on oils, wax esters, biodiesel, and glycerol.

AFTERNOON

TUESDAY

N/A

WEDNESDAY

N/A

Posters

Chair(s): R. Weselake, University of Alberta, Canada; and D. Hayes, University of Tennessee, USA

Plasma Lipid Profiling by LC/ESI-MS Using a Single Quadrupole Mass Spectrometer: A Student Exercise. A. Kuksis, University of Toronto, Toronto, ON, Canada

As a follow up to a high temperature GLC profiling of phospholipase C modified plasma total lipid extracts, introduced as a student exercise previously (94th AOCS Abstracts 2003, p. 130.), I now wish to present a brief outline of plasma lipid profiling by LC/ESI-MS using unmodified total lipid extracts. Simple LC-MS provides the masses of molecular species of lipids as Na+ or NH4+ adducts (e. g. 50-120 V). More complete identification is obtained by MS/MS, which is based on specific mass spectrometric fragmentation of primary ions. LC/ESI-MS/MS with a single quadrupole instrument is obtained by a separate run and collision-induced dissociation (CID) spectra of all charged species (e. g. 200-300 V). The computer program along with the original mass spectra is transferred to the personal computer of each student for the extraction of appropriate ions from the total ion current profile and for recording of

single ion mass chromatograms, with or without spectra subtractions, for complete identification of molecular species of specific lipid classes, as required. This personal involvement with the data manipulation and analysis provides the student with confidence and practical experience in MS/MS analysis of lipids.

From Light Harvesting and CO2 Fixation to the Accumulation of TAG.
D. Hildebrand, University of Kentucky, Lexington, KY, USA

Plant oils are an important food component and source of renewable chemicals. In this educational poster we will chart the key steps from light harvesting and CO2 fixation to the accumulation of hydrocarbon in triacylglycerol (TAG) in seeds. In the light reactions of photosynthesis energy from sunlight is used to abstract hydrogen from water and generate a high energy synergent for biochemical reactions ATP. NAD and NADP carry the hydrogen and provide it in the conversion of CO2 to hydrogen rich fatty acids and the glycerol backbone of TAG. All of the key steps from the conversion of CO2 into 3 carbon acids to the formation of fatty acids and glycerol and assembly into TAG will be charted in this educational poster.

Who Likes Eating a Lump of Fat?
J.L. Harwood, Cardiff School of Biosciences, Cardiff, Wales, UK

Chocolate is derived from fruits of the tropical tree Theobroma cacao. Cocoa products were first recorded in 1100 BC and were extensively used by the Aztecs. Their king, Montezuma, was known to be fond of a bitter cocoa bean drink called xocolati. Later in the 17th and 18th centuries, chocolate houses were popular with the fashionable elite in European cities. In 1847 the English firm Fry and Sons produced the first modern chocolate bars and in 1875 the Swiss developed milk chocolate. Since then, chocolate has remained one of the most popular confectioneries (sales of $50 billion each year!).The unique characteristics of chocolate derive from the special properties of cocoa butter (as well as the flavour provided by fermented fruits and their roasted products). There are also minor ingredients which have pharmacological or physiological properties.When communicating with the general public, chocolate is an instantly popular subject. The trick then lies with imparting serious scientific knowledge rather than just playing to a popularist gallery. Nevertheless, anecdotes (and free samples!) can be used to illustrate the basic science.

Lipid Science Confusion: How to Simplify the Message and Regain the Confidence of the Public.
N.A.M. Eskin, M. Aliani, University of Maitoba, Winnipeg, Manitoba, Canada

The constant barrage in the media on the evils of lipids plus the pyramid that encouraged greater consumption of carbohydrates, at the expense of lipids, resulted in the largest number of obese and unhealthy adults and children in North America. Attempts to curtail this trend by completely redesigning the pyramid and changing the message not only confused the public but questioned the credibility of professional scientists in Government and Universities. The challenge for lipid scientists is how to overcome this confusion by providing simple yet accurate information in a user-friendly format on the benefits of food lipids. The negative connotation between lipids and fat provides unique challenges in getting this message across. To get the attention of the public, particularly school children, the information must be simple, clear and presented in a creative and humorous format including song. This poster will present some of these elements in an attempt to better inform the public about good lipid choices in the diet.

Beyond Good Grammar: Essential Scientific Communication Skills Every Student Should Learn.
C.L. Snyder, R.J. Weselake, Department of Agricultural, Food & Nutritional Science, University of Alberta, Edmonton, Alberta, Canada

Despite the "publish or perish" culture of research, the intense competition for research funding, and the mass media appeal of topics relevant to lipid science, many students exit their graduate programs without a clear understanding of how to effectively communicate their research to various scientific and non-scientific audiences. In providing feedback to students who struggle with writing, it is often tempting to focus on the most concrete issues, such as scientific content or grammar; however, this is a missed opportunity to reinforce the more fundamental rhetorical principles that are the essence of all effective communication. This poster will discuss the application of these principles to scientific communication, and offer practical advice to instructors wishing to bolster their students′ communication skills.

Human Nutrition Study of Blood Lipids Supports Experiential Learning in Undergraduate Class.
A.J. Wright, University of Guelph, Guelph, ON, Canada

The Nutritional and Nutraceutical Sciences (NANS) B.Sc. Major at the University of Guelph is concerned with understanding how food and natural health product (NHP) consumption contributes to growth, biological function, health maintenance and disease treatment. Senior NANS students take NUTR*4330 (Applied Nutritional and Nutraceutical Sciences – II) which has the main course objective to provide students with valuable learning opportunities surrounding the human testing of foods & NHPs. The unique curriculum includes a clinical trial project in which students are invited to volunteer as study participants. The study relates to the influence of fish oil and soluble fiber consumption on blood lipids, as risk factors for cardiovascular disease. Throughout the semester, this activity provides a context in which to discuss key concepts associated with human nutrition research, including: ethics, clinical protocols, study design, nutritional biomarkers, data analysis, results′ dissemination and ultimately utilization of the study findings to support the regulatory approval of products. An overview of the clinical trial project and how it is integrated with lectures and assignments to support the course learning objectives will be provided.

How to Teach Biochemistry to Undergraduate Engineering Students.
Douglas G. Hayes, University of Tennessee, Knoxville, TN, USA

Biochemistry is an important core topic for undergraduate biological engineers. Yet, the approach typically employed by chemistry departments does not serve biological engineers well due to the overemphasis on memorization. This poster will highlight BsE 231, "Biochemistry for Engineers", a course designed to teach biochemistry in a manner which minimizes the extent of memorization needed and emphasizes the application of biochemistry for solving problems. The course replaces the second semester of Freshman Chemistry. Topics covered in the course consist of acid / base chemistry, bioorganic chemistry, amino acids / proteins / enzymes and their reactions, stereochemistry / saccharides / biomass and bioenergy, metabolism, and DNA / RNA. The course employs reading assignments from several different sources, employs meticulously prepared lecture notes, and makes use of in-class group problems to enhance comprehension. For each of the abovementioned six topical units, a study guide is prepared which lists specific reading assignments, memorization and non-memorization objectives, and application-oriented homework problems. The use of spreadsheeting for problem-solving is emphasized.

Teaching Lipid Processing Techniques to Undergraduate Students through Research Opportunities.
Silvana Martini, Utah State University, Logan, UT, USA

Undergraduate research can be used as a tool to introduce students to commonly used lipid technologies. The involvement of undergraduates in lipid research them exercise common sense and independent thinking and obtain training and experience in the use of commonly used techniques and instrumentation. During undergraduate research opportunities, students get exposed to the scientific method and learn how to manage a project from the experimental design to the data interpretation and reporting. Financial support for undergraduate research from academic institutions is an important plus to this experience. Small undergraduate research grants can be provided to the students which allow them to take "ownership" of this research. Regional meetings that allow students to share the findings of their research are also an activity that students find very motivating. These activities initiate undergraduate students in the scientific world and allow them to understand the importance of clear dissemination of their research. The use of undergraduate research to train students in the use of common techniques used in lipid processing has been used in my laboratory for the last 6 years. It is a pleasure to observe the commitment and responsibility developed by the students to their projects and to see them grow from a professional point of view. This poster will present the infrastructure available at Utah State University to perform undergraduate research and how these opportunities have been used to train students in lipid research. Some of the outcomes from undergraduate researchers will be also presented.

Beyond the Classroom: Lipid and Lipid Quality Education.
Usha Thiyam Hollander, James Friel, University of Manitoba, Winnipeg, Manitoba, Canada

Through my experience of teaching at the Department of Human Nutritional Sciences graduate and undergraduate courses at the University of Manitoba, more specifically HNSC 3260 - Food Quality Evaluation and HNSC 7500 Lipid Chemistry, which is concerned with understanding how food quality example lipid quality contributes will be

discussed. How such issues are interpreted by students in the first place in this savvy social network era will be discussed. The classroom lectures were further enhanced by Industry tours/visits. Beyond the classroom how fats and oils are interpreted by students apart from their perception of rancidity was openly discussed during industry visits and the class following this. Some reflections of interest will be shared. One of the objectives of the courses mentioned above is to provide students with valuable learning opportunities surrounding the interpretation of lipid and lipid consumption, quality beyond the classroom through tours to food industry and discussions using lipid ingredients. This poster will discuss the interpretation of lipids and lipid quality testing beyond the classroom and discussions on how to enhance the students′ understanding.

Teaching Genetic Control of Soybean Fatty Acid Synthesis Through Hands-On Experience with Applied Plant Breeding, DNA Selections, and Near Infra-Red and Gas Chromatography Analyses.

V. Pantalone, E. Meyer, D. Landau-Ellis, University of Tennessee, Knoxville, Tennessee, USA

Understanding synthesis of fatty acids is difficult because of the many enzymes involved in the lipid pathway. By focusing on the five predominant fatty acids of soybean (C16:0, C18:0, C18:1, C18:2, and C18:3), students gain an appreciation of lipid synthesis. Our goal is to apply knowledge learned to create new genetic lines of soybean that have practical importance for the oilseed industry. This includes, for example, low linolenic soybeans for reduced or zero trans-fat food products and higher oleic acid soybeans for improved oxidative stability in food products. Quantitative trait loci (QTL) analysis is used to detect genomic regions governing fatty acid synthesis. Students engage in hands-on learning through managing a population of soybean lines in the field and evaluating relationships between DNA markers and measured fatty acids in the laboratory. Students obtain approximations of fatty acid content through near infra-red analyses of whole or ground seeds. After extracting seed oil and creating methyl esters, they get more precise values of fatty acid composition through gas chromatography. Specific genes are discovered by scientists, and single nucleotide polymorphisms (SNPs) are often identified by our colleagues. We apply those new tools for marker assisted selection (MAS) in order to accelerate progress.

Teaching Rheology with Chocolate.

M. Warren[1], A. Lechter[2], R. Hartel[1], [1]University of Wisconsin, Madison, WI, USA, [2]ADM Cocoa, Milwaukee, WI, USA

The concepts of fluid flow and mechanical properties can be taught using chocolate as an example. Melted chocolate provides an interesting (and edible) example of complex rheological behavior, with different properties needed for chocolates of different applications. Solidified chocolate gives an opportunity to demonstrate mechanical properties of semi-solid materials.

Biofuels Instruction Strategies: Pilot Plant and the Role of Accessible Recorded Materials.

Y.Y. Shim, M. Reaney, Department of Plant Sciences, University of Saskatchewan, Saskatoon, SK, Canada

Successful undergraduate and graduate food science students studying in universities will fill the needs of industry, government and academia. Current students are diverse and come from a wide range of linguistic backgrounds that can create challenges and opportunities for their instructors. In a three credit course taught at a fourth year undergraduate level over six years a number of teaching innovations were introduced. Initially all lectures were recorded with a DVD camera and made available on the university streaming server. Student attendance in all classes remained high even when lectures were provided in an electronic format. In 2010−11 the lectures were recorded using iShowU HD software. This software allows the user to record high-quality video screen captures with audio and improved picture quality of lecture slides. Students, especially those for whom English was a second language, reported using the videos for study purposes. Tracking software revealed heavy use of online resources before each exam. The typical file size of a DVD recording of a 50-minute lecture and a viewable iShowU HD video (403 ± 85 MB) were similar. The University of Saskatchewan has a Bioprocessing Pilot Plant available to provide examples of equipment used in industrial processes. Students were taught topics related to major classes of biofuels in both a classroom setting and in a pilot plant. Focus areas of instruction included: 1) fermentation of carbohydrates to ethanol, 2) ethanol recovery by distillation, 3) oilseed extraction 4) biodiesel production, 5) biodiesel refining, 6) cellulosic biomass products, 7) production of pyrolysis oils, char and syngas from biomass, 8) polysaccharide hydrolysis, 9) oilseed co-product

utilization, 10) fermentation co-product utilization 11) biomass drying. The students favorably received the combination of online access to lecture materials and experience in the pilot plant facility.