2013 Annual Meeting Abstracts

Processing

MONDAY

AFTERNOON

PRO 1: New Technology/Sustainability
Chair(s): B. Gursky, Oil-Dri Corporation, USA; T. Hitchman, DSM Food Specialties, USA

The Biotechnology Revolution in Fats & Oils

C. Dayton[(1)]
[(1)]Bunge, United States of America

Not unlike the Industrial Revolution where changes in agriculture, manufacturing, and transportation had a profound effect; the utilization of enzymes for extraction, purification, and modification of fats, oils, and other lipids have transformed the processing and manufacturing of lipids while dramatically reducing the energy, chemical, and water demands compared to the ?traditional? chemical methods. At the beginning of the 21st century, only a handful of industrial installations utilized enzymes for phospholipid removal or lipid modification. In 2012, over 75 industrial facilities had implemented degumming, interesterification, synthesis and modification, and/or biodiesel operations utilizing enzymes as processing aids. Additionally, a number of publications have been published describing the use of enzymes in the preparation, extraction, and other techniques in lipid chemistry. This presentation will not focus on genetically modified crops or foods, but on the specific chemistries utilized to selectively purify, modify, and transform fats and oils using enzymatic processing aids in feed, food, and/or biofuels.

Recent Developments in Enzymatic Degumming

T. Hitchman[(1)]
[(1)]DSM Food Specialties, United States of America

The use of enzymes for degumming of vegetable oils is now an established process option for many oilseed processing plants. The benefits of an enzyme-based process compared to traditional process have been well documented. Higher oil yields are the economic driver for adopting enzymatic degumming. Validation by major oilseed processors that the enzyme-treated oil exceeds standard quality specifications reduces the perception of risk. The ability for an enzyme to create oil suitable for physical refining provides a strategic incentive, and can be applied in the production of edible oil or biodiesel.

Enzymatic degumming for food and technical applications

L. Hua[(1)], D. Lima[(2)], F. Galina[(3)], A. Shevchenko[(4)], b. sarup[(5)]

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Degumming is the step to remove phospholipids because they lead brown discolouration of oil after heating in subsequently refining steps and accelerate oxidative degradation of oil. However, phospholipids are emulsifiers which cause oil losses during traditional degumming process. Enzymatic degumming, already validated on an industrial scale, is an alternative degumming route that addresses the yield-loss issue. Phopholipase A (PLA) reacts specifically with phospholipids in oil, forming lysophospholipids that are poor emulsifiers and entrain much less neutral oil. Purifine? phospholipase C (PLC) converts phospholipids into diacylglycerols (DAG) and a water-soluble phosphate-bearing ester fragment. The DAG produced by Purifine PLC degumming is a bonus oil yield that is retained throughout the refining process. Alfa Laval has delivered more than 10 enzymatic degumming plants worldwide for either food or technical applications. In this presentation, the performance of enzymatic degumming process on phospholipids removal and oil yield improvement is reviewed.

Improving the sustainability of vegetable oil production by applying enzymatic processing

D. Cowan[(1)]
[(1)]Novozymes, United Kingdom (Great Britain)

Sustainable production does not mean that we have to reduce growth but rather that we should strive to find better ways to make more with less. Reducing losses, improving raw material utilisation and looking for alternatives can all go towards a more sustainable process. This presentation examines some of the improvements that can be made in sustainability, highlighting the simple steps that can be used to improve and document it. It will focus on both food and non-food uses of vegetable oils.

Ice Condensing in Edible Oil Processing: More than Only Reducing Effluent and Energy

M. Kellens[(1)]
[(1)]Desmet Ballestra Group, Belgium

The need for milder refining methods to purify heat sensitive oils like fish oil without damaging the fatty acid structures or nutritionally valuable minor components, or to avoid unwanted reactions like formation of glycidyl esters in for example palm oil, are challenging technology providers to look for new technical reliable and cost efficient solutions. The ice condensing technology has been introduced in the edible oil refining industry since the early 90?s. Its initial purpose was to reduce the environmental impact of a refinery, i.e. to produce less effluent and odour. Since then, the technology has become state of the art in a modern edible oil refinery, because it has proven to be also far more economical than classical barometric vacuum systems. With the increasing electricity and steam costs, the use of ice condensing systems has become a true economical choice. Although the technology is not cheap, with a return of investment of typically less than 4 years, today one should not look to when such an investment is paid back, but rather to what such a system can bring in savings over the whole life span of a refinery. Ice condensing systems today maintain easily low pressures in deodorizers, typically below 2 mbar, by the condensation and freezing of sparge steam from the deodorisation process on internally cooled tubes. To avoid problems in fouling of these ice condensers, the amount of fatty matter accepted in these vapours is rather limited, hence a prescrubbing of the vapours to remove the main

Micronutrient Recovery and Enrichment of Deodorizer Destillates

B. Sarup[(1)], A. Hukkerikar[(2)], D. Lima[(3)], L. Cunico[(4)], R. Gani[(5)], R. Ceriani[(6)]
[(1)]Alfa Laval Copenhagen A/S, Denmark [(2)]Technical Univ. Denmark, Denmark [(3)]Alfa Laval Ldta, Brazil [(4)]Technical University of Denmark, Denmark [(5)]Technical University of Denmark, Denmark [(6)]University of Campinas, Brazil

Deodorizer destillates contain a number of components such as tocopherols, tocotrienols, sterols and squalene, often referred to as micronutrients. When feasible, such micronutrients are taken to dedicated processing facilities for multiple separation operations to isolate and transform individual micronutrients into marketable products. However, in many cases the concentration of micronutrients in the destillates is too low to merit transport to and treatment in such processing locations. The increasingly widespread use of enzymes for degumming for physical refining aggravates the situation either by further dilution through more free fatty acids and/or more diacylglycerides with vapour pressures close to the micronutrients. Further insights into micronutrient recovery and enrichment in refining plant are therefore of considerable interest. Recent advances in modelling of lipid processing open for more detailed process design and optimization studies. Such advances will be briefly reviewed. The main focus of this work is tocopherol recovery and enrichment and falls in two parts, one being field data obtained from steam stripping column operating as a biodiesel pre-treatment unit and the modelling of those data. The second part of the work reports the outcome of a systematic study of steam stripping column configurations for soybean oil. The study includes processing scenarios of chemical and physical refining, as well as biodiesel pre-treatment. Conclusions include description of trade-offs between tocopherol recovery and enrichment in a number of design and operating scenarios.

Hydrotreating Practices for Green Diesel Production

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[(1)]Air Products, United States of America [(2)]Air Products, Inc., United States of America [(3)]Air Products, Inc., United States of America [(4)]Farr Technologies, United States of America

Production of renewable fuels from biomass has been growing steadily over the last decade due to depletion of petroleum reserves, government incentives, and environmental concerns like global warming. Various hydrotreating technologies have been developed in recent years for converting biomass like edible and non-edible vegetable oils into biodiesel and green diesel with chemical properties similar to or better than that of petroleum derived diesel. They are being commercialized as true drop-in fuels for diesel combustion engines. In this presentation we shall discuss hydrotreating technologies that are currently being used for producing biodiesel and renewable diesel from vegetable oils and compare properties of biodiesel and renewable diesel with petroleum derived diesel. We shall also discuss different hydrogen technologies and examples of their efficient usage for the production of biodiesel and renewable diesel.

Nano Neutralization?A Technology Step-Change in Edible Oil Processing through Chemical Economy and Yield Improvement

C. Mitchell[(1)]
[(1)]Desmet Ballestra, United States of America

Resource stewardship as well as competitive considerations have been, and continue to be, of primary concern to edible oil processors. By harnessing the phenomenon of hydrodynamic cavitation, processors are able to benefit from an industrially proven process to both increase yield as well as reduce required chemical consumption in the refinery. The increase in oil yield also gives the corresponding benefit of reduced co-product generation, soapstock, which in

many cases can be a costly or undesirable to handle. Latest operational data will be presented to give processors an indication of expected process performance.

Reducing Waste Water in a Solvent Extraction Plant

M. Ducharme[(1)]
[(1)]Crown Iron Works Company, United States of America

The Crown Zero Effluent Discharge system (ZED) is designed to eliminate waste water from your extraction plant. The waste water is concentrated in specially designed pressure vessels and converted to 40 psig steam for 100% reuse in the extraction plant. Blow down water from other plant sources (ex. cooling tower) can also be added for further savings. Not only will you be able to save on waste water treatment costs, but this system also lessens the need for boiler chemical treatment.

TUESDAY

MORNING

PRO 2/PCP 2.1: Hexane-Free Oil Extraction (Green Extraction)
Chair(s): F. Temelli, University of Alberta, Canada; D. Balke, BioExx Specialty Proteins Ltd., Canada

Recent Advances in Enzyme-assisted Aqueous Extraction of Soybeans

L. Johnson[(1)], J. Nobrega de Moura[(2)], T. Wang[(3)], S. Jung[(4)]
[(1)]Iowa State University, United States of America [(2)]Iowa State University, United States of America [(3)]Iowa State University, United States of America [(4)]Iowa State University, United States of America

Concerns over safety and pollution are driving alternative soybean processing technologies. One such alternative is aqueous extraction. When soybeans are ground in water, a small amount of free oil and a larger amount of oil-rich cream float on a protein- and sugar-rich solution (soy skim) retaining small amounts of emulsified oil. The fiber settles out. After centrifuging, 45% of the oil is recovered as a stable cream emulsion. The skim contains 19% of the oil, most of the sugars and 92% of the protein. Lower oil yields and dilute protein streams unsuitable for feed remain challenges. Many advances have been made including: cracking, dehulling, flaking and expanding to rupture cell walls and pseudomembranes around oil bodies (improves oil extraction to 71%); employing protease to enhance oil extraction (improves oil extracton to 96%); employing two countercurrent extraction stages (improves oil extraction to 99% and protein extraction to 96% while reducing water by 40%); using protease in the second or both stages to produce proteins with different functionalities; breaking the cream emulsion using the same protease as used for extraction; recycling enzyme from cream demulsification into extraction; recovering protein by isoelectric precipitation when using enzyme in the second stage only or by membrane filtration when using enzyme in both stages; and using soy skim to slurry corn for fermentation in a soybean-corn biorefinery. When integrating these advances the process is known as enzyme-assisted aqueous extraction processing and 98% oil extraction, 79% oil recovery and 97% protein recovery are possible.

The Development of a ?Green? Aqueous Enzymatic Process to Extract Corn Oil From Corn Germ

R. Moreau[(1)], D. Johnston[(2)], K. Hicks[(3)]
[(1)]USDA ARS, United States of America [(2)]USDA ARS, United States of America [(3)]USDA ARS, United States of America

We developed an aqueous enzymatic oil extraction process that uses cellulase and it results in oil yields of greater than 90% from wet milled corn germ and from E-germ. We also developed a second process that uses a combination of an acidic cellulase and an alkaline protease and it results in oil yields of 50-70% from dry milled or dry fractionate corn germ. Experimentation is underway to increase these oil yields. Both processes do not involve the use of hexane or any other organic solvents. Today, more than half of the ~200 dry grind ethanol plants in the US are removing oil (for use as a biofuels and/or animal feed ingredient) after fermentation and distillation at the ?back end? of the plant. Removal of corn germ at the ?front end? of dry grind ethanol plants and extraction of the oil using an aqueous enzymatic oil extraction process could potentially result in higher oil yields and higher value oil.

Review of the current status of enzymatic aqueous extraction processing in China

X. Sui[(1)], Y. Li[(2)], L. Jiang[(3)]
[(1)]Northeast Agricultural University, Singapore [(2)]Northeast Agricultural University, China [(3)]Northeast Agricultural University, China

Commercial oils today are mainly extracted using organic solvents, however, the organic solvents have environmental and safety problems, and, due to the increased awareness of safety and environmental issues, it is possible to develop alternative methods to organic solvent extraction. The enzymatic aqueous extraction processing (EAEP) method as an alternative approach to the conventional organic solvent extraction method has been widely applied to extract oil from several seeds. In China, numerous studies were carried out aimed to extract oil from several varieties of seeds using EAEP method, such as perilla seed, hemp seed, tea seed, hazelnut seed, etc.; and studies aimed to de-emulsify the cream layer from EAEP, thereby improving the oil extraction yield. So on and so forth, the EAEP method gets faster development in China. This review summarized the current status of EAEP method in China.

Recovery of oil and saponin from Camellia oleifera seeds by aqueous enzymatic extraction

Y. Wang[(1)], X. Luan[(2)]
[(1)]Academy of State Administration of Grain, China [(2)]Acedemy of State Administration of Grain, China

Camellia oleifera is native to China and its seeds have high contents of oil rich in oleic acid and many natural antioxidants with various biological activities and contain saponin. Aqueous enzymatic extraction (AEE) is a safe and efficient vegetable-oil extraction process that may also result in value-added by-product. In this research, the chemical characteristics of Camellia oleifera seed kernel were determinided in order to design and evaluate studies on aqueous enzymatic extraction oil and saccharicterpenin from the kernels. The pretreatment of the materials and the effectiveness of a number of cellular degrading enzymes were tested by treating meals of the kernels with one or more of these enzymes and comparing the yields of free oil and saccharicterpenin. And the best enzyme was selected with higher oil yield and non emulsion layer in the processing chart. Through the single factor experiment and optimization experiment, the optimum technological conditions are determined and the free oil and thea saponin yields were 89.17% and 81.20%. The liquid phase containing saponin and carbohydrate were recycled by ceramic membrane and can act as feed additive saccharicterpenin.

Developing Sustainable Oilseed Extraction Using Extended-Surfactants

L. Do[(1)], D. Sabatini[(2)]
[(1)]University of Oklahoma, United States of America [(2)]University of Oklahoma, United States of America

The vegetable oil extraction industry is the primary contributor of volatile organic compound emissions in the food industry in the U.S. The annual hexane loss in the soybean oil extraction process could be as high as 210 ? 430 million liters. There are growing health concerns and increased environmental regulations regarding the use of hexane in vegetable oil extraction. The U.S. Environmental Protection Agency (EPA) established regulations on hexane emission due to growing environmental concerns. There is a pressing need for more sustainable extraction method as an alternative to hexane. This presentation will give an overview of existing alternative oilseed extraction technologies and discuss the advantages and disadvantages of these methods. We will next present our pioneering research work on aqueous-surfactant-based extraction method for oilseed extraction. With the advancement in the surfactant science, a novel class of surfactant, so-called extended-surfactant, which has an intermediate polarity groups inserted between the head and tail of a surfactant molecule, is able to produce ultralow interfacial tension with a wide range of vegetable oils at ambient temperature within a reasonable time frame. At optimum extraction conditions, we achieved more than 90% extraction efficiency for peanut and canola oils at 25oC in both batch and semi-pilot scale study using desirable operating conditions. The oil quality produced from the aqueous extended-surfactant based method was found to be comparable or even superior to that obtained from hexane-based extraction, further demonstrating the viability and sustainability of aqueous extended-surfactant based extraction.

Isopropyl Alcohol Extraction of De-hulled Yellow Mustard Flour

S. Sinichi[(1)], L. Diosady[(2)]
[(1)]Univeristy of Toronto, Canada [(2)]University of Toronto, Canada

S. Sinichi[(1)], L. Diosady[(2)]
[(1)]Univeristy of Toronto, Canada [(2)]University of Toronto, Canada

Fossil fuels represent a significant source of worldwide energy consumption. The search for alternative sources of energy is a necessity. Vegetable oils which have an energetic content close to fossil fuels are an example of a renewable and potentially inexhaustible source of energy. An annual production of almost 160,000 tonnes of mustard (2008) makes Canada the world?s largest exporter of mustard seed. Mustard seed oil contains erucic acid which is known to contribute to certain heart conditions such as myocardial lipidosis. As a result, in Europe and North America mustard oil is banned for human consumption. It is also known that the presence of erucic acid in mustard seed oil is responsible for its high lubricity, a positive property of bio-fuels. As a result mustard seed is a good candidate for production of biodiesel. Investigation of oil recovery from de-hulled yellow mustard flour using isopropyl alcohol (IPA), as the solvent, has been performed. This investigation helps current understanding of IPA extracted mustard oil composition which affects the transesterification process for biodiesel production. IPA is a polar solvent therefore some non-acylglycerol material may also be extracted along with the oil, such as phosphorus, water, carbohydrates and protein. The composition of the miscella (IPA+Oil) and meal residue resulted from extraction has been determined. In addition to oil, IPA was shown to have significant affinity towards water and some affinity to carbohydrates. The effect of water content of the IPA on the components dissolved in the solvent was further investigated.

Ultrahigh Pressure Supercritical Fluid Extraction ? Déjà Vu

J. King[(1)], G. List[(2)]
(1) *(2)*

Genesis-Engineering Research Center, United States of America Retired, Consultant, United States of America

Recent research and development activity in supercritical fluid extraction (SFE) has seen the increase use of extraction pressures above 700 bar, thereby resulting in extracts that are more representative of the botanical source matrix and having critical constituents showing bioactive properties and health benefits. By conducting extractions up to 1000 bar in pressure with CO2, the enhanced extraction of more difficult to extract components having higher cohesive energies, polarity and molecular weights is realized, resulting in a superior product containing ingredients up to twenty-fold higher in concentration relative to those obtained at much lower pressures. By optimizing the size of the extraction vessels in the pilot or production plant, costs for such plants become comparable to those operating at lower extraction pressures. These ?new? results will be compared with unpublished studies of Friedrich and colleagues at the USDA involving SFE over the pressure range of 650-1025 bar in which vegetable oil and natural product extracts exhibiting different tinctorial properties were obtained. The physicochemical basis of the resultant extracts will be rationalized by comparing the reduced density and solubility parameters of SC-CO2 with those solutes undergoing extraction enhancement. SFE results will be presented for commodity and specialty seed oils, natural pigments, and some spices. These results as well as more recent data for the enhanced extraction of fatty acids, sterols, vitamins, and pigments from seed oils and cakes, algae, as well as other botanicals will be used to illustrate the value of this approach.

Supercritical Carbon Dioxide Technology as Part of a Biorefinery: A case for the Processing of Distillers Grains

O. Ciftci[(1)], F. Temelli[(2)]
[(1)]University of Alberta, Canada [(2)]University of Alberta, Canada

Supercritical carbon dioxide (SC-CO2) technology has been established as an efficient and ?green? technology for the extraction of lipids from a variety of natural materials. To take full advantage of the benefits of SC-CO2, incorporation of SC-CO2-based operations into a biorefinery shows great potential to maximize utilization of biomass resources, targeting both food and industrial products. A case study will be presented to demonstrate that SC-CO2 can be used not only for the extraction of lipids from dried distillers? grains with solubles (DDGS), but also for the continuous bioconversion of the extracted lipids to fatty acid methyl esters (FAME) to be used as biodiesel in two integrated operations. DDGS was a good inexpensive source of lipids and valuable minor lipid components such as carotenoids, tocols and phytosterols. SC-CO2-extracted DDGS lipids were converted into FAME in a continuous SC-CO2 bioreactor using immobilized lipase. Supercritical process yielded FAME up to 95%, and it did not have any inhibitory effect on the immobilized enzyme. Continuous bioconversion of DDGS lipids to FAME in SC-CO2 is a simple, efficient and ?green? alternative to the conventional processes. Such an integrated supercritical approach to lipids processing, avoiding the use of organic solvents, fits well into larger biorefineries.

AFTERNOON

PRO 3: Plant Operations/Safety/Food Safety
Chair(s): V. Jain, Bunge, USA; R. Sidoo, Richardson Oilseed Ltd., Canada

The Influence of oil Composition, Acidity and nhp Content on the Efficiency of Enzymatic Degumming

D. Cowan[(1)]
[(1)]Novozymes, United Kingdom (Great Britain)

Enzymatic degumming has been implemented at many plants worldwide and is generally a robust process. However, the quality of the oil presented for degumming can vary according to location, climate and storage conditions of the seeds as well as the type of crop used. The main benefit of enzymatic degumming is yield increase and for this to be maximised, control of the degumming parametrs is essential. This paper reports research on the factors controlling the efficiency of enzymatic degumming and how the process can be adjusted to take account of oil quality variations. In addition, steps which can be taken to maximise yield while reducing chemicals consumption to improve sustainability will be reported.

Energy Optimization in Fatty Acid Distillation

D. Gaige[(1)]
[(1)]Process Plus, United States of America

When processing commercial fatty acids, the distillation of the product is very energy intensive. While standard economizations schemes recover a portion of this energy to preheat the feed to the stills, a major portion of the energy, that present in the condensing of the fatty acids, is removed at relatively low temperatures. This reduces the value of economizing in the system. A method of more effectively using the latent heat energy at the highest possible temperatures using stagewise condensation to recover this energy was investigated to reduce the overall energy requirements of this distillation. The typical fatty acid distillation scheme, where the feed is preheated via economization uses approximately 562 BTU of steam per pound of product. The process being presented here uses a stagewise condensation scheme. By condensing in stages, a majority of the product can be condensed at elevated temperatures. This allows the generation of a significant amount of medium pressure (100 psig) and low pressure (15 psig) steam which is then used as to supply the vacuum systems and column stripping steam in the distillations. By more effectively utilizing the condenser heat load via multiple partial condensations, the overall steam usage is reduced to 381 BTU of steam per pound of product.

Cost Reductions and Schedule Improvments Through Project pre Planning

D. Smith[(1)]
[(1)]Industrial Design Group, United States of America

Large capital projects must be well planned and evaluated in order to assure that the end product meets the intended commercial requirements, is within the required budget and can be completed within the required time frame. When a project is not completely vetted, the following problems can occur: ? The return from a project is small compared to the project cost resulting in a project that has a return that does not justify the expenditure. ? The approval of a project is based on an inaccurate estimate. The project would not have been approved if the true costs had been known. ? A project is approved based on a rough time estimate. This results in a project that results in poor budget control and an unpredictable schedule. There is a way to avoid these types of mistakes. This is through the implementation of a Phased & Gated approach to project development and review. Using this stepped approach, the project is approved in three phases. Whenever one phase is completed, the project development is stopped and a review is conducted by the entire project team. This is called a gate. Once the project has progressed through three phases and passed through the third gate, the team then submits the project for management review, knowing the cost estimate is within 10%, has a good commercial/project scope, and knows the time needed to complete the project. This presentation is a review of the Phased & Gated project development process as outlined by the Construction Industry Institute.

Odour reduction in canola processing using Biofilter technology

M. Hunter[(1)]
[(1)]Riverland Oilseeds, Australia

The use of Biofilters to treat odour emissions from a vegetable oil processing plant is relatively new for the industry. Additionally each site has its own challenges specific to the nature of its operations, volumes and concentrations of its air emissions. In determining the best solution to reduce odorous concentrations at site boundaries, a range of potential solutions are available including chemical scrubbing, extension of stack heights, incineration , enzymes and activated carbon. Each of these need to be assessed in regards to economics, environmentally sustainability as well as some safety factors. This presentation discusses odour concentration and odour destruction efficiencies achieved through Biofiltration, design issues associated with odour collection along with operational considerations. Biofiltration uses a bed of organic matter without chemicals to break down ?offensive? odours The combination of modifications to existing equipment and processes to suit Biofilter operation whilst taking into account the safety factors for operation of a mechanical pressing, chemical extraction and refining plants enabled Riverland Oilseeds to meet the Environment Protection Authorities objectives regarding offensive odours and dramatically improved relations with the local community.

Improvement in Oilseed Extraction: Evaluation of Several Bio-solvents

F. Fine[(1)], X. Pages[(2)], P. Carre[(3)], A. Fabiano-Tixier[(4)], M. Vian[(5)], F. Chemat[(6)]
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Oils represent an important part in human diet and contain essential nutriments. Consumers are more and more swayed by the argument of product origin. As for industries, they understood it?s not possible anymore to produce without thinking about the environment. This study deals with the use of bio-solvents to substitute hexane which the most widely used solvent in oilseed extraction. Indeed, hexane presents numerous drawbacks like high flammability, dangerousness for health and environment and a non-renewable origin. Its use in the field of extraction is discussed since the 80s with a renewed intensity since the 00s. The potential of alternative solvents (ethanol, isopropanol) and bio-solvents (limonene, ?-pinene and p-cymene) was evaluated. Extraction yields and oil compositions were especially studied.

Advanced Reactor Designs for Continuous Oil Crystallization and Enzymatic Interesterification

G. Calliauw[(1)]
[(1)]Desmet Ballestra, Belgium

Like all edible oil processing technologies, oil modification is continuously reconceived and improved in order to economize without giving in on performance and reliability. While some of these typical 20th century technologies are in decline because of nutritional reasons or environmental costs, other modification technologies are steadily gaining ground. Generally, these contemporary processes have in common their greener image because of their safer, more sustainable and efficient way of operation. Two developments in those state-of-the-art technologies serve as examples: Continuous fractionationof edible oil is not a technological novelty, but the recent introduction of an advanced crystallizer design has enabled fractionation plants to work in an entirely continuous fashion without the typical drawbacks of fouling, product variability or cross contamination. In combination with a smart integration in the plant,

the industrially proven advantages are numerous: increased throughput, increased yield, and not in the least, energy consumption (steam and electricity) can be reduced by a whopping 30-40%. Enzymatic interesterification is getting also more and more applied in the edible oil industry. This type of technology has vast advantages over the classic interesterification via alkali-based catalysts. As the cost of enzyme has a major impact on the overall operation cost of enzymatic interesterification, maintaining the productivity (total expected turnover) and activity (expected turnover rate) is of utmost importance to make this process viable from an economic point of view. The presentation therefore will map out the improved reactor designs developed to meet these expectations.

Plant Safety

C. Coffey[(1)]
[(1)]Ag Processing Inc., United States of America

The safety of all employees should be a priority for management staff. This session presents strategies to improve employee safety at the plant level.

Food Safety - a new dimension in plant safety

D. Strayer[(1)]
[(1)]Bunge North America, United States of America

With the passage of the Food Safety Modernization Act (FSMA) and the first proposed regulation on Preventative Controls, the food safety concerns in a plant facility are now elevated to the level of personnel safety concerns. The traditionally process of reviewing the personal safety equipment and a plant?s safety requirements before entering a production area must now also be supplemented with an education of the food safety requirements. The individual is now charged with following and obeying all the company?s safety provision, both personnel and food safety. The FSMA law gives the FDA new responsibility and authority as well as directing them to write and implement fifty new regulations and guidances covering many aspect of the manufacturing process. This paper will review the proposed regulations of Preventive Controls which was published earlier this year and the implications for the Fat & Oils processor.

NFPA36 ? Update on the 2013 Edition

R. Barton[(1)]
[(1)]N Hunt Moore & Associates, Inc, United States of America

Whereas NFPA36 is non-governmental document produced by an US professional association, its acceptance by industry and governmental units around the world has established this standard as the primary tool for design of fire prevention and operational guidelines in solvent extraction plants. The 2013 Edition includes several revisions which will impact future plant design and operation. This presentation will cover these revisions and offer an opportunity for discussion.

WEDNESDAY

MORNING

PRO 4/EXH 2: Exhibitor Session
Chair(s): F. Skold, Solex Thermal Science Inc., Canada; T. Neuman, GEA Mechanical Equipment US Inc., USA

Thermal Efficiency Optimisation for Preheater and Conditioner in Oilseed Crush Plants

F. Skold[(1)]
[(1)]Solex Thermal Science, Canada

Plant operators that use recycled energy, or heat recovered from various operations in the plant as hot water or condensate need to design the heat recovery loop with many factors in mind, optimisation of energy recovery , capital and installed cost of equipment, maintenence costs etc. The receovered energy is typically used in the preheater in the preparation plant, hence the design and operation of the pre hetaer needs close analysis . The paper covers various scenarios and combinations for use of Hot water , condensate and steam and addresses key items to be considered.

Generating True 3d Process Facility Representation by Adopting Advanced Laser Scanning Technology.

M. Williamson[(1)]
[(1)]ADF Engineering, Inc, United States of America

Traditional 3D computer modeling has been successfully used for project development and masterplanning in existing manufacturing facilities. However, it has been limited to large capital projects or applied to very minimal areas due to the cost and complexity of developing sufficient dimensional accuracy. This has been true especially for food processing and pharmaceutical facilities where complex piping, limited budgets and clean area personnel access constrain this development. Yet similar facilities which have highly accurate 3D models of the existing equipment and piping arrangements are in a better position to comply with the upcoming requirements of the Food Safety Modernization Act (FSMA). Breakthrough laser scanning technology is now practical for both old and new facilities to develop comprehensive and precise CAD-based 3D models of their processing areas by converting point cloud data. How can this remarkable new tool be applied to prepare for upcoming food safety regulations? How can detailed 3D modeling be used for documentation, incident investigation and capital upgrade planning? This emerging technology has already been proven in numerous processing facilities.

New Innovations in oil Seed Prepartion

C. Brockmeyer[(1)]
[(1)]Buhler Inc., United States of America

Kubex T Pelletmill of the future OLFB New generation Flaker DFZK Energy saving hammermill

Latest Approach for Recovery of Tocopherols during Deodorization

C. Mitchell[(1)]
[(1)]Desmet Ballestra, United States of America

To be submitted.

Harnessing Filtered Light Waves to Identify Measured Change for In-line Process Control

T. Schwalbach[(1)]
[(1)]Optek Inc., United States of America

Real-time measurement of colors like Chlorophyll, AOCS/Lovibond Red, ICUMSA, Suspended Solids Soap Stock, Condensate Contamination, Fermentation, oil in water and water in oil, and Dissolved Solids.

A field perspective on best practices around enzymatic degumming in today's crushing & refining operations

S. Gregory[(1)]
[(1)]DSM, United States of America

Still to be provided

BASF Catalysts for Biorenewables

A. Thornton[(1)]
[(1)]BASF Corporation, United States of America

The development of fuels and chemicals based on biological feedstocks is critical to a sustainable future, and BASF is proud to provide the catalysts to support this growing industry. BASF has established itself as a frontrunner in this field by offering high quality sodium methylate, the homogeneous catalyst used for biodiesel production. In addition to biodiesel, BASF also offers a suite of heterogeneous catalysts and adsorbents that can be used to convert a range of biorenewable feedstocks into valuable fuels and chemicals. Catalysts and adsorbents for the production of biofuels as well as catalysts for bio-based chemicals will be presented.

The Reflex Extractor, benefits and recent innovations

A. Subieta[(1)]
[(1)]Desmet Ballestra North America, Inc., United States of America

In addition to low residual oil in meal and high throughput, a recent innovation in the Reflex extractor reduces the content of hexane in the meal.

New challenges in seed processing and crude oil refining

H. Boeck[(1)]
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New seed varieties as well as new market requirements for press oil and protein meal present new processing challenges. Improved analytical accuracy together with increased health awareness put special focus on crude oil refining techniques and final product qualities. Understanding the correlation of process parameters and quality is essential in order to design the process and the equipment to meet today's high standards.

Applied Technology For Edible & Inedible Biodiesel Feedstocks

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Biodiesel industry as looked back upon today is generally acknowledged to date back to the early 1990´s. It is however during the last 10 years its real numbers has evolved in regard to global capacity and distribution. As an emerging industry the plethora of technologies and volatile feedstock scene can be difficult to assess for observers and stakeholders. In this presentation we provide a brief outlook to the global biodiesel production situation. Conventional and alternative technology is discussed, both in the field of reaction and purification with an emphasis towards inedible high free fatty acid feedstock. Since the integration of Swedish Ageratec 2010, fats & oils technology household name Alfa Laval can cater for pilot to large scale biodiesel production, from virgin to recycled oils & fats of vegetable and animal origin.

AFTERNOON

PRO 5: General Processing
Chair(s): P. Scott, GEA Mechanical Equipment Canada Inc., Canada; J. Mulholland, N Hunt Moore & Associates Inc., USA

Comparison of Rapeseed Protein Extraction Technologies

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Rapeseed proteins - which are present at about 20 to 25 % of dry seed weight - besides their high nutritional value possess promising functional properties. Therefore, a lot of new higher value applications in human nutrition, animal and particularly fish feeding and for different technical purposes are envisaged. Numerous descriptions of technologies for processing and application of rapeseed proteins are found in the literature. However, there are only few commercial applications. The presence of both, two major protein fractions, napin (albumin) and cruciferin (globulin), and some characteristic secondary plant substances (glucosinolates, sinapic and phytic acid) interacting with the proteins, makes the extraction of rapeseed proteins more difficult than of other plant proteins. The presentation will compare different rapeseed protein extraction and purification technologies, in terms of their effectiveness, resulting product quality and

possible applications.

Production of Canolol by Fluidized bed Roasting and co2 Extraction of Rapeseed Meal

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Rapeseed contains high amounts of phenolic compounds, which mostly remain within the cake or the meal during oilseed processing due to their polar properties. The main fraction of these phenolics is sinapic acid esterified with choline (3,5-dimethoxy-4-hydroxycinnamicacid), the so called sinapine. It has been shown, that during heating of rapeseed 2,6-dimethoxy-4-vinylphenol (vinylsyringol), so called canolol, is formed by decarboxylation of sinapic acid. Canolol is more unpolar leading to a better solubility in oil. Acc. to different authors, canolol exhibits high antioxidative activity as well as antimutagen and anticarcinogen properties, which make it interesting as food or cosmetic additive. One option for canolol recovery consists in thermal treatment of the rapeseed meal followed by extraction of the formed canolol. The advantage is that the established oil mill process has not to be changed, whereas the meal can be valorized. The paper will describe experimental investigations carried out in lab and pilot scale as well as the results.

Performance Evaluation of Zero Waste Technology for Palm Oil Mill in Malaysia

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Rapid growth of palm oil production in Malaysia in these few decades has caused major problems to the environment; namely the large waste effluent discharged into the rivers and methane released from palm oil mill effluent to the atmosphere. This study evaluates the performance of zero waste technology in palm oil mill through management of solid and liquid waste produced at the end of milling process. This technology suggested that total composting of solid waste sprayed with liquid waste in the presence of thermophilic microbes will be able to evaporate all the liquid, thus resulted in zero effluent discharge. Constant monitoring on a new developed mill together with a composting plant has been done, involving important variables such as palm oil production, composting process and nutrient content in compost products. We found that total evaporation of water from the liquid waste and the composting process were successfully achieved during the 12 months continuous monitoring, subjected to a certain limit of palm fruits processing capacity. The nutrient-rich compost product was in excellent condition to be use as a fertilizer in oil palm plantation. While others are making efforts in the advanced treatment of waste effluent, this technology has put itself in a whole different level by eliminating the wastes from palm oil mill. This holistic design of zero waste technology is a promising technology for the palm oil mills especially in the concern of Malaysia?s government towards producing greener and cleaner technology.

Fatty Acids in Emulsion and Free Fatty Acids Through Integrated Processing of Flaxseeds

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Removal of mucilaginous polysaccharides from flaxseeds allow to fractionate all the other coupounds of the seeds by an integrated process. The developed integrated process is a "green way" to concentrate valuable plant molecules. Applied on oleaginous seeds, this process gives especially native lipids in concentrated emulsion. An optional step of processing seeds is an enzymatic lipids hydrolysis. It permit to transform triacylglycerol content in fatty acids. Such fatty acids emulsion obtained after hydrolysis is different of the oil-in-water native emulsion coming from processing seeds without enzymatic hydrolysis step. Flaxseeds are thereby processed after mucilage extraction. Physical treatments in aqueous medium give an homogenized crushed medium. Enzymatic hydrolysis break triacylglycerols into fatty acids and glycerol. Fatty acids are then concentrated in an emulsion during fractionation. Properties and composition of transformed lipids emulsion are compared with other fatty acids emulsions coming from same processing of others oleaginous seeds. Furthermore, free fatty acids can be recovered from emulsion by simple ethanol extraction.

Transformational Technology for Processing Vegetable Oil, Fats, and Biodiesel. Part 1. Neutralization of High Acid Corn Oil

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The objective of this presentation is to describe the successful pilot plant application of a transformational fiber process technology to the neutralization of acid corn oil recovered from ethanol DDGS. Fiber technology (FR) provides continuous, non-dispersive, and static neutralization processes with very low neutral oil loss. Because the FR is non-dispersive, it eliminates mechanical dispersion, long settling times, and centrifuges in vegetable oil refining and biodiesel manufacturing. The heart of the FR consists of thousands of fibers in a pipe. A continuously pumped polar phase is constrained to the fibers and the vegetable oil is pumped between the wetted fibers allowing chemical reactions to occur as oil travels along the wetted fibers. The phases are never dispersed so separation is simple and efficient. The process is very effective at extracting free fatty acids from either crude vegetable oils/fats or oil miscella. This eliminates soap stock and the trapped oil lost by conventional processes. A single pass of acid corn oil through a 2 meter processor recovered all the oil and reduced the FFA by over 99% from 12-15% of the crude acid corn oil to 0.1% in the product oil. Eliminating mixers and centrifuges significantly decreases capital, maintenance, operating costs, and water pollution making the process more sustainable.

Ultrasound-assisted Separation and Recovery of Palm Oil

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High frequency ultrasound (400 ? 2000 kHz) effects on two process streams (containing oil, non-oil solids and water) in palm oil milling were examined. Ultrasound of the ex-screw press feed obtained on pressing the sterilised palm fruit and underflow sludge from the vertical clarification tank enhanced oil separation on gravity settling and total oil recoverable (i.e. oil separated under gravity plus decantable oil on centrifugation of the fraction remaining after removing oil on gravity settling). Increased recovery of oil upon ultrasonication was accompanied by an increased rate of oil separation on gravity settling. Application of high frequency ultrasound generates standing waves which promote de-emulsification. The enhanced separation from process streams was attributed to acoustic forces exerted on suspended particles in the feed by the standing waves which cause the oil to concentrate towards the anti-nodes and non-oil solids (vegetal matter and residual soil) to the nodes of the acoustic wave. This work demonstrated the

potential of applying high frequency ultrasound to improve the separation of oil in the clarification tanks and reduce oil lost in the sludge underflow from the separators. Ultrasound-assisted separation of palm oil presents a step-change innovation in palm oil milling operations which reduces oil loss during milling.

3-mcpd and Glycidyl Esters: Latest Results From the German Fei-project on Mitigation

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In the first German FEI-project, running from 2009 to 2011, different approaches for the mitigation of 3-MCPD and glycidyl esters during the processing of refined oils were identified. The aim of the second German FEI-project is to optimize these strategies for the large scale application and to provide the referring technological fundamentals. Thus the project especially focuses on the effects of the minimization and removal strategies on product shelf-life and physicochemical and sensory quality parameters. The main aspects in this context are to define specific parameters for the quality of the raw material, to describe the optimal conditions of the refining process and the subsequent product treatment. The lecture will present the latest results showing the effect of washing the raw oil, application of auxillary means during deodorisation, two-step deodorisation and short path distillation on the formation of 3-MCPD and glycidyl esters as well as the different quality parameters of the refined oil. Additionally some results from a model oil showing the effect of precursors on the formation of the esters are given.

Enzymatic Fish Oil Refining ? Three Steps Towards Maximizing Yields and Minimizing Environmental Impact

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Essential omega-3 fatty acids are important dietary supplements for humans. Efficient utilization of marine raw materials and reduced consumption of chemicals and energy are two of the driving factors for innovation in this field. This work will present three enzymatic processing steps that will help to meet these demands. Treating crude fish oil with lipase under vacuum can reduce FFA from 5% to 1% or lower. This will greatly reduce the alkali and water needed for neutralization and more important increase oil yields as the soap fraction and associated neutral oil loss will be much smaller. Similarly the use of strong base or harsh metal alcoxide catalysts in fish oil ethylation can be replaced by an enzymatic process. 93% ethyl esters can be reached using lipase and 1,33 eq. of EtOH. The mild processing conditions help to protect the omega-3 fatty acids and prevent degradation of other sensitive compounds in the oil. The enzymatic process also gives a superior quality glycerol side product without color and salts. The market for Omega-3 products is shifting from ethyl esters to triglycerides. Enzymatic stirred batch and fixed bed processes have been developed for fatty acid/ethyl ester and glycerol condensation to produce high Omega-3 TAG. Both are currently in operation around the world with yields up to 80% TAG and reuse of the enzyme for 20-60 consecutive cycles. Helping fish oil producers move towards greener technology will help to maximize the utilization of raw materials and help build a sustainable omega-3 neutraceutical market.

Adsorbent Purification of Biodiesel Feedstock using Synthetic Magnesium Silicate

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Fats and oils used as feedstock for biodiesel can contain a wide variety of impurities that must be removed in order to properly react to produce biodiesel. A number of these impurities have been known to cause problems during the transesterification reaction, including sterol glucosides, soaps, phosphorus and other metals. In this study, synthetic magnesium silicate was used to treat a crude Soybean oil to remove these impurities and produce finished oil with high quality. This process helps to ensure that the resulting biodiesel produced meets certain specifications and can also yield higher overall plant efficiencies. Treatment of the crude Soybean oil with synthetic magnesium silicate resulted in: ? Soap reduction of 83-92% ? Water reduction of 40-61% ? Phosphorus reduction of 85-94% ? Sterol Glucoside reduction of 56-84% ? Ca reduction of 50% ? Mg reduction of 50-80% ? Na reduction of 80% ? K reduction of 65-80%

Processing Posters

Chair(s): P. Adu-Peasah, Dow AgroSciences, USA

CANCELLED - Enrichment of Polyunsaturated Free Fatty Acids by Crystallization

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Extraction of Castor Bean oil Using Ethanol in a Semi-continuous Extractor

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[(1)]University of Brasilia, United States of America [(2)]UnB, Brazil [(3)]UnB, Brazil [(4)]UnB, Brazil

Ricinoleic acid is the major fatty acid present in castor oil (up to 90 %). In order to avoid the use of hexane, the extraction of the oil from castor beans may be carried out using ethanol because of the interaction of the hydroxyl groups of the ethanol and ricinoleic acid. Focused in these properties a semi-continuous extractor was built to test the efficiency of anhydrous or hydrated ethanol. The extraction efficiencies were calculated using AOCS Ae 3-52 standard method. Comparing anhydrous ethanol and hexane use observed a similar extraction yield. However, when using hydrated ethanol it was observed a diminishing in the extraction yield proportional to the amount of water. When using hydrated ethanol it was also observed the extraction of non lipid materials, which increases with the amount of water.

Effect of Enzyme-assisted Degumming on Composition and Emulsification Properties of Canola Lecithin

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In recent years enzyme-aided degumming has been adapted by a few vegetable oil refiners. Phospholipases used during the enzymatic degumming change the chemical structure of native phospholipids. It is expected that surface active properties of lyso gums obtained from enzyme-aided degumming process would be lower than the native lecithin. However, enzymatically treated egg lecithin is commercially available and suitable for applications such as mayonnaise production. To the best of our knowledge functional properties of gums from enzymatic degumming of vegetable oils have not been reported to date. The objective of this study is to evaluate the effect of phospholipases used in enzymatic degumming on the composition and emulsifying properties of gums obtained from canola oil. Phospholipase A1 was used in the enzymatic degumming of crude canola oil. Gums from crude canola oil water degumming were used as the reference. Both phospholipid and glycolipid content and composition of the samples were determined by using an HPLC-ELSD method. The emulsification property of canola Acetone Insolubles (AI) was examined by measuring the stability of oil-in-water emulsions prepared with AI. Glycolipid content of AI obtained from enzymatic degumming with phospholipase A1 (AIEDP), 6% (w/w), and that from water degumming (AIWD),

6.6% were similar. Phosphatidylcholine and phosphatidylethanolemine contents of AIWD, 26.8 % and 10.3 %, were significantly lower than those for AIEDP, 4.7% and 1.4 %, respectively. Lysophosphatidylcholine which was not detected in AIWD accounted for 20.1% of the AIEDP. AIEDP produced a stronger oil-in-water emulsion than AIWD.

Optimization of Microwave Assisted Extraction of High Value Industrial Lipid From Grain Amaranth

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There is renewed interest in the grain amaranth which grows in many tropical, subtropical as well as temperate countries. Amaranth produces good yields of cereal-like seeds under arid conditions and in poor soils where conventional cereal crops do not grow well. Approximately 60 species of amaranth are recognized, in which several species are considered as weed. The oil content of amaranth seed is high varying between 6-9%, compared to other grains. This study optimized the methodology for extracting high value lipid from grain amaranth, which is a rich source of squalene, phytosterols, tocopherol & polyphenols and has an application in nutraceutical & cosmetic based industries. The method used microwave energy to enhance the extraction diffusion processes and to release oil from the grain amaranth at reduced extraction time and reduced solvent consumption as compared with conventional extraction methodologies. Statistical designs were used to identify the process factors ? solvent to material ratio, solvent to solvent ratio and extraction time at constant microwave power, which governed the oil yield & preserved the best quality of its high value constituents.

Retrograde Vaporization of Rice Bran oil and wax Using Supercritical Carbon Dioxide

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RETROGRADE VAPORIZATION OF RICE BRAN OIL AND WAX USING SUPERCRITICAL CARBON DIOXIDE Masahiro Matsubara1, Yasuhisa Nakato2 and Eiichi Kondoh1 1Mechanical System Engineering, University of Yamanashi, Kofu, 400-8511, Japan 2KOA Electronics Co.,Ltd.,Nisijyo 733, Anann-Cho, Simoina-Gun, Nagano,399-1504,Japan Rice bran oil (RBO) is popularly known as a nutritional and edible oil, getting a crucial attention in cooking market places with replacing soybean oil, upon a trans-fatty acid regulation. We studied RBO extraction from rice bran using supercritical carbon dioxide. The effects of temperature and pressure on the extraction yields of crude oil, oil and wax are analyzed, respectively. The tendency on crude oil was similar to that of oil. Contrarily, the wax yield curves have crossover points at 20-24MPa. These tendencies are nearly the same as those of soybeans reported by Quirin [1] and King [2,3]. Note that the oil yield is high at a low temperature for all over pressure range, whereas the wax yield is low at a lower temperature at above 25MPa. Utilizing this retrograde vaporization at above 25MPa, it is possible to separate oil and wax from crude RBO with SCF,enabling an easy fabrication of the edible rice bran oil. [1] Von K. W. Quirin, Fette Seifen Anstrichmittel,Nr.12, 1982, 460-468 [2] J.W.King,Grasasy Aceites, Vol.53, Fasc.1, 2002, 8-21 [3] J.W.King,Journal of Chromatographic Science, Vol.27, 1989, 355-364

Trans,trans Conjugated Linoleic Acid Production From cis-9,trans-11 and trans-10,cis-12 CLA Isomers by Photo-irradiation.

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The objective of this study was to produce a 50% trans,trans CLA oil from Tonalin, a commercial source of cis,trans and trans,cis CLA triacylglyceride oil. Recent studies have shown that a 20% trans,trans CLA-rich soy oil significantly reduces heart disease and diabetes risk factors in obese rats. Furthermore, trans,trans CLA has been reported to have superior anti-carcinogenic activity than that of other CLA isomers. Therefore, a concentrated source of trans,trans CLA triglyceride oil would be highly desirable. Tonalin, a commercial source of cis,trans and trans,cis isomers of CLA was photo-isomerized in presence of 0.35% iodine for 120 min. The total CLA was measured by GC-FID FAMEs analysis and the CLA isomeric composition was determined by silver ion HPLC. A~56% trans,trans CLA-rich oil was obtained in 2h, which is three times more than 17% trans,trans CLA yield previously obtained in 12 hours with soy oil. This was possible because soy oil linoleic acid is relatively slowly converted to cis,trans and trans,cis CLA; but these CLA

isomers are rapidly converted to the more thermodynamically stable trans,trans isomers.

Isopropyl Alcohol Extraction of De-hulled Yellow Mustard Flour

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Fossil fuels represent a significant source of worldwide energy consumption. The search for alternative sources of energy is a necessity. Vegetable oils which have an energetic content close to fossil fuels are an example of a renewable and potentially inexhaustible source of energy. An annual production of almost 160,000 tonnes of mustard (2008) makes Canada the world?s largest exporter of mustard seed. Mustard seed oil contains erucic acid which is known to contribute to certain heart conditions such as myocardial lipidosis. As a result, in Europe and North America mustard oil is banned for human consumption. It is also known that the presence of erucic acid in mustard seed oil is responsible for its high lubricity, a positive property of bio-fuels. As a result mustard seed is a good candidate for production of biodiesel. Investigation of oil recovery from de-hulled yellow mustard flour using isopropyl alcohol (IPA), as the solvent, has been performed. This investigation helps current understanding of IPA extracted mustard oil composition which affects the transesterification process for biodiesel production. IPA is a polar solvent therefore some non-acylglycerol material may also be extracted along with the oil, such as phosphorus, water, carbohydrates and protein. The composition of the miscella (IPA+Oil) and meal residue resulted from extraction has been determined. In addition to oil, IPA was shown to have significant affinity towards water and some affinity to carbohydrates. The effect of water content of the IPA on the components dissolved in the solvent was further investigated.

The Thermo-mechano-chemical Fractionation of Sunflower Whole Plant in Twin-screw Extruder, an Opportunity for its Biorefinery

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Biorefinery of sunflower whole plant is conducted according to an aqueous process using a twin-screw extruder. Aqueous extraction of oil is looked upon as an environmentally cleaner alternative technology to solvent extraction. Twin-screw extruder carries out three unit operations continuously: conditioning and grinding of whole plant, liquid/solid extraction and liquid/solid separation. Extraction efficiency depends on screw speed, and input flow rates of whole plant and water. In best conditions, oil yield is 57%, and residual oil content in cake meal is 14%. These conditions lead to the co-extraction of proteins, pectins and hemicelluloses. Oil is extracted in the form of two oil-in-water emulsions stabilized by phospholipids and proteins at interface. They could be used as co-emulsifiers for creams production in cosmetic industry. An aqueous extract containing part of the water-soluble constituents from whole plant, mainly proteins and pectins, is also generated. It can be recycled to the process. As a mixture of fibers and proteins, the cake meal can be moulded by thermo-pressing. Denser fiberboards have promising mechanical properties in bending. They could be used in furniture industry. Fiberboards with the lowest densities are more fragile but they could be used for their heat insulation properties in building industry.

Influence of Processing Parameters on Acyl Migration During Enzymatic Synthesis of Palm Stearin-canola oil Blends Based Structured Lipids

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Interesterification reactions may provide intermediate compounds such as free fatty acids (FFA), monoacylglycerols (MAG) and diacylglycerols (DAG) in such amounts that can result in the occurrence of an undesired thermodynamic process known as acyl migration. To investigate the influence of reaction temperature, flow and chemical composition of the substrate on the quality of the structured lipid produced, Response Surface Methodology (RSM) was applied for experimental designing and process parameters optimization. Enzymatic interesterification was held in a continuous bed reactor packed with sn-1,3 specific lipase Lipozyme TL IM®, using blends of palm stearin with canola oil in

different proportions. Fatty acid and acylglycerol compositions of the lipids were determined by gas chromatography and high performance liquid chromatography, respectively. The regiospecific fatty acid distribution was determined by C13 Nuclear Magnetic Resonance and the thermal behavior and crystal structure of the samples were studied by Differential Scanning Calorimetry and Polarized Light Optical Microscopy.

Development of Structured Lipids by Enzymatic Acidolysis of Single Cell oil Rich in Ara/dha With Medium Chain Fatty Acids

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Most natural fats and oils have limited application because they present certain tendencies of fatty acids regiospecific distribution. To expand their use, focusing on the development of functional oils and fats, some strategies of modification can be used, including interesterification. Structured lipids are triacylglycerols produced by chemical or enzymatic interesterfication, a reaction capable to esterify a particular fatty acid to a specific position of the glycerol backbone. Thus, structured lipids can present new therapeutic and nutritional properties.The purpose of this work was to incorporate short or medium chain fatty acids, as a prompt source of energy, to the glycerol backbone of single cell oil rich in docosahexaenoic acid (DHASCO) and arachidonic acid (ARASCO), both essential fatty acids. For this purpose, mixtures of DHASCO or ARASCO with short or medium chain fatty acids in free form underwent acidolysis catalyzed by the enzyme lipase Lipozyme TL IM. Purification of this product is required and will be performed by short path distillation in the future. The process yield will be measured by the percentage of incorporation of short or medium chain fatty acids in the sn-1,3 position using Response Surface Methodology. Butyric (C:4), caproic (C:6), caprylic (C8:0), capric (C:10) and lauric (C12:0) acids were used in molar ratios of 1:4, 1:6, 1:8, 1:10 and 1:12 (DHASCO or ARASCO:free fatty acids) in order to evaluate the influences of free fatty acid chain length and its molar concentration on the efficiency of production of the structured lipid.

CANCELLED - Kinetic Study of the Acidolysis of High Oleic Sunflower oil With Stearic-palmitic Acid Mixtures Catalysed by Immobilised Rhizopus Oryzae Lipase

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Secondary currents in the flow of concentrated suspensions through non-axisymmetric conduits

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Secondary currents induced by second normal stress differences in polymer flows have been experimentally observed in non-axisymmetric conduits [e.g. see Giesekus, Rheol. Acta (1965)]. The simulations of Ramachandran and Leighton [J. Fluid Mech. (2008)] showed that such currents could also exist for suspensions of rigid, non-colloidal particles that are known to exhibit second normal stress differences. The objective of this work was to experimentally establish the existence of secondary currents in suspension flows. Two contrastingly-dyed suspensions were passed through a square channel at unequal flow rates. The interface between the two suspensions was photographed under fully developed flow conditions. The images reveal a progressive distortion of the interface along the length of the channel that is deterministic, not diffusive, in nature. The profile of the interface matches the prediction based on the calculations of secondary currents reported by Ramachandran and Leighton (2008). This demonstration shows that the co-extrusion of two suspensions is not possible, unless certain special symmetry criteria are met. Secondary currents may also provide a new mechanism of solute mass transfer in flowing suspensions.

Potential of low phorbol ester Jatropha curcas for biodiesel and animal feed

(1) *(2)* *(3)* *(4)*

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Low phorbol ester varieties of Jatropha curcas from Mexico have been introduced to Central America to produce biodiesel and animal feed. This study compared the potential for biodiesel and animal feed of a Mexican low-phorbol ester with toxic Cabo Verde and Hindu Salvadoreña varieties. A completely randomized design with three replicates was used to obtain seeds harvested in late 2011. Protein and total oil were measured on dehulled seeds and a defatted meal. Total phorbol ester content of whole seed, its structural components (hull, embryo and cotyledons with tegment), oil and defatted meal was measured by HPLC. Oil was extracted with an expeller and partially refined (filtered, degummed and neutralized). Crude and partially refined oil yields were recorded and oil quality measured. Biodiesel yield and quality were measured according to ASTM D6751. Protein (49%) and total oil content (20%) was similar for Mexican, Cabo Verde and Hindu. Whole seed phorbol ester content was significantly lower in the Mexican variety (600 ?g/g) than Hindu (890 ?g/g) and Cabo Verde (2570 ?g/g). The Mexican variety had lower phorbol ester in every seed component, oil and defatted meal than Cabo Verde and Hindu. Most of total phorbol esters were found in cotyledons with tegment. Oil of the Mexican variety had a significantly higher content of linoleic acid (43%) than Cabo verde (38%) and Hindu (37%). However, oil and biodiesel yield as well as stability and quality were similarly optimum indicating potential for the less toxic Mexican variety.

3-MCPD 1-palmitate-2-linoleate and 3-MCPD 1-linoleate-2-palmitate: Acute Oral Toxicity in Swiss mice and cytotoxicity in NRK-52E rat kidney cells

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The acute oral toxicity was investigated for 1-linoleoyl-2-palmitoyl-3-chloropropanediol (3-MCPD 1-linoleate-2-palmitate) and 1-palmitoyl-2-linoleoyl-3-chloropropanediol (3-MCPD 1-palmitate-2-linoleate) using 10 male and 10 female Swiss mice at a single dose of 0 and 5000 mg/kg BW according to the preliminary study results. The LD50 (median lethal dose) value for 3-MCPD 1-linoleate-2-palmitate was determined 5000 mg/kg body weight (BW), whereas the LD50 value for 3-MCPD 1-palmitate-2-linoleate was greater than 5000 mg/kg BW. The results showed that mean body weight of mice fed with 3-MCPD 1-linoleate-2-palmitate or 3-MCPD 1-palmitate-2-linoleate was lower than that of the control mice. However, food intakes and water consumption in the test group were greater than that for the control group. Both 3-MCPD esters might significantly increase serum urea nitrogen and creatinine. Renal tubular necrosis, protein casts, necrosis in the subcortical region of the brain, and spermatids decrease in the seminiferous tubules and epididymis were discovered in the dead mice during the. In vitro MTT assay showed that only 3-MCPD 1-linoeate-2-palmitate at the 300 uM significantly inhibited NRK-52E rat kidney cells growth 48 h after the treatment. In conclusion, 3-MCPD 1-linoleate-2-palmitate was more toxic than 3-MCPD 1-palmitate-2-linoleate under the experimental conditions. These results suggested the fatty acid in the 3-MCPD esters might play an important role for the overall toxicity.

3-MCPD 1-mono- and di-palmitate: Acute Oral Toxicity in Swiss mice and Cytotoxicity in NRK-52E rat kidney cells

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1-palmitoyl-3-chloropropanediol (3-MCPD 1-monopalmitate) and 1, 2-bis-palmitoyl-3-chloropropanediol (3-MCPD dipalmitate) were evaluated for their acute oral toxicity in Swiss mice, as well as their cytotoxicity in NRK-52E rat kidney cells. The LD50 (median lethal dose) value of 3-MCPD 1-monopalmitate was 2676.81 mg/kg body weight (BW), and the LD50 value was greater than 5000 mg/kg BW for 3-MCPD dipalmitate. The results also showed that 3-MCPD 1-monopalmitate might decrease the mean body weight in a dose-dependent manner, and significantly increase serum urea nitrogen and creatinine in mice. Primary histopathological changes in dead mice fed 3-MCPD 1-monopalmitate included necrosis of renal tubular epithelial cells, protein casts, spermatids decrease, and disperse array or desquamation of constructive cells in the single seminiferous tubule. Also observed was the dose-dependent cytotoxicity of 3-MCPD 1-monopalmitate in NRK-52E rat kidney cells according to MTT and LDH assay data, while

3-MCPD dipalmitate had no effect on cell proliferation. Together, both the results indicated a greater toxicity of 3-MCPD 1-monopalmitate than 3-MCPD dipalmitate.

Enzymatic synthesis of 1-stearoyl-3-oleoyl-glycerol as a fat replacer

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Preparation of 1-stearoyl-3-oleoyl-glycerol to be used as dietary oil for weight reduction has been investigated. The preferred production method was direct esterification of monoolein and food grade stearic acid. In this procedure, three immobilized commercial lipases namely Novozym 435, Lipozyme RM IM, and PLG from Alcaligenes sp were investigated. The reactions were carried out at 60 º C and reduced pressure (20 mbar). The molar ratio between monoolein and stearic acid was ca. 1. Consumption of the substrates, rate of reaction, ratio of 1,3- to 1,2-diacylglycerols, and production of triacylglycerols was compared. The best results were obtained with Lipozyme RM IM which produced more than 70 % of 1,3-diacylglycerols in 2 hours. This product is intended to be used as a fat replacer of meat products.

Comparison of molecular distillation and liquid CO2 extraction for monoolein purification

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A food grade monoolein mixture (monoacylglycerol content ca. 40 % w/w) was used as starting material to compare molecular distillation and supercritical fluid extraction for monoolein purification. Molecular distillation was carried out at 200 ºC and pressure of ca. 0.005 bar at two different flow rates (500 and 250 mL/h). In addition, a second pass of the residue obtained after the first distillation was also studied to improve the global yield of the procedure. Countercurrent supercritical fluid extractions were effected using the same starting material as in molecular distillation experiments at two different solvent to feed ratios namely 100 and 50. Three different pressures (160, 120, and 80 bar) at 60 ºC were evaluated. In all experiments, purity and yield of monoolein besides oxidative status of the different products attained was compared. Best monoolein purity was achieved by molecular distillation (c.a. 95%, w/w).

RHEOLOGICAL BEHAVIOR OF ANHYDROUS MILK FAT FRACTIONS PRODUCED BY SUPERCRITICAL CARBON DIOXIDE FRACTIONATION

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Anhydrous milk fat (AMF) is widely consumed food commodity because of its long shelf-life and contribution to flavor and quality. Anhydrous milk fat contains a large variety of fatty acids and different melting fractions. The behavior of fractions may vary with the liquid/solid phase and crystal size formed during rapid or slow cooling and storage. The crystallization and rheological properties of milk fat are important to determine the end use applications, texture, appearance and the taste of products. In this study, AMF was fractionated by supercritical carbon dioxide system. Six fractions were produced at 40oC using pressure values from 10 to 36 MPa. Fatty acids of milk fat and fractions were analyzed by a gas chromatography. Short chain and medium chain fatty acids were decreased from fraction obtained in the order of 10 to 36 MPa, while long chain fatty acids and unsaturated fatty acids were increased. Crystallization and melting profiles were obtained with a differential scanning calorimeter. Crystallization of AMF and its fractions were carried out at 25, 50 and 100 1/s shear rates using a rheometer. Significant changes occurred in the chemical composition of the fractions led to distinctive differences in their thermal profile and rheological behavior. Fractions obtained at 10 and 20 MPa exhibited lower melting and crystallization behaviors than those obtained above 30 MPa. The rheological profiles obtained suggested that milk fat fractions studied had weak structures during early stage of crystallization. These subsequently developed into semi-solids structure on further crystallization.

EFFECTS OF TEMPERING AND TEMPERATURE FLUCTUATION ON BLOOM FORMATION AND APPEARANCE OF DARK CHOCOLATE

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Structural change of dark chocolates from different temper regimes (optimal temper, under temper and over temper) was examined during 3 weeks storage period. Fat bloom formation was accelerated by repeated temperature cycling between 20 and 32ºC with a 50% relative humidity for preventing sugar bloom. Changes in surface properties were examined using macroscope, hunter colormeter and gloss meter. Polymorphic transition in dark chocolate was evaluated by X-ray diffractometers and Differential Scanning Calorimeter. Temperature fluctuation influenced melting properties of chocolates causing from Form V transition to Form VI within only 1 day for under and over temper chocolates. Images of chocolate surfaces showed similar results and bloom formation was occurred in quickly. The formation and development of fat bloom were occurred in different ways for three types of chocolate studied. While the surface of over temper chocolate had large separated fat crystals, the surface of under temper chocolate had dull and smaller whitish-brown spots. The results suggested that both storage and process conditions are important on bloom formation of chocolate.

Generation of 3-MCPD and Glycidyl esters from diolein with various levels of Glycidyl ester and Chloride

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3-MCPD esters and glycidyl esters (GEs) are heat induced process contaminants generated mainly through high temperatures during the deodorization process in edible oil production. Understanding the generation mechanisms of these contaminants is an important step in establishing effective strategies for their mitigation. Previously, we reported characteristic reactions at deodorization temperature that generated these contaminants from tri-, di-, and monoolein [1]. MAG and DAG worked as precursors for both contaminants, but TAG did not substantially generate either contaminant. In current study, we focused on DAG, which is the dominant partial acylglycerol in vegetable oils, and investigated the influence of the amount of GE and chloride source on the generation of the contaminants to discuss the mechanisms. As the results of heating tests of diolein at 240 °C, the GE levels tended to converge to a constant level with time regardless chloride and initial GE content. Contrary, the levels of 3-MCPD ester increased with both parameters. [1] Shimizu, M., Vosmann, K. and Matthäus, B. Eur.J. Lipid Sci. Technol. 2012, 114, 1268?1273

Characterization of Oleins from Enzymatically Interesterified Palm Oil

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Palm oil is largely used as such or after fractionation in the formulation of several fat food products. There is today a large tendency to ban partially hydrogenated oils and to replace chemical by enzymatic processes. In this context, combination of enzymatic interesterification of palm oil and dry fractionation takes a predominant place. The purpose of this study was to evaluate the quality of olein fractions obtained after dry fractionation of enzymatically interesterified (EIE) palm oil and to compare with oleins obtained from standard palm oil. In practice, palm oil was enzymatically interesterified on pilot scale and subsequently dry fractionated in a pilot crystallizer and series of oleins were isolated by vacuum and membrane press filtrations. Meanwhile, palm oil was dry fractionated with the same crystallizing unit and regular oleins were produced. The selected oleins had identical iodine value (56-65) whether obtained from EIE or RBD palm oil. All of the obtained olein fractions were evaluated for a number of quality parameters including triacylglycerol composition by HPLC, solid fat content profile by pulsed NMR and Mettler cloud point. Crystallization and melting behavior were examined by differential scanning calorimetry and polymorphism properties assigned using the powder X-ray diffraction pattern. This work clearly demonstrated poorer cold stability at identical iodine value for the oleins obtained from EIE palm oil compared to the ones obtained from standard palm oil. This behavior was attributed not only to different triacylglycerol compositions but also to formation of saturated sn-2 isomers (acyl-migration).

Enzymatic remediation of crude palm oil

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Crude palm oil characterized by high FFA and DAG contents is traditionally physically refined and dry fractionated for use in many fat food products. High DAG content may affect throughput and yield during fractionation; high grade specialty fats like the HPMF require premium crude palm oil to secure adequate crystallization properties; DAG are also generally considered as a main precursors for the formation of glycidyl esters during high temperature deodorization. The purpose of this study was to investigate on lab-scale the effect of enzymatic treatment on FFA and DAG reductions in crude palm oil. The enzyme was a lipase (Novozymes, Denmark) capable to convert DAG into TAG by condensation with FFA. In practice, series of process parameters were studied and the quality of enzymatically treated crude palm oils was examined. High sensitivity of the enzyme with respect to oil quality was highlighted; in all cases, the TAG composition was significantly modified. Enzymatically remediated crude palm oil was physically refined on lab-scale and used as feedstock for dry fractionation. The non remediated crude palm oil was also physically refined on lab-scale. Dry fractionation comparative tests were executed in a pilot crystallizer. The first objective was to evaluate and compare the produced olein quality. The remediated palm oils and olein fractions were analyzed for their TAG composition (HPLC), solid fat content profile (NMR), Mettler cloud point, thermal properties (DSC) and polymorphism (powder XRD).

Recovery of whey oligosaccharides by membrane filtration at pilot-scale

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Juliana M. L. N. de Moura Bell 1*, Luciana B. da Fonseca 1, Renata F. Ferraz 1, Boyu Li 1, Valerie Weinborn 1, Amy Zhong 1, Hyeyoung Lee 1, David A. Mills 1,2,3, Daniela Barile 1,3 1Department of Food Science & Technology, University of California Davis,Davis, CA, 95616, USA 2Department of Viticulture, University of California Davis,Davis, CA,USA 3Foods for Health Institute, University of California Davis, Davis, CA,USA. *jumanobrega@gmail.com Human milk oligosaccharides are complex sugars that possesses prebiotic and anti-infective properties; acting as selective growth substrate for benefitial bacteria in the infant gastroinstestinal system. Bovine milk/dairy streams are potential sources of those components, although in lower quantities and having simpler structure complexity. High global production of bovine whey claims for the recovery of its fuctional components such as glycoproteins, oligosaccharides and naturally occurring peptides. A two-stage cross-flow membrane filtration (10kDa and 1kDa- PES spiral wound membranes) and an upstream lactose hydrolysis (fungal lactase) step were employed to assess the recovery of whey oligosaccharides at pilot scale (100 L of whey). Discontinuous diafiltration was employed to increase purity of the oligosaccharide-rich retentate by simple sugars removal. High-performance liquid chromatography, thin-layer chromatography, and advanced mass spectrometry were employed to analyze retentates and permeates regarding their composition. The development of fully-scalable fractionation and purification processes at pilot-scale is essential to enable large-scale production of targeted bioactive milk compounds for their utilization in clinical trials, a pre-requisite step before its use as food products and supplements supplements having significant health benefits for human nutrition.

Program