MONDAY

MORNING

PRO 1.1: Algal Oil Processing

Chair(s): N. Dunford, Oklahoma State University, USA; and B. Yeh, Science Applications International Corporation, USA

The Rich Diversity of Lipid Distributions in Microalgae. J.K. Volkman, CSIRO Marine and Atmospheric Research, Hobart, Tasmania, Australia

Microalgae contain a rich diversity of lipids, carotenoids and other chemicals. Many of these so-called biomarkers can be used to identify sources of organic matter in seawater and sediments. With rapid advances in molecular biology it is now feasible to assign biomarkers to specific lipid biosynthetic pathways and to understand how these biosynthetic pathways might have evolved over geological time. This talk will focus on a few compound classes that appear to be unique to microalgae such as C25 and C30 highly branched isoprenoid alkenes found in specific genera of diatoms. C30 and C32 alkyl diols having a mid-chain hydroxyl group at C-15 have been identified in eustigmatophyte microalgae and shown to be precursors of highly aliphatic biopolymers (algaenans). Perhaps the most unusual compounds found in microalgae are the C37-C39 straight-chain unsaturated ketones (alkenones) found in prymnesiophyte algae such as Emiliania and Gephyrocapsa. The ratio of the di- and tri-unsaturated C37 alkenones is now widely used as a record of sea surface temperatures in ancient sediments. The talk will also discuss features of the fatty acid and sterol distributions that distinguish microalgal lipid profiles and some of the applications of these lipids in commercial products.

Designer Triglyceride Oils and Renewable Chemicals. W. Rakitsky, Solazyme, South San Francisco, CA, USA

Solazyme has developed a unique and proprietary industry-leading microbial chemicals platform which exploits designer triglyceride oils as the basis for the next generation of high performance bio-based fluids and green chemicals. Solazyme?s core technology utilizes microalgae to transform carbohydrate feedstocks into fatty acids in the triglyceride form. These triglyceride oils can then be converted through biological or chemical routes to numerous value-added chemicals, such as surfactants, lubricants and polymers in existing industry infrastructure. Properties of the designer oils are manipulated to increase their value over existing renewable oils by optimizing chain length distribution and levels of saturation. Solazyme?s industrial fermentation manufacturing platform allows production of thousands of tons of designer oils from multiple carbohydrate feedstocks and thus can be deployed worldwide. In this presentation, we will discuss how and why Solazyme?s renewable chemicals platform expands the possibilities for further replacements of petroleum derived oils with renewable, sustainable alternatives.

Opportunities of Microalgal Oil in Foods. R.B. Draaisma[1], R.H. Wijffels[2], [1]Unilever Research & Development Vlaardingen, Zuid-Holland, The Netherlands, [2]Wageningen University, Gelderland, The Netherlands

Microalgae represent a promising future source of sustainable, natural edible oils and are therefore of interest for Unilever. Microalgae can accumulate vast amounts of lipids with diversity in fatty acid profiles. Sustainable sourcing of edible oils from microalgae has a huge potential, as photoautotrophic microalgae can be grown on seawater, sunlight and CO2. Lipid productivity can be boosted to higher levels and microalgae do not have to compete for land suitable for agriculture. To execute R&D projects with state of the art microalgal biotechnology we collaborate with the academic group Bioprocess Engineering in Wageningen University and Research Centre in the Netherlands with scientific programmes in Wetsus and AlgaePARC.The potential of photoautotrophic production of edible oils by microalgae and their potential in food applications will be reviewed in combination with findings from our collaborative programmes with Wageningen University.

The Commercialization of Algae - State of Technology. B. Yeh[1], P. Marrone[2], [1]Science Applications International Corporation, Oakland, CA, USA, [2]Science Applications International Corporation, Newton, MA, USA

Algae holds much promise as a future feedstock for oils, biofuels and green chemicals. It's attributes include the ability to capture carbon, avoiding the food versus fuel debate, and the ability to grow in areas that are utilized. However, numerous challenges remain including the lack of infrastructure and the cost of production. This paper will review the challenges that exist for algae today and the work that is being performed to eliminate the barriers to the commercialization of algae.

Commercial Application of Microalgae. Barry Toyonaga[1], David Brune[2], James M. Carlberg[1], James C. Levin[1], Michael J. Massingill[1], Greg Schwartz[1], Jon C. Van Olst[1], [1]Kent BioEnergy Corporation, San Diego, CA USA, [2]University of Missouri, Columbia, MO, USA

Founded in 2008, Kent Bioenergy provides microalgae-based industrial solutions using intellectual property developed over decades of employing microalgae to remediate water in a commercial fish aquaculture setting. The company recognized the opportunity to combine the treatment of waste with a nutrient need in algae production operations to produce sustainable products while simultaneously using less energy, conserving phosphorous, emitting less carbon, and without competing with food production.Thus, the use of waste nutrients for algae production offers economic and environmental value - critical factors for the commercial development algal biomass as feedstock which has the promise to replace our dependence on petroleum and to reduce GHG emissions.The company's technological advances are now solving problems that have limited the use of microalgae for waste treatment in the past. One major obstacle has been the lack of cost-effective harvest technology for separating algal biomass from water after the excess nutrients have been removed. Technologies for algae harvest include bioflocculation, biologically enhanced sedimentation, and other advanced techniques. Positive results, to date, encourage us to pursue the development and deployment of technologies more

broadly than ever - to convert waste into higher value co-products using algae's photosynthetic machinery.

Next Generation Algae Extraction and Fractionation Technology. Brian L. Goodall, SRS Energy, USA

It is generally accepted that microalgae represent the most promising and most productive alternate source of precursors for the products currently derived from fossil crude. However, in order to realize the full commercial potential offered by algae it is critical to fractionate the harvest into marketable product streams. These products will include both consumer products (e.g. animal feed and nutraceuticals such as omega-3 oils) and feedstocks for the existing refining infrastructure and conversion into chemicals and liquid transportation fuels.SRS Energy has spent 4 years of focused R&D to develop a technology that is now ready to fulfill this pivotal need in the algae industry. Our AlgaFrac? technology has the proven ability to extract oils from wet algal biomass with unsurpassed efficiency (very high yield and low energy input). The technology is robust, proven over a wide number of algae strains and requires a small footprint and few moving parts. The technology can be tailored to a given clients needs and has been demonstrated on pilot scale and effect fractionation of algae into valued lipid, protein and carbohydrate fractions. Demonstrated product streams include biodiesel, ?hydrotreatable algal oil?, HRJ (hydrotreated renewable jet fuel), omega-3 rich lipids, sugars and proteins. The technology and product offerings will be outlined in detail.

Supercritical Methanol Extraction of Algae. M. Tegen, Inventure Chemical, Tuscaloosa, AL, USA

PRO 1: Safety, Operational Cost Reductions at Plant Level

Chair(s): J. Willits, Desmet Ballestra North America Inc., USA; and M. Snow, Bunge North America Inc., USA

Reducing Operational Costs by Improving Thermal Efficiency of the Refinery. J. Piazza, R. Jones, Alfa Laval Inc., Richmond, VA, USA

A review of the operational costs associated with adjusting the temperature of vegetable oils at the various processing steps within a typical refinery. Focus on the value of interchanging energy. Review of the effect of various heat exchanger designs.

Total Asset Reliability. D. Brooks, MRG Inc., Southbury, CT, USA

This paper will discuss aspects of "Total Asset Reliability", as it applies to manufacturing and processing industries. The discussion will include design, purchasing, installation, and maintenance for asset reliability, as well as the key requirements regarding "People", "Processes", and "Programs" necessary to sustain operations at the designed asset utilization levels required to meet manufacturing and processing targets. Maintenance and Reliability

readiness for new plant installation and start-up, as well as Maintenance and Reliability improvement for existing plants will be included in the discussion. Significant reductions in manufacturing costs can be realized through the total asset reliability approach to installing and maintaining plant assets.

Improving Operational Efficiency with Phospholipase C Enzymatic Degumming. Tim Hitchman, Verenium Corporation, San Diego, CA, USA

Oilseed processing plants are highly integrated operations where several product streams are generated from a single oilseed feedstock. As a result, making a change to the process parameters on one product line can have significant operational and economic impacts throughout the plant. Understanding and managing these consequences is crucial in deciding how to modify fundamental process steps. Enzymatic degumming with Purifine® PLC is a unique process that results in increased yield of degummed oil by reducing heavy phase oil losses and release of the DAG component of the gums. The value of implementing Purifine PLC degumming is further enhanced by integration into downstream refining (for edible oil or biodiesel end uses) and can enhance the quality and value of co-products.

Don't Pay the Price of Falls from Heights. E.C. (Ted) Hamill, Bunge Canada, Oakville, ON, Canada

A fall from height at work can have a devastating effect on workers, their families and the workplace. The turmoil caused by an injury suffered in a fall can lead to decreased morale and efficiency. The incident may also be such a distraction that it leads to additional injuries through inattention. A fall from height may also attract the attention of regulators and potential enforcement actions. Industry has a regulatory and moral responsibility to identify fall from height exposures. Once identified, these exposures must be eliminated or reduced through corrective or preventive actions to improve safety. A wide range of guards, barriers, restraint or protective devices are available to address these exposures.Eliminating falls from height can save lives, time and money.

Values Consequences in Animal Nutrition of Adjusting the Protein Dispersibility Index of Oilseed Meals. V. Perez, D. Hill, L. Pordesimo, ADM Alliance Nutrition, Quincy, IL, USA

Residual oilseed meals after oil extraction are used as a protein sources in animal feeding, with soybean meal being used in the greatest amounts. Most soybean meal today is processed by cracking, heating, flaking and hexane extraction. Quality of the protein in the meal is dependent on 1) reduction of anti-nutritional factors, and 2) maintenance of protein digestibility. Protein dispersibility index (PDI) may give a more accurate assessement of protein quality. PDI measures the amount of soybean meal dispersed in water after blending in a high speed blender. PDI has been used in the feed industry for almost a quarter of a century as a method to distinguish soybean meal quality for feed use. Soymeal.org publications indicate that meal with a PDI of 45 or lower is adequately heat processed. This value is higher than the 15 to 30 recommended by the National Oilseed Processors Association. Taking this recommendation as the lower bound of acceptable meal quality, what is the value in terms of nutritional performance, and economics to soy processors in modifying soybean meal PDI through process

adjustments? These issues through an review of published literature and consultation with animal and poultry nutritionists.

AFTERNOON

AM 2 / PRO 2.1: Food and Feed Safety

Chair(s): G. Ideus, Archer Daniels Midland Co., USA; and G. Graul, Bunge Oils Inc., USA

Salmonella Risk Assessment in Pet Food and Animal Feed Manufacturing - Factors to Consider. D.A. Hill[1], L.A. Carrasquillo[2], F.T. Jones[3], [1]ADM Alliance Nutrition, Inc, Quincy, IL, USA, [2]American Dehydrated Foods, Inc, Springfield, MO, USA, [3]Performance Poultry Consulting, LLC, Springdale, AR, USA

Producing safe food and safe feed is the constant objective of pet food and animal feed manufacturers. Pet foods and treats are often found in the home kitchen and in food preparation areas. Pet foods and certain animal feeds are often handled by children, elderly and others with immune system deficiencies. Food safety issues involving direct human contact with processed pet foods and animal feeds is a major regulatory focus by US FDA and the US Congress. Salmonella is capable of surviving for extended periods in a variety of environments on numerous materials. Complete elimination of pathogens is not realistic, but adherence to GMPs can help reduce/control pathogens and industry risk level. Some practices are easy to apply, others may require significant plant redesign to accomplish. This presentation focuses on risk considerations and scenarios, expectations, Salmonella kill steps, recall considerations, product sampling and chemical decontamination of facilities.

Melamine in the Feed and Food Chain. Christian W Cruywagen, Tanja Calitz, Stellenbosch University, Stellenbosch, South Africa

Melamine contains 667 g/kg N, which makes it an attractive protein adulterant, as it has the ability to inflate the crude protein content of feed- and foodstuffs artificially. Our research confirmed for the first time that a pathway exists for the transmission of melamine from feed to milk. Melamine appeared in the milk as soon as 8 h after first ingestion and reached a maximum concentration within 56 h after first ingestion. Upon melamine withdrawal, milk melamine concentration responded rapidly and dropped 85% within 32 h. Only after 152 h upon melamine withdrawal, melamine was non-detectable in the milk samples. Excretion via milk accounted for only 2% of the ingested melamine. An experiment with sheep showed that the apparent absorption rate of ingested melamine was 77%. Urine was the major excretion route at 53%, followed by faeces at 23%. Approximately 3.5% of the ingested melamine was deposited in muscle. Our research also confirmed that melamine is excreted in eggs as soon as one day after first melamine ingestion. Maximum concentrations were reached on day 3 of melamine ingestion and four days after melamine withdrawal, melamine disappeared from the eggs. A milk production study was also done where cows grazed pasture that was fertilized with a melamine contaminated fertilizer. Melamine was observed in the milk within 8 hours after cows grazed on the pasture.

FDA, Center for Veterinary Medicine Update. T. Schell, FDA, Center for Veterinary Medicine, USA

Topics of his talk will include, New Legislation, Salmonella CPG, Feed Contaminants, Reportable food Registration, Other 2011 Issues.

PRO 2: New Technologies / Hot Topics in Processing

Chair(s): R. Narayanan, Ag Processing Inc., USA; and G. Hatfield, Bunge Canada, Canada

Development of a Soy-Based, High Oleic Oil for Food. Susan Knowlton, DuPont Company, USA

Food package labeling requirements which commenced in 2006 have been highly effective in bringing about a dramatic change in the food industry away from fats containing trans fatty acids. Trend estimates show that there has been a shift in use away from partially hydrogenated soybean oil into alternatives including palm and canola oils which has reduced soy acreage in these markets. In addition, portions of the industry continue to struggle with replacement oils that do not have the stability that partially hydrogenated offered. The use of inferior oils has resulted in undesirable physical consequences such as polymerization and less than satisfactory sensory properties of food produced with oils other than soy.Plenish? is a soy-based, high oleic oil which has exceptional oxidative stability making it an attractive choice for food companies seeking a highly stable, zero-trans, solution, The oil has an ideal fatty acid profile with >75% oleic acid and less than 3% linolenic acid. Coupled with traditional processing technologies, it makes an ideal basestock for production of shortenings and high stability frying and spray oil products. This presentation will describe the functional performance and commercial status of this new, highly anticipated, improved soybean oil.

The Impact of API's New Recommended Practices, RP 752 & 753, on Facilities Covered by OSHA PSM Regulation 29 CFR 1910.119. D. Gaige, Process Plus LLC, Cincinnati, OH, USA

OSHA and US EPA both require chemical facility owners to document that their equipment complies with Recognized And Generally Accepted Good Engineering Practice (RAGAGEP). Both agencies consider the new API Recommended Practice, RP 752 & 753, as de facto RAGAGEP Standards, and expect owners of PSM, and/or RMP covered facilities to include them in their compliance programs. These new RP's provide guidance on the management of risks from explosions, fire and toxic material releases events that can occur at chemical facilities, and their impact on-site personnel located in new and existing buildings which are intended for occupancy. A proper understanding and application of these RP′s, will help facility owners and their management in assessing, and preventing or mitigating the risks associated with these type of events.Dennis will walk you through the language and methods described in these RP′s and provide a good understanding of their intent. Using a practical engineering and design approach, along with real life project experience, Dennis will provide design examples that incorporate the risk impact assessment philosophies and tools described within these RP′s and will also provide insight into how facility owners can use these guidelines to assess the impacts of potential events

that could occur within their facilities.

New Approaches for Chlorophyll Removal in Oil Processing. K. Carlson[1], R. Mikkelsen[2], J. Borch Soe[2], [1]Danisco USA, New Century, KS, USA, [2]Danisco A/S, Brabrand, Denmark

Presentation of new biotechnological processing method for removing chlorophyll from rapeseed (canola) oil, soybean oil and other "green" oils. The process can be applied to the crude oil and eliminates the need for acid activated bleaching earths. This reduces operating costs, oil losses as well as investment costs for new plant installations.

Use of Nano Reactors in Edible Oil Processing. W. De Greyt[1], M. Kellens[1], T. Kemper[1,2], J. Willits[1,2], [1]Desmet Ballestra Group, Zaventem, Belgium, [2]Desmet Ballestra North America, Marrietta, GA, USA

The big challenge for oil refiners today is to produce high quality oils with a sustainable and cost efficient process. One of the possible new techniques that could meet these goals is hydrodynamic cavitation (Nano Reactor Technology). Hydrodynamic cavitation is a known technique that is already used in the (bio-)chemical industry to improve mass transfer and increase reaction rates. It has also been described as a very efficient process for biodiesel production. Studies on the potential applications of Nano Reactor Technology in edible oil refining, started a few years ago. Meanwhile, it has been tested with success in chemical neutralization (Nano Neutralization). Processing crude oil through a Nano Reactor makes the phospholipids more hydratable so they can be removed without the need of upstream acid treatment of the oil. This will result in a direct cost saving (elimination of the total acid cost and part of the caustic) and also in less oil losses in the soapstock. In addition, the neutralized oil contains less soaps which will make further refining (silica treatment or washing) more cost efficient. Other potential applications of Nano Reactor Technology in edible oil processing that are studied include Nano Degumming of palm oil and Nano Degumming of soft oils (physical refining).

Development and Launch of a Fully Biodegradable Margarine Container from Renewable Resources: Case Study. Steven Rumsey, Bunge Brasil, Brazil

This package represents a first-in-class innovation. A margarine tub which is fully biodegradable - based on PLA (Polylactic Acid), a resin obtained from the fermentation and polymerization of corn starch. The margarine tub obeys the national and international standards of biodegradability and compostability, including the Brazilian, European and American Technical Norms (ABNT, EN, ASTM), and has received the international seal of Biodegradability from the Institute of Biodegradable Packaging (BPI).

The Optimisation of Existing and Development of New Enzymatic Processes in the Oils and Fats Industry. W.D. Cowan[1], H.C. Holm[2], [1]Novozymes UK, Chesham, Bucks, UK, [2]Novozymes DK, Bagsvaerd, Denmark

Three main application areas exist for enzymes in the oils and fats industry for degumming, interesterification and condensation of fish oil fatty acids. This paper will focus on how these

applications can be optimized now that they are well established. In addition it will focus on new application areas under development in oil remediation, degumming and interesterification to show how spin off from one research opportunity can lead to new developments in a related area. The main focus will be upon procesess which are expected to be suitable for industrial scale application within a 12 month time horizon.

TUESDAY

AFTERNOON

PRO 3: Sustainability - Waste Utilization and Reduction

Chair(s): M. Boyer, Agribusiness & Water Tech Inc., USA; B. Gursky, Oil-Dri Corporation, USA; and L. Polak, Bunge North America, Inc., USA

Sustainability in Agribusiness/LCA and Supply Chain Challenges in Developing and Implementing a Major Company Program. L. Polak, Bunge North America, Inc., St. Louis, MO, USA

Many companies have established sustainability programs, and most are further developing their programs. Sustainability issues have been recognized as core business drivers. Gathering and reporting sustainability metrics have become deeply ingrained within these companies (e.g., energy efficiency, greenhouse gas emissions, water usage, waste generation, etc.). However, customers, suppliers, and governmental organizations are advancing and expanding the sustainability demands through Life Cycle Assessments (LCAs) and Value Chain questionnaires. This presentation will outline the challenges and opportunities that are generated as companies become engaged in LCAs and as they respond to Value Chain questionnaires.

Sustainable Approach to Spent Bleaching Earth Management. D. Brooks, R. Hollis, Oil-Dri Corporation of America, Chicago, IL, 60060, USA

An estimated 1.0 to 1.5 million tons of spent bleaching earth (SBE) will be produced in 2011. SBE, containing up to 50% organic fatty matter, historically has been disposed of in landfills or waste dumps; incinerated; and incorporated into animal feed. Regulatory restrictions placed on these options, along with the need to lessen the environmental impact of this material, are of growing importance and concern. Finding a universal application that meets the needs of the industry is impeded by the characteristics of the SBE; the diverse nature of the fatty material of the oil from which it was derived; logistical issues; handling costs; production costs; and shipping restrictions. This paper will present an overview of the problem; discuss proper handling techniques; and review the applications of interest that have shown promise including composting, construction materials, and residual oil recovery. Additionally, this presentation also explores a process that employs the use of fatty acid methyl esters (FAME) to enhance water extraction of residual oil from spent bleaching earth (SBE). De-oiling efficiencies of various combinations of water and FAME (up to 10X wt per wt SBE) were evaluated for reducing oil content of spent bleaching earth (SBE) from palm and soybean oil refineries. FAME assisted water extraction provided rapid dispersion of the SBE in the FAME at room temperature; ease of

transport to the filter press; improved water permeability of the SBE filter cake; improved de-oiling efficiency; and improved friability of the extracted cake.

Current Events and Developments in Managing Recovered Oils, Soapstock, and Other Byproducts in Oilseed and Oil Processing. M. Dasari, Feed Energy, USA

Sustainability of Nickel Catalysts. D. Seaman, Johnson Matthey Catalysts, USA

Fats and oils are receiving increased interest as more food production is required and new non-edible uses to replace petrochemicals are being developed. It will be shown that nickel catalysts are a key factor in delivering these sustainability targets. Also the sustainability of the catalyst manufacture and use itself will be discussed, in view of natural resource availability.

Current Developments in Water/Wastewater Management in Oilseeds, Oil Processing, and Biofuels. M. Boyer, Agribusiness & Water Tech Inc., USA

The presentation will offer an overview of industry trends in processing including mega trends that are both resulting from and impact water management and other sustainability issues. Specific examples will be discussed with respect to total water recycle, waste reduction and future trends.The impacts of corporate sustainability programs will be reviewed as it relates to overall programs in water and wastewater.

PRO 3.1/EXH 2: Processing Exhibitor Presentations

Chair(s): T. Neuman, GEA Westfalia Separator Inc., USA; and J. Piazza, Alfa Laval Inc., USA

Winterisation - Comparison of the Classical method and HF?s Combined Process. R. Speck, Harburg-Freudenberger Maschinenbau GmbH, Germany

New Drives for Separators and Decanters. T. Neuman, GEA Westfalia Separator, USA

The New Sieve Tray Oil Stripper, Efficiency and Reliability. A. Subieta, Desmet Ballestra, Marietta, GA, USA

A new, more efficient Final Oil Stripper is in the market. It is designed to increase the contact oil/steam for a better stripping efficiency. At the same time, the stainless steel trays are less prone to fouling than that of the traditional carbon steel disk and donut trays. This in turn makes the new Sieve Tray Oil Stripper a very reliable one.

Saving on Energy: Waste Heat Utilization in Crushing Plants. F. Salaria, Solex Thermal

Science, Calgary, AB, Canada

The use of efficient heat transfer equipment to reduce steam consumption is an easy way to reduce overall energy costs in a crush plant.There are various sources of waste heat in an oilseed plant where low grade energy can be recovered as hot water. This recovered energy can be utilized in the the preparation step of the plant to reduce steam consumption. However, only efficient modes of heat transfer, can justify the use of additional capital cost required to accompolish this. Calculating savings on steam based on typical steam rates and consumption, at various ambient temperatures through the year,show a payback period of two years or less.

Dry Condensing. S. Lassen, GEA Process Engineering A/S, Soeborg, Denmark

Precise Control of Suspended Solids, Dissolved Solids, Clarity, and Color in Process Water and Oil using Specific Light Wave Technology. Tom Schwalbach, Optek Inc., Germantown, WI, USA

Introduction to the use of light waves for precise and repeatable control of turbidity and color change in a real time process.We will explore the edible oil industry uses of this technology and why it is used for Condensate monitoring, Waste water control, filter monitoring and Bleaching process color control of impurities.

The Technology of Soybean Dehulling. Chuck Brockmeyer, Buhler Inc., Plymouth MN, USA

Buhler is a global specialist in the field of process technology, a leader in supplying equipment for grinding, blending and mixing, bulk handling, thermal treatment, and shaping for processing cereal grains and foods. Buhler?s top priority is to improve our customers? performance. To this end, Buhler collaborates closely with customers throughout the life cycles of their production facilities, thereby enhancing the value of their products. Buhler employs over 7,500 people around the world. In 2010, the Group generated sales of $2 billion.

Purification of Glycerin from Biodiesel Plants. Perry Alasti, Artisan Industries Inc., Waltham, MA 02451, USA

With the expected growth of biodiesel production in North America thanks to reinstatement of the blender?s tax credit, coupled with the global political turmoil causing oil to potentially reach $100/barrel or higher, we can expect a glut of crude glycerin in the coming years, as more biodiesel plants come on stream and existing plants will begin to ramp up production. Refining glycerin to various purities will be instrumental in insuring profitability regardless of feedstock and energy costs. We will present Artisan?s refining process and compare it with two alternate processes currently available in the market.

The Next Generation of High Speed Separators - The Alfa Laval eDrive Author. J. Piazza, Alfa Laval Inc., USA

WEDNESDAY

MORNING

PRO 4: General Processing

Chair(s): J. Mulholland, N. Hunt Moore & Assoc Inc., USA; and T. Gum, Agribusiness & Water Tech Inc., USA

New Opportunities in the Enzymatic Refining and Modification of Fish Oils. W.D. Cowan[1], H.S. Yee[2], M.L. Damstrup[3], H.C. Holm[3], [1]Novozymes UK, Chesham, Bucks, UK, [2]Novozymes MY, Kuala lumpur, Malaysia, [3]Novozymes A/S, Bagsvaerd, Denmark

Enzymatic condensation of Fatty Acid Ethyl Esters is commonly applied in the production of highly concentrated fish oil products for nutraceutical and other applications. However, the whole production process utilizes a number of chemical reactions which result in yield loss and/or damage to the sensitive unsaturated fatty acids. This paper examines new findings on how enzymatic degumming and esterification can be applied to improve overall process efficiency and increase the sustainability of the fish oil process. Alternative reactor configurations are also considered to maximize enzyme working life.

Reducing Energy Consumption in Biodiesel Purification. M. Hastie, M.A. Dubé, A.Y. Tremblay, University of Ottawa, Ottawa, Ontario, Canada

The biodiesel purification process typically generates a wastewater stream containing residual catalyst, glycerol, methanol, and soaps. This stream must be treated prior to recycling or discharge, resulting in high purification costs and energy usage. In many biodiesel plants, evaporation is the preferred means of water purification for the purpose of recycling. The proposed Renewable Fuel Standard (RFS2) includes a Life Cycle Analysis (LCA) when determining if a fuel qualifies as an advanced biofuel. The LCA includes the energy consumed in regenerating the wastewater. The direct reuse of this water can result in considerable energy savings.Biodiesel produced from waste frying oil and RBD canola oil was washed with water with increasing sodium content to simulate the conditions encountered in a counter-current biodiesel purification system. Partition coefficients of the contaminants of interest, including sodium, glycerol and soaps, between the biodiesel and water phases were determined using ICP Spectroscopy and GC. The energy consumed in removing the impurities from the biodiesel was studied. The impact of regenerating the wastewater stream by evaporation, ultrafiltration or ion exchange on energy consumption was determined. Various counter-current washing schemes were studied to decrease water consumption in the purification process.

Microreactors - An Innovative Tool for Development of Transesterification Reaction Continuous Processes. R. Richard[1,2], S. Thiebaud-Roux[1,2], L. Prat[3], [1]Université de Toulouse; INPT; LCA (Laboratoire de Chimie Agro-Industrielle); ENSIACET, F-31030 Toulouse, France, [2]INRA; LCA (Laboratoire de Chimie Agro-Industrielle), F-31030 Toulouse, France, [3]Université

de Toulouse; INPT; CNRS; Laboratoire de Génie Chimique; UMR 5503, F-31030 Toulouse, France

To substitute fossil fuels, biodiesel can be produced from vegetable oils, animal fats, and waste cooking oils by transesterification with ethanol. This reaction, generally conducted in batch reactors, leads to high conversion of triglycerides into ethyl esters with diglycerides and monoglycerides as reaction intermediates and glycerol as by-product. Function of the scheme and the thermokinetic properties of the system, continuous processes may withdraw existing obstacles of batch processes such as the large number of steps, secondary reactions, stable equilibria and difficulties to separate the products. This system is complex due to phase equilibria and important coupling of phenomena (reaction, mixing, heat and mass transfers). Hence, to properly design a continuous process, numerous data are required. In this work, we transferred the batch reaction into a continuous microstructured device, which induces a better control of heat and mass transfers. Furthermore, it enables us to perform the reaction with small amounts of reactants to screen the operating conditions. The results show that reaction and separation can be carried out consecutively or simultaneously in microreactors and products can be obtained with higher purity. Continuous processes would reduce ethyl esters production costs.

Proof-of-concept of Two-stage Countercurrent Enzyme-assisted Aqueous Extraction Processing of Soybeans. Juliana Maria Leite Nobrega de Moura, Devin Maurer, Stephanie Jung, Lawrence A. Johnson, Iowa State University, Ames, Iowa, USA

Proof-of-concept of integrated continuous, two-stage, countercurrent, enzyme-assisted aqueous extraction processing of soybeans was demonstrated at pilot-plant scale (75 kg soybeans) over an eleven-day period with recycling of the enzyme used in the cream demulsification into the extraction step. Oil, protein, and solids extraction yields of 98.0 ± 0.5, 96.5 ± 0.4, and 86.8 ± 0.5%, respectively, were achieved by the integrated process. The use of a continuous three-phase centrifuge to separate solids achieved a concentrated cream fraction thereby reducing the amount of enzyme used for demulsifying the cream and recycling to extraction stages. Reduced enzyme use reduced the degree of hydrolysis (DH) when moving from laboratory to pilot-plant scale (7.2 ± 1.2 and 16.4 ± 2.0 vs. 8.8 ± 2.2 and 10.7 ± 3.0, for 1st and 2nd extraction stages, respectively). Enzymatic cream demulsification yield of 91.6% and free oil recovery of 93.0% were achieved when integrating extraction and cream demulsification. Approximately 6% of cream oil was lost during centrifugation and decantation procedures. About 79% overall free oil recovery relative to the initial amount of oil present in the extruded flakes was achieved, the remainder being unrecovered oil in the skim fraction (19%) and unextracted oil in the insolubles (2%).

Biodiesel and Value-added Glycerol Carbonate from Supercritical Dimethyl Carbonate. Zul Ilham, Shiro Saka, Department of Socio-environmental Energy Science, Graduate School of Energy Science, Kyoto University, Kyoto, Japan

Biodiesel has been successfully produced from triglycerides and dimethyl carbonate, utilizing non-catalytic supercritical dimethyl carbonate process in one-step and two-step methods. In this study, it was demonstrated that, the supercritical dimethyl carbonate process successfully converted triglycerides to fatty acid methyl esters (FAME) with glycerol carbonate and citramalic acid as by-products, while free fatty acids were converted to FAME with glyoxal.

These by-products from this process possess higher value in applications than the abundantly available glycerol. In addition, the yield of FAME is high, comparable with supercritical methanol method and satisfies the international standard for use as biodiesel fuel. Therefore, supercritical dimethyl carbonate process can be a good candidate as a non-catalytic process for biodiesel production.

High Efficiency Biorefining with Fiber Processors. J.L. Massingill[1], P.N. Patel[2], T.C. Sorensen[2], G.B Sutton[2], [1]Advanced Materials and Processes, San Marcos, TX, USA, [2]Texas State University, San Marcos, TX, USA

Dispersion free process technology has been applied to the problem of biodiesel manufacturing and refining fats and oils. The Fiber Reactor(TM) is an innovative, emulsion free processor that easily and simply handles gums and FFA in triglycerides. The following processes will be discussed:1. Removal and recovery of phospholipids by extraction with ethanolic solvent. 2. Removal and recovery of free fatty acids by extraction with ethanolic NaOH solution.3. Triglyceride to biodiesel by base catalyzed transesterification.4. Triglyceride and/or FFA to biodiesel by acid catalyzed esterification/transesterification.This new processor gives instantaneous separations and eliminates long settling times and centrifuges. The basic mode of operation and performance of the Fiber Reactor in these processes will be illustrated.

Destabilization of the Emulsion Produced during Aqueous Extraction of Dehulled Yellow Mustard Flour using Organic Solvents. S. Tabtabaei, L.L. Diosady, University of Toronto, Toronto, Ontario, Canada

Aqueous extraction is an emerging alternative to the hexane-based solvent extraction of vegetable oils since it reduces the dangers associated with processing, and eliminates organic vapour emissions to the air. Since yellow mustard oil has a sharp flavor and contains high levels of erucic acid (~36.5%), it is unsuitable for food use, but it is potentially useful for production of industrial feedstocks due to its superior lubricating properties. In this study, the aqueous extraction of dehulled yellow mustard flour was investigated. During aqueous processing much of the oil was tied up in a stable emulsion. We solubilised the yellow mustard emulsion in organic solvents such as dimethylformamide (DMF), tetrahydrofuran (THF), and 1,4-dioxane to fully recover the oil in a useful form for industrial applications. The oil distribution after aqueous extraction and the composition of the emulsion produced will be presented. The oil recovery from the emulsion was optimized, based on experimentally prepared ternary phase diagrams of DMF/oil/water, THF/oil/water, and dioxane/oil/water. The results suggest that this approach can successfully recover essentially all of the oil from the emulsion, and therefore this may be an industrially viable approach to industrial oil recovery.

Monitoring of 3-MCPD Esters Formation in Palm Oil on a Pilot Scale Refining. Muhamad Roddy Ramli, Wai Lin Siew, Nuzul Amri Ibrahim, Raznim Arni Abdul Razak, Ainie Kuntom, Kalanithi Nesaretnam, Malaysian Palm Oil Board (MPOB), Kuala Lumpur, Malaysia

The formation of 3-monochloropropane-1,2-diol (3-MCPD) esters in refined oils has been associated with high temperatures, chloride ions and acidic conditions during processing. Some studies have shown that refined palm oil has elevated amount of 3-MCPD esters as compared to

other oils due to high deodorization temperature. This paper discusses the role of degumming and bleaching steps in the formation of the esters during physical refining of palm oil. Three acid activated and four natural clays with different dosages of phosphoric acid for degumming as well as water degumming were performed in a 200 kg pilot refining plant. The formation of the esters was monitored in crude, bleached and refined oils. Detectable levels of 3-MCPD esters are observed as early as at bleaching stage and significantly increased after deodorization. On the average, phosphoric acid degumming in combination with acid activated clays produced the highest amount of 3-MCPD esters in the refined oil. Lower esters content and acceptable refined oil quality could be obtained by water degumming coupled with natural bleaching clays. The study offered alternatives for palm oil refineries in producing acceptable refined oil quality with a control amount of 3-MCPD esters.

Optimized Oil Refining Process for Low 3-MCPD Palm Oil Production. Y.R. Jiang[1], W. Luo[1], Y.T. Liu[2], Y. Wang[1], L.K. Gui[3], H. Yang[1], X.B. Xu[1], [1]Wilmar Biotechnology Research & Development Center (Shanghai) Co., Ltd., Shanghai, China P.R., [2]Wilmar Edible Oil GmbH, Nordstrasse 40, D-26919 Brake, Germany, [3]PGEO Edible Oils Sdn, Bhd, Pasir Gudang, Johor, Malaysia

Occurrence of 3-MCPD (3-monochloropropane-1, 2-diol) and its fatty esters in refined edible oils, especially palm oil, has attracted great attention in the past three years. While its formation mechanism during oil refining process is being investigated, the occurrence of 3-MCPD fatty esters in each refining step has been studied. In order to avoid the 3-MCPD formation during oil refining process, many attempts have been performed, including raw materials selection, refining condition optimization, refining sequence modification and component elimination. After a sequence of optimized oil refining steps, low 3-MCPD content refined palm oil could be produced. A formation mechanism of 3-MCPD and its fatty esters during oil refining process is also proposed.

Unique Fractionation Technologies ? Its Application and Advances. Rajan Skhariya, Mecpro Heavy Engineering Ltd., New Delhi, India

PALM OIL FRACTIONATION TECHNOLOGY Palm Oil fractionation process is designed to separate Palm Oil into two fractions, Olein and Stearin without the addition of chemical or solvent. With our fractionation plant one can count on producing stable and filterable crystals giving a product which meets standard and quality requirements.Our crystallizers used for fractionation having unique design of cooling coil with a large cooling surface area. It helps in formation of better crystal nuclei on which crystals grow. The slow agitation and agitator configuration keeps the oil mass moving without stagnation close to cooling. The proper crystal developed during process are separated out by using membrane filter press allowing squeezing out the stearin cake for as much liquid olein, as possible.PROCESS METHODOLOGYGenerally R.B.D. Palm oil is used for fractionation. For getting R.B.D. Palm oil, Crude Palm oil is refined, bleached and deodorized.After getting desired quality of R.B.D. Palm oil, Oil is pre-heated upto 70oC to give a homogenerous mass with nil solid. We have provided a PHE by which oil temperature could be maintained.The physical properties of Olein and Stearin fractions, such as cloud point, slip melting point and solid fat content, are dependent on the crystallization temperature. The iodine values of the olein and stearin fractions increases as the crystallization

temperature decreases and both fractions starts to cloud at lower temperatures. The palmitic acid content of stearin and olein fractions is also affected by the crystallization temperature.

Extraction and Deacidification of Oils Using Supercritical Carbon Dioxide. Didem Yucesen, Nalan Akgun, Yildiz Technical University, Esenler, Istanbul, Turkey

Samples of several fruit seeds including watermelon, apple, pomegranate and cucumber, and spent Turkish coffee grounds were collected, and then dried in the oven. The dried samples were grounded to a powdered form using mortar. The samples were extracted in a Soxhlet apparatus using n-hexane. The oil content is ranged from 15.08% to 32.94% for pomegranate and cucumber seeds, respectively. The physical and chemical properties of all crude oils were determined using TS EN standard methods. GC analysis indicated dominant fatty acids being oleic and linoleic acids, ranging from 34.75% in apple seeds and 62.86% in watermelon seeds, respectively. However, the spent Turkish coffee grounds oil is found totally different from any of the fruit seeds oils due to high free fatty acid content and unsaponifiables. Then, all crude oils were tried to purify by supercritical CO2 extraction. The extraction conditions, i.e., pressure (143.2-176.8 bars) and temperature (41.6-58.4 °C) were optimized through an experimental design to achieve the lowest FFA content in raffinate phase. The best purity of oil was achieved as 77% for watermelon seed oil at 150 bars, 55°C and 1 h while the best quality for spent Turkish coffee grounds oil was obtained as 52%.

Importance of Soap Adsorbent in Edible Oil Refining. Sandeep Kumar Sharma, Sheel Chand Agroils Pvt. Ltd., Rudarpur, Uttrakhand, India

Soap adsorbent is useful in all edible oil refining process in batch type and continues refining process. Soap adsorbent can be remove soap particle, metal & phospholipids in neutral oil.After removal of soap from neutral oil in neutralizer, we are applied one pre-wash by hot water.which increase the loss of neutral oil and time by water wash. Soap adsorbent is required dosage is 0.08-0.15% which is depend upon soap ppm in neutral oil. Generally soap adsorbent is required 1 kg per 1 MT of neutral oil.Required quantity of soap adsorbent is charge at temp 85-90ºC with constant stirring for 20-30 minutes & than you can go next process for bleaching.Required dosage of soap adsorbent for elimination soap is two times grams soap adsorbent per mt oil. If soap ppm is 500 in neutral oil, quantity required is 500x2=1000 gm of soap adsorbent in 1 MT neutral oil.And with the help of soap adsorbent we can save Rs. 1000/MT.Corresponding Author:Sandeep Kr. SharmaVinod Vihar, Near Sandeep Gas Godown, Sharanpur-247001, IndiaE-mail: sandy38812@yahoo.comPhone: +918057827255

AFTERNOON

PRO 4: General Processing

Chair(s): J. Mulholland, N. Hunt Moore & Assoc Inc., USA; and T. Gum, Agribusiness & Water Tech Inc., USA

Improving Quality and Performance in Chemical Interesterification of Fats and Oils by

Modifying Dry Catalyst Deactivation Process. M. Jozi, M. Hatami, R&D Department, Jahan Vegetable Oil Co, Zanjan, Zanjan, Iran

Separation technique was used in dry catalyst deactivation in chemical interesterification of oils and fats to improve product quality, reduce investment costs, simplifying plant operation-maintenance and recovering byproduct.The research was done in laboratory scale and also in industrial scale. A measured quantity of blend of oils was neutralized with caustic soda and then interesterified with sodium methoxide as catalyst under reduced pressure. After this, 10 % citric acid solution (lower concentration compared to 20% conventional usage) was added to inactivate the catalyst. The reaction mixture then was remained in the reactor for proper separation of water phase. The water phase was discharged form the drain valve and the oil was sent to postbleaching unit. Postbleaching was performed with 0.2 to 1.0 % of three types of bleaching earths and postbleached oil was investigated for lovibond color, FFA, and soap content and results was compared with fat which was processed by conventional dry catalyst deactivation process. The fat which was obtained from current modification had lowest lovibond color and FFA content with minimum bleaching earth consumption.Clogging of filter leaves also minimized due to the elimination of sodium citrate salt.

Processing Posters

Chair(s): V. Jain, Mars Chocolate North America, USA

Solubility of Phosphatidylcholine in Supercritical Carbon Dioxide with Propane Co-solvent.
D.L. Sparks[1], S. Crymble[2], J. McEwen[2], R. Hernandez[2], T. French[2], [1]Department of Biochemistry and Molecular Biology, Mississippi State University, Mississippi State, MS 39762, [2]Dave C. Swalm School of Chemical Engineering, Mississippi State University, Mississippi State, MS 37962

Cells of microorganisms can contain a variety lipid types including free fatty acids, glycerides, and phospholipids. Each of these lipid classes varies in terms of molecular structure. Therefore, the selection of the proper solvent/solvent system for lipid extraction can vary depending upon the particular lipid classes being targeted. The use of pressurized organic liquid solvents (hexane, methanol, acetone, etc?) for lipid extraction from microbial matrices has been well studied. Although this technique can be very efficient in terms of the extraction, a post-extraction separation step (typically distillation) is still required to remove the solvent from the lipid extract. Supercritical carbon dioxide and subcritical propane have also been shown to be effective lipid extraction media with the additional benefit of being easily separated from solutes after extraction. In this study, the solubility of Phosphatidylcholine (a common phospholipid) in supercritical carbon dioxide with propane modifier was determined experimentally at temperatures of 308.15, 323.15, and 338.15 K and at pressures of 8, 21.5, and 35 MPa. Additionally, the experimental results were used to evaluate the efficacy of Chrastil-type models that relate solubility to solvent density.

Extraction, Isolation, and Identification of Phenolic Compounds from the Pericarps of

Camellia spp.
Haiyan Zhong, Qingming Cao, Central South University of Forestry and Technology, Changsha, Hunan, China

Camellia oil is known as "Eastern olive oil" which ranks first for its yield in woody vegetable oils in China. About 100 million tonnes of pericarp of oil-tea camellia (POC) fruit are discarded annually since camellia oil is extracted from the seed. Therefore, the integrated utilization of POC was confronted in order to develop value-added products and minimize the environmental damage. In our study, biophenols in POC were extracted, isolated and identified using ethanol/water as extracting solvent, macroporous resin purification and HPLC. The optimum extracting condition combination was that POC was extracted by ethanol and water (50/100, v/v) at 60 â?? for 60 min with the ratio of solid to solvent at 1:15 (w/v). And (9.07Â±0.21) mg GA/g the total phenol was obtained at this condition. Gallic acid, catechin, tannin were found by HPLC compared with the retention times of relevant standards compounds in phenolic extract. As part of bioactive compounds in POC, the phenolic extract could be used as antioxidant additive in food and feed.

Study on the Thermal Degradation of 3-MCPD Esters in Model Systems.
A. Ermacora, W. Acton, K. Hrncirik, Unilever R&D Vlaardingen, The Netherlands

3-Monochloropropane-1,2-diol (3-MCPD) and its esters are food-borne contaminants mainly formed during high-temperature processing of fat-containing matrices. Several studies showed that 3-MCPD esters are formed in oils during the refining process, in particular during deodorization that is typically performed at temperatures around 240-265°C. In view of their toxicity, which is currently assessed assuming that in vivo 100% of 3-MCPD is released from its esters, the study of the formation and decomposition of these compounds is nowadays a subject of great interest. Free 3-MCPD is known to readily decompose to glycerol via the intermediate epoxide, glycidol, in aqueous alkaline media. Nevertheless, very little information is available on the mechanism and kinetics of decomposition of 3-MCPD esters in non-polar media, such as oil. Previous studies showed a positive correlation of the rate of 3-MCPD decomposition with the temperature in the range 100-230°C. Aim of this work was to investigate the mechanism of decomposition of 3-MCPD esters in model systems mimicking the processing conditions of refined oils. The major degradation products were identified and the breakdown pathways deduced.

Characterisation of the Physicochemical Properties of Two Species of Dragon Fruit Seed Oil (*Hylocereus undatus* and *Hylocereus polyrhizus*).
Wijitra Liaotrakoon [1], Nathalie De Clercq [1], Vera Van Hoed [2], Koen Dewettinck [1], [1]Ghent University, Laboratory of Food Technology and Engineering, Ghent, Belgium, [2]Ghent University, Department of Sustainable Organic Chemistry and Technology, Ghent, Belgium

Oil was extracted from the seed of white-flesh (*Hylocereus undatus*; WFSO) and red-flesh (*Hylocereus polyrhizus*; RFSO) dragon fruits using a cold extraction process with petroleum ether. The delta-, gamma-, and alpha-tocopherol content, fatty acid and triacylglycerol composition, thermal and rheological properties of the extracted dragon fruit seed oils were analysed. The results showed that the dragon fruit seeds contained a high amount of oil up to

34.13%. The principal tocopherol in WFSO and RFSO was alpha-tocopherol. The total tocopherols content of RFSO was 1.6 times higher than that of WFSO. The three main fatty acids in these oils were palmitic acid (C16:0), oleic acid (C18:1) and linoleic acid (C18:2). The seed oil is interesting from a nutritional point of view: the essential fatty acid content of WFSO and RFSO counts up to 55.64% and 45.37% respectively. The main triacylglycerol in WFSO and RFSO was LLL, LLO, PLL, LOO and PLO. The thermal curves for WFSO and RFSO consisted of two main endothermic peaks with a broader temperature range around these peaks of -49.58 and 3.41 °C. The apparent viscosity of WFSO and RFSO was similar (14.24-14.32 mPa.s). Thus the dragon fruit seed oils can be considered as a new source of tocopherols and essential fatty acids.

Reducing Cloud Point of Current Biodiesel by Urea Inclusion.
Junli Liu, Bernie Tao, Purdue University, West Lafayette, IN, USA

Urea inclusion can separate linear molecules from non-linear molecules. In current biodiesel, the main components is fatty acid esters (FAEs). FAEs include linear molecules and non-linear molecules. Moreover, the linear molecules usually have high melting points. After urea inclusion, the linear high melting point components are removed and the residual biodiesel become the liquid enriched non-linear low melting point components. Consequently, the cloud point of biodiesel reduced. In this study, Urea inclusion is used to reduce serveral types of biodiesel, the cloud points of the residual after urea incluson reduced.

Efficient Separation of Tocotrienols and Tocopherol from Palm Vitamin E Concentrate Using Selective Adsorption and Desorption Method.
Vincent Teo, Shary Ong, YL Yap, Davos Life Science, Singapore

In contrast to the common antioxidant tocopherols (TP), tocotrienols (T3) were recently demonstrated to possess unique health benefits in the prevention of various chronic diseases (cardiovascular diseases and cancers). Palm vitamin E concentrate (TRF) derived using conventional process contains T3 and TP. Process to separate TP from TRF is a costly chromatographic process. Current new process modification aims to combine column separation with selective adsorption and desorption using silicagel to improve loading capability and to lower processing cost. Our result indicated that in the T3 enrichment step, T3 was directly absorbed on a fixed bed of adsorbent while TP was eluted out selectively. Subsequent T3 desorption step yielded a high purity T3 product with

Selective Enrichment of Symmetric Monounsaturated Triacylglycerols from Palm Stearin by Double Solvent Fractionation.
Kyoung Kyu Kang[1], Chan Lee[1], In-Hwan Kim[2], Byung Hee Kim[1], [1]Department of Food Science and Technology, Chung-Ang University, Anseong, Gyeonggi-Do, Republic of Korea, [2]Department of Food and Nutrition, Korea University, Chungneung-Dong, Sungbuk-Gu, Seoul, Republic of Korea

The aim of this study was to produce a fractionated palm stearin enriched in symmetric monounsaturated triacylglycerols (SMUT), such as 1,3-dipalmitoyl-2-oleoyl-glycerol (POP), 1-palmitoyl-2-oleoyl-3-stearoyl-*rac*-glycerol (POS), and 1,3-distearoyl-2-oleoyl-glycerol (SOS)

using a two-stage acetone fractionation. Palm stearin containing 35.5% total SMUT (30.2% POP, 4.9% POS, and 0.4% SOS) along with 29.4% tripalmitin (PPP) was used as a starting material for the fractionation. A liquid phase fractionated from palm stearin under the optimal conditions (temperature, 17 °C; weight ratio of palm stearin to acetone, 1:8; fractionation time, 8 h) established in the study is free of PPP (

Juniperus Extraction: A Comparison of Species and Solvents.
F. Eller, J. Teel, NCAUR, USDA, ARS, Peoria, IL, USA

The effectiveness of three solvents, hexane, ethanol and methanol were compared for their ability to extract non-polar and polar materials from the wood of three Juniper species. The bioactivity of these extracts against wood-rot fungi was also investigated.