inform **June 2012** Volume 23 (6) 337–400

www.aocs.org

inform

AOCS

International News on Fats, Oils, and Related Materials

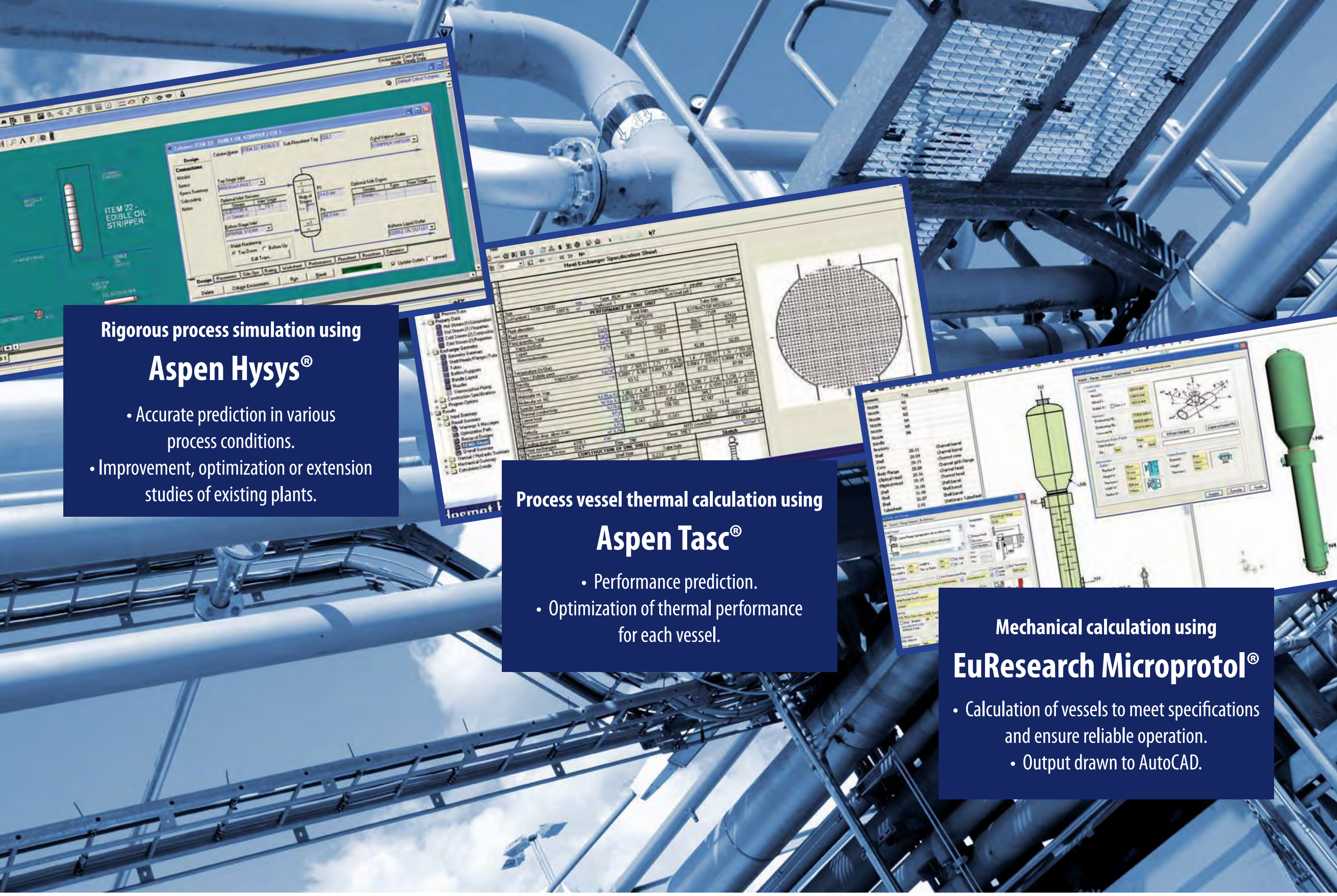
SCIENCE & MODERN ART

ALSO INSIDE

Hydrocolloids in personal care

Sustainable coatings

Making grease with microwaves


Rigorous process simulation using
Aspen Hysys®
• Accurate prediction in various process conditions.
• Improvement, optimization or extension studies of existing plants.
Process vessel thermal calculation using
Aspen Tasc®
• Performance prediction.
• Optimization of thermal performance for each vessel.
Mechanical calculation using
EuResearch Microprotol®
• Calculation of vessels to meet specifications and ensure reliable operation.
• Output drawn to AutoCAD.

On the cover: Tubes of Gimborn artists' oil paint from the 1920s, courtesy of Francesca Caterina Izzo and Klaas Jan Van den Berg.

Departments and Information

AOCS Mission Statement
To be a global forum to promote the exchange of ideas, information, and experience, to enhance personal excellence, and to provide high standards of quality among those with a professional interest in the science and technology of fats, oils, surfactants, and related materials.

inform • International News on Fats, Oils, and Related Materials
ISSN: 0897-8026 IFRMEC 23 (6) 337–400

www.aocs.org

inform

AOCS

June 2012 Volume 23 (6) 337–400

Calendar

For details on these and other upcoming meetings, visit www.aocs.org/meetings.

July

July 8–13, 2012. 20th International Symposium on Plant Lipids, Seville, Spain. Information:
ispl2012.org.

July 9–12, 2012. 8th Asia-Pacific Conference on Algal Biotechnology, Adelaide, Australia. Information: sapmea.asn.au/conventions/apcab2012/index.html.

July 12–15, 2012. Kern Lipid Conference, Vail, Colorado, USA. Information: kernconference.org.

July 15–20, 2012. FASEB Conference: Phospholipid Metabolism—Disease, Signal Transduction, and Membrane Dynamics, Saxtons River, Vermont, USA. Information: https://secure.faseb.org/faseb/meetings/Summrconf/Programs/11524.pdf.

July 22–27, 2012. FASEB Conference: Lipid Droplets—Metabolic Consequences of the Storage of Neutral Lipids, Snowmass Village, Colorado, USA. Information: https://secure.faseb.org/faseb/meetings/Summrconf/Programs/11697.pdf.

July 22–27, 2012. FASEB Conference: Lipid Signaling Pathways in Cancer, Steamboat Springs, Colorado, USA. Information: https://secure.faseb.org/faseb/meetings/Summrconf/Programs/11724.pdf.

July 30–August 1, 2012. Australian Grains Industry Conference, Melbourne, Australia. Information: australianoilseeds.com.

August

August 19–23, 2012. 244th American Chemical Society National Meeting & Exposition, Philadelphia, Pennsylvania, USA. Information: acs.org.

August 19–23, 2012. 16th World Congress of Food Science and Technology, Salvador, Brazil. Information: iufost2012.org.br/ingles.

August 23–25, 2012. Regulation of Protein Trafficking and Function by Palmitoylation, Oxford, UK. Information: biochemistry.org/Conferences/AllConferences/tabid/379/View/Conference/MeetingNo/SA139/Default.aspx.

September

September 4–9, 2012. 53rd International Conference on the Bioscience of Lipids, Banff, Canada. Information: icbl.unibe.ch/index.php?id=81.

September 5–9, 2012. 5th Global Jatropha World 2012, Jaipur, India. Information: biodieselacademy.com.

September 11–13, 2012. Royal Society of Chemistry Conference: Lipids and Membrane Biophysics, London, UK. Information: rsc.org/ConferencesAndEvents/RSCConferences/FD161/index.asp.

September 12–14, 2012. OFI Asia 2012, Kuala Lumpur, Malaysia. Information: oilsandfats-international.com or rosalindpriestley@quartzltd.com.

September 13–16, 2012. EMBO/EMBL Symposium on Diabetes and Obesity, Heidelberg, Germany. Information: embo-embl-symposia.org/symposia/2012/EES12-05/index.html.

Index to advertisers

*Corporate member of AOCS who supports the Society through corporate membership dues.

AOCS Meeting Watch

September 30–October 4, 2012. World Congress on Oleo Science & 29th ISF Conference (JOCS/AOCS/KOCS/ISF Joint Conference), Arkas Sasebo, Nagasaki Prefecture, Japan. Information: www2.convention.co.jp/wcos2012.

October 29–31, 2012. Singapore 2012: World Conference on Fabric and Home Care, Shangri-La Hotel, Singapore. Information: email: meetings@aocs.org; phone: +1 217-693-4821; fax: +1 217-693-4865; email: meetings@aocs.org; singapore.aocs.org.

April 28–May 1, 2013. 104th AOCS Annual Meeting & Expo, Palais des congrès de Montréal, Montréal, Québec, Canada. Information: phone: +1 217-693-4821; fax: +1 217-693-4865; email: meetings@aocs.org; AnnualMeeting.aocs.org.

May 4–7, 2014. 105th AOCS Annual Meeting & Expo, The Henry B. Gonzalez Convention Center, San Antonio, Texas, USA. Information: phone: +1 217-693-4821; fax: +1 217-693-4865; email: meetings@aocs.org; aocs.org/meetings.

For in-depth details on these and other upcoming meetings, visit aocs.org/meetings.

September 17–19, 2012. Soy & Grain Trade Summit, New Orleans, Louisiana, USA. Information: soyandgraintrade.com.

September 19–21, 2012. Biocatalysis in Lipid Modification, Greifswald University, Greifswald, Germany. Information: sfel.asso.fr/fr/biocatalysis-in-lipid-modification,article-91.html.

September 23–26, 2012. 10th Euro Fed Lipid Congress, Kraków, Poland. Information: eurofedlipid.org.

September 24–27, 2012. Algae Biomass Summit, Denver, Colorado, USA. Information: algaebiomasssummit.org.

September 25–27, 2012. Practical Guide to Gelling and Thickening Agents, Leatherhead, Surrey, UK. Information: leatherheadfood.com/training-and-conferences.

September 27–28, 2012. 4th European Workshop on Lipid Mediators, Paris, France. Information: workshop-lipid.eu.

September 27–28, 2012. US Regulatory Network Meeting, Bethesda, Maryland, USA. Information: leatherheadfood.com/training-and-conferences.

September 30–October 4, 2012. World Congress on Oleo Science & 29th ISF Conference (JOCS/AOCS/KOCS/ISF Joint Conference), Arkas Sasebo, Nagasaki Prefecture, Japan. Information: www2.convention.co.jp/wcos2011.

September 30–October 5, 2012. SCIX2012 (national meeting of the Society for Applied Spectroscopy), Kansas City, Missouri, USA. Information: scixconference.org.

October

October 2–4, 2012. Practical Trouble Shooting—What Can Go Wrong and How to Resolve It, Leatherhead, Surrey, UK. Information: leatherheadfood.com/training-and-conferences.

October 10–11, 2012. American Fats & Oils Association Annual Meeting, Grand Hyatt Hotel, New York. Information: phone: +1 803-252-7128; email: afoa@afoaonline.org.

October 9–11, 2012. Emulsions and Emulsifiers—Scientific Principles and Application, Leatherhead, Surrey, UK. Information: leatherheadfood.com/training-and-conferences.

October 17–19, 2012, Algae Europe 2012, Milan, Italy. Information: algaeurope.eu/en_lfm/index_alg.asp.

CONTINUED ON NEXT PAGE

inform

AOCS

2710 South Boulder Drive
P.O. Box 17190
Urbana, IL 61803-7190 USA
Phone: +1 217-359-2344
Fax: +1 217-351-8091
Email: publications@aocs.org

Advertising Instructions and Deadlines:
Closing date is approximately the first of the month preceding date of issue. Insertion orders received after closing will be subject to acceptance at advertiser's risk. No cancellations accepted after closing date. Ad materials must be in final form for press upon materials' closing date. Materials received after deadline or requiring changes will be published at advertiser's risk. Send insertion orders and mechanical materials to advertising offices at the address listed above.

NOTE: AOCS reserves the right to reject advertising copy that in its opinion is unethical, misleading, unfair, or otherwise inappropriate or incompatible with the character of *inform*. Advertisers and advertising agencies assume liability for all content (including text, representation, and illustrations) of advertisements printed and also assume responsibility for any claims arising therefrom made against the publisher.

AOCS Advertising: Liz Barrett
Phone: +1 301-215-6710 ext. 114
Fax: +1 301-215-7704
Email: ebarrett@townsend-group.com

Formerly published as *Chemists' Section, Cotton Oil Press*, 1917–1924; *Journal of the Oil and Fat Industries*, 1924–1931; *Oil & Soap*, 1932–1947; news portion of *JAOCS*, 1948–1989. The American Oil Chemists' Society assumes no responsibility for statements or opinions of contributors to its columns.

inform (ISSN: 0897-8026) is published 10 times per year in January, February, March, April, May, June, July/August, September, October, November/December by AOCS Press, 2710 South Boulder Drive, Urbana, IL 61802-6996 USA . Phone: +1 217-359-2344. Periodicals Postage paid at Urbana, IL, and additional mailing offices. POSTMASTER: Send address changes to *inform*, P.O. Box 17190, Urbana, IL 61803-7190 USA.

Subscriptions to *inform* for members of the American Oil Chemists' Society are included in the annual dues. An individual subscription to *inform* is $185. Outside the U.S., add $35 for surface mail, or add $120 for air mail. Institutional subscriptions to the *Journal of the American Oil Chemists' Society* and *inform* combined are now being handled by Springer Verlag. Price list information is available at www.springer.com/pricelist. Claims for copies lost in the mail must be received within 30 days (90 days outside the U.S.) of the date of issue. Notice of change of address must be received two weeks before the date of issue. For subscription inquiries, please contact Doreen Berning at AOCS, doreenb@aocs.org or phone +1 217-693-4813. AOCS membership information and applications can be obtained from: AOCS, P.O. Box 17190, Urbana, IL 61803-7190 USA or membership@ aocs.org.

October 21–25, 2012. ASA-CSSA-SSSA (American Society of Agronomy-Crop Science Society of America-Soil Science Society of American) 2012 International Annual Meetings, Cincinnati, Ohio, USA. Information: acsmeetings.org/meetings.

October 24–25, 2012. Oils and Fats—Production, Properties and Uses, Leatherhead, Surrey, UK. Information: leatherheadfood.com/training-and-conferences.

October 29–31, 2012. Singapore 2012: World Conference on Fabric and Home Care, Shangri-La Hotel, Singapore. Information: email: meetings@aocs.org; phone: +1 217-693-4821; fax: +1 217-693-4865; email: meetings@aocs.org; singapore.aocs.org.

November

November 4–8, 2012. 32nd Practical Short Course on Vegetable Oil Extraction, Texas A&M University, Food Protein R&D Center, College Station, Texas, USA. Information: Rich Clough, phone: +1 979-862-2262; fax: +1 979-845-2744; email: rclough@tamu.edu; foodprotein.tamu.edu.

November 6, 2012. Foundation Certificate in Sensory Principles, Leatherhead, Surrey, UK. Information: leatherheadfood.com/training-and-conferences.

November 7–8, 2012. MassSpec 2012: New Horizons in MS Hyphenated Techniques and Analyses, Biololis, Singapore. Information: sepscience.com.

November 13–14, 2012. Predicting and Controlling the Shelf-Life of Foods, Leatherhead, Surrey, UK. Information: leatherheadfood.com/training-and-conferences.

November 13–15, 2012. Health Ingredients Europe and Natural Ingredients, Messe Frankfurt, Germany. Information: hieurope.ingredientsnetwork.com.

November 19–20, 2012. World Cocoa Conference, Abidjan, Côte d'Ivoire. Information: icco.org.

November 27–29, 2012. Chocolate Confectionery Production, Leatherhead, Surrey, UK. Information: leatherheadfood.com/training-and-conferences.

December

December 6–9, 2012. World Congress on Clinical Lipidology, Budapest, Hungary. Information: clinical-lipidology.com.

2013

March 17–22, 2013. Pittcon 2013, New Orleans, Louisiana, USA.

April 7–11, 2013. 245th American Chemical Society National Meeting & Exposition, New Orleans, Louisiana, USA. Information: acs.org.

April 28–May 1, 2013. 104th AOCS Annual Meeting & Expo, Palais des congrès de Montréal, Montréal, Québec, Canada. Information: phone: +1 217-693-4821; fax: +1 217-693-4865; email: meetings@aocs.org; AnnualMeeting.aocs.org.

May 29–31, 2013. 11th Yeast Lipid Conference, Halifax, Canada. Information: yeastlipidconference.tugraz.at/Future.htm.

June 10–12, 2013. 9th World Surfactant Congress and Business Convention, Barcelona, Spain. Information: cesio-congress.com.

July 13–17, 2013. Institute of Food Technologists' Annual Meeting and Expo, McCormick Place, Chicago, Illinois, USA. Information: ift.org.

September 8–12, 2013. 246th American Chemical Society National Meeting & Exposition, Indianapolis, Indiana, USA. Information: acs.org.

September 17–21, 2013. 54th International Conference on the Bioscience of Lipids, Bari, Italy. Information: icbl.unibe.ch/index.php?id=81.

September 18–20, 2013. oils+fats 2013, Munich, Germany. Information: oils-and-fats.com.

October 9–10, 2013. American Fats & Oils Association Annual Meeting, New York, New York, USA. Information: americanfatsandoilsassociation.com.

October 27–30, 2013. 11th Euro Fed Lipid Congress and 30th ISF Lectureship Series, Antalya, Turkey. Information: eurofedlipid.org/.

2014

March 2–7, 2014. Pittcon, Chicago, Illinois.

March 16–20, 2014. American Chemical Society, Dallas, Texas, USA. Information: acs.org.

May 4–7, 2014. 105th AOCS Annual Meeting & Expo, The Henry B. Gonzalez Convention Center, San Antonio, Texas, USA. Information: phone: +1 217-693-4821; fax: +1 217-693-4865; email: meetings@aocs.org; aocs.org/meetings. ■

What's new with you?

Retiring? Moving? Celebrating an anniversary? Recent promotion? New child? Won an award? AOCS wants to help you spread the good news. Let us know what's going on. Email us and we'll share your news in the next AOCS member newsletter. Contact Nicole Philyaw at nicolep@aocs.org

Science and MODERN ART

Imagine you have just discovered an oil painting in your attic, signed by Dutch-American abstract-expressionist Willem de Kooning (1904–1997).

Catherine Watkins
Catherine Watkins is associate editor of inform *and can be reached at cwatkins@aocs.org.*

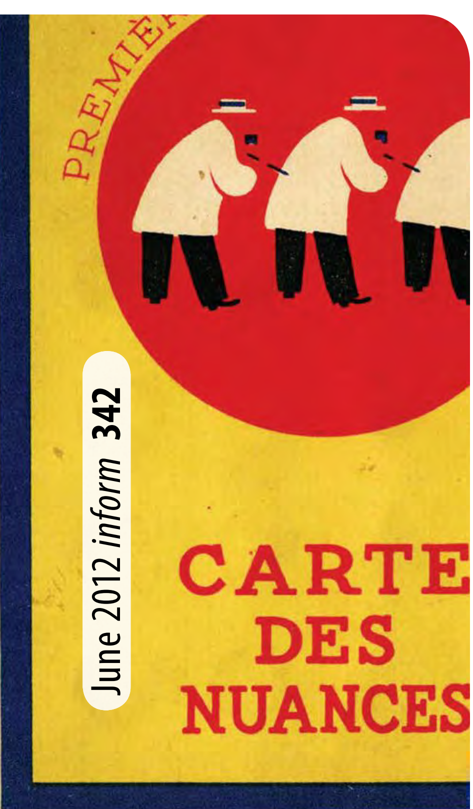
Your initial feeling of elation and visions of early retirement quickly pass. Even though one of de Kooning's paintings sold for $137.5 million in 2006, this one probably is worth much less. In fact, it is a mess. The paint is weeping long, sticky drips up to 20 cm in length. Some of the colors have faded. It looks as if the support is inexpensive fiberboard or wood pulp paper. It clearly needs an intervention by trained specialists.

This hypothetical art emergency mimics those faced every day by art conservators and conservation scientists, particularly as they deal with Western artworks created after the introduction of manufactured oil paints in the late 1800s. These scientists grapple with complex issues of materials science that involve establishing what materials the artist used as well as how the materials react with each other, with environmental conditions, and with conservation compounds and methods.

"I think this period of the first 50–60 years of the 20th century is extremely interesting," says Francesca Casadio, Andrew W. Mellon senior conservation scientist for the Art Institute of Chicago. "It challenges analytical techniques. While we are equipped with a suite of extremely powerful analytical tools for inorganic materials characterization—such as micro-Raman, electron energy loss spectroscopy, and the like—we are not as well equipped for organic materials analysis and mapping at a variety of length scales, from nano to macro."

The pressing need to reverse-engineer the formulation of 20th-century oil-based paints before artworks deteriorate has led to the use of a variety of old and new analytical methods, including a novel gas chromatography-mass spectrometry (GC-MS) method developed as part of her dissertation by an Italian post-doctoral researcher named Francesca Caterina Izzo. (See Table 1 for a representative sampling of investigative techniques.)

Her method aims to tease out information about lipid binders and additives that have been used in historical and modern commercial oil paints as well as characterizing their alterations over time.



Background

Relatively little is known—generally speaking—about artists' techniques and materials over time because most often painters were too busy creating to document the details of their work. Until the 1800s, the "Old Masters" worked within a guild system, teaching apprentices their often secret techniques. The formulation of hand-mixed oil paints remained static from roughly 1500 forward. The rise of industrial chemistry in the 1800s brought new materials with proprietary formulations to the studio at a time when the breakdown of the guild system led

One forensic challenge for art conservators is distinguishing oil-based house paints such as those made by the Ripolin company from tube paints in the early 20th century works of Picasso, among others. Courtesy of the Copyright Conservation Department, the Art Institute of Chicago.

to a proliferation of experimental techniques and media.

The organized scientific study of artworks is fairly recent; the Louvre, for example, opened its conservation laboratory in 1931. Halting degradation is a complex endeavor. After all, paintings are complicated three-dimensional objects, consisting of a support; a ground layer or layers, which prepare the support for painting; the actual painting; and often—in older paintings—a top layer used to protect the painting and, sometimes, affect the color saturation by the refraction of light. The support can be wood, canvas, cardboard, or any other material an artist chooses. Part of the detective work done by conservators is establishing the identity of all these materials, as well as the intent of the artist in using them—no small feat.

Since the mid-15th century, artists have favored linseed, poppyseed, and walnut oils to mix with pigments; over time, these drying oils solidify and bind pigments permanently to the ground layer. Oxidation of the drying oils creates a tough film, but the pigments often lose saturation as the medium leaches out into the absorbent grounds, scattering light on the surface. Thus, the Old Masters varnished their work with natural resins. It should be noted that a majority of modern painters have steered clear of varnish, leading to other conservation and cleaning problems outside the scope of this article.

Modern manufactured paints cater to the mass amateur market; permanence is not the goal. In the early 20th century, new synthetic resin binders came on the market, and artists such as Pablo Picasso (1881–1956) and Jackson Pollock (1912–1956) were quick to experiment with new materials such as house paints and even commercial automobile enamels. Oil paints, though, were never completely supplanted after the shift from paints that traditionally were hand-mixed in the atelier to high-volume commercial production of proprietary formulations using additives such as stabilizers, dispersion agents such as metal stearates or soaps, and drying agents such as metallic salts. Other additives include water, waxes, resins, fillers, and adulterants, particularly in less expensive paints.

CONTINUED ON PAGE 345

Table 1. Some investigative techniques used in the conservation of modern oil paintings[a]

Technique	Advantages	Disadvantages	Uses
X-ray	Noninvasive.	Penetrates below superficial layers.	Identification of double-paintings and other changes not visible to the naked eye.
OM	Can address layering issues and questions about artists' techniques.	Some analyses require excised samples.	Characterization of pigments, textile fibers, paper fibers, woods, and corrosion products. Also useful to gain information about gross surface features.
SEM-EDS	Can be used to examine a diverse range of artists' materials and their associated degradation products.	Some analyses require excised cross sections.	Examination of the layered structure of an oil painting through analysis of cross sections.
XRF	Nondestructive; no pretreatment required.	Penetrates below superficial layers.	Characterization of pigments, driers, and inorganic materials.
FT-IR	Versatile, sensitive, fast; when attenuated total reflectance accessory is used, no preparation of samples is required.	Interference peaks when analyzing complex mixtures; FT-IR distinguishes between families (such as oils, proteinaceous binders, and so on) but not different kinds of substances within the same family.	Characterization of binding media and degradation by-products as well as characterization of inorganic and organic compounds based on their functional groups.
TG	Gives information on percent mass losses of a sample when the temperature is raised as a function of time; can operate in reactive or inert atmosphere.	Destructive technique (a few mg are needed).	Identification and quantification of compounds; characterization of the stability and behaviors of oil paints and additives.
DSC	Qualitative and quantitative analysis of physical transitions (such as exothermic and endothermic processes) occurring in a sample subjected to a programmed variation of temperature (e.g., glass transition, crystallization, melting); can operate in reactive or inert atmosphere.	Destructive technique (a few mg are needed).	Identification and quantification of compounds; characterization of the stability and behaviors of oil paints and additives.
GC-MS	Combines gas-liquid chromatography and mass spectrometry to identify different substances within a sample, also from complex mixtures; allows for the study and identification of organic materials; extremely sensitive.	Destructive technique (less than 1 mg is needed).	Used to separate mixtures of chemicals into individual components; of fundamental importance in the study of organic oil and proteinaceous binders and identification of waxes and low-molecular-weight natural resins containing di- and triterpenes.

[a]Abbreviations: X-ray, X-radiography; OM, optical microscopy; SEM-EDS, scanning electron microscopy with energy-dispersive spectrometry; XRF, X-ray fluorescence spectroscopy; FT-IR, Fourier-transform infrared spectroscopy; TG, thermogravimetry; DSC, differential scanning calorimetry; GC-MS, gas chromatography-mass spectrometry.

Francesca Caterina Izzo works with oil paint samples in the RCE (Rijksdienst voor het Cultureel Erfgoed) laboratory in Amsterdam.

In addition to the traditional drying, or siccative oils—linseed, poppyseed, and walnut—20th-century paint manufacturers used other drying or semidrying oils, sometimes as less-expensive alternatives to linseed oil. Commonly used vegetable oils include sunflower, safflower, soybean, tung, perilla, rapeseed, castor, and cottonseed. Generally, oil binders were not listed on manufacturers' labels.

Francesca Casadio sums up the challenge faced by conservators: "We need to adopt an integrated approach. In addition to work in the lab, we need to perform industrial espionage by researching the patent literature, technical manuals, and industrial publications. In fact, the more we know about what went into these paints, the more we will be able to tailor our analytical techniques to find those minor components."

Even if art conservationists had the luxury of complete data on all proprietary paint formulations and knowledge of what oil paints were used on which paintings, there is a further complication: the artists themselves, endlessly experimenting with media. The weeping de Kooning is a perfect illustration. From the mid-1960s to the mid-1970s, de Kooning famously whipped together blended paints, safflower oil (a nondrying oil), water, and kerosene or another solvent. He worked by feel and not by formula, adding oil and water on an as-needed basis. Then he covered the mixtures with plastic wrap. They remained workable for weeks. But they also have never fully dried even to this day and thus are in a particularly vulnerable condition.

GC-MS to the rescue

Enter Francesca Caterina Izzo, who currently is a postdoctoral researcher in conservation science at Ca' Foscari University of Venice. Her doctoral research, completed in 2011, investigated 20th-century manufactured oil paints by developing a GC-MS method for the detection of lipidic binders and additives. Part of the research was conducted at RCE (Rijksdienst voor het Cultureel Erfgoed) in Amsterdam, Netherlands. The work was completed under the supervision of Klaas Jan Van den Berg and Henk Van Keulen within the 20th Century Oil Paints Project, which was carried out by RCE in collaboration with the Courtauld Institute of Art and the Tate in London and the Getty Conservation Institute in Los Angeles.

"Industrial artists' oil paints contain not only oils and pigments, but also a huge variety of additives," Izzo notes. "Additives such as metal stearates and other lipidic materials are often used in low concentrations (<5%) and are very difficult to detect and quantify."

CONTINUED ON NEXT PAGE

Cans from the historic paint collection of the Art Institute of Chicago. Courtesy of the Copyright Conservation Department, the Art Institute of Chicago.

Izzo's innovative methodology for the detection of different oils, metal stearate, and fatty acid additives was developed by analysis of selected oil paint films. Films were prepared *ad hoc* with variable and known amounts of the same ingredients that were used in modern manufactured artists' oil paints. In addition, commercial tube oil paints from Winsor & Newton, Old Holland, Talens, Gimborn, HKS, and Maimeri were tested. Then, Izzo and her team analyzed samples from 20th-century oil paintings.

The method employs a simplified extraction procedure with an alternative derivatization process. It aims to detect lipidic additives through a one-step extraction and is performed on about 0.1 mg of sample using a mixture of methanol and chloroform to separate the free fatty acids and glycerol from the glycerides and metal soaps. After extraction, residue and extract are derivatized with TMTFTH [(*m*-trifluoromethylphenyl)trimethylammonium hydroxide)] in methanol (MethPrepII™) and analyzed using GC-MS.

Izzo's method allows for the identification of various oil binding media and the detection of metal soaps additives at a 1% concentration. By using this technique, commercial oil paints and samples from actual paintings appeared to contain different kinds of drying, semidrying, and nondrying oils, small amounts of metal soaps (as aluminum and zinc soaps), free fatty acids, and hydrogenated castor oil.

Real-world use of the method

Izzo and her team performed GC-MS analyses on a number of paintings, including works by Lucio Fontana (1899–1968), in collaboration with restorer Barbara Ferriani and the Lucio Fontana Foundation in Milan. One of the most important Italian artists of the 20th century, Fontana was also a philosopher of art and a founder of the Spazialismo movement.

"The name 'Spazialismo' is an homage to the contemporaneous spatial explorations," explains Izzo in her dissertation, "which Fontana related to the 'artistic space,' or the space where art and scientific and technological discoveries meet."

One Fontana painting the researchers examined is a monochromatic pink oval painting on canvas with punctures, slashes, and graffiti. Their analyses outlined the presence of a lipidic binding media consisting of a mixture of linseed oil and rapeseed oil (a nondrying oil). After extraction, transesterification, and GC-MS analysis, the paints showed the presence of stearates (2–5%) in the paint formulation, used as dispersion agents.

"The painting showed a particular degradation observed in the painted surfaces: whitish spots spread all over the surface. The spots might have been the result of the presence of a mixture of linseed oil with a rapeseed oil containing a high amount of unsaturated acids," Izzo says. "In fact, oleic, erucic, and gondoic acids were detected almost 50 years after the creation of the painting. These

THE PHILOSOPHy OF SAMPLING IN ART OBJECTS

As Francesca Caterina Izzo notes in her dissertation: "Taking samples is surely a kind of destructive action as it requires the exportation of material fragments from the work of art. Nevertheless, it has to be stressed that the sample's dimensions are very small normally, in the order of 10^{-3} g or less, often comparable to falling fragments due to the natural degradation processes.

"So, the 'sacrifice' of art samples is one of the most advantageous operations, as it allows the characterization of art production constituents, the determination of the state of conservation of art objects, and the identification of degradation causes.

"Sampling areas must be chosen in a rational way, considering the artistic and historical background as well; a programmed sampling is always related to the purposes of the analytic approach.

"Sampling cannot damage the reading and the formal content of the work of art. Samples have to be as significant as possible, few in number, and tiny. Fragments may be taken by abrading the surface with a scalpel (for example to analyze superficial particulate) or by exporting with a micro-scalpel a sample in its entirety."

unsaturated fatty acids could have reacted with zinc white from the painted layers to form metal soaps. It is probable that zinc soaps were present as added soaps in the paint formulation and that they migrated and agglomerated on the surface, creating white spots."

Another piece the group analyzed belonged to Fontana's *Concetto Spaziale* (Olii) series. "The wrinkles and widespread craquelures [fine patterns of cracks], which tended to detach from the fabric support, were due to the presence, as a medium, of castor oil and not to environmental factors such as aging, humidity, heat, or radiation," says conservator Barbara Ferriani of Milan. Knowing this helped her to find the right intervention in the consolidation of the pictorial layers, she added.

Next steps

Much more analytical work remains to be done to ensure the conservation of modern oil paintings, according to Izzo, Casadio, and Ferriani.

"So far, scientific research has largely overlooked 20th-century oil-based paints, so that their specific characteristics and physicochemical response to aging and conservation treatments are poorly understood," says Casadio. "Advancing the knowledge of their characteristics and performance under stress is very important for preserving their integrity for future generations. At the same time, industrial polymers and coatings based on triglyceride oils utilize similar cure chemistries to that of many artists' oil-based paints and are receiving an increasing amount of attention as sustainable replacements for traditional synthetic coatings. Thus, investigation of oil-based paints has high societal benefits with ramifications extending far beyond the art world." ■

information

- Burnstock, A., K.J. van der Berg, S. de Groot, *et al.*, An investigation of water-sensitive oil paints in the 20th century paintings, in T.J.S. Learner, P. Smithen, J. Krueger, and M.R. Schilling (eds.), *Modern Paints Uncovered*, The Getty Conservation Institute, Los Angeles, California, USA, 2008, pp. 177–188.
- Lake, S., S.Q. Lomax, and M.R. Schilling, A technical investigation of Willem de Kooning's paintings from the 1960s and 1970s, *Preprints of the 12th Triennial Meeting of the International Council of Museums Committee for Conservation, Lyon, 29 August–3 September 1999*, Vol. 1, London: James and James (Science Publishers) Ltd., London, UK, 1999: pp. 381–385.
- Izzo, F.C., 20th century artists' oil paints: a chemical-physical survey (2011). Available online at dspace.unive.it/bitstream/10579/1100/1/tesi_Izzo.pdf.

Hydrocolloids get personal

Laura Cassiday

For decades, food manufacturers have added hydrocolloids such as xanthan gum, pectin, and carrageenan to give salad dressings, jams, ice creams, and other foods their characteristic textures. Hydrocolloids are substances that alter the flow properties, or rheology, of aqueous solutions in which they are dispersed. More recently, these food ingredients have found a fit in the personal care industry, where they often replace synthetic chemicals with similar properties. Driven by consumers' thirst for "all-natural" products, many manufacturers are trying to leverage the long history of hydrocolloids in the food industry for personal care applications.

COURTESY OF CP KELCO.

"Technically, there's not much difference between Thousand Island salad dressing and facial moisturizer," says Arthur Rich, a cosmetic chemist consultant and founder of A. Rich Development, LLC, in Chestnut Ridge, New York, USA. Hydrocolloids that make a salad dressing feel rich and creamy can impart similar characteristics to a moisturizer or body lotion. Hydrocolloids already appear in the ingredients lists of many lotions, creams, hair care products, shower gels, sunscreens, toothpastes, antiperspirants/deodorants, and cosmetics.

Hydrocolloid functions

Hydrocolloids are hydrophilic polymers derived from plant, animal, microbial, or synthetic sources. When added to water, hydrocolloids disperse evenly as microscopic particles. At sufficiently high concentrations, the polymers become entangled with each other, forming loose networks that change the flow and spread properties of solutions. Many hydrocolloids, such as gelatin and pectin, can form gels by hydrogen bonding within and between polymers. The structure, charge, and concentration of a hydrocolloid and its interactions with other ingredients determine the rheology of the solution.

In addition to acting as rheology modifiers, hydrocolloids serve other functions in personal care products. By surrounding oil droplets in oil-in-water emulsions, hydrocolloids can prevent the droplets from coalescing. This droplet stabilization helps prevent products from separating, settling, or clinging to their container and improves their heat resistance. Some amphiphilic hydrocolloids, such as acrylate copolymers, can actually penetrate the oil-water interface of a droplet. By reducing the interfacial tension, amphiphilic hydrocolloids can make it easier to produce small oil droplets in an aqueous solution.

CONTINUED ON NEXT PAGE

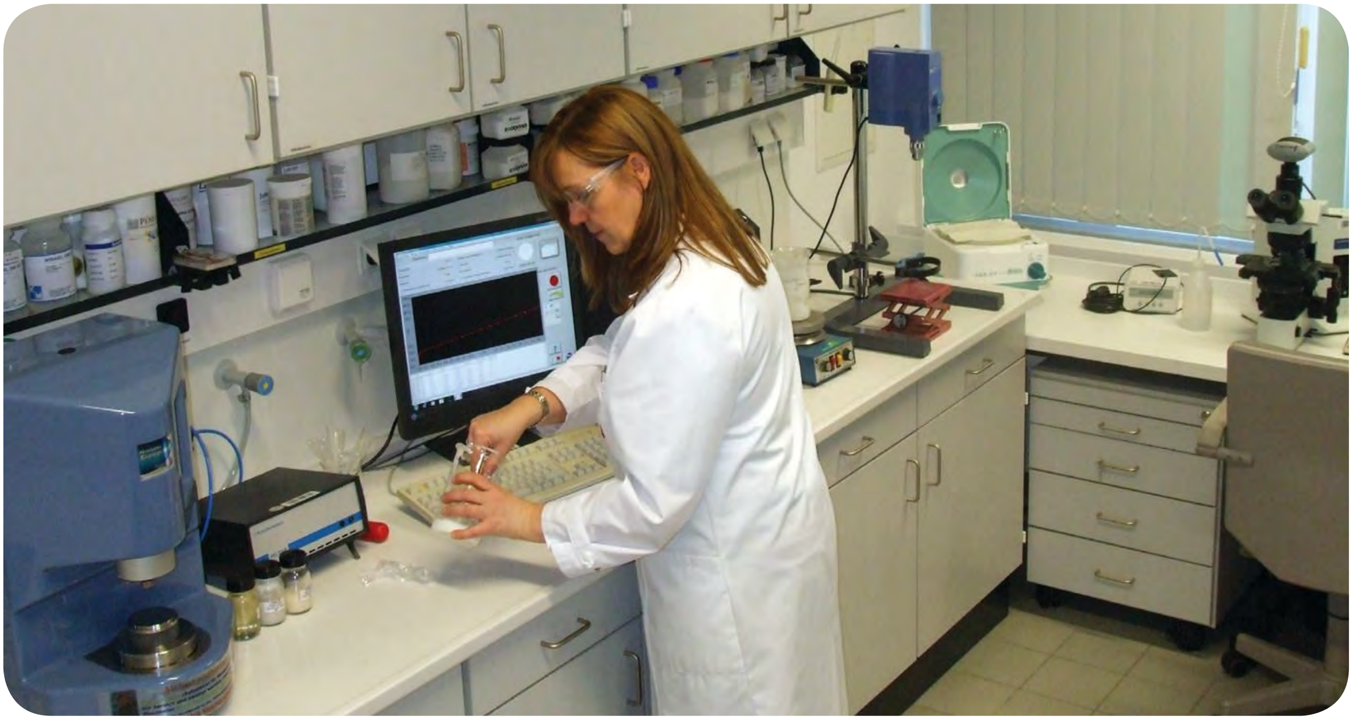


FIG. 1. *A researcher in a cosmetics laboratory uses a rheometer to measure the flow properties of a formulation. Courtesy of Azelis, Moers, Germany.*

Another important function of hydrocolloids is to reduce the tendency of a fluid to thin upon agitation—the so-called thixotropic behavior. Reducing thixotropy is particularly important for sunscreens, says Holger Seidel, senior technical service manager at Azelis Kosmetik, GmbH, which is based in Moers, Germany. Azelis is the leading pan-European distributor of specialty chemicals, including hydrocolloids.

"When you apply sunscreen to your skin, the formulation breaks down immediately," says Seidel. "If the structure is not able to recover very quickly, then the sunscreen will flow into your wrinkles, and your skin will not be completely protected." Hydrocolloids help the sunscreen emulsion recover its structure after application, allowing uniform and long-lasting protection from the sun.

Hydrocolloids also make formulations more aesthetically pleasing. "Hydrocolloids allow your toothpaste to be extruded from the tube with a lovely shape and stay on your brush," says Marie-Laure Roumiguière, pharma and personal care category manager in Paris, France, at Cargill Texturizing Solutions, an international producer of texturizers and emulsifiers. Hydrocolloids can help suspend millimeter-sized particulates, such as luffa sponges or plastic beads, in exfoliating cleansers, or enhance a cleanser's foaming action. They also contribute to the "skin feel" of a cream or lotion—whether the product feels rich, creamy, sticky, slippery, or stringy when applied to the skin.

Some hydrocolloids used in moisturizers form films on the skin surface. "When the product dries down, the hydrocolloid leaves a film that inhibits the evaporation of moisture from the skin," explains Rich.

Many hair care products contain hydrocolloids as lubricants. "Hair is in one of its most vulnerable states when it's wet," says Jeni Thomas, principal scientist and scientific communications manager at Procter & Gamble (P&G) in Cincinnati, Ohio, USA. "Using hydrocolloids is a great way to provide the lubrication that helps keep hair protected from breakage during washing and wet combing."

Hydrocollloid sources

Common synthetic hydrocolloids are acrylic acid polymers, also known as carbomers. Natural hydrocolloids are derived from plant (pectin, carrageenan, cellulose gum, locust bean gum), animal (gelatin), or microbial (xanthan gum, gellan gum) sources.

"If you've ever had old cabbage in your refrigerator that gets a bit slimy, there's actually a bacterium, *Xanthomonas campestris*, that consumes the natural sugar of the cabbage and produces a protective gum, which is in essence xanthan gum," says Bruce Hein, global positioning manager at CP Kelco, an international producer of specialty hydrocolloids with headquarters in Atlanta, Georgia, USA. CP Kelco's facilities ferment *X. campestris* on an industrial scale. They then purify and further process the xanthan gum into special grades that impart specific rheological properties. Other natural sources of hydrocolloids are shown in Table 1 on page 352.

Some chemical manufacturers have combined science with nature to generate semisynthetic hydrocolloids. For example, chemists produce cellulose gum by adding carboxymethyl groups to the backbone of cellulose, a polysaccharide derived from wood pulp or cotton. The carboxymethyl group imparts a negative charge to cellulose and makes it water soluble. Specific modifications to the cellulose backbone influence the rheology and thixotropy of the solution.

Synthetic hydrocolloids offer certain advantages over their natural counterparts, such as increased potency, resistance to microbial degradation, and solution clarity. However, many manufacturers of personal care products are trying to replace synthetic hydrocolloids with natural ones in order to satisfy consumer demand. "There's a trend in the personal care industry to move away from the more chemical-sounding products to food ingredients that are more familiar to the consumer," says Hein.

"Natural" hydrocolloids

According to a 2011 research study published by Market Publishers Ltd., the US consumer market for natural and organic skin care, hair care, and makeup boomed 61%—to $7.7 billion—from 2005 to 2010. As a result, many manufacturers are jumping on the all-natural bandwagon, seeking a "green" stamp of approval from natural-product-certifying agencies such as ECOCERT and the Natural Products Association.

However, the standard for what constitutes "natural" can vary greatly among certifying agencies, particularly with regard to semisynthetic ingredients. "There's no strict definition of 'natural' in the personal care industry," says Phillip Mitteness, technical development manager at Univar, a global chemical distributor with a personal care industry focus, headquartered in Redmond, Washington. USA. "Many personal care companies are looking to certifying agencies to provide them with a definition."

But for personal care companies eager to go green, finding a natural replacement for a synthetic hydrocolloid isn't trivial. "When you switch from a synthetic hydrocolloid to a natural version, the product appearance completely changes," says Seidel. "You don't have the same flow properties, you may have a lumpy appearance, and the formulation is no longer crystal clear."

"There's typically a tradeoff between having a natural product, and aesthetics or performance," agrees Mitteness. "And of course, the price goes up for natural products."

Some manufacturers try to grasp the best of both worlds by using semisynthetic hydrocolloids, which they can advertise as being "naturally derived." In 2009, P&G launched the Pantene® Nature Fusion hair care collection. Key to the line's marketing approach is that Nature Fusion products contain a chemically modified version of cassia gum, a hydrocolloid from the seeds of a legume native to India. Pantene scientists found that adding hydroxypropyltrimonium cations to the cassia polysaccharide enhanced its hair-conditioning properties.

In Nature Fusion shampoo, the positively charged cassia polymer interacts with anionic surfactants to form a conditioning complex, or coacervate. "The coacervate is a very, very hydrated complex that separates out of the rinse water and deposits on the hair fiber surface," says Thomas. Even after rinsing, the modified hydrocolloid lubricates hair, minimizing friction and preventing breakage during wet combing.

Cationic polymers such as the modified cassia polymer play a different role in conditioners. "Hair has a negative charge, and the more damaged it is, the more negative charge it takes on," explains Thomas. "In conditioners, the electrostatic interaction between cationic polymers and the negative charges on hair helps reinforce weakened areas on the hair fiber." This interaction not only helps strengthen hair but also reduces static charge buildup, says Thomas.

Product formulation

Another trend in the personal care industry is a move toward low-sulfate or sulfate-free cleansers. Sulfates such as sodium lauryl sulfate are efficient emulsifiers, but they can irritate sensitive skin. Some hydrocolloids, such as hydroxypropyl methylcellulose, can perform double duty as emulsifiers. And because most hydrocolloids are large polymers, they are less likely to penetrate the skin and cause irritation.

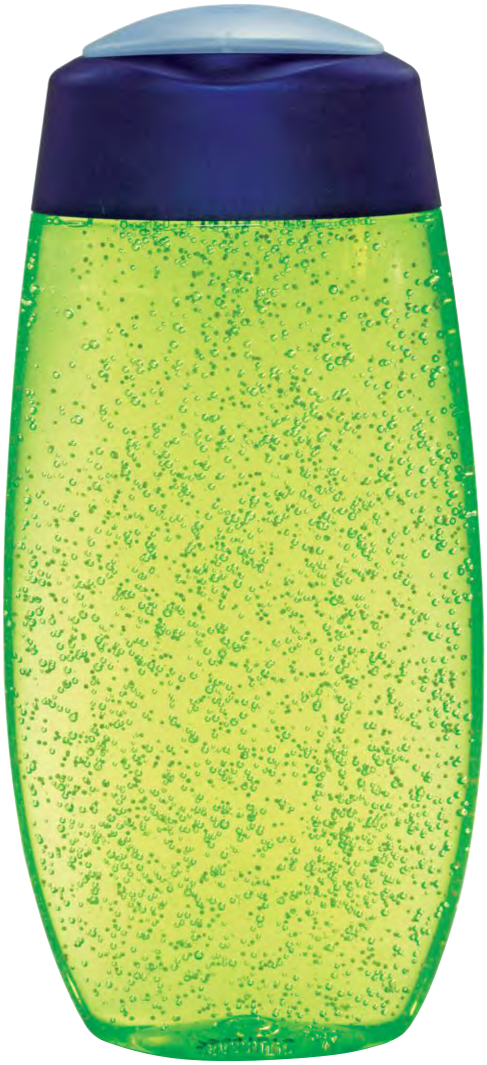


FIG. 2. *This shower gel contains xanthan gum, which helps thicken the solution and suspend cosmetic beads within the gel.*

Given all the variables that go into product formulation, selecting the appropriate hydrocolloid for a particular application can be challenging. Fortunately, many chemical suppliers and distributors offer extensive technical support for their products. According to Seidel, the technical service department at Azelis Kosmetic Germany GmbH fields about 700 technical requests per month from Germany, Austria, and Switzerland alone, some of them involving hydrocolloids. The company has a well-equipped application lab where researchers develop prototype formulas and assist customers with their technical service requests.

CP Kelco offers customers a personal care demo kit, which highlights the use of the company's hydrocolloids in product samples such as sunscreen, shower gel, hand sanitizer, body lotion, and a seaweed gel mask. The company provides the recipe for each prototype formula,

Table 1. Examples of natural hydrocolloids found in personal care products

Hydrocolloid	Source	Functions	Found In
 Cellulose gum	Wood pulp or cotton	Thickening, forming films	Lotions, shower gels, toothpaste
 Carrageenan	Red seaweed	Thickening, stabilizing, forming gels and films	Lotions, shampoos, shave gels, toothpaste
 Gellan gum	*Sphingomonas elodea* bacteria, found on water lily	Suspending, stabilizing, forming gels and films	Sprayable sunscreens, body washes, toothpaste
 Pectin	Citrus peel, sugar beets	Thickening, skin feel, pH buffering	Lotions, aftershave creams and gels
 Xanthan gum	*Xanthomonas campestris* bacteria, found on cabbage plants	Thickening, suspending, stabilizing	Lotions, sunscreens, mascara, body washes, toothpastes

Adapted from: www.cpkelco.com/market_personalcare/index.html

including the type and amount of hydrocolloid, which gives customers a baseline for formulating their own products. Other companies with marketing and technical capabilities, including Univar and Azelis, have likewise developed prototypes to assist customers in product formulation.

Ultimately, the selection of hydrocolloid depends on the desired properties of the personal care product. When choosing among the many hydrocolloids on the market, formulation chemists must consider the product's rheology, skin feel, shelf life, compatibility with other ingredients, pH range, delivery method, and whether the product is to be marketed as "natural." In addition, manufacturers and consumers alike are increasingly concerned about the sustainability of the ingredients and the environmental footprint of the production process.

Sometimes, a mixture of hydrocolloids functions better in a product than either one in isolation. "If you mix xanthan gum and carrageenan, you get different flow characteristics than you would with either separately," says Mitteness. "And when you combine two hydrocolloids in different ratios, the properties change as well."

Because the natural products movement shows no signs of losing steam, consumers are increasingly likely to recognize ingredients from salad dressing or ice cream in their moisturizer or shower gel. "It's very exciting to translate our food expertise in texturizing solutions to the personal care industry," says Roumiguière. Although the long history of food hydrocolloids provides a solid foundation, the unique demands of a wide array of personal care products will likely require innovation in the form of new hydrocolloid sources, mixtures, and modifications.

Laura Cassiday is a freelance science writer and editor based in Hudson, Colorado, USA. She has a Ph.D. in biochemistry from the Mayo Graduate School and can be contacted at lauracassiday@yahoo.com.

Briefs

In March 2012, Royal DSM N.V. (Heerlen, Netherlands) and Verenium (San Diego, California, USA) announced that DSM has acquired "certain assets, licenses, and other agreements in the area of food enzymes and oilseed processing from Verenium for a total consideration including transaction and related expenses of $37 million."

■■■

The EU-27 (minus Greece, Malta, and Luxembourg) produced 150 million metric tons (MMT) of compound feed in 2011, which was 1% below 2010 production, according to AllAboutFeed.com. "All types of production—whether cattle, swine, or poultry—have seen their production fall, with cattle feed seeing the sharpest decline at –3%. For the second year, poultry feed is the leading segment of compound feed, slightly above pig feed. Rising soybean meal prices because of high Chinese demand and seasonal drought in South America will be factors in 2012, the European Feed Manufacturers' Federation noted.

■■■

Production of Canadian sunflowerseed declined 78% in 2011–2012 after an 81.5% decline in seeded acreage, from 135,000 acres (almost 55,000 hectares) in 2010–2011 to 25,000 acres in 2011–2012, according to the National Sunflower Association of Canada (CNSA). The group said in March that it expects Canadian sunflower production will double in 2012. Confection seeds account for roughly 75% of Canada's sunflower production, CNSA said.

■■■

Bunge Ltd. (White Plains, New York, USA) announced in April 2012 that it has purchased substantially all of the assets, including the patent portfolio, of MCN BioProducts Inc., a privately held Canadian technology company. Financial terms of the transaction were not disclosed. Assets purchased include intellectual property related to the conversion of canola and rapeseed meals into nutritionally dense protein concentrates that can replace both fish meal and vegetable protein concentrates in animal diets, including aquaculture. ■

News & Noteworthy

Is it meat or vegetable?

It looks like a cutlet, it is juicy and fibrous like a cutlet, and it even chews with the consistency of a real cutlet (or so the researchers say), but the ingredients are 100% vegetable.

Researchers in the EU project known as "LikeMeat" are studying a number of plants—including wheat, peas, lupins, and soybeans—for use as meat substitutes and have also developed a new method to prepare them.

"Studies have shown that many Europeans are ready to give up meat, but there have only been a handful of alternatives until now," explains lead researcher Florian Wild of the Fraunhofer Institute for Process Engineering and Packaging (IVV) in Freising, Germany. "Our goal is to develop a vegetable surrogate for meat that is both juicy and fibrous, but that also has a pleasant flavor. The product should have a long shelf life, it should not be more expensive than meat, and be suitable for vegetarians and allergy sufferers."

In addition to the scientists at IVV, experts from the University of Natural Resources and Life Sciences in Vienna, Austria, are also participating in the development, as are consumer researchers from the University of Wageningen, in the Netherlands, and 11 small- to medium-sized corporations that manufacture or do business in food or food ingredients. The team roster also includes one Dutch and two Austrian companies that have until now only processed meat, as well as an organic food producer from Spain.

"As a group, we are seeking to engineer a simple production chain in which pure vegetable raw materials are used to produce a meat substitute that corresponds to consumer preferences," as Wild notes. "We are intentionally not tying ourselves down to one type of plant because many people get an allergic reaction to one or the other substance. In the process, we have developed a variety of recipes. They are the basis for a product spectrum that offers a broad selection to people who suffer food intolerance or allergies."

PROCESSING TECHNOLOGY

"The processing technology was the biggest challenge," recalls Wild.

CONTINUED ON NEXT PAGE

The conventional method of producing meat substitutes, in which plant proteins are mixed with a little water and heated under high pressure, proved to be useless: With this conventional hot extrusion process, the mass is heated up under high pressure. At the moment that it pushes through the die, the temperature drops dramatically, steam is released, and the mass foams up.

Instead, Wild and his colleagues used a new process especially developed for meat substitutes. The main ingredients—water and plant proteins—are brought to a boil and slowly cooled. Since no sudden release of pressure takes place, no steam blows out of the paste. As the temperature drops, the protein molecules polymerize. This gives rise to a fibrous structure that is quite similar to that of meat.

The prototype of the new vegetarian cutlet factory is currently located in the IVV laboratory. The system is no larger than two table tennis tables and can produce one continuous piece of meat approximately one centimeter thick that can be shaped as desired. The research team is currently able to produce 60 to 70 kg of the meat substitute per hour—or 300 to 500 kg/day.

"Consistency and texture are already superb," Wild contends. But he says there is still "a little work to do on the flavor."

First olive oil monitoring in US

Olive oil products are now included in the US Department of Agriculture's (USDA) fee-based Quality Monitoring Program (QMP), the agency announced in April 2012.

The program began in 2008 and currently monitors 90 commodities. Pompeian, Inc., a privately held olive oil importer based in Baltimore, Maryland, will be the first company to take part in the service. Pompeian's two major shareholders are Aïcha of Morocco and Moreno S.A., a Spanish company half-owned by Hojiblanca Group.

Monitoring consists of a two-part process beginning with a detailed quality control questionnaire and a three-week in-facility audit with product sampling to benchmark the company's quality control systems. This is followed by monthly monitoring, including announced visits. Samples collected during these audits will be sent to the USDA Blakely Laboratory (Georgia) to ensure that they match the recently revised US standards for grades of olive and olive-pomace oil.

Certification under the standard itself would have been more expensive than the quality monitoring program, according to a report in the *Olive Oil Times* (*OOT*), an online publication. *OOT* quoted a USDA official as saying that under the US standard, the agency would have "pulled a lot more samples" to achieve a "95% confidence for each lot."

Announcement of the inclusion of olive oil in the USDA QMP followed word that California olive oil producers are drafting a federal marketing order "that would set higher quality standards, redefine grades, and require new testing of all olive oil" produced in the United States, *OOT* reported. If the order is adopted by USDA, producers apparently "will push for the rules to apply to imports, too," *OOT* added.

The draft marketing order is available at tinyurl.com/CalifMO.

EPA cancels green chemistry grants

In mid-April 2012, the US Environmental Protection Agency (EPA) suddenly cancelled its long-awaited $20-million green chemistry research program without explanation, a mere three weeks before the deadline for grant applications. Several days later, the agency just as mysteriously—*sans* explanation—announced on Twitter that it would reissue the call for proposals in the third quarter of 2012.

The EPA told the *Nature News* blog by email that: "The two solicitations were cancelled in order to allow for a review to ensure new and emerging research is accurately reflected and incorporated into the request for applications. On rare occasions, solicitations are cancelled or revised when necessary to ensure the integrity of our grants process."

Originally, the agency solicited requests for proposals to fund four research centers. Two were to study the toxicity of compounds over their lifecycle, from creation and use through recycling or disposal. The other two would work on creating safer chemicals by researching what properties lead to toxicity.

For more information, see tinyurl.com/EPA-Green-Grants.

Sinapic acid in mustard seed meal

University of Alberta (Canada) researcher Christina Engels has described how to extract sinapic acid from mustard seed (*Brassica juncea*) meal. Previous work has characterized sinapic acid in rapeseed and canola, as well as in vegetables in the *Brassica* family, such as kale and cauliflower. Sinapic acid shows antibacterial effects against organisms such as *Staphylococcus aureus*, *Escherichia coli*, and *Listeria monocytogenes*, all of which can cause grave illness and even death in humans.

Engels' isolation of sinapic acid [3-(4-hydroxy-3,5-dimethoxyphenyl)prop-2-enoic acid] lends a useful function to mustard seed meal, a by-product of oil processing. Whereas the oil can be used in making biodiesel and in some Asian markets as cooking oil, "the defatted seed meal left over is currently of little economic value," said Engels.

"That means the mustard seed meal can be used as a source for natural food preservatives," she noted. Canada is the world's largest exporter of mustard seed.

The results appeared in *European Food Research & Technology* (doi:10.1007/s00217-012-1669-z, 2012).

Maggots: protein feed alternative

A British entrepreneur in South Africa believes that maggots, the larvae of the common house fly (*Musca domestica*), are a viable protein-rich alternative for making animal feed.

According to AllAboutFeed.com, "David Drew, managing director of AgriProtein Technologies, plans to set up in South Africa the world's first large-scale factory producing 'Magmeal,'" as a replacement for the fishmeal currently used to fatten up chickens and pigs.

The factory is expected to be operational at the end of 2013. The plant would consume 65,000 liters of abattoir blood per day, feeding 100 metric tons of maggots, and producing 20 MT of "Magmeal."

In related news, feed trial research in the Unites States has produced farmed marine fish with a wild fish in:farmed fish out (FIFO) ratio of less than 1:1.

Over the past five years, a series of feed trials for farmed marine fish have tested the use of soy ingredients as a replacement for fishmeal and fish oil. Recent trials conducted by Kampachi Farms (Kona, Hawaii), collaborating with the University of Nebraska, have produced farmed carnivorous fish with a FIFO ratio of 0.89:1.

An eight-month feed trial in 2011 tested an experimental diet of 40% soy protein concentrate (SPC) and a 50:50 blend of fish oil and high-α-linolenic soybean oil against a standard commercial feed traditionally used to raise kampachi (a sashimi-grade Hawaiian yellowtail). With taurine (a nonessential amino acid) added to the SPC diet, the kampachi showed improved growth rates. Also, in controlled taste tests, consumers could not detect any difference from fish raised on a conventional diet.

The oil used in the trial was developed by researchers at the University of Nebraska and has approximately 25–30% each of stearidonic and α-linolenic acids. The genetically engineered soybean is the result of the insertion of two transgenes: a Δ6 desaturase from borage and a Δ15 desaturase from *Arabidopsis thaliana*.

"Attaining a FIFO of under 1:1 has been the holy grail of marine fish feed research for some time," said Neil Anthony Sims, president of Kampachi Farms. "We show here that we can produce premium, sashimi-grade fish with a net increase in marine proteins: that is, we produce more fish than our fish eat. This represents a significant step forward for the economics and the ecological efficiencies of marine fish culture."

In 2012, Kampachi Farms will run trials to test refined diets with the SPC and soy oil, as well as incorporating a strain of microalgae into these experimental feeds as a natural source of taurine and EPA/DHA (eicosapentaenoic and docosahexaenoic acids). Future research will also include a market analysis of the cost effectiveness of these diets. ■

Sustainability watch

In April 2012, an expert group of marine scientists recommended that fishing for "forage fish" should be halved globally because of their critical role as prey for larger species.

The Lenfest Forage Fish Task Force conducted what it says is the most comprehensive worldwide analysis of forage fish populations to date. Its report, "Little Fish, Big Impact: Managing a Crucial Link in Ocean Food Webs," concluded that in most ecosystems, fishing for smaller species should be cut by 50%.

Forage fish are small- to medium-sized species such as anchovies, herring, sardines, and menhaden. The demand for them in recent decades has increased greatly because of the use of fish meal and oil in feed for farmed fish, pigs, and chickens, as well as their use in nutritional supplements for humans.

"Traditionally we have been managing fisheries for forage species in a manner that cannot sustain the food webs, or some of the industries they support," said Ellen K. Pikitch of the Institute for Ocean Conservation Science at Stony Brook University (New York, USA), who convened and led the Lenfest Forage Fish Task Force. "As three-fourths of marine ecosystems in our study have predators highly dependent on forage fish, it is economically and biologically imperative that we develop smarter management for these small but significant species."

The report is available at tinyurl.com/lenfest-report.

■■■

Procter & Gamble (P&G; Cincinnati, Ohio, USA) is offering its Excel-based environmental scorecard analysis tool free of charge to other companies. P&G estimates the scorecard has led to almost $1 billion in operational savings owing to cutbacks in energy use, water use, waste production, and carbon dioxide emissions over the past decade, according to EnvironmentalLeader.com. For more, see tinyurl.com/PG-shares-tool.

■■■

Barry Callebaut (Zurich, Switzerland) has begun a 10-year sustainability initiative to increase farm productivity, enhance quality, and improve family livelihoods in key cacao-producing countries in West and Central Africa and Indonesia, at a cost of CHF 40 million ($43.5 million). In fiscal year 2011–2012, the company said it will invest CHF 5 million in farmer training, infrastructure, and community education and health programs. The activities will be undertaken in cooperation with agricultural and development experts and government institutions. Barry Callebaut said it will focus first on large producer countries, including Côte d'Ivoire, Ghana, Indonesia, Cameroon, and Brazil, and aims to expand the initiative, called Cocoa Horizons, to other cocoa-producing countries with high development potential over the coming years. ■

ÖHMI
Aktiengesellschaft

Berliner Chaussee 66
D-39114 Magdeburg

Phone ++49-391/85 07-0
Fax ++49-391/85 07-150

E-Mail: oehmi@oehmi.de
www.oehmi.de

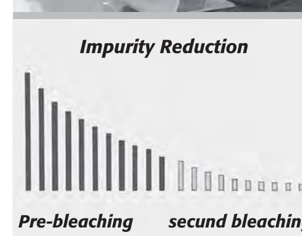
ÖHMI bleach®

get to grips with costs and quality

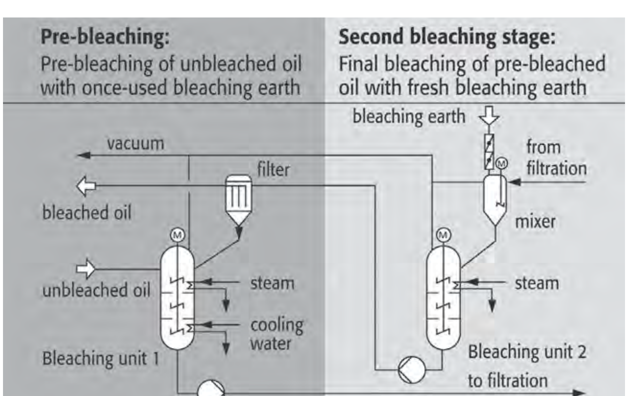
- ***Less bleaching earth***
- ***Less silica***
- ***Less activated carbon***
- ***Less oily filter cake***
- ***Less oil losses***
- ***Less handling of bleaching earth and filter cake***

www.oehmi.de

The worldwide patented ***ÖHMI bleach®*** process achieves savings in bleaching earth consumption in the region of 40 %. This technology can also be integrated into existing systems. US Patent 5,753,103



ÖHMI bleach® process diagramm



- ***Licenses***
- ***Engineering***
- ***Equipment***
- ***Plant construction***

References
Ajinomoto/Japan • Palmaju/Malaysia • Bunge/Poland...

Briefs

Qantas Airways Ltd. operated Australia's first commercial flight fueled by biofuel on April 13, 2012. The flight went from Sydney to Adelaide and back. The plane, an Airbus A330, was powered by 50% conventional jet fuel and 50% biofuel produced from used cooking oil by the Dutch company SkyNRG. This flight apparently will not be repeated in the near future. Qantas' Head of Environment John Valastro, said the goal of the flights was to raise awareness about the potential for sustainable aviation fuel in Australia. He added, "We know that sustainable aviation fuel can be used in commercial aviation just like conventional jet fuel. But until it is produced at a commercial scale, at a competitive price, the industry will not be able to realize its true benefits."

■■■

Porter Airlines has also jumped on the bandwagon for biofuels. It conducted the first biofuel-powered commercial flight in Canada in April, 2012, flying one of its Bombardier Q400 turboprop airliners on a 50:50 blend of biofuel/jet A1 fuel. The biofuel portion was derived from oil harvested from *Camelina sativa* (49%) and *Brassica carinata* (1%). Porter is a regional airline serving eastern Canada and selected US cities.

■■■

In the first quarter of 2012, Sunho Biodesel Corp. (Taipei, Taiwan) announced it had developed a new enzymatic process for production of pure monoglycerides. The process can produce a mixture of different types of monoglycerides or a neat product consisting of only one type of monoglyceride. The company's lipid-based technology uses enzymatic transesterification, esterification, and glycerolysis to produce up to 100% yield. The process takes place at room temperature, allowing production of unsaturated monoglycerides under appropriate conditions.

■■■

Science journal publisher Elsevier announced a new journal in April, *Algal Research*. Co-Editors in Chief are José Olivares, of the National Alliance for Advanced Biofuels and Bio-Products (NAABB), which is housed at the Los Alamos National Laboratory (LANL; New Mexico, USA), and Richard Sayre, who is with the Bioscience Division of

CONTINUED ON NEXT PAGE

Biofuels News

Ames scientists and students from the Undergraduate Student Research Program and Foothill DeAnza Community College worked with the Sunnyvale Water Pollution Control Plant, Calif., to measure the methane oxidized by microbes in its open ponds. Credit: Drew Detweiler

US space agency delves into algae

Two prototypes of a device called RoboAlgae have been successfully designed and constructed by scientists in the Ames Exobiology Branch of NASA, in collaboration with engineers from the Mission Development Division at the Ames Research Center (Moffett Field, California, USA) and students from Santa Clara University (California). These sensors float in algae-growing systems, for example, ponds, where they wirelessly transmit chemical and physical data to the grower, giving some indications of the health of the system. The next iterations of these sensors will incorporate technology to monitor irradiance, temperature, mixing, and weather conditions so that growers can respond to these changes.

Commercial algae growers advised the researchers, who were studying the production of lipids by different algal species under specific conditions (tinyurl.com/algaeNASAlipids), that algae for biofuel must be grown and harvested rapidly and in constant succession. To produce algae on a large scale, producers need real-time information about the health of the algae cells in ever-changing weather (or laboratory culture) conditions. Automation can help provide timely decisions for rapid crop turnovers.

The researchers are also modeling the data they are collecting to assess and predict changes in the health of algae crops. The goal is to minimize or prevent algae-growth crop crashes.

The Exobiology Branch at the Ames Research Center (part of NASA, the US National Atmospheric and Space Administration) conducts astrobiology research into the origin and early evolution of life, the potential of life to adapt to different environments, and the implications for life elsewhere. The

CONTINUED ON NEXT PAGE

LANL. The first issue of *Algal Research* appeared in May 2012. Areas that the journal plans to cover include emerging technologies in algal biology, biomass production, cultivation, harvesting, extraction, bioproducts, conversion to fuels, and econometrics. The journal will publish original scientific research papers, review articles, and invited commentaries. It is fully peer-reviewed.

■■■

OriginOil Inc. announced the release of a new entry-level, low-cost algae harvester for producers and researchers to try and, the company hopes, buy. The price of the harvester, called an Algae Appliance™ Model 4, is low enough that the company expects users to be able to upgrade industrial-scale models easily. The Model 4 has a rated capacity of about 4 liters a minute and can operate either continuously or intermittently for testing purposes. The entire process—dewatering, cell rupture, and the fi al concentration stage—are carried out in the same vessel. The manufacturer's suggested price of the Model 4 is $50,000, with credits available according to the circumstances. For further information see http://www.originoil.com/company-news/originoil-introduces-evaluation-size-algae-appliance-model-4-to-speed-adoption-of-new-harvesting-technology.html.

■■■

Research from North Carolina State University Department of Forest Biomaterials (Raleigh, USA) suggests that forest-based feedstocks including loblolly pine, natural hardwood, and eucalyptus may present more attractive financial returns [from using these as ethanol feedstocks] when compared to switchgrass and corn stover, mainly due to their composition (%C, %H, %ash) and alcohol yield. For further information see *Fuel Processing Technology 94*:113–122, 2012. ■

scientists who designed the sensors are part of the Algae for Exploration Group within that branch.

Algae to be grown for biodiesel, fish food

At the end of the first quarter World Health Energy Holdings, Inc. (WHEH; Tel Aviv, Israel) announced progress with its letter of intent with Prime Inc., an Indian industrial and transport company, to develop a facility to produce biodiesel from algae in India. The budget for the first facility will be as much as $100 million, and the site may ultimately include 250 acres (100 hectares). Proposed sites for algae biofuel development are in Tamil Nadu and Karnataka, India.

A second project, with SHK Energy Projects of India, has a proposed budget of $25 million, and will encompass 45 acres. Combined sales from the two projects are expected to bring in $200 million in revenue during 2013. Current clients of Prime Inc. include Exxon, Shell, General Electric, and Siemens (tinyurl.com/WorldHealthEnergy).

An algae enhancement technology, called GB 3000 by its developer, GNE-India, will be used to grow algae quickly and efficiently for the production of fish feed, proteins, and biofuel. WHEH recently acquired GNE-India and has exclusive rights to distribute and license the GB 3000 system in India and Croatia. The system has also been tested with *Spirulina* algae, a combination of local algal species, and *Chlorella*, to see what their productivity would be in the GB 3000 system.

Construction on both projects will begin in 2012, and WHEH Chairman Chaim Lieberman predicts they will be operational by June 2013.

Brassica carinata to be grown commercially in Canada

Saskatoon-based Agrisoma Biosciences announced on April 3, 2012, that it had selected Winnipeg's Paterson Grain as its long-term partner for identity-preserved distribution of Resonance, a variety of *Brassica carinata* (also known as Ethiopian mustard) developed for the Canadian Prairies' brown soil zone.

Resonance will be the first carinata to be grown commercially in Canada. Paterson will distribute the seeds through its outlets, which will handle commercial contracting with growers, the companies agreed. According to Steven Fabijanski, chief executive officer of Agrisoma, "The commercial introduction of Resonance . . . is the final link in the bio-jet-fuel value chain that connects Canadian growers to airline passengers, with many others performing critical roles in between" (patersongrain.com/news, dated April 6).

Agrisoma is on a steering committee, announced in 2011, to review the possibilities for feedstock production, processing requirements, potential commercial partners, logistics, and infrastructure needed to produce drop-in jet fuels on the Canadian prairies.

The Canadian government's Agriculture and Agri-Food Canada ran trials in 2009 showing that Resonance seed yielded 44% oil and 28% protein. These yields, said Agrisoma and Paterson, "deliver attractive economics for growers."

Jatropha failing in Madagascar

GEM BioFuels planted 55,737 hectares of jatropha in Madagascar between 2007 and 2009. On April 12, 2012, the company announced, "[A] lack of resources has resulted in significantly less success than had been hoped. Low intervention and maintenance following planting has resulted in a lower than anticipated number of plants reaching maturity and producing oil-bearing seeds." The board of directors of the company is now "determining a strategic plan to maximize the returns from its existing plantations, as well as how best to make use of the Company's significant presence in Madagascar for the production of other crops" (tinyurl.com/GEMjatropha).

The business, headquartered in Douglas, Isle of Man (UK), was founded in 2004 to capitalize on the opportunity presented by the local agricultural and socio-economic conditions in Madagascar to produce jatropha oil for use as a biodiesel feedstock.

RTP fuel

At the Advanced Biofuels Leadership Conference held in Washington, DC, USA, in April 2012, Honeywell-UOP and Ensyn announced two projects. These were summarized by Jim Lane, of BiofuelsDigest.com (tinyurl.com/Honeywell-UOP-Ensyn).

One pertains to the release of technology for the conversion of alcohol-to-jet fuel, suggesting that costs for producing aviation biofuels from alcohols might prove more affordable and scalable than making them from plant oils.

The other pertains to fuel made by a pyrolysis process termed "rapid thermal processing" (RTP). Ensyn claims it can produce RTP fuel, at scale, for $45 per barrel (of oil equivalent). Furthermore, the RTP fuel can be upgraded at the refinery, saving the refinery from having to blend its fuel with other fuels to achieve the desired properties. Ensyn said it can make a minimum of 70 gallons of hydrocarbon transportation fuel from a ton of wood biomass (290 liters per metric ton), and it has demonstrated the process has the potential to produce over 100 gallons per metric ton (tinyurl.com/EnsynPresentation).

Indonesia to develop aviation biofuel

With an investment of about $80 million, Wilmar Indonesia is developing a palm oil-based aviation biofuel at its biofuel plant in Gresik, East Java. Wilmar's subsidiary, PT Wilmar Nabati Indonesia, and Elevance Renewables Sciences Inc. (Bolingbrook, Illinois, USA) are collaborating in this effort.

Operation of the biorefinery in which the fuel will be manufactured began in December 2011. By the fourth quarter of 2012, production should reach 500 metric tons of biofuel per day. Of that, about 80% will be biodiesel, and 20% will be bio-olefin. The company says the latter will be directed into biojet fuel after further processing.

The *Jakarta Post* newspaper quoted PT Wilmar Nabati Indonesia Executive Director Taufik Tamin as saying, "We still need to process the chemical components further, and it may take several years to produce ready-to-use aviation biofuel suitable for jets." (tinyurl.com/WILMARbiofuel).

Solazyme, Bunge form joint venture

In early April, Solazyme, Inc. (South San Francisco, California, USA) and Bunge Global Innovation LLC, a subsidiary of Bunge Ltd. (White Plains, New York, USA), signed an agreement to form a joint venture to build, own, and operate a commercial-scale renewable tailored oils production facility adjacent to Bunge's Moema sugarcane mill in Brazil. Annual production capacity for Solazyme Bunge Produtos Renováveis is being scaled to 100,000 metric tons of oil annually.

The facility will couple Solazyme's renewable tailored oil production with Bunge's sugarcane supply and processing capabilities to produce sustainable tailored triglyceride oils for use in oleochemical and fuel applications in the Brazilian domestic market.

Solazyme's proprietary biotechnology platform creates renewable oils through the oil production capabilities of microalgae. Most microalgae produce their own cell materials by using CO_2 and sunlight in a photosynthetic process, but Solazyme's process depends on heterotrophic growth of algae. By using standard industrial fermentation equipment, Solazyme has been able to scale and accelerate the natural oil production time of microalgae to just a few days and at commercial levels.

CONTINUED ON NEXT PAGE

Oil removal from DDGs raises concerns

In the past year or so, corn oil has become a profitable niche by-product for ethanol producers, according to Dow Jones Newswires (tinyurl.com/CornOilDDGs). The oil is obtained by extraction from dissolved distillers grains (DDGs), the powdery substance remaining after ethanol producers are done with the corn they have fermented to make ethanol.

DDGs are widely used in animal feeds, in part because they are less expensive than soybean meal.

Extraction and sale of corn oil from DDGs gives ethanol producers another stream of revenue when ethanol prices fall. But animal producers may become cautious about using DDGs from which oil has been extracted because they are less effective at helping animals grow ahead of slaughter. The Dow Jones Newswire quoted Don Roose, president of US Commodities (Des Moines, Iowa, USA), as saying that as corn oil extraction "becomes more widespread, livestock producers, particularly of hogs, will begin to shift feeding back to [soy]meal."

Ethanol producers can turn a reasonable profit from corn oil once the initial investment has been made, and the Dow Jones Newswire suggests that "A backlash from livestock producers is unlikely to cause plants to rethink their corn-oil strategy."

US Navy tests biobutanol as jet fuel

The US Navy reached an agreement in March with Cobalt Technologies and Albemarle Corp. to produce biojet fuel from butanol. The biobutanol is already being produced by Cobalt Technologies at its Baton Rouge, Louisiana, USA, processing facility. Albemarle then converts the *n*-butanol into 1-butene, followed by oligomerization of the biobutene to aviation jet fuel using technology developed by Navy researchers at the Naval Air Warfare Center Weapons Division (NAWCWD, China Lake, California) working in collaboration with Cobalt (tinyurl.com/CobaltAlbemarle)

Albemarle, a catalyst manufacturer, will scale up the NAWCWD process of converting *n*-butanol to jet fuel to produce the quantities of fuel needed for ground testing. Those tests will be conducted by the Naval Air Warfare Center Aircraft Division.

Cobalt does not yet have a partner for commercial-scale production of alcohol-to-jet (ATF) fuel.

Andy Meyer, senior vice president of Cobalt for business development, pointed out that his company is focusing on jet fuel and diesel because *n*-butanol has a high cetane number, whereas isobutanol is better suited for gasoline blending because of its higher octane value

Cobalt has recently entered a partnership with chemicals manufacturer Solvay-Rhodia to build a plant in Brazil to produce *n*-butanol from bagasse. This will add to the amount already being produced in Baton Rouge (tinyurl.com/CobaltBrazil). The company anticipates commercial production by 2015, which coincides with the time scale on which ASTM plans to have approved ATJ for use.

DuPont stover project recognized

At the World Biofuels Markets 2012 Congress held in March in Rotterdam, Netherlands, DuPont and its Pioneer Hi-Bred business (Des Moines, Iowa, USA) won the Sustainable Biofuels Award in the Feedstock Innovation Category. The company was recognized for its Stover Harvest Collection Project, a collaborative endeavor involving experts in agronomy from Pioneer Hi-Bred and Iowa State University (Ames, USA), working in conjunction with custom harvest equipment manufacturers and more than 50 local farmers. The project develops knowledge on the sustainable collection, transport, and storage of corn stover for conversion to cellulosic ethanol. The project is continuing, and it will involve up to 150 farmers in 2012. The stover collected will be used in the biorefinery that DuPont is constructing in Nevada, Iowa, which should come onstream in late 2013. ■

2012

AOCS Since 1909 Your Global Fats and Oils Connection

MEMBERSHIP APPLICATION

12inf

Street Address: 2710 S. Boulder Drive, Urbana, IL 61802-6996 USA.
Mail Address: P.O. Box 17190, Urbana, IL 61803-7190 USA.
Phone: +1 217-693-4813; **Fax:** +1 217-693-4857; **Email:** membership@aocs.org; **Web:** www.aocs.org

Please print or type. All applicants must sign the Code of Ethics.

❑ Dr. ❑ Mr. ❑ Ms. ❑ Mrs. ❑ Prof.

Last Name/Family Name ______ First Name ______ Middle Initial ______

Firm/Institution ______

Position/Title ______

Business Address (Number, Street) ______

City, State/Province ______

Postal Code, Country ______ Birthdate ______

Business Phone ______ Fax ______ Previously an AOCS student member? ❑ Yes ❑ No

E-mail ______ Expected Graduation Date ______

Invited to be a member by ______

MEMBERSHIP DUES

$ ______

	U.S./Non-U.S. Surface Mail	Non-U.S. Airmail
❑ Active	❑ $157	❑ $242
❑ Corporate	❑ $775	❑ $775
❑ Student*	❑ $ 0	❑ N/A

Membership dues include a subscription to **inform.**
Active membership is "individual" and is not transferable.
Membership year is from January 1 through December 31, 2012.

*Complimentary student membership includes free access to online *inform* only. Student membership applies to full-time graduate students working no more than 50% time in professional work, excluding academic assistantships/fellowships. A professor must confirm these conditions every year, in writing.

OPTIONAL TECHNICAL PUBLICATIONS

$ ______

JAOCS	❑ $165
Lipids	❑ $165
Journal of Surfactants and Detergents	❑ $165

These prices apply only with membership and include print and online versions and shipping/handling.

inform—**Student member only, rate for print**

U.S./Non-U.S. Surface Mail	Non-U.S. Airmail
❑ $30	❑ $115

DIVISIONS AND SECTIONS DUES (Students may choose one free Division membership.)

$ ______

Divisions	Dues/Year	Divisions	Dues/Year	Sections	Dues/Year	Sections	Dues/Year
❑ Agricultural Microscopy	$16	❑ Industrial Oil Products	$15	❑ Asian	$15	❑ India	$10
❑ Analytical	$15	❑ Lipid Oxidation and Quality	$10	❑ Australasian	$25	❑ Latin American	$15
❑ Biotechnology	$15	❑ Phospholipid	$20	❑ Canadian	$15	❑ USA	FREE
❑ Edible Applications	$15	❑ Processing	$10	❑ European	$25		
❑ Food Structure and Functionality	$20	❑ Protein and Co-Products	$12				
❑ Health and Nutrition	$15	❑ Surfactants and Detergents	$30				

MEMBERSHIP PRODUCTS

$ ______

❑ Membership Certificate: $25 ❑ AOCS Lapel Pin: $10 ❑ *AOCS Directory*: $15

❑ Membership Certificate and AOCS Lapel Pin: $30

PREFERRED METHOD OF PAYMENT

❑ Check or money order is enclosed, payable to AOCS in U.S. funds drawn on a U.S. bank.
❑ Send bank transfers to: Busey Bank, 100 W. University, Champaign, IL 61820 USA. Account number 111150-836-1. Reference: 12member. Routing number 071102568. Fax bank transfer details and application to AOCS.
❑ Send an invoice for payment. (Memberships are not active until payment is received.)
❑ I wish to pay by credit card: ❑ MasterCard ❑ Visa ❑ American Express ❑ Discover

TOTAL REMITTANCE
$ ______

Credit Card Account Number ______ Name as Printed on Card ______

Expiration Date ______ CSC ______ Signature ______

Dues are not deductible for charitable contributions for income tax purposes; however, dues may be considered ordinary and necessary business expenses.

AOCS: Your international forum for fats, oils, proteins, surfactants, and detergents.
This Code has been adopted by AOCS to define the rules of professional conduct for its members. As a condition of membership, it shall be signed by each applicant.
AOCS Code of Ethics • Chemistry and its application by scientists, engineers, and technologists have for their prime objective the advancement of science and benefit of mankind. Accordingly, the Society expects each member: 1) to be familiar with the purpose and objectives of the Society as expressed in its Articles of Incorporation; to promote its aim actively; and to strive for self-improvement in said member's profession; 2) to present conduct that at all times reflects dignity upon the profession of chemistry and engineering; 3) to use every honorable means to elevate the standards of the profession and extend its sphere of usefulness; 4) to keep inviolate any confidence that may be entrusted to said member in such member's professional capacity; 5) to refuse participation in questionable enterprises and to refuse to engage in any occupation that is contrary to law or the public welfare; 6) to guard against unwarranted insinuations that reflect upon the character or integrity of other chemists and engineers.

I hereby subscribe to the above Code of Ethics. Signature of Applicant ______

Health & Nutrition News

Briefs

Increased intake of long-chain polyunsaturated omega-3 fatty acids is linked to decreased inflammation and fatigue among breast cancer patients, according to research published in the *Journal of Clinical Oncology* (doi:10.1200/JCO.2011.36.4109, 2012). Researchers led by Catherine Alfano of the National Cancer Institute in Bethesda, Maryland, USA, found that as levels of C-reactive protein (CRP; an indicator of inflammation) increased, behavioral and sensory fatigue scale scores increased, but the association was attenuated after adjustment for comorbidity and medication use. After full adjustment, breast cancer survivors with high CRP levels were 1.8 times more likely to experience fatigue. Those who had higher intakes of omega-6 compared with omega-3 fatty acids had higher CRP levels and were more likely to experience fatigue.

■■■

Previous studies have shown that coffee drinkers are at a lower risk for developing Type 2 diabetes, which accounts for 90–95% of diabetes cases. In fact, those studies showed that those who drink four or more cups of coffee daily have a 50% lower risk of Type 2 diabetes; every additional cup of coffee brought another decrease in risk of almost 7%.

Researchers led by Ling Zheng of the Huazhong University of Science and Technology in Wuhan, China, decided to see if coffee's beneficial effects might be due to substances that block hIAPP (human islet amyloid polypeptide). Why? Because previous work has implicated the misfolding of hIAPP in causing Type 2 diabetes. In fact, Zheng and his team did, indeed, identify two categories of compounds in coffee that significantly inhibited hIAPP. The researchers suggest that this effect explains why coffee drinkers show a lower risk for developing diabetes. "A beneficial effect may thus be expected for a regular coffee drinker," they conclude. Their work appears in the *Journal of Agricultural and Food Chemistry* (doi:10.1021/jf201702h, 2011). ■

Sperm quality and dietary fat

The type and amount of fat men eat may affect their semen quality, according to researchers led by Jill Attaman, who was a clinical and research fellow in reproductive endocrinology and infertility at Massachusetts General Hospital (Cambridge, USA) at the time the research was completed.

A study of 99 men found an association between a high total fat intake and lower total sperm count and concentration. It also found that men who ate more omega-3 polyunsaturated fats had better-formed sperm than men who ate less. The researchers warn, however, that this was a small study, and its findings need to be replicated by further research.

A number of previous studies have investigated the link between body mass index and semen quality, with mixed results. However, little is known about the potential role of dietary fats and semen quality, and so Attaman and her colleagues set out to investigate it in men attending a fertility clinic.

Between December 2006 and August 2010, the team questioned the men about their diet and analyzed samples of their semen; they also measured levels of fatty acids in sperm and seminal plasma in 23 of the 99 men taking part in the study.

The men were divided into three groups according to the amount of fats they consumed. Those in the third tertile with the highest fat intake had a 43% lower total sperm count and 38% lower sperm concentration than men in the tertile with the lowest fat intake. "Total sperm count" is defined as the total number of sperm in the ejaculate, while "sperm concentration" is defined as the concentration of sperm (number per unit volume).

The World Health Organisation provides a definition of "normal" total sperm count and concentration as follows: the total number of spermatozoa in the ejaculate should be at least 39 million; the concentration of spermatozoa should be at least 15 million per milliliter.

The study found that the relationship between dietary fats and semen quality was largely driven by the consumption of saturated fats. Men consuming the most saturated fats had a 35% lower total sperm count than men eating the least, and a 38% lower sperm concentration. "The magnitude of the association is quite dramatic and provides further support for the health efforts to limit consumption of saturated fat given their relation with other health outcomes such as cardiovascular disease," said Attaman.

Men consuming the most omega-3 fats had slightly more sperm (1.9%) that were correctly formed than men in the tertile that had the lowest omega-3 intake.

Of note: Seventy-one percent of all the men in the study were overweight or obese, and the health effects of this could also affect semen quality. However, the researchers made allowances for this. "We were able to isolate the independent effects of fat intake from those of obesity using statistical models," said Attaman. "Notably, the frequency of overweight and obesity among men in this study does not differ much from that among men in the general population in the USA (74%)."

The study is subject to a number of limitations that could affect the results; for instance, the use of a food frequency questionnaire might not accurately reflect men's actual diets, and only one semen sample per man was collected. The authors point out that studies like theirs cannot show that dietary fats cause poor semen quality, only that there is an association between the two.

"To our knowledge, this is the largest study to date examining the influence of specific dietary fats on male fertility," they write. But they conclude: "Given the limitations of the current study, in particular the fact that it is a cross-sectional analysis and that it is the first report of a relation between dietary fat and semen quality, it is essential that these findings be reproduced in future work."

Attaman and her colleagues are continuing to investigate how dietary and lifestyle factors influence fertility in men and women as well as the treatment outcomes of couples undergoing fertility treatment.

The study appeared in *Human Reproduction* (doi:10.1093/humrep/des065, 2012).

Soy and hot flashes

A meta-analysis of 17 clinical trials affirms that supplementation with soy isoflavones may reduce the frequency of and severity of menopausal hot flashes. Because there often is a significant placebo effect, some women taking isoflavone supplements "will likely see at least a 50% reduction compared to doing nothing," according to study co-author Melissa Melby of the University of Delaware (Newark, USA).

"The results from this comprehensive analysis show that soy isoflavones consistently alleviate hot flashes to a clinically relevant extent," said Mark Messina, another co-author. Messina is an adjunct professor at Loma Linda University in California (USA). "Further, the results provide justification for health professionals recommending that women wanting a nonhormonal alternative to estrogen for hot flash relief try isoflavones."

The meta-analysis—which is the largest and most comprehensive conducted to date, according to the authors—revealed that ingestion of soy isoflavones for six weeks to 12 months significantly reduced the frequency of hot flashes by more than 20% compared with placebo. Soy isoflavones also significantly reduced hot flash severity by more than 26% compared with placebo. The analysis found that the decrease in hot flash frequency in longer trials (more than 12 weeks) was approximately three times greater than the decrease in shorter trials.

Although a number of different isoflavones exist in nature, the three primary isoflavones in soy are genistein, daidzein, and glycitein. According to the authors of the study, isoflavone supplements providing higher amounts of genistein were approximately 50%–200% more effective at reducing hot flash frequency than isoflavone supplements containing lower amounts of genistein.

"Supplements providing a daily total of about 50 mg of total isoflavones will be effective as long as they also provide at least 19 milligrams of genistein," Messina noted.

Of the 17 studies included in the meta-analyses, 13 trials (including 1,196 women) evaluated hot flash frequency, and nine trials (including 988 women) evaluated hot flash severity. The study will appear in the July issue of *Menopause* (doi:10.1097/gme.0b013e3182410159, 2012).

Aspirin and *trans* fat-related stroke risk

Older women whose diets include a substantial amount of *trans* fats are more likely than their age cohorts to suffer an ischemic stroke, a new study shows. However, the risk of stroke associated with *trans* fat intake was lower among women taking aspirin, according to the findings from University of North Carolina at Chapel Hill (UNC; USA) researchers.

The study of 87,025 generally healthy postmenopausal women aged 50 to 79 found that those whose diets contained the largest amounts of *trans* fats were 39% more likely to have an ischemic stroke (clots in vessels supplying blood to the brain) than women who ate the least amount of *trans* fat. The risk was even more pronounced among nonusers of aspirin: those who ate the most *trans* fat were 66% more likely to have an ischemic stroke than females who ate the least *trans* fat.

However, among women who took aspirin over an extended period of time, researchers found no association between *trans* fat consumption and stroke risk—suggesting that regular aspirin use may counteract the adverse effect of *trans* fat intake on stroke risk among women.

Researchers from the UNC Gillings School of Global Public Health studied women who were enrolled in the Women's Health Initiative Observational Study. From 1994 to 2005, 1,049 new cases of ischemic stroke were documented.

Women who consumed the highest amount of *trans* fat also were more likely to be smokers, have diabetes, be physically inactive, and have lower socioeconomic status than those who consumed the least *trans* fat, the study showed.

"Our findings were contrary to at least two other large studies of ischemic stroke," said Ka He, associate professor of nutrition and epidemiology at the UNC School of Global Public Health. "However, ours was a larger study and included twice as many cases of ischemic stroke. Our unique study base of older women may have increased our ability to detect the association between *trans* fat intake and ischemic stroke among nonusers of aspirin."

The UNC researchers did not find any association between eating other kinds of fat (including saturated, monounsaturated, or polyunsaturated) and ischemic strokes.

"Our findings highlight the importance of limiting the amount of dietary *trans* fat intake and using aspirin for primary ischemic stroke prevention among women, especially among postmenopausal women who have elevated risk of ischemic stroke," said lead author Sirin Yaemsiri, a doctoral student in the school's epidemiology department.

The study was published in the journal *Annals of Neurology* (doi:10.1002/ana.23555, 2012).

Inhaled anesthetics and lipids

The reason that inhaled anesthetics cause unconsciousness may lie in their effect on the organization of lipids in the outer membrane of cells.

"A better fundamental understanding of inhaled anesthetics could allow us to design better ones with fewer side effects," says Hirsh Nanda, a scientist at the US National Institute of Standards and Technology's (NIST) Center for Neutron Research (NCNR), which conducted the research. "How these chemicals work in the body is a scientific mystery that stretches back to the Civil War."

At the turn of the 20th century, doctors suspected inhaled anesthetics had some effect on cell membranes. Despite considerable investigation, however, they were unable to demonstrate that anesthetics produced changes in the physical properties of membranes large enough to cause anesthesia.

CONTINUED ON PAGE 394

Briefs

In mid-March 2012, *The Wall Street Journal*, citing investment firm Monness Crespi Hardt (New York City, USA), said that Origin Agritech Ltd. (Beijing, China) is close to becoming the first seed developer to have a genetically modified seed product approved for the Chinese market. The company is working to develop corn, rice, cotton, and canola.

■■■

A poll of 2,126 US adults found that 37% considered genetically modified (GM) foods to be safe, 39% said they were not, and 24% were not sure. Conducted March 23–26, 2012, by IBOPE Zogby Interactive, an international market research and public opinion firm, the poll also found that 65% are less likely to buy GM foods, 87% agreed that such foods should be clearly labeled, and 47% were not sure what percentage of the fruits and vegetables they buy are GM. The margin of error of the poll was ±2.2%.

■■■

In February 2012, the environment ministry of France asked the European Union (EU) executive to ban the planting of Monsanto's MON 810 genetically modified (GM) corn (*inform 23*:232, 2012) even though the Conseil d'Etat, France's highest administrative court, had ended a moratorium on GM corn in the country in November 2011 (*inform 23*:90, 2012).

On March 29, 2012, the French growers' group AGPM (Association générale des producteurs de maïs), the French seeds firms' group UFS (Union française des semenciers), and the maize [corn] and sorghum producers' federation FNPSMS (Fédération nationale de la production de semences de maïs et de sorgho) issued a joint statement saying, "This restriction does not rely on any serious scientific element, and maize producers, hit by [insects], sustain real financial damage" (tinyurl.com/FrenchGMcorn).

Farmers in France, as well as in other EU nations, have expressed concern that EU hostility to GM organisms will cause them to fall behind in the competitive world grain market. ■

Biotechnology News

Trials underway of GM wheat that "frightens" aphids

Experiments are being conducted at the Rothamsted Research agricultural institute, Hertfordshire, UK, on a genetically modified (GM) wheat that produces an aroma that will drive off aphids.

The scientists working on this project have engineered the genes of the winter wheat cultivar Cadenza to emit (E)-β-farnesene, an alarm pheromone that aphids produce to warn one another of danger. (Some other plants were already known to produce (E)-β-farnesene as a natural defense mechanism.) Not only does this compound repel aphids, it also attracts the enemies of aphids (tinyurl.com/RothamstedWheat). Researchers are investigating whether predatory ladybird beetles and parasitic wasps will visit the genetically modified (GM) crop early enough in the growing season to prevent aphid infestations.

The gene incorporated into the wheat responsible for this odor is found in peppermint plants. John Pickett, scientific leader of chemical ecology at Rothamsted Research, describes the smell of (E)-β-farnesene as more like Granny Smith apples than peppermint and too faint for humans to be able to detect (tinyurl.com/InsectPheromone).

Eight test plots of the wheat have been planted at Rothamsted, each six meters square. Under the rules established by the government's Advisory Committee on Releases to the Environment, which oversees all outdoor GM experiments and field trials, the wheat produced in these experiments cannot be eaten by humans or animals at the end of the experiment. Furthermore, a tall metal fence surrounds the plots as part of the effort to interdict movement of pollen and seeds and to exclude humans and animals.

According to Maurice Moloney, director of Rothamsted Research, "GM has traditionally been associated with killing something. Either killing the weeds or killing the insects. In this case what we are doing is putting a 'no parking' sign on every leaf of the plant" (tinyurl.com/Aphids-beetles-wasps).

Only two other small-scale trials of GM plants, both involving potatoes, are currently are being carried out in England.

Is high rate of *Bt* hybrid usage called for?

In January 2012, the University of Illinois College of Agricultural, Consumer and Environmental Sciences (UIUC-ACES; Urbana-Champaign, USA) conducted a series of Corn and Soybean Classic meetings around the state to provide farmers with timely information related to crop production and pest management. Attendees were asked to indicate whether they had planted a *Bt* hybrid in 2011. Ninety-five percent said they had. Most said they planned to plant *Bt* hybrids in 2012 as well.

This high rate of usage has been common for several years across Illinois even though the numbers of key insect pests that are susceptible to the *Bt* toxin, such as the European corn borer and the western corn rootworm, have been low.

Michael Gray, crop sciences extension coordinator in the department of crop sciences in ACES, said, "I have questioned the wisdom of applying such intense selection pressure on insect populations when many of the pest species are well below economic levels in most producers' fields" (http://tinyurl.com/Bt-hybrid-ACES).

When *Bt* hybrids were commercialized in 1996, standard protocol in the Corn Belt of the United States was the use of a 20% refuge, based on using *Bt* hybrids aimed for the most part at European corn borers, which express a high dosage level for Cry proteins. In 2003, *Bt* hybrids were introduced for corn rootworms.

Even though the *Bt* targeted at corn rootworms was not high dose, and even though the mating characteristics and the dispersal patterns of adult corn rootworms are different from those of European corn borers, the same refuge requirements were set up for the new product.

Gray explained why the refuge requirements for these disparate insects were similar by attributing them to "... familiarity, convenience, and thus, the greater likelihood of implementation of the 20% structured refuge by producers rather than tailoring refuge requirements to the unique biological characteristics of corn rootworms."

Follow-up on monarch butterflies

An article in the September 2011 issue of *inform* (*22*:505–506) summarized evidence that plantings of corn and soybeans genetically engineered to resist the herbicide Roundup (manufactured by Monsanto Co., St. Louis, Missouri, USA) have affected monarch butterflies (*Danaus plexippus*) in the Midwest of the United States. This butterfly receives much attention from the public for its behavior of overwintering in a very small area of Mexico, from which it migrates to the Midwest in the spring and early summer, and to which it returns in the fall.

The herbicide does not harm the butterflies *per se*. Rather, as it is applied to crops genetically modified to resist Roundup, it eliminates the weeds, especially milkweed (*Asclepias* spp.), on which the animals prefer to lay their eggs.

Newly published research out of Iowa State University (Ames, USA) and the University of Minnesota (St. Paul, USA) investigated whether the decline in the size of the overwintering population of monarchs in Mexico can be associated with the loss of milkweed plants in agricultural fields in the Midwest. Details of the study design, reported by J.M. Pleasants and K.S. Oberhauser, appear in the journal *Insect Conservation and Diversity* (doi:10.1111/j.1752-4598,2012.00196x, 2012).

The authors estimate that there has been a 58% decline in milkweeds on the Midwest landscape and an 81% decline in monarch production in the Midwest from 1999 to 2010. They also report a positive correlation of the production of monarch butterflies in the Midwest each year with the size of the subsequent overwintering population in Mexico.

Other research, cited by Pleasants and Oberhauser, has reported declines in the populations of overwintering populations of monarch butterflies in Mexico over the last 15 years. According to the *Minneapolis Star-Tribune* newspaper (tinyurl.com/GMO-butterflies), the butterflies occupied seven acres (three hectares) in their refuge west of Mexico City in the winter of 2012. This area is 28% less than in 2011, and only 15% of the 45 acres occupied in 1996, a peak year.

According to Pleasants and Oberhauser, their results provide evidence that a loss of agricultural milkweed plants is a major contributor to the decline in the population of monarch butterflies.

The suggestion by Pleasants and Oberhauser that the smaller number of monarchs may make the species more vulnerable to other conservation threats may have been borne out since they finished their data collection in 2010. The extreme drought in 2011 in the southwestern United States, an area normally providing water and nectar-yielding flowers for migrating butterflies, was reported in the popular press to have greatly reduced the number of butterflies flying through on their way to Mexico (tinyurl.com/butterflies-texas; tinyurl.com/butterflies-drought).

Do GM foods affect animal health?

A review that appeared in *Food and Chemical Toxicology* (*50*:1134–1148, 2012) assessed the health impact of genetically modified (GM) plant diets in long-term and multigenerational animal feeding trials. The British and French authors examined 12 long-term studies (as short as 90 days, as long as two years in duration) and 12 multigenerational studies (from two to five generations). Diets contained GM corn, potato, soybean, rice, or triticale.

Biochemical analyses, histological examination of specific organs, hematology, and the detection of transgenic DNA were used to monitor the parameters of interest.

Results from the 24 studies did not suggest any health hazards, and for the most part there were no statistically significant differences with the parameters observed. Some small differences were observed, but none fell outside the normal range of variation of the considered parameter. The reviewers concluded that the evidence they had considered showed that GM plants are nutritionally equivalent to their non-GM counterparts and can be used in food and feed safely.

The authors also suggested that, if required, a 90-day feeding study performed in rodents according to the OECD (Organisation for Economic Co-operation and Development) Test Guideline is generally sufficient to evaluate the health effects of GM feed. ■

Surfactants, Detergents, & Personal Care News

Canada completes preliminary review of triclosan

A Canadian review panel said that industry should voluntarily remove the antibacterial chemical triclosan from consumer products because it may harm aquatic organisms. The panel did not, however, find triclosan to be harmful to human health or uncover a clear link between use of products containing triclosan and antibacterial resistance.

"Based on environmental concerns identified in this assessment, the government will initiate consultations with industry on the potential for voluntary reductions in the use of triclosan in products," said Peter Kent, minister of environment.

Triclosan is used as a material preservative and antimicrobial in a wide range of cosmetics and personal care products, including nonprescription drugs. It has been proven to provide health benefits in some products, such as in toothpaste to protect against gingivitis. Triclosan also is used as a material preservative in the manufacture of textiles, leather, paper, plastic, and rubber to prevent the growth of bacteria, fungi, and mildew, and to prevent odors.

Following release of the report, US Rep. Edward J. Markey (Democrat–Massachusetts) sent a letter to the US Food & Drug Administration, pushing for the agency to release a final rule on over-the-counter antibacterial products. The rule was first proposed in 1972.

The American Cleaning Institute (ACI)—a trade group based in Washington,

Briefs

We like to keep our eye on new technologies that may affect the home and personal care markets. Here's one that almost certainly will not prove to be disruptive but is interesting nonetheless. An Australian backpacker has introduced the Scrubba wash bag: a portable, pocket-sized "washing machine" weighing 180 g. The idea for the Scrubba came when Ashley Newland was preparing to climb Mount Kilimanjaro. "I realized that I would only be able to take a few changes of clothing and would have to wash them regularly," he told www.digitaltrends.com. "While waterproof bags can be used to soak clothing, they really aren't very efficient. It was then that I had the revelation that washboards have been around for centuries and they work!" Newland incorporated a flexible washboard into a sealable bag, and hopes to change the way travelers wash their clothes. To see a picture of Newland's invention, visit tinyurl.com/Scrubba.

■■■

In related news, industrial designer Elie Ahovi has created a concept washing machine for Electrolux that uses no water and cleans clothes with dry ice. Even better, Ahovi's Orbit machine is powered by a battery-filled ring containing a metal laundry basket at the center of the circular machine. According to digitaltrends.com, the batteries create a magnetic field that levitates the basket "as the machine's electrical resistivity drops."

■■■

Denmark's AAK (AarhusKarlshamn) has signed an agreement with the government of Burkina Faso to triple its activities over the next two years with women's cooperatives in rural areas of the West African country. AAK has been sourcing shea kernels from West Africa since the 1950s. The company hopes to involve up to 30,000 women in the next several years, it said in a statement.

■■■

A strategy for conjugating co-polymers to human hair for cosmetic applications has been developed by British

CONTINUED ON NEXT PAGE

DC, USA—noted in a statement that the Canadian review found no evidence of harm to human health or a contribution to antibiotic resistance from the use of triclosan.

"Antibacterial soaps and washes play a beneficial role in the daily hygiene routines of millions of people throughout the US and worldwide," said Richard Sedlak, ACI senior vice president, technical & international affairs. "They have been and are used safely and effectively in homes, hospitals, and workplaces every single day."

The Canadian review is expected to become final in the third quarter of 2013. The notice and summary of the report appeared in the *Canada Gazette*, Part 1 on March 31, 2012; see tinyurl.com/triclosan-canada.

Kao building new facility in Indonesia

Japan's Kao Corp. said in March 2012 that its Kao Indonesia Chemicals subsidiary in Bekasi is constructing a new surfactants plant at Karawan International Industry City (KIIC), located in the suburbs of Jakarta. The new plant site covers about 120,000 square meters, which is double the area of the production site currently being used. Construction began in February 2012; the plant will open in January 2013.

The new facility will increase Kao's annual surfactant production capacity by approximately 50% compared to current capacity, the company said in a statement. The initial investment is estimated at over ¥4 billion ($49 million)

Can water float on oil?

Thousands of years of conventional wisdom, starting with Aristotle, suggest that water cannot float on oil.

Now, however, scientists led by Chi M. Phan of Curtin University in Perth, Australia, report that in certain cases, the conventional wisdom is wrong. The discovery has important potential applications in cleaning up oil spills that threaten seashores and fisheries, they say. The report appears in *Langmuir* (doi:10.1021/la204820a, 2012).

Phan's team decided to test the idea that crude oil, with a density of about 58 pounds per cubic foot (about 0.93 grams per cubic centimeter)), cannot float on sea water, which has a density of 1.03 g/cm^3 using computer models in the lab.

They report that, in certain cases, the conventional wisdom is wrong. By adding tiny amounts of water to a floating droplet of oil, they found that the ability of water drops to float at the surface of an oil bath depends on both the size of the droplet and the type of oil. Commercial vegetable oil has enough surface tension at its interfaces with air and water to support a droplet's weight, whereas pure mineral oils do not. At the same time, the researchers found that vegetable oil could not support drops bigger than about 1/100th of a cubic inch (0.16 cm^3). The authors suggest the new knowledge could help clean up oil spills, where water-borne, oil-eating microbes will mix more easily into the oil if suspended in the tiny droplets they describe.

"This result can lead to a new and advanced mechanism in processing oil/water mixtures, such as biodegrading process of unwanted oils, including vegetable oils, sand oil tailings, and oil spillages," the authors said.

D5 safe in personal care, review panel finds

A Canadian review panel cleared continued use in that country of decamethylcyclopentasiloxane, or D5, in personal care products such as skin creams, antiperspirants, and shampoos. The compound does not harm the environment, and any bioaccumulation is not dangerous to biodiversity, the panel found.

"The silicones industry welcomes the minister's declaration that D5 is safe for the environment and fully supports the removal of D5 from a proposed list of toxic substances," said Karluss Thomas, executive director of the Silicones Environmental, Health & Safety Council of North America, according to a report by *Chemical & Engineering News* (*C&EN*) magazine.

The report also noted that the European Silicones Centre (CES) said that European regulators "continue to review the environmental safety of D5." D4, or octamethylcyclotetrasiloxane, also is still under review in Europe. Canadian regulators "still intend to move ahead on limiting use of D4," *C&EN* said. Final restrictions are expected no later than July 15, 2012.

researchers. The research apparently is the first report of the combination of polymer synthesis through catalytic chain transfer polymerization and subsequent thiol-ene addition to keratin (a complex, three-dimensional molecule). The work was led by Stacy Slavin of the University of Warwick in Coventry, UK, and appeared in *Polymer Chemistry* (doi:10.1039/c2py20040f, 2012).

■■■

Bunge Global Innovation and Solazyme will partner on a factory in Brazil that will make triglyceride oils from algae for both oleochemical and biofuel products. The factory will be built next to Bunge's sugarcane mill in Moema. It is expected to come online in the second half of 2013, with an annual capacity of 100,000 metric tons. ■

L'Oréal and EPA team up

The US Environmental Protection Agency (EPA) and France's L'Oréal cosmetic company are collaborating to determine whether EPA's chemical toxicity forecaster (ToxCast) can be used in systemic toxicity tests. EPA is using ToxCast to screen chemicals for their potential impact on processes in the human body that lead to adverse health effects.

"Because of the high costs and length of time it takes for animal testing, not all the chemicals in use have been thoroughly evaluated for potential toxicity. ToxCast is able to rapidly screen thousands of chemicals in hundreds of tests and provide results that are relevant to various types of toxicity," said David Dix, acting director, EPA National Center for Computational Toxicology.

L'Oréal is providing EPA $1.2 million in collaborative research funding plus robust safety data from a set of representative substances from the cosmetic sector, expanding the types of chemical groups assessed by ToxCast. EPA will compare the ToxCast results to the L'Oréal data to determine if the reliability and the relevance are appropriate for use in the safety assessment of chemicals in cosmetics.

"The urgent need for more efficient and relevant methods of safety testing is

CONTINUED ON NEXT PAGE

underscored by the tens of thousands of inadequately assessed chemicals in the environment," said Andrew Rowan, chief scientific officer of The Humane Society of the United States and president and chief executive officer of Humane Society International. "A successful outcome of this partnership will go a long way toward demonstrating the value of advanced, non-animal testing tools and the need for ongoing investment in this area."

EPA researchers have published scientific papers showing how ToxCast can be used to predict a chemical's potential for liver toxicity, developmental toxicity, reproductive toxicity, and cancer. ToxCast is screening over 1,000 chemicals in more than 700 fast, automated tests known as high-throughput screening. More information on ToxCast is available at epa.gov/ncct/toxcast.

Study calls for content labeling

A peer-reviewed study by the Silent Spring Institute (SSI; Newton, Massachusetts, USA) recommends that chemicals in household and consumer products be identified on labels, particularly when products contain multiple chemicals that may interact with each other.

SSI, a foundation that funds research into the links between the environment and women's health, had 213 "conventional" consumer products in 50 categories tested independently by Battelle Memorial Institute in Columbus, Ohio, USA, for 60 specific compounds associated with either asthma or endocrine disruption. Researchers also analyzed concentrations of those compounds in 43 "alternative" products, many of which were advertised as "green" or "natural."

The study, called the "first of its kind" by *Forbes* magazine, appeared in *Environmental Health Perspectives* (Endocrine disruptors and asthma-associated chemicals in consumer products, doi: 10.1289/ehp.1104052, 2012).

Battelle found that the concentrations ranged from low to considerable. Among the chemicals analyzed were parabens, phthalates, bisphenol A, triclosan, fragrances, and the ultraviolet light-blocking compounds used in sunscreens. Levels were below the equipment's detection level of 1 microgram per gram for most samples, but the study found 26 chemicals at levels above the detection limit in conventional as well as alternative products.

The American Cleaning Institute, a trade group based in Washington, DC, USA, expressed disappointment with the study, which it said "wrongly raises unfounded safety concerns over cleaning products and ignores enhanced efforts to communicate with consumers about product ingredients.

"An enormous amount of research, development, and testing takes place before cleaning products hit the shelves," said Richard Sedlak, ACI executive vice president, technical & international affairs. "Detailed safety assessments are conducted by companies throughout the life cycle of a product. In essence, safety is built into the DNA of cleaning product development and manufacturing."

The report is available at tinyurl.com/SSIReport.

"Natural" personal care in demand

Demand for "natural" personal care products remains strong within the well-established markets of Western Europe and North America, maintaining high growth rates. The most recent findings, from global consulting and research firm Kline & Co. show that, while the segment's 2011 growth waned slightly compared to the five-year compound annual growth rate of 13.9%, it still consistently outperformed the overall beauty market.

Both of these markets are distinctly different, as market leaders vary from region to region; moreover, within Europe, the dynamics of the naturals market vary significantly among countries. In Western Europe, the natural segment is becoming more mainstream, but it is the largely untapped markets of Central and Eastern Europe where opportunities show great promise. Additionally, European and American shares of the total market have been decreasing over the past five years at the expense of Brazil and China.

Large—predominantly German—drug store chains, such as DM, Schlecker, and Rossmann, represent the fastest growing pan-European distribution channel. In the United States, traditional natural health food stores still lead the way; however, mass outlets, such as Wal-Mart Stores, Inc.—which as an indicator of the retailer's faith in the naturals' market, recently introduced its own private-labels products—are quickly increasing in significance.

Indeed, more mass-market brands are recognizing the vitality and viability of the naturals segment with its inherent market cachet and consumers' increasing readiness to pay a premium for genuinely natural products. The benefits are manifold: Increasing the channels of distribution and allowing consumers easier access to natural products both ultimately contribute to the segment's growth.

Kline's Consumer Industry Manager Nancy Mills attributes the resilience of the natural personal care sector to ever-growing consumer awareness of health, environmental, and sustainability concerns. "These drivers are near universal, but their influence varies significantly between markets," observes Mills. "In Western Europe, consumers have a higher awareness and interest concerning product ingredients, business ethics, and sustainability practices, and many are astutely avoiding products which are natural only in positioning. In Eastern Europe, where the movement is starting to blossom, consumers aren't yet as discerning.

"Natural personal care is not a fad, but a genuine movement that's manifesting itself in ever diverse product applications," continues Mills. "The consumer is better educated, and this can serve the marketer well, particularly as credible certification standards are being implemented and recognized."

The global market for natural personal care products is expected to maintain strong growth with a compound annual growth rate of almost 10% through 2016. The growth of truly natural products likely will outpace that of natural-inspired brands across most regions; however, natural-inspired brands will continue to dominate the global natural personal care market.

More information about the report is available at kline.com. ■

People News/ Inside AOCS

IFT announces awards

The Institute of Food Technologists (IFT) announced its 2012 Achievement Award recipients and Fellows in advance of its annual meeting, which will be held June 25–28 in Las Vegas, Nevada, USA. The following AOCS members will be recognized:

Engeseth

Nicki J. Engeseth will receive the William V. Cruess Award, which honors an IFT member who has achieved excellence in teaching food science and technology. Engeseth is in the Department of Food Science and Human Nutrition at the University of Illinois at Urbana-Champaign (USA).

Past AOCS President **Casimir C. Akoh** will receive the Nicholas Appert Award. This award recognizes an individual for preeminence in and contributions to the field of food science and technology. Akoh teaches and carries out research in the College of Agricultural & Environmental Sciences at the University of Georgia, Athens, USA.

Akoh

Michael A. Eskin, of the Department of Human Nutritional Sciences of the University of Manitoba, Winnipeg, Canada, will receive IFT's Stephen S. Chang Award, which honors an IFT-member food scientist or technologist who has made significant contributions to lipid or flavor science.

Eskin

Peter Morgan Salmon (founder of the International Food Network, foodnetwork.com) and **Liangli (Lucy) Yu** (College of Agriculture & Natural Resources, University of Maryland, College Park, USA) were elected Fellows of IFT. This designation is conferred for outstanding and extraordinary contributions in the field of food science and technology. In a given year, no more than 0.3% of the professional membership is eligible for this recognition, and fewer than that earn the honor.

Juarez joins SG Biofuels

On March 20, 2012, SG Biofuels, Inc. (SGB; San Diego, California, USA) announced the addition to its staff of **Benito Juarez** as director of breeding. Juarez joins SGB's breeding and biotechnology team as it expands its global development and deployment of improved hybrid varieties of jatropha. He comes to SGB with 17 years of experience, some of them with Monsanto, where he had a successful program breeding and conducting field experiments with watermelons.

POET names new CEO

Jeff Lautt was named chief executive officer (CEO) of POET, the ethanol company located in Sioux Falls, South Dakota, USA, in April 2012. Lautt has been with POET since 2005, serving most recently as president of the company. Company founder **Jeff Broin** will step down after 25 years as the CEO but will continue managing and leading the company's board as executive chairman.

"For the past 25 years, Jeff Broin has led POET and the entire ethanol industry," said Lautt in the company announcement. "He has grown POET from one small plant to a leadership position in the global renewable fuels industry."

In the time that Broin has led the company, POET has grown from producing 1 million gallons (4 million liters) of ethanol in its first year to an annual capacity in excess of 1.6 billion gallons.

Miller new president at CCC

Patti Miller joined the Canola Council of Canada (CCC) on April 30, 2012, as its president. Miller came to the CCC following a varied career in government and industry. She left her position with Agriculture and Agri-Food Canada (AAFC) in Winnipeg, where she managed large scale program delivery for several years, to come to CCC. During her career with AAFC she was responsible for working with Canadian grains and oilseeds producers and industry on policy, trade, market development, and research issues in order to facilitate sustainable, profitable market growth in the sector.

Before the AAFC, Miller served a multinational agri-food company in Winnipeg where she provided leadership and advice to senior managers on all aspects of corporate and employee communications.

POS Bio-Sciences names sales manager

Catherine Twerd became North American sales manager for POS Bio-Sciences (Saskatoon, Saskatchewan, Canada) in March 2012. She has 27 years of sales and marketing experience with the US division for Jamieson Laboratories, Mead Johnson Nutritionals, and Stanley Pharmaceuticals. She is tasked with focusing on client relationship management for POS Bio-Sciences.

What's new with you?

Retiring? Moving? Celebrating an anniversary? Recent promotion? New child? Won an award? AOCS wants to help you spread the good news. Let us know what's going on. Email us and we'll share your news in the next AOCS member newsletter. Contact Nicole Philyaw at nicolep@aocs.org

Extracts & Distillates

Development of a phenol-enriched olive oil with both its own phenolic compounds and complementary phenols from thyme

Rubió, L., *et al.*, *J. Agric. Food Chem.* *60*:3105–3112, 2012.

Besides affecting the oil's sensorial characteristics, the presence of herbs and spices has an impact on the nutritional value of the flavored oils. The aim of the study was to develop a new product based on the phenol-enrichment of a virgin olive oil with both its own phenolic compounds (secoiridoid derivatives) plus additional complementary phenols from thyme (flavonoids). We studied the effect of the addition of phenolic extracts (olive cake and thyme) on phenolic composition, oxidative stability, antioxidant activity, and bitter sensory attribute of olive oils. Results showed that flavonoids from thyme appeared to have higher transference ratios (average 89.7%) from the phenolic extract to oil, whereas secoiridoids from olive presented lower transference ratios (average 35.3%). The bitter sensory attribute of the phenol-enriched oils diminished with an increase of the concentration of phenols from thyme, which might denote an improvement in the consumer acceptance.

Production of a conjugated fatty acid by *Bifidobacterium breve* LMC520 from α-linolenic acid: conjugated linolenic acid (CLnA)

Park, H.G., *et al.*, *J. Agric. Food Chem.* *60*:3204–3210, 2012.

This study was performed to characterize natural CLnA isomer production by *Bifidobacterium breve* LMC520 of human origin in comparison to conjugated linoleic acid (CLA) production. *Bifidobacterium breve* LMC520 was found to be highly active in terms of CLnA production, of which the major portion was identified as *cis*-9,*trans*-11,*cis*-15 CLnA isomer by GC-MS [gas chromatography-mass spectrometry] and NMR [nuclear magnetic resonance] analysis. *Bifidobacterium breve* LMC520 was incubated for 48 h using MRS medium (containing 0.05% L-cysteine hydrochloride) under different environmental conditions such as atmosphere, pH, and substrate concentration. The high conversion rate of α-linolenic acid (α-LNA) to CLnA (99%) was retained up to 2 mM α-LNA, and the production was proportionally increased nearly sevenfold with 8 mM by the 6 h of incubation under anaerobic conditions at a wide range of pH values (between 5 and 9). When α-LNA was compared with linoleic acid (LA) as a substrate for isomerization by *B. breve* LMC520, the conversion of α-LNA was higher than that of LA. These results demonstrated that specific CLnA isomer could be produced through active bacterial conversion at an optimized condition. Because many conjugated octadecatrienoic acids in nature are shown to play many positive roles, the noble isomer found in this study has potential as a functional source.

γ-Oryzanol reduces adhesion molecule expression in vascular endothelial cells via suppression of nuclear factor-κB activation

Sakai, S., *et al.*, *J. Agric. Food Chem.* *60*:3367–3372, 2012.

γ-Oryzanol (γ-ORZ) is a mixture of phytosteryl ferulates purified from rice bran oil. In this study, we examined whether γ-ORZ represents a suppressive effect on the lipopolysaccharide (LPS)-induced adhesion molecule expression on vascular endothelium. Treatment with LPS elevated the mRNA expression of vascular cell adhesion molecule-1 (VCAM-1), intercellular adhesion molecule-1 (ICAM-1), and E-selectin in bovine aortic endothelial cells (BAEC). Pretreatment with γ-ORZ dose-dependently decreased the LPS-mediated expression of these genes. Western blotting also revealed that pretreatment with γ-ORZ dose-dependently inhibited LPS-induced VCAM-1 expression in human umbilical vein endothelial cells. Consistently, pretreatment with γ-ORZ dose-dependently reduced LPS-induced U937 monocyte adhesion to BAEC. In immunofluorescence, LPS caused nuclear factor-κB (NF-κB) nuclear translocation in 40% of BAEC, which indicates NF-κB activation. Pretreatment with γ-ORZ, as well as its components (cycloartenyl ferulate, ferulic acid, or cycloartenol), dose-dependently inhibited LPS-mediated NF-κB activation. Collectively, our results suggested that γ-ORZ reduced LPS-mediated adhesion molecule expression through NF-κB inhibition in vascular endothelium.

Organogel-emulsions with mixtures of β-sitosterol and γ-oryzanol: influence of water activity and type of oil phase on gelling capability

Sawalha, H., *et al.*, *J. Agric. Food Chem.* *60*:3462–3470, 2012.

In this study, water-in-oil emulsions were prepared from water containing different salt concentrations dispersed in an oil phase containing a mixture of β-sitosterol and γ-oryzanol. In pure oil, the β-sitosterol and γ-oryzanol molecules self-assemble into tubular microstructures to produce a firm organogel. However, in the emulsion, the water molecules bind to the β-sitosterol molecules, forming monohydrate crystals that hinder the formation of the tubules and resulting in a weaker emulsion-gel. Addition of salt to the water phase decreases the water activity, thereby suppressing the formation of sitosterol monohydrate crystals even after prolonged storage times (~1 year). When the emulsions were prepared with less polar oils, the tubular microstructure was promoted, which significantly increased the firmness of the emulsion-gel. The main conclusion of this study is that the formation of oryzanol and sitosterol tubular microstructure in the emulsion can be promoted by reducing the water activity and/or by using oils of low polarity.

New insights into the role of iron in the promotion of lipid oxidation in bulk oils containing reverse micelles

Chen, B., *et al.*, *J. Agric. Food Chem.* *60*: 3524–3532, 2012.

Formation of physical structures, known as association colloids, in bulk oils can promote lipid oxidation. However, the cause of this accelerated lipid oxidation is unknown. Therefore, the aim of this study was to investigate whether transition metals were important pro-oxidants in bulk oils containing reverse micelles produced from 1,2-dioleoyl-*sn*-glycero-3-phosphocholine (DOPC) and water. The Fe(III) chelator deferoxamine (DFO) increased the oxidative stability of stripped soybean oil (SSO) containing reverse micelles from 2 to 7 days. Because phosphatidylcholine (1,2-dibutyl-*sn*-glycero-3-phosphocholine), which does not form reverse micelles, is not pro-oxidative, these results suggest that the pro-oxidant activity of DOPC reverse micelles could be due to their ability to concentrate both endogenous iron and lipid hydroperoxides at the water–lipid interface, thereby increasing the ability of iron to decompose lipid hydroperoxides. DFO was also able to improve the activity of α-tocopherol and Trolox in SSO containing DOPC reverse micelles increasing the lag phase from 2 to 11 and 13 days, respectively. DOPC reverse micelles decreased iron-promoted α-tocopherol and Trolox decomposition and decreased the ability of α-tocopherol and Trolox to decrease Fe(III) concentrations. Overall, these results suggest that iron is an important pro-oxidant in bulk oils containing reverse micelles; therefore, finding ways to control iron reactivity in association colloids could provide new technologies to increase the oxidative stability of oils.

Minerals, trace elements, vitamin D and bone health: associations of dietary polyunsaturated fatty acids with bone mineral density in elderly women

Järvinen, R., *et al., Eur. J. Clin. Nutr. 66*:496–503, 2012.

Significance of dietary fatty acids on bone health is not clear, and the evidence is controversial. This study aimed to investigate the relationship between dietary polyunsaturated fatty acids (PUFA) and bone mineral density (BMD) among elderly women. Subjects ($n = 554$) were drawn from the Kuopio OSTPRE Fracture Prevention Study. At baseline they filled a 3-day food record and a questionnaire on lifestyle factors, diseases, and medications. BMD was measured at lumbar spine (L2–L4), femoral neck and total body by dual energy X-ray absorptiometry at baseline and after 3 years. The associations between dietary fatty acids and BMD were analyzed by a linear mixed model adjusting for potential dietary and nondietary confounders. Our findings suggested a positive relationship between the dietary PUFA and BMD at lumbar spine and in total body but not at femoral neck. Further analyses revealed that these results were due to associations among the women without hormone therapy (HT) at baseline. Among them, the intake of total PUFA as well as the intakes of linoleic and linolenic acids and total n-3 and n-6 fatty acids was significantly associated with BMD at lumbar spine; P for trend over the quartiles ranged between 0.013 and 0.001. Similarly, significant associations were demonstrated for total body BMD and fatty acids with an exception of total PUFA. No significant associations were found among women with HT at baseline. Our findings among elderly women without HT support the suggested beneficial effect of dietary PUFA on bone health.

Quantitative analysis of hydroperoxy-, keto- and hydroxy-dienes in refined vegetable oils

Morales, A., *et al., J. Chromatogr. A 1229*:190–197, 2012.

Quantitative analysis of the main oxidation products of linoleic acid—hydroperoxy-, keto-, and hydroxy-dienes—in refined oils is proposed in this study. The analytical approach consists of derivatization of triacylglycerols into fatty acid methyl esters and direct analysis by high-performance liquid chromatography-ultraviolet spectroscopy. Two transmethylation methods run at room temperature were evaluated. The reactants were KOH in methanol in method 1 and sodium methoxide (NaOMe) in method 2. Method 1 was ruled out because it resulted in losses of hydroperoxydienes as high as 90 wt%. Transmethylation with NaOMe resulted to be appropriate as derivatization procedure, although inevitably also gives rise to losses of hydroperoxydienes, which were lower than 10 wt%, and formation of keto- and hydroxydienes as a result. An amount of 0.6–2.1 wt% of hydroperoxydienes was transformed into keto- and hydroxydienes, being the formation of the former as much as three times higher. The method showed satisfactory sensitivity (quantification limits of 0.3 μg/mL for hydroperoxy- and ketodienes and 0.6 μg/mL for hydroxydienes), precision (coefficients of variation ≤6% for hydroperoxydienes and ≤15% for keto- and hydroxydienes) and accuracy (recovery values of 85(±4), 99(±2) and 97.0(±0.6)% for hydroperoxy-, keto- and hydroxydienes, respectively). The method was applied to samples of high-linoleic (HLSO), high-oleic (HOSO) and high-stearic high-oleic (HSHOSO) sunflower oils oxidized at 40°C. Results showed that the higher the linoleic-to-oleic ratio, the higher were the levels of hydroperoxy-, keto- and hydroxydienes when tocopherols were completely depleted, i.e., at the end of the induction period (IP). Levels of 23.7, 2.7, and 1.1 mg/g oil were found for hydroperoxy-, keto-, and hydroxydienes, respectively, in the HLSO when tocopherol was practically exhausted. It was estimated that hydroperoxydienes constituted approximately 100, 95, and 60% of total hydroperoxides in the HLSO, HOSO, and HSHOSO, respectively, along the IP.

LipidXplorer: a software for consensual cross-platform lipidomics

Herzog, R., *et al., PLoS One* 7(1):e29851, 2012; DOI: 10.1371/journal.pone.0029851

LipidXplorer is the open source software that supports the quantitative characterization of complex lipidomes by interpreting large datasets of shotgun mass spectra. LipidXplorer processes spectra acquired on any type of tandem mass spectrometers; it identifies and quantifies molecular species of any ionizable lipid class by considering any known or assumed molecular fragmentation pathway independently of any resource of reference mass spectra. It also supports any shotgun profiling routine, from high throughput top-down screening for molecular diagnostic and biomarker discovery to the targeted absolute quantification of low abundant lipid species. Full documentation on installation and operation of LipidXplorer, including tutorial, collection of spectra interpretation scripts, FAQ [frequently asked questions] and user forum are available through the wiki site at: https://wiki.mpi-cbg.de/wiki/lipidx/index.php/Main_Page.

Omega-3 fatty acids and their lipid mediators: towards an understanding of resolvin and protectin formation

Weylandt, K.H., *et al., Prostaglandins Other Lipid Mediat.* 97:73–82, 2012.

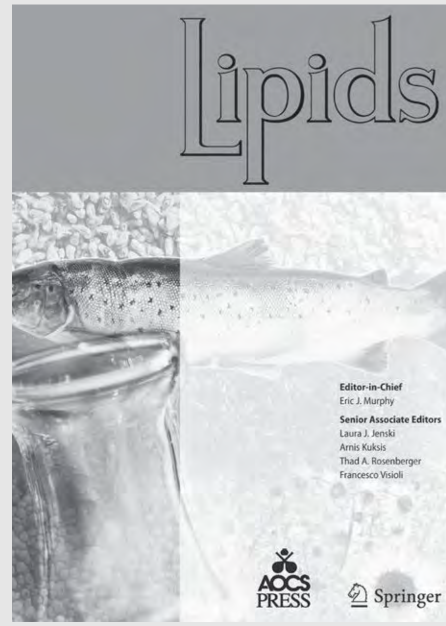
Omega-3 polyunsaturated fatty acids (n-3 PUFA) have long been associated with decreased inflammation and are also implicated in the prevention of tumorigenesis. Conventional thinking attributed this mainly to a suppressive effect of these fatty acids on the formation of arachidonic acid-derived prostaglandins and leukotrienes. Recent years have seen the discovery of a new class of inflammation-dampening and resolution-promoting n-3 PUFA-derived lipid mediators called resolvins and protectins. Chemically, these compounds are hydroxylated derivatives of the parent n-3 PUFA eicosapentaenoic acid (EPA) for the E-resolvins, and docosahexaenoic acid (DHA) for the D-resolvins and protectin D1. While a relatively large number of

CONTINUED ON PAGE 374

AOCS Journals

Journal of the American Oil Chemists' Society (May)

- Organogels: an alternative edible oil-structuring method, Co, E.D., and A.G. Marangoni
- Application of multivariate analysis in mid-infrared spectroscopy as a tool for the evaluation of waste frying oil blends, Hocevar, L., V.R.B. Soares, F.S. Oliveira, M.G.A. Korn, and L.S.G. Teixeira
- The role of mixing temperature on microstructure and rheological properties of butter blends, Buldo,P., and L. Wiking
- Simplified radiocarbon analysis procedure for measuring the renewable diesel concentration in diesel fuel blends, Norton, G.A., and M.X. Woodruff
- Effect of enzymatic trans- and interesterification on the thermal properties of groundnut and linseed oils and their blends, Sharma, M., and B.R. Lokesh
- A kinetic model describing antioxidation and prooxidation of β-carotene in the presence of α-tocopherol and ascorbic acid, Shibasaki-Kitakawa, N., M. Murakami, M. Kubo, and T. Yonemoto
- Functional food ingredients based on sunflower protein concentrates naturally enriched with antioxidant phenolic compounds, Salgado, P.R., S.E. Molina Ortiz, S. Petruccelli, and A.N. Mauri
- Stabilization of camelina oil with synthetic and natural antioxidant, Fröhlich, A., G. O'Dea, R. Hackett, D. O'Beirne, D. Ni Eidhin, and J. Burke
- Do apo-lycopenoids have antioxidant activities *in vitro*? Müller,L., E. Reynaud, P. Goupy, C. Caris-Veyrat, and V. Böhm
- Analysis and formation of *trans* fatty acids in corn oil during the heating process, Yang, M., Y. Yang, S. Nie, M. Xie, and F. Chen
- Solubility differences of major storage proteins of Brassicaceae oilseeds, Wanasundara, J.P.D., S.J. Abeysekara, T.C. McIntosh, and K.C. Falk
- Physicochemical properties, chemical composition and antioxidant activity of *Dalbergia odorifera* T. Chen seed oil, Lianhe, Z., H. Xing, W. Li, and C. Zhengxing
- Preparation and evaluation of biodiesel from *Sterculia foetida* seed oil, Bindhu, Ch., J.R.C. Reddy, B.V.S.K., Rao, T. Ravinder, P.P. Chakrabarti, M.S.L. Karuna, and R.B.N. Prasad
- Physicochemical properties and adhesion performance of canola protein modified with sodium bisulfite, Li, N., G. Qi, X.S. Sun, M.J. Stamm, and D. Wang
- Phosphate esters functionalized dihydroxyl soybean oil tackifier of pressure-sensitive adhesives, Ahn, B.K., J. Sung, and X.S. Sun
- Magnetic solid base catalysts for the production of biodiesel: Evaluation of biodiesel derived from *Camelina sativa* oil, Soriano, N.U., and A. Narani
- Magnetic solid base catalysts for the production of biodiesel, Guo, P., F. Huang, M. Zheng, W. Li, and Q. Huang
- The isolation of yellow mustard oil using water and cyclic ethers, Tabtabaei, S.. and L.L. Diosady
- Recovery and functional properties of soy storage proteins from lab- and pilot-plant scale oleosome production, Kapchie, V.N., L.T. Towa, C.C. Hauck, and P.A. Murphy
- Unfounded solvent recovery process by membrane filtration, Dijkstra, A.J.
- Considerations on the use of nanofiltration for solvent purification in the oil industry, Darvishmanesh, S., T. Robberecht, P. Luis, J. Degrève, and B. Van der Bruggen



Lipids (May)

- Inhibition of macrophage oxidative stress prevents the reduction of ABCA-1 transporter induced by advanced glycated albumin, de Souza, R., G. Castilho, B.A. Paim, A. Machado-Lima, N.M. Inada, E.R. Nakandakare, A.E. Vercesi, and M. Passarelli
- Phospholipid peroxidation: lack of effect of fatty acid pairing, Norris, S.E., T.W. Mitchell, and P.L. Else
- Enhancement of intestinal permeability utilizing solid lipid nanoparticles increases γ-tocotrienol oral bioavailability, Abuasal, B.S., C. Lucas, B. Peyton, A. Alayoubi, S. Nazzal, P.W. Sylvester, and A. Kaddoumi
- Tocotrienol attenuates triglyceride accumulation in HepG2 cells and F344 rats, Burdeos, G.C., K. Nakagawa, F. Kimura, and T. Miyazawa
- Dietary supplementation with 22-*S*-hydroxycholesterol to rats reduces body weight gain and the accumulation of liver triacylglycerol, Kase, E.T., N. Nikolić, N.P. Hessvik, Å.-K. Fjeldheim, J. Jensen, G.H. Thoresen, and A.C. Rustan

- Mechanisms underlying decreased hepatic triacylglycerol and cholesterol by dietary bitter melon extract in the rat, Senanayake, G.V.K., N. Fukuda, S. Nshizono, Y.-M. Wang, K. Nagao, T. Yanagita, M. Iwamoto, and H. Ohta
- Influence of maternal diet during early pregnancy on the fatty acid profile in the fetus at late pregnancy in rats, Fernandes, F.S., M.d.G. Tavares do Carmo, and E. Herrera
- Camelina meal increases egg n-3 fatty acid content without altering quality or production in laying hens, Kakani, R., J. Fowler, A.-U. Haq, E.J. Murphy, T.A. Rosenberger, M. Berhow, and C.A. Bailey
- Automated high-throughput fatty acid analysis of umbilical cord serum and application to an epidemiological study, Lin, Y.H., N. Salem Jr., E.M. Wells, W. Zhou, J.D. Loewke, J.A. Brown, W.E.M. Lands, L.R. Goldman, and J.R. Hibbeln
- Statistical methodological issues in handling of fatty acid data: percentage or concentration, imputation and indices, Mocking, R.J.T., J. Assies, A. Lok, H.G. Ruhé, M.W.J. Koeter, I. Visser, C.L.H. Bockting, and A.H. Schene

Journal of Surfactants and Detergents (May)

- Wettability of aqueous solutions of eco-friendly surfactants (ethoxylated alcohols and polyoxyethylene glycerin esters), Jurado, E., J.M. Vicaria, J.F. García-Martín, and M. García-Román
- Calcium chelating sugar-based surfactants for hard-water detergency, Ferlin, N., D. Grassi, C. Ojeda, M.J.L. Castro, A. Fernández-Cirelli, J. Kovensky, and E. Grand
- Protease and amylase stability in the presence of chelators used in laundry detergent applications: correlation between chelator properties and enzyme stability in liquid detergents, Lund, H., S.G. Kaasgaard, P. Skagerlind, L. Jorgensen, C.I. Jørgensen, and M. van de Weert.
- Mechanistic studies of particulate soil detergency: I. hydrophobic soil removal, Rojvoranun, S., C. Chadavipoo, W. Pengjun, S. Chavadej, J.F. Scamehorn, and D.A.Sabatini

- Comparative study of effect of surfactant-polymer interactions on properties of alkyl polyglucosides and alpha olefin sulphonate, Momin, S.A., and P. Yeole
- Interfacial properties of polyethylene glycol/vinyltriethoxysilane (PEG/VTES) copolymers and their application to stain resistance, Chao, Y.-C., S.-K Su, Y.-W Lin, W.-T Hsu, and K.-S Huang
- Synthesis of bis[N,N′-(alkylamideethyl) ethyl] triethylenediamine bromide surfactants and their oilfield application investigation, Zhou, M., J. Zhao, and X. Hu
- Cationic micelles modulated in the presence of α,ω-alkanediols: A SANS, NMR and conductometric study, Chavda, S., K. Singh, D.G. Marangoni, V.K. Aswal, and P. Bahadur
- Mixed micellization behavior of *m*-2-*m* gemini surfactants with some conventional surfactants at different temperatures, Sood, A.K., K. Singh, J. Kaur, and T.S. Banipal
- Synthesis and properties of organosilicon quaternary salts surfactants, Li, J., Q. Zhang, Y., Wang, W. Zhang, and T. Li.
- Simple and efficient synthesis and surfactant properties of N-alkyl-3-boronopyridinium acid triflates, Savsunenko, O., H. Matondo, Y. Karpichev, V. Poinsot, A. Popov, I. Rico-Lattes, and A. Lattes
- Glycine surfactants derived from dodecenyl succinic anhydride, Dix, L., and A. Moon
- Surface properties, thermodynamic aspects and antimicrobial activity of some novel iminium surfactants, Aiad, I., M.M. El-Sukkary, A. El-Deeb, M.Y. El-Awady, and S.M. Shaban
- Effect of hydrophobicity of PEO–PPO–PEO block copolymers on micellization and solubilization of a model drug nimesulide, Parmar, A., U. Yerramilli, and P. Bahadur
- Effect of a hydrophilic PEO–PPO–PEO copolymer on cetyltrimethyl ammonium tosylate solutions in water, Patel, V., S. Chavda, V.K. Aswal, and P. Bahadur
- A new PVC membrane ion selective electrode for determination of cationic surfactant in mouthwash, Devi, S. and M.C. Chattopadhyaya

CLASSIFIED

EXTRACTS & DISTILLATES (CONTINUED FROM PAGE 371)

these compounds have been identified and characterized until now, with differences in the positions of the hydroxyl groups as well as in the chirality at the different carbon atoms, all compounds share common precursor metabolites, 17-hydroperoxydocosahexaenoic acid (17-H(p)DHA) for the DHA-derived compounds and 18-hydroperoxyeicosapentaenoic acid (18-H(p)EPE) for the EPA-derived compounds. In this review we summarize the current knowledge about EPA- and DHA-derived resolvins and protectins and explore the potential use of the pro-resolvins 17-hydroxydocosahexaenoic acid (17-HDHA) and 18-hydroxyeicosapentaenoic acid (18-HEPE) as indicators of anti-inflammatory n-3 PUFA mediator formation.

Should raising high-density lipoprotein cholesterol be a matter of debate?

Athyros, V.G., *et al.*, *J. Cardiovasc. Med.* *13*:254–259, 2012.

High-density lipoprotein cholesterol (HDL-C) has been identified as an independent inverse predictor of coronary heart disease, leading to the inclusion of HDL-C in certain risk engines. However, negative results also exist and create confusion regarding the value of interventions that increase HDL-C. The possible reasons for these conflicting findings are many, including not only patient selection (e.g., baseline HDL-C levels) but also the effect of the treatment on the quantity and quality of HDL. In the present review, the results of some HDL-C trials are discussed. They suggest that HDL-C function as well as quantity is clinically relevant. Furthermore, "dysfunctional" HDL may be present in conditions such as diabetes or acute coronary syndromes. Efforts should focus on improving HDL particle functionality in addition to a numerical increase in HDL-C levels.

Vitamin A metabolism: an update

D'Ambrosio, D.N., *et al.*, *Nutrients 3*:63-103, 2011.

Retinoids are required for maintaining many essential physiological processes in the body, including normal growth and development, normal vision, a healthy immune system, normal reproduction, and healthy skin and barrier functions. In excess of 500 genes are thought to be regulated by retinoic acid. 11-*cis*-Retinal serves as the visual chromophore in vision. The body must acquire retinoid from the diet in order to maintain these essential physiological processes. Retinoid metabolism is complex and involves many different retinoid forms, including retinyl esters, retinol, retinal, retinoic acid, and oxidized and conjugated metabolites of both retinol and retinoic acid. In addition, retinoid metabolism involves many carrier proteins and enzymes that are specific to retinoid metabolism, as well as other proteins which may be involved in mediating triglyceride and/or cholesterol metabolism. This review will focus on recent advances for understanding retinoid metabolism that have taken place in the last 10–15 years.

Plant sterols and cardiovascular disease: a systematic review and meta-analysis

Genser, B., *et al.*, *Eur. Heart J.* *4*:444–451, 2012.

The impact of increased serum concentrations of plant sterols on cardiovascular risk is unclear. We conducted a systematic review and meta-analysis aimed to investigate whether there is an association between serum concentrations of two common plant sterols (sitosterol, campesterol) and cardiovascular disease (CVD). We systematically searched the databases MEDLINE, EMBASE, and COCHRANE for studies published between January 1950 and April 2010 that reported either risk ratios (RR) of CVD in relation to serum sterol concentrations (either absolute or expressed as ratios relative to total cholesterol) or serum sterol concentrations in CVD cases and controls separately. We conducted two meta-analyses, one based on RR of CVD contrasting the upper vs. the lower third of the sterol distribution, and another based on standardized mean differences between CVD cases and controls. Summary estimates were derived by fixed and random effects meta-analysis techniques. We identified 17 studies using different designs (four case-control, five nested case-control, three cohort, five cross-sectional) involving 11,182 participants. Eight studies reported RR of CVD and 15 studies reported serum concentrations in CVD cases and controls. Funnel plots showed evidence for publication bias indicating small unpublished studies with nonsignificant findings. Neither of our meta-analyses suggested any relationship between serum concentrations of sitosterol and campesterol (both absolute concentrations and ratios to cholesterol) and risk of CVD. Our systematic review and meta-analysis did not reveal any evidence of an association between serum concentrations of plant sterols and risk of CVD.

A review analyzing the industrial biodiesel production practice starting from vegetable oil refining

Santori, G., *et al.*, *Appl. Energy 92*:109–132, 2012.

One of the most promising renewable fuels proposed as an alternative to fossil diesel is biodiesel. The competitive potential of biodiesel is limited by the price of vegetable oils, which strongly influences the final price of this biofuel. On the other hand, extensive use of vegetable oils may cause other significant problems such as starvation in developing countries. Appropriately planning and designing the whole production process, from the seed to the biodiesel end product, are essential to contain the influence of energy inefficiencies on the high price of the end product. The present study reviews the technologies currently used in the production of biodiesel. We first discuss the technologies for extracting the vegetable oil from the seed, and its subsequent refining and conversion into biodiesel. This study focuses on the characteristics of the production processes currently used in the sector, illustrating the technological options and emphasizing the drawbacks of certain practices and the best choices available. The vegetable oils tend to be processed using procedures that are well established, but oriented more toward obtaining products suitable for the foodstuffs industry, and that consequently use technologies that are sometimes excessive for energetic purposes. The processes for extracting the vegetable oil from the seed generally include a set of steps, the complexity of which depends on the raw material. Basically, the two extraction technologies involved rely on the use of pressure or solvents. In practice, the two systems are often combined. Using the vegetable oils as a source of energy makes some of these steps superfluous and enables technologies to be used that would be unsuitable for foodstuffs production. This study focuses on feasible technological improvements that would give rise to oil that is still suitable for use as a source of energy, but at a lower cost. The refined vegetable oil can subsequently be converted into biodiesel by means of a great variety of technologies, many of which are still not suitable for applications on an industrial scale. The solution that has met with the greatest favor is homogeneous alkaline transesterification with KOH and methanol. Even when dealing with this type of conversion alone, it is impossible to establish a universal schema to describe the conversion or purification stages because there are numerous possible different solutions. When we then look more closely at the state of the art in industrial biodiesel production plants, we encounter the potential problems introduced by the type and characteristics of the original raw material. Comparing some of the reference solutions that have inspired numerous installations, a sensitivity analysis is conducted on the main elements involved in the process, focusing on their behavior in different working conditions to obtain products with the characteristics required by the international standards (EN 14214:2008, ASTM D 6751 07b).

Effects of monounsaturated fatty acids on cardiovascular risk factors: a systematic review and meta-analysis

Schwingshackl, L., *et al., Ann. Nutr. Metab. 59*:176–186, 2011.

The appropriate pattern of macronutrient distribution for dietary protocols aimed at treating or preventing obesity and its associated cardiovascular diseases is still a controversial topic of discussion. Recommendations considering a specific percentage or range for monounsaturated fatty acids (MUFA) are rare. It was the aim of this study to analyze long-term, randomized, controlled dietary intervention trials and to investigate the effects of MUFA on the biomarkers of obesity and cardiovascular risk factors. Dietary regimens with a high amount of MUFA (>12%) were compared to those with ≤12%. The biomarkers taken into account were weight, waist circumference, fat mass, total cholesterol, low density lipoprotein cholesterol, high density lipoprotein cholesterol, triacylglycerols, systolic and diastolic blood pressure, as well as C-reactive protein. A total of 12 studies met the inclusion criteria. Data analysis was performed using the Review Manager 5.0.25 software. Significant differences between high-and low-MUFA protocols could be observed with respect to fat mass [–1.94 kg (confidence interval –3.72, –0.17), $p = 0.03$], systolic blood pressure [–2.26 mm Hg (confidence interval –4.28, –0.25), $p = 0.03$] and diastolic blood pressure [–1.15 mm Hg (confidence interval –1.96, –0.34), $p = 0.005$] favoring the dietary protocols with >12% MUFA. Therefore, MUFA might represent a useful tool in the design of dietary regimens for obesity and cardiovascular disease.

Determination of vegetable oils and fats adulterants in diesel oil by high performance liquid chromatography and multivariate methods

Brandao, L.F.P., *et al., J. Chromatogr. A 1225*:150–157, 2012.

Current legislation requires the mandatory addition of biodiesel to all Brazilian road diesel oil A (pure diesel) marketed in the country and bans the addition of vegetable oils for this type of diesel. However, cases of irregular addition of vegetable oils directly to the diesel oil may occur, mainly due to the lower cost of these raw materials compared to the final product, biodiesel. In Brazil, the situation is even more critical once the country is one of the largest producers of oleaginous products in the world, especially soybean, and also it has an extensive road network dependent on diesel. Therefore, alternatives to control the quality of diesel have become increasingly necessary. This study proposes an analytical methodology for quality control of diesel with intention to identify and determine adulterations of oils and even fats of vegetable origin. This methodology is based on detection, identification, and quantification of triacylglycerols in diesel (main constituents of vegetable oils and fats) by high-performance liquid chromatography in reversed phase with ultraviolet detection at 205 nm associated with multivariate methods. Six different types of oils and fats were studied (soybean, frying oil, corn, cotton, palm oil, and babassu), and two methods were developed for data analysis. The first one, based on principal component analysis (PCA), nearest neighbor classification (KNN), and univariate regression, was used for samples adulterated with a single type of oil or fat. In the second method, partial least squares regression (PLS) was used for the cases where the adulterants were mixtures of up to three types of oils or fats. In the first method, the techniques of PCA and KNN were correctly classified as 17 out of 18 validation samples on the type of oil or fat present. The concentrations estimated for adulterants showed good agreement with the reference values, with mean errors of prediction (RMSEP) ranging between 0.10 and 0.22% (v/v). The PLS method was efficient in the quantification of mixtures of up to three types of oils and fats, with RMSEP being obtained between 0.08 and 0.27% (v/v), mean precision between 0.07 and 0.32% (v/v), and minimum detectable concentration between 0.23 and 0.81% (v/v) depending on the type of oil or fat determined in the mixture.

Dietary intake of PUFAs and colorectal polyp risk

Murff, H.J., *et al., Am. J. Clin. Nutr. 95*:703–712, 2012.

Marine-derived n-3 (omega-3) polyunsaturated fatty acids (PUFA) may reduce risk of developing colorectal cancer; however, few studies have investigated the association of n-3 PUFA intakes on colorectal polyp risk. The objective of this study was to examine the associations of dietary PUFA intake on risk of colorectal adenomatous and hyperplastic polyps. Design: This was a colonoscopy-based case-control study that included 3,166 polyp-free control subjects, 1,597 adenomatous polyp cases, and 544 hyperplastic polyp cases. Dietary PUFA intake was calculated from food-frequency questionnaires and tested for association by using unconditional logistic regression. The urinary prostaglandin E_2 metabolite, which is a biomarker of prostaglandin E_2 production, was measured in 896 participants by using liquid chromatography and tandem mass spectrometry. n-6 PUFA were not associated with adenomatous or hyperplastic polyps in either men or women. Marine-derived n-3 PUFA were associated with reduced risk of colorectal adenomas in women only, with an adjusted OR of 0.67 (95% confidence interval: 0.47, 0.97) for the highest quintile of intake compared with the lowest quintile of intake (P-trend = 0.01). Dietary intake of α-linolenic acid was associated with an increased risk of hyperplastic polyps in men (P-trend = 0.03), which was not seen in women. In women, but not in men, dietary intake of marine-derived n-3 PUFAs was negatively correlated with urinary prostaglandin E_2 production ($r = -0.18$, $P = 0.002$). Higher intakes of marine-derived n-3 PUFA are associated with lower risk of adenomatous polyps in women, and the association may be mediated in part through a reduction in the production of prostaglandin E_2. This trial was registered at clinicaltrials.gov as NCT00625066. ■

Patents

Published Patents

Emulsification-free degumming of oil

Chou, C., Oilseeds Biorefinery Corp., US8076123, December 13, 2011

This invention relates to an oil degumming method that is free of emulsification. Crude oil is treated with immobilized phospholipase and extracted with pure water or an aqueous solution.

Binder composition and asphalt mixture

Laurens, C., *et al.*, Shell Oil Co., US8076399, December 13, 2011

A binder composition and asphalt mixture for asphalt pavements are disclosed. The binder composition comprises a resin of vegetable origin, an oil of vegetable origin, and a polymer, and the polymer comprises functional groups chosen from carboxylic acid anhydride, carboxylic acid, and epoxide groups.

Production of acylglycerol esters

Lai, O.M., *et al.*, Universiti Putra Malaysia, Golden Hope Research Sendirian Berhad, US8076497, December 13, 2011

The present invention relates to the production of oil and fat containing acylglycerol esters including diacylglycerols, medium-chain and long-chain fatty acid triacyglycerols comprising an esterification reaction between an acyl group donor and an acyl group acceptor in the presence of a heterogeneous chemical catalyst consisting of an ion-exchange resin preparation. The product is further subjected to dehydration and separation to produce diacylglycerols and/or medium-chain and long-chain fatty acid triacyglycerols at a high yield in a short period of time.

Method for preparing fatty acid esters with alcohol recycling

Elst, K., *et al.*, Vlaamse Instelling Voor Technologisch Onderzoek N.V. (Vito), US8076498, December 13, 2011

A method produces fatty acid esters by transesterification of fats and oils with an alcohol at high pressure and temperature. Unreacted alcohol is separated inline from the reaction mixture and continuously recycled into the transesterification process. The separation is performed by obtaining a vapor phase and higher-density phases of the reaction mixture and concentrating the alcohol in the vapor phase.

Liquid developer and image forming apparatus

Teshima, T., *et al.*, Seiko Epson Corp., US8080355, December 20, 2011

A liquid developer includes an insulation liquid containing a fatty acid monoester and toner particles comprised of a polyester resin. By using the liquid developer it is possible to provide superior fixing characteristic of toner particles to a recording medium. An image forming apparatus that can suitably use such a liquid developer is also provided.

Cleansing bar compositions comprising a high level of water

Salvador, C.R., *et al.*, Procter & Gamble Co., US8080503, December 20, 2011

Cleansing bar compositions having high water content comprise: (i) at least 15% water; (ii) 40–84% soap; and (iii) 1–15% inorganic salt. The bar compositions further comprise a component selected from the group consisting of carbohydrate structurant, humectant, free fatty acid, synthetic surfactants, and mixtures thereof. The bar compositions preferably have a water activity (A_w) of less than 0.85. The bar compositions are preferably manufactured by a milling process.

Self-emulsifying preparations

Kawa, R., and U. Issberner, Cognis IP Management GmbH, US8080586, December 20, 2011

The invention relates to new self-emulsifying preparations containing (i) 7–20% stearyl oligoglycoside, (ii) 7–20% cetyl oligoglycoside, (iii) 0.1–3% myristyl oligoglycoside, (iv) 0.5–7% lauryl oligoglycoside, (v) 4–12% cetyl alcohol, (vi) 10–20% stearyl alcohol, (vii) 20–30% $C_{16/18}$ partial glycerides containing 58–62% monoglyceride, and (viii) 20–30% $C_{16/18}$ partial glycerides containing 30–45% monoglyceride, with the proviso that the quantities shown add up to 100% by weight with water.

Low hysteresis rubber elastomer

Bergman, B.R., Michelin Recherche et Technique S.A., US8080603, December 20, 2011

Curable elastomer compositions and cured and/or curable articles made therefrom are disclosed. The curable elastomer composition comprises an essentially unsaturated rubber elastomer between 0.5 and 25 PHR [parts per hundred parts of resin] of a metal salt of a carboxylic acid, an effective amount of a peroxide curing agent for curing the elastomer composition, and between 0.1 and 10 PHR of a hysteresis-decreasing multifunctional curing coagent that decreases the hysteresis of the cured elastomer composition. The hysteresis is measured using a rotorless shear rheometer as a loss tangent at 150°C, 41.85% strain, and 10 Hz. The hysteresis of such a cured composition may decrease by at least 15% or, alternatively, by at least 25%. The elastomer is useful in tires including, for example, the sidewall supports, the carcass reinforcement, and the tread.

Integrated process for preparing a carboxylic acid from an alkane

Benderly, A., *et al.*, Rohm and Haas, US8080686, December 20, 2011

The present invention relates to an integrated process for producing unsaturated carboxylic acids from the corresponding C_2–C_4 alkane. Thermally integrated dehydrogenation reactions are carried out to convert a C_2–C_4 alkane to its corresponding C_2–C_4 alkene and exothermically convert a portion of an alkane to its corresponding alkene by oxidative dehydrogenation in an exothermic reaction zone in the presence of oxygen and a suitable catalyst. The products of the exothermic reaction zone are fed to an endothermic reaction zone wherein at least a portion of the remaining unconverted alkane is endothermically dehydrogenated to form more of the corresponding alkene, in the presence of carbon dioxide and another suitable catalyst. The alkene products of the thermally integrated dehydrogenation reactions are then provided to a catalytic vapor phase partial oxidation process for conversion of the alkene to the corresponding unsaturated carboxylic acid or nitrile. Unreacted alkene and carbon dioxide are recovered from the oxidation product stream and recycled back to the thermally integrated dehydrogenation reactions.

Complexes of fatty acid esters of polyhydroxyalkanes and pyridine carboxy derivatives

Weidner, M.S., Astion Dermatology A/S, US8084049, December 27, 2011

The present invention relates to novel combinations of fatty acid derivatives and pyridine carboxy derivatives, including fatty acid esters with glycerol and 3-carboxy pyridine derivatives such as niacinamide. Such combinations have surprisingly shown antiviral and antimicrobial activity, and the use for the treatment of inflammatory conditions and infections is disclosed herein.

Bioerodible film for ophthalmic drug delivery

Kabra, B.P., *et al.*, Novartis AG; Alcon Inc., US8084054, December 27, 2011

Drug delivery film compositions containing a combination of water-soluble, film-forming polymers and a fatty acid glyceride or ester are suitable for delivering ophthalmic drugs.

Preparation of a lipid blend and a phospholipid suspension containing the lipid blend

Hui, P.K., *et al.*, Lantheus Medical Imaging Inc., US8084056, December 27, 2011

The present invention describes processes for the preparation of a lipid blend and a uniform filterable phospholipid suspension containing the lipid blend; the suspension is useful as an ultrasound contrast agent.

Method of identifying maize plants having increased oil content using quantitative trait locus 6 (QTL6)

Allen, W.B., *et al.*, Du Pont Pioneer Hi Bred International, Inc., US8084208, December 27, 2011

Compositions related to the quantitative trait locus 6 (QTL6) in maize and methods for their use are provided. The compositions are novel molecular marker loci that are genetically linked with QTL6 and which are associated with increased oil content and/or increased oleic acid content and/or an increased oleic acid/linoleic acid ratio of a plant or plant part thereof. These novel markers are characterized by the presence of at least one polymorphism relative to the corresponding marker locus from the QTL6 region of non-high-oil non-high-oleic acid maize plants. In some embodiments the novel marker loci comprise coding sequence for a maize DGAT1-2 polypeptide or biologically active variant thereof. The marker loci of the invention, and suitable fragments thereof, are useful in methods of the invention for manipulating oil and/or oleic acid content and/or oleic acid/linoleic acid ratio of a plant or plant part thereof, for marker-assisted selection of a plant, for example, a maize plant or plant part thereof, having an increased oil content and/or increased oleic acid content and/or an increased oleic acid/linoleic acid ratio, and for marker-assisted breeding of the high-oil and/or high-oleic acid trait.

Catalytic process for converting renewable resources into paraffins for use as diesel blending stocks

Dindi, H., *et al.*, Du Pont, US8084655, December 27, 2011

A process for converting renewable resources such as vegetable oil and animal fat into paraffins in a single step is disclosed. A lipid feed is contacted with hydrogen and a catalyst.

Production of biodiesel and glycerin from high free fatty acid feedstocks

Jackam, J.P., *et al.*, Seneca Landlord LLC, US8088183, January 3, 2012

A system and method for the conversion of free fatty acids to glycerides and the subsequent conversion of glycerides to glycerin and biodiesel includes the transesterification of a glyceride stream with an alcohol. The fatty acid alkyl esters are separated from the glycerin to produce a first liquid phase containing a fatty acid alkyl ester-rich (concentrated) stream and a second liquid phase containing a glycerin-rich (concentrated) stream. The fatty acid alkyl ester-rich stream is then subjected to distillation, preferably reactive distillation, wherein the stream undergoes both physical separation and chemical reaction. The fatty acid alkyl ester-rich stream is then purified to produce a purified biodiesel product and a glyceride-rich residue stream. The glycerin-rich stream may be further purified to produce a purified glycerin product and a (second) wet alcohol stream.

Method for the continuous production of unsaturated carboxylic acid anhydrides

Broell, D., and H. Siegert, Evonik Roehm GmbH, US8084640, December 27, 2011

Process for continuously preparing unsaturated carboxylic anhydrides of unsaturated organic radicals having 2–12 carbon atoms by trans-anhydridization of an aliphatic carboxylic anhydride with a carboxylic acid also unsaturated with 2 to 12 carbon atoms in a rectification column having an upper, middle, and lower region. An inert boiling oil is initially charged in the bottom of the column; the reactants are fed into a reaction region in stoichiometric ratios; the carboxylic acid formed as the by-product is withdrawn at the top of the column; the unconverted reactants are recycled into the reaction region, and the product is obtained via a side draw preferably between the middle and lower column region.

CONTINUED ON PAGE 400

Welcome New Members

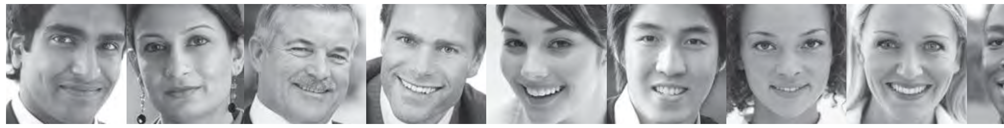
AOCS Since 1909
Your Global Fats and Oils Connection

AOCS is proud to welcome our newest members*.

*New and reinstated members joined from January 1 through March 31, 2012.

Mark Adriaenssens, Barry Callebaut
Sanjay K. Agarwal, Saudi Basic Industries Corp (SABIC)
Lynn Agate, EP Minerals
Kollbe Ahn, Kansas State University
Carine Alfos, ITERG
James N. Anderson, Caravan Ingredients Co
Jamie Anderson, Sun Products Corp
Donald B. Appleby, Procter & Gamble Food Ingredients
Elmira Arab-Tehrany, LIBIO ENSAIA
Torey J. Arvik, Sonomaceuticals
Kornkanok Aryusuk, King Mongkuts Univ of Tech Thonburi
Peggy Ashman, Bunge Oils
Erica Bakota, USDA ARS NCAUR
Phongsakorn Banjai, Petroleum & Petrochem College
Sheila Baradaran, University of Oklahoma
Trygg N. Barnung, Moreforsking Marin
Caroline Baron, DTU Food
Sergio L. Baruffi, Incobrasa Industries Ltd
Olivier Berdeaux, INRA CSGA
Ruben D. Betancourt Cortes, Team Foods SA
Casey Bewley, Broward College
Alexia Blake, University of Guelph
Mary Bolton, California Olive Ranch
Julie H. Boucher, Wacker Chemical Corp
James Bowers, MeadWestvaco Corp
Leah M. Bradley, Veronica Foods Co
Luke A. Brislain, Bunge North America
Gunther Buck, Mibelle AG
Suzanne M. Budge, Dalhousie University
Juergen M. Buenger, IPA
Walter A. Burchardt, Schutter Lab Paraguay SA
Neil A. Burns, P2 Science Inc
Sheng-Suan Cai, Syagen Technology Inc
Ian T. Cartwright, New Jersey Feed Lab Inc
Pradosh P. Chakrabarti, Indian Institute of Chemical Tech
Jarussri Chanwattanakit, Petroleum & Petrochem College
Vinod Chaudhary, Brigham Young University
Kai-Yu Chen, Kyungpook National University
Mark Chimel, DSM Nutritional Products
Thitirat Choke-arpornchai, Petroleum & Petrochem College
Salisa Chumsantea, King Mongkuts Univ of Technology
Stuart W. Chundrlek, South Chicago Packing Co
Ki Sung Chung, Greenenergy
Brian Connolly, Denomega Pure Health
Lanfranco S. Conte, Universita of Udine
Erin Craft, DSM Nutritional Products
Henri Cramail, LCPO
Dedi Rosa Putra Cupu, University of Riau
Sara Cutler, Kemin Nutrisurance Inc
June Ann D'Angelo, Washington University, St Louis
William S. Dahl, Viterra Inc
Amy L. Dalby, Northern Illinois University
Yeshwanth G. Das, University of Mysore
Arturo Davila, DuPont
Nathalie De Clercq, Ghent University
Rita de Kassia Garcia, University of Campinas, UNICAMP
Praveen Depa, Procter & Gamble Co
Saikrishna Devarakonda, PZ Cussons Internations Ltd
Fitriya N. Dewi, Wake Forest University
Lorna Doore, Prairie View A&M University
Francis Dottin, Roberts Mfg Co Ltd
Geoffrey Duncalf, Savonnerie Anglaise Ltd
Erwann Durand, CIRAD UMR IATE
Carlos Elizondo, Proteinas Naturales SA de CV
Daniel Ellig, UOP/Honeywell
Andy Enneking, ConAgra Foods Inc
Roja Ergun, Dow Chemical Co
Adelia Faria-Machado, Embrapa Food Technology
Jerry G. Fawbush, Industrial Design Group LLC
Bruce Firth, Elevance Renewable Sciences
Beate Fuchs, University of Leipzig
Atsunobu Fujii
Takashi Fukushima, Inst for Early Developments of Japan
Emmanuelle Gailly, Puratos
Brent Gillespie, Pioneer Hi-Bred Production LP
Ronald Goldie, South Chicago Packing Co
Charmaine R. Graham, Food Science & Technology Ctr
Troy Graham, Sun Products Corp
Racquel Grant, Prairie View A&M University
Andrew Gravelle, University of Guelph
Ben Gu, Colgate-Palmolive Co
Ramon Hall, Dairy Innovation Australia
Srinivas Hanumansetty, University of Oklahoma
Sylvio Jorge Hares, Jr, Universidade de Sao Paolo
Mirza Hasanuzzaman, Sher-e-Bangla Agricultural University
Christine Hastilow, Abbott Labs
Chad M. Hazlewood, AkzoNobel
Jan Hemann, Novozymes AS
Kendra J. Hendrickson, University of Wisconsin, Madison
Edgar E. Hernandez, POET Nutrition
Todd Ryan Gregory Hill, Promethean Biofuels Coop Corp
Miyako Hisamoto
Jeppe Hjorth, AAK AB
Nils Hoem, Aker BioMarine Antarctic
Klaus Funch Hoeyer, SPX Flow Technology AS
Hironori Hondoh
Gholahossein Hosseinkhani, GFE Inc
LiLi Hu, Guangzhou Blue Moon Industrial
Min Hu, DuPont Health & Nutri
Stan R. Huddleston, Grace
Clint Huerter, ConAgra Foods Inc
Naomi E. Hughes, CSM
Charles J. Hunka, South Chicago Packing Co
Shah Hussain, University of Malakand
Tai Huynh, University of Arkansas
Nao Inoue, Tohoku University
Jerome Jacobs, J Rettenmaier USA LP
Yogini S. Jaiswal, SNDT Womens University
Giselle Janssen, Codexis
Irwandi Jaswir, Intl Islamic University Malaysia
Monica Jefferson, ConocoPhillips Co
Rodger Jonas, PL Thomas & Co
Robert Jones, Alfa Laval Inc
Chricilia Jordaan, SGS South Africa (Pty) Ltd
Laureline Jourdain, Nestle Research Center
Manuel V. Julca, Universidad Nacional de Ingenieria
Michael E. Jung, Verenium Corp
Lucie Kalvodova, Wiley-VCH
Paweena Kanokkarn, Petroleum & Petrochem College
Tugba Kara, Selcuk Universitesi
Stephanie Kassner, DSM Nutritional Products
Dawn Kaufmann, Gusmer Enterprises Inc
Daisuke Kawamura, Tokyo University of Science
John Keeler, POET Research
Robert Kennedy, Lubrizol Corp
Paramet Kerdkaew, Petroleum & Petrochem College
Erica L. Khamari, W R Grace & Co
Tai Khan, Food Quality Lab
Janel Kieffer, Ecolab Inc
Ji-Yeon Kim, Kyungpook National University
Minyoung Kim, Korea University
Boonyarch Kitiyanan, Petroleum & Petrochem College
Suragarn Klomkao, Petroleum & Petrochem College
Jes C. Knudsen, University of Copenhagen
Jakub Kobylinski, Warwaw University of Life Sciences
Sabeena F. Koduvayur Habeebullah, Technical University of Denmark
Varun Chandra Koneru, Utah State University
Elaine Krul, Solae LLC
Kepher Kuchana, Makerere University, PIBID Project
Robert Kuhlmeier, Albemarle Corp
Megan H. Lamb, Louisiana State University
Buddhi P. Lamsal, Iowa State University
Marika Lassila, University of Turku
Shami Lee, Sr, Chant Oil Co Ltd
Show-Ling Lee, Iowa State University
Junzhong Li, Ecolab Inc
Song Li, University of Illinois
Kelsy Lindsay, Barry Callebaut
Markus Link, Bruker BioSpin GmbH
Scott Long, Novus International Inc
Fred D. Lowder, ConocoPhillips Co
Roberto A. Luizon, Universidade Estadual Paulista
Samanthi Madawala, Swedish University of Agricultural Scis
Daniel Madgwick, Alteca Labs
Randy Maglinao, Montana State University, Northern
Michael J. Mahon, IOI Loders Croklaan
Haroon Malak, Mars Chocolate North America
Craig Mallon, DSM Nutritional Products
Maria Mangas, University of Brasilia
Phani Kumar Margani, SRM University
J. M. Nazrim Marikkar, Universiti Putra Malaysia
Gabriela Marquina, DuPont
Katrina J. Martin, Chuch & Dwight Co Inc

All members contribute to the success of the Society while furthering their professional goals.



Chloe Masselon, Rhodia-Solvay Group
Masahiko Matsubara, University of Yamanashi
Richard S. McLean, Viterra Inc
Velva McWhinney, CARC-CAHS-PVAMU
Michelle Meister, Clasen Quality Coatings Inc
Behannis J. Mena, Louisiana State University
Gabriella Mendes Candido de Oliveira, University of Illinois
Jorge A. Montenegro, CI SIGRAS SA
Juan Angel Morales-Rueda, UASLP
John Morris, Syringa Bioscience Pty Ltd
Cameron C. Murphy, University of Nebraska, Lincoln
Bijan Naghshbandi, GFE Inc
Andras Nagy, Evonik Goldschmidt Corp
Kamrun Nahar, Kagawa University
Akash Narani, Montana State University, Northern
Khairul Yu Nasution, University of North Sumatera
Micah Needham, DSM Nutritional Lipids
Mark Nejako, DSM Nutritional Lipids
Flora T. T. Ng, University of Waterloo
Frederyk Ngantung, Amyris
Brian Nies, Morpho Detection
Kazumi Ninomiya, Nihon University
Dedi Noviendri, Intl Islamic University Malaysia
Gary W. Nowak, Solae
Nora O'Brien, University College Cork
John O. Oghomi, Inspectorate America Corp
Kousaku Ohinata, Kyoto University
Charles O. Okpala, Monash University
Clara Olivia, University of Saskatchewan
Suyapa G. Padilla, Utah State University
Xavier Pages, ITERG
Xue Pan, University of Alberta
Jessica Paschal, Novozymes North America Inc
Jitendrakumar Patel, Riverland Oilseeds Pty Ltd
Stephen Patton, Wacker Chemical Corp
Luigi Pedrocchi, Mibelle Group/Mibelle AG
Kathrene Perakis, George Washington University
Jaime-David Perez-Martinez, Autonomous University of San Luis Potosi
James Perleberg, North Dakota State University
Matthew Perry, St Francis Xavier University
Emmanuel Petiot, Novozymes North America Inc
Aree Pinpiti, Petroleum & Petrochem College
Georges Piombo, CIRAD Persyst
Susan Poehlmann, Technical University of Munich
Prayashini Prabhaharan, IOI Loders Croklaan Oils Sdn Bhd
David Priestley, CAS
Dean Prince, Highplains Bioenergy
Frank Pudel, PPM Pilot Pflanzenoeltechnologie
Juliana Ract, University of Sao Paulo
Deepak S. Rajawat, Dayalbagh Educational Institute
Shalla Ramnarain, DSM Nutritional Products
Pramoch Rangsunvigit, Petroleum & Petrochem College
Kalina Ranguelova, Bruker BioSpin Corp
Darunrat Ratanalert, Petroleum & Petrochem College
Piret Raudsepp, University of Copenhagen
Madhuram Ravichandran, University of Arkansas
Hary L. Razafindralambo, University of Liege
Matthias Rebmann, Perimondo
Stacey Reeder, Aquatrols
Luiz Antonio Regi, Sina
Fernanda Ribeiro Burgel, PUC-Rio
Joseph P. Riley, FEC Solutions
Amjad Sadi, Al-Azhar University, Gaza
Tomoko Sakurai, Inst for Early Developments of Japan
Stella S. Salisu, DSM Nutritional Products
Anwesha Sarkar, Nestle Research Center
Faith Savanhu, Stepan Co
Diana D. Scala, Colgate-Palmolive Co
Liliana Scarafia, Agbiolab Inc
Charles Schasteen, Solae LLC
Kim Schippers, Dilling Group/IDG
Charles Schoenfeldt, Northbrook Trading Co
Michael W. Scholin, Oil-Dri Corp
Arjen Sein, DSM Food Specialties
Mark Sewald, General Mills Inc
Samana Shabanikakroodi
Vaidehi Shah, Church & Dwight Co Inc
Michael F. Sharphouse, Fairleigh Dickinson University
James Shewmaker, J Rettenmaier USA LP
Shiori Shimizu, Nihon University
Milind N. Shinde, Shivaji University, Kolhapur
Mike Shindelar, Feed Energy Co
Jaclyn A. Shingara, Novozymes North America
Sara E. Shinn, University of Arkansas
Ya'el Shufan, Hebrew University
Sergiy Shulga, Inst for Food Biotech & Genomics
Roberta Claro Silva, Universidade de Sao Paulo
Julian R. Silverman, City University of New York
Harjinder Singh, Massey University
Mares A. R. Sipahutar, Universitas Sumatera Utara
Stephen W. Sohn, UOP LLC
Ponisseril Somasundaran, Columbia University
Ewa Sosinska, University of Lethbridge
Flemming Vang Sparso, DuPont Health & Nutrition
Chayasari Srimingkwanchai, Petroleum & Petrochem College
Isaac T. Streit, University of Waterloo
Nan-Wei Su, National Taiwan University
Xiaonan Sui, National University of Singapore
Yuko Sukegawa, Tohoku University
Surendranath P. Suman, University of Kentucky
Craig Sungail, Croda Inc
Andreia H. Suzuki, Federal University of Santa Catarina
Peter Svensson, Aker BioMarine ASA
Naaman Tan Jiunn U, Universiti Sains Malaysia
Chin Yiap Tan, Utah State University
Shuaikun Tang, University of California, Davis
Vinod Tarwade, DSM Nutritional Products
Linda Terwilliger, AkzoNobel Surface Chemistry
Kurt Thomsen, Novozymes AS
Fang Tian, University of Massachusetts, Amherst
Djenontin Tindo Sebastien, University of Abomey-Calavi
Pinky P. Tobiano, Qualibet Testing Services Corp
Jacqueline M. Tordik, Strahl & Pitsch Inc
Duane S. Treybig, Syrgis PCHem
Sirithon Tubsangtong, Charoen Pokphand Foods PCL
Muhammad Usman, Sindh Agricultural University Tandojam
Sri Krishna Bharath Vagu, Utah State University
Theo H. VanderBurgt, Genencor
Daniel Vari, Wacker Chemical Corp
Bruno E. Vaschetto, Universidad Catolica Argentina
Joe T. Verrill, IOI Loders Croklaan
Stefanie Verstringe, Ghent University
Ryan Vikan, Nease Corp
Nerissa M. Villaluna, Church & Dwight Co Inc
Ashwini Wagh, Utah State University
John Walter, Supreme Oil Co
Chanchan Wang, University of Alberta
Sumudu Warnakulasuriya, Nova Scotia Agricultural College
Earl Washington, III, Corn Products International
Jamie Washington, Prairie View A&M University
Shingo Watanabe, Johnson Matthey
Michael Waterman, Vanderbilt University
Michelle L. White, Xavier University of New Orleans
Al Wilhelm, Richardson Oilseed Ltd
Alisa Williams, Prairie View A&M University
Candace L. Williams, Mississippi State University
Luciano Winck, ECOMIL
Deborah S. Winetzky, Winetzky Consulting Services
Michael K. Woodman, Agilent Technologies
Nazia Yaqoob, University of Illinois
Sung Won Yoon, Korea University
Eamd Yousif, Al-Nahrain University
Yi Zhou, University of California, Davis
Karina Zinatullina, Plekhanov Russian Univ of Economics
Dhahanjay D. Zope, Universite Laval
Joseph Zwillinger, Solazyme Inc

To become a member of AOCS, complete, sign, and fax back the membership application in this issue or contact us.
AOCS
Barb Semeraro
Area Manager, Membership
+1 217-693-4804
barbs@aocs.org
www.aocs.org

Corporate memberships are available!

Call today and find out how your company can become a vital part of the AOCS network.

AOCS CORPORATE MEMBER

Advancing sustainable coatings

John Schierlmann and Madhukar (Duke) Rao

Emissions of volatile organic compounds (VOC) to the earth's atmosphere deplete the ozone layer and can lead to the formation of smog, which affects people's health. These adverse effects will ultimately lead to the demise of solvent-based industrial coatings. Major regulations to limit the use of VOC have already been enacted in the United States in California, the northeastern states, and the Great Lakes states (see Tables 1, 2) as well as in Canada. The US AIM (Architecture and Industrial Maintenance) regulations are expected to get much tougher in the next year or two. Meanwhile, volatility in crude oil pricing and limited availability of certain petrochemicals have already had a dramatic effect on the production of paints, inks, coatings, and plastics and will continue to exert pressure on hydrocarbon (petroleum)-solvent-based products in the foreseeable future.

Water-based materials offer coatings manufacturers the potential to produce products with low to zero VOC and little or no odor. Present-day water-based products contain some hydrocarbon-derived petrochemicals as well, but the use of readily renewable chemicals in such products offers a relative stability both on availability and pricing for materials used in allied industries. Additionally, lack of odor is a benefit to the do-it-yourself (DIY) consumer who wants to tackle a staining or painting project without the necessity for ventilation that a petrochemical solvent-based product requires. Still, petrochemical-solvent-based products do have practical benefits—such as brushing ease, chemical resistance, color clarity, workability, cost, and the ability to be top-coated with almost any material—that make it difficult to replace solvents in coatings and stain products.

Some successful work has already been completed on new bio-based technologies. Here, the authors share the approaches two of the biggest US consumer coatings companies, Sherwin-Williams (Cleveland, Ohio) and Rust-Oleum (Vernon Hills, Illinois) recently took to tackle the renewability and use of soy-based materials in new coatings.

Going green with water-based alkyd paints

Sherwin-Williams Co. won the Designing Greener Chemicals Award in June 2011 from the US Environmental Protection Agency for

CONTINUED ON PAGE 382

TABLE 1.
Regulations to limit volatile organic compound (VOC) emissions from architectural coatings in the United States and Canada: 2011

UNITED STATES

Environmental Protection Agency regulations (September 11, 1998)

- See: epa.gov/ttn/atw/183e/aim/fr1191.pdf

California Air Resources Board (CARB)

- Pertains to the entire state except SCAQMD
- For listings for the 20 air districts in the state as of August 16, 2011, see: arb.ca.gov/coatings/arch/rules/VOClimits.pdf
- Alternatively, see: ppgpro.com/ecological-solutions/government-regulations/california-air-resources-board.aspx

South Coast Air Quality Management District (SCAQMD)

- This entity is the air pollution control agency for all of Orange County and the urban portions of Los Angeles, Riverside, and San Bernardino counties, the smoggiest region of the United States.
- Regulations and definitions for this district appear at: aqmd.gov/rules/reg/reg11/r1113.pdf

Ozone Transport Commission (OTC)

- This regulatory body encompasses Maine, New Hampshire, New York, Connecticut, Massachusetts, Pennsylvania, New Jersey, Maryland, Delaware, and northern Virginia.
- Its model regulations, which each state in the OTC can adopt or vary to fit its particular needs, can be accessed at otcair.org/upload/Documents/Model%20Rules/OTC_model%20rule_AIM_2010_v15.pdf.

Lake Michigan Air Directors Consortium (LADCO)

- Not a regulatory body, but does make recommendations to participating states (Ohio, Michigan, Indiana, Wisconsin, and Illinois)
- It recommended the OTC model regulations, and at least three of the states (Illinois, Michigan, and Ohio) have modeled their regulations after it.
- Illinois' regulations can be accessed at ipcb.state.il.us/SLR/IPCBandIEPAEnvironmentalRegulations-Title35.asp

US Architecture and Industrial Maintenance (AIM) regulation

- epa.state.oh.us/dapc/regs/3745_113.aspx

CANADA (CND)

- Regulations for the country may be accessed at gazette.gc.ca/rp-pr/p2/2009/2009-09-30/html/sor-dors264-eng.html

TABLE 2. Examples of VOC limits for architectural coatings in the United States and Canada[a]

Category	Example	US AIM[b]	CARB[b]	SCAQMD[b]	OTC[b]	LADCO[b]	CND[b]
Non-flat primer	Primer, low sheen interior paint	150	100	100	150	150	150
Non-flat high gloss	Semigloss or glass house paint	250	100	100	250	250	250
Industrial maintenance	Paint for shop equipment	340	250	250	340	340	340
Floor–concrete	Concrete or garage floor paint	250	100	100	250	250	250
Rust preventative	Clear or pigmented metal finishes	400	400	400	400	400	400
Stain—interior	Wood stains	250	250	250	250	250	250
Varnish	Clear coating for wood	350	275	275	350	350	350

[a]For abbreviations, see Table 1.
[b]VOC limits: grams per liter, less water and exempt compounds.

creating a new family of low-volatility organic water-based alkyd paints using soybean oil and recycled polyethylene terephthalate (PET) as raw materials. According to Madhukar (Duke) Rao, leader of the team that developed these paints, soybean oil and PET help provide the best properties of oil-based paints in a waterborne system while reducing VOC emissions and maintaining product shelf life.

Alkyd paints have been around for about 80 years. The alkyds that form their base are oil-based polyesters made from soybean or other vegetable oils, various polyols, and acids. Because alkyds tend to be viscous, solvents such as mineral spirits or xylenes are typically added to reduce this viscosity so that the resulting paint will be easier to spread.

In the 1950s, acrylic-based waterborne latex emulsions with better stability and shelf life began to displace solvent-based alkyd paints. But there continues to be a technology void, because latex paints do not have the same performance characteristics, such as ease in application and gloss of the finish, that contractors and DIY users like about alkyds, according to Rao. "Another development in the past 20 years is the concern over the safety of VOCs. So there is a drive now toward developing waterborne chemistry to match the performance of alkyd systems but that reduces the amount of VOCs."

To meet that need, Sherwin-Williams researchers undertook to combine the best of alkyd and latex chemistries to develop a hybrid water-based alkyd system. The resultant technology, which the company calls Water-Based Acrylic Alkyd Technology (WBAAT), produces coatings with alkyd properties that can be cleaned up with water and that have less odor than currently available alkyd materials. A WBAAT product is created in a multistep process that begins with controlled digestion of recycled PET using a tin catalyst with soybean fatty acid that serves as a reactant. The resulting fatty acid-terminated PET oligomeric particles are then repolymerized to form an alkyd by reaction with polyols and acids.

Next, the alkyd is functionalized with different hydrophobic and hydrophilic acrylic monomers by graft polymerization using soybean oil as a solvent. This soy-PET acrylic-alkyd polymer is then dispersed in water by using an amine to form an anionic dispersion. The high molecular weight of a WBAAT product, its high glass transition temperature (T^g), and epoxy tar segments provide rigidity to help resist hydrolytic degradation, Rao explains. In addition, the acrylic functional groups enhance performance properties such as shorter drying time and improved durability, and the soybean oil improves flexibility and gloss.

Hydrolytic stability and durability are important, because Sherwin-Williams paints are distributed to some 3,000 retail stores from Canada to the Virgin Islands. Plus, the paint needs to avoid phase separation over time to remain usable. WBAAT avoids the use of surfactants, which can lead to water sensitivity, typical of latex systems, and uses minimal amounts of traditional organic solvents as well. About 60% of the components of WBAAT are derived from renewable and recycled materials. And the technology significantly improves shelf life from about one year to up to three years without loss of performance.

To meet continuing regulatory requirements, Sherwin-Williams launched WBAAT in the United States in 2010 with three products. More are in the pipeline. ProClassic smooth enamel finish is a water-based alkyd semigloss system comparable to traditional oil-based coatings used for trim on doors, cabinets, and custom woodwork for residential and commercial interiors. It's formulated to generate less than 50 g/L of VOC. ProMar 200 interior water-based semigloss paint, for spray, brush, and roller applications, is geared toward commercial paint contractors and emits less than 100 g/L of VOC. And ProIndustrial Waterborne Alkyd Enamel is designed for humidity- and corrosion-resistant high-gloss metal primer and topcoat applications.

Sherwin-Williams' comparative analyses indicate that WBAAT considerably outperforms traditional alkyd paints with its lower VOC emissions and durability, and it matches traditional paints in application, gloss, and adhesion. Although WBAAT paints cost more than traditional paints, they offer improved performance and value and exceed the most stringent environmental regulations.

Green polyurethane and acrylic coatings

In an effort to expand the use of more biobased products in its consumer brand of polyurethane coatings, Rust-Oleum has partnered with a water-based resin manufacturer to develop a water-based soy polyurethane and a soy acrylic.

The soy polyurethane was created to offer the same durability and chemical resistance as its solvent-based counterpart. Polyurethanes sold up to 2005 were primarily the products of the reactions of isocyanates and polyester polyols. While a very limited number of vegetable-based polyurethanes were available (based on linseed and castor oils), there were no soy-based polyurethanes. Using soybean oil as a constituent of the polyurethane allows the latter to be cured by oxidation via reactive driers. (Oxidative driers react with the double bonds on the linolenic and linoleic chains in the presence of oxygen to form a higher crosslink density.) This allows the water-based soy-polyol to have better household chemical resistance than a typical polyurethane dispersion would. It further achieves better scratch resistance due to higher crosslink density.

Another facet of this unique material is its higher nonvolatile content, which causes the coating to cure quicker. Higher solids content allows a higher solids material to dry about 5–15 minutes quicker than some of the previous nonbiobased products. The soy-based polyurethane has several advantageous qualitative factors as well. It brushes on similarly to solvent-based polyurethanes, providing a smooth brush feel and excellent flow and leveling. It can also achieve a higher gloss level. While a water-based polyurethane varnish will typically achieve a 60° angle sheen of 82 (total reflectance is 100), the water-based soy-polyurethane will approach 91 sheen, which is very comparable to an oil-based polyurethane.

The second phase of the project was to create a soy-based acrylic. Acrylics are typically products of the reactions of methacrylic acids or acrylates in the presence of catalysts. While they offer many performance attributes, modern acrylics are composed of 100% petroleum content.

The soy-acrylic offers many of the same performance gains:

- It bridges the gap between oil-based alkyds and water-based acrylics.
- Its resin uses both a cross-linkable soy fraction and acrylic monomers, which provide the best of both chemical properties.
- The soy portion gives the oil a desirable look and feel as well as chemical resistance.
- The acrylic portion provides a fast, hard dry, with good ultraviolet light weathering resistance and clarity (both are critical attributes when replacing current acrylic and alkyd paints, as well as stains, with water-based products).

CONTINUED ON PAGE 400

Base oils supplement: betting on bio for better base oils

Cynthia Challener

The lubricants market is committed to increasing the sustainability of its products and processes, but that is not the primary driving force behind the growth of biobased base oils, lubricating oils, and greases. Cost-effective performance remains paramount, and both vegetable-derived and biosynthetic base oils provide certain performance advantages over their petrochemical counterparts for some applications. Their biodegradability is an added advantage.

Biobased lubricants account for only a small fraction of the total lubricants market: Estimates range from 2–5% to less than 1%. However, demand is growing at a healthy rate—most believe about 5–10%/year globally. Major players include large agribusinesses such as Minneapolis, Minnesota (USA)-based Cargill, which offers vegetable-based oils, but there are many smaller companies participating in the market such as LubriGreen BioSynthetics, of Irvine, California (USA), and Performance Biolubes, of Cedar Falls, Iowa (USA).

More recently, biotech start-up companies such as Elevance Renewable Sciences in Woodridge, Illinois (USA), and California firms Amyris in Emeryville and Solazyme in South San Francisco have developed fermentation-based processes for the production of base oils from renewable raw materials.

Petroleum disconnect

All of these companies are taking advantage of the growing need for higher-performing, longer-lasting lubricants that are cost effective and avoid the uncertain pricing schemes associated with lubricants derived from crude oil. "The desire to disconnect from petroleum pricing and not rely on a single source of supply has been a key driver for the interest in our NovaSpec base oils and EvoShield lubricants," notes Jim Richardson, president of lubricants and fuels at Amyris.

Cargill has had a similar experience, with most customer inquiries centered around finding an alternative to petroleum-based products, says Cargill industrial oils and lubricants president Kurtis Miller.

Lubricant end users are also operating their equipment for longer periods under more extreme conditions. "Lubricants that can withstand these more severe operating conditions, plus contaminants such as dirt, sludge, and water, will be more valued by the industry," says Dan Deneen, Solazyme director of business development, lubricants. For these value-added applications, polyol esters derived from fatty acid feedstocks between C8 and C18 have worked well, because they exhibit good cost performance, a wide temperature operating range, and good oxidative and thermal stability.

"The need for improved longer-term performance has been a real driver for our business. And with states like California calling for longer lifetimes for lubricants, we only see this demand driver becoming more important," adds Jacqueline Garmier, president of Renewable Lubricants in Hartville, Ohio (USA).

The "green" nature of biobased lubricants is the third factor contributing to their growth. "Like biofuels, the use of sustainable lubricants helps to reduce carbon in the atmosphere," says Allen Barbieri, chief executive officer of LubriGreen Biosynthetics. They are also nontoxic and biodegradable. According to the EPA [US Environmental

CONTINUED ON NEXT PAGE

Protection Agency], over 40% of water pollution in the United States comes from used motor oil that is either improperly disposed of or that leaks on to roadways and washes into streams and lakes.

The biodegradability of biobased lubricants is therefore a key advantage, particularly for lubricants used in "total loss" applications, and even more so when these applications are environmentally sensitive, such as forestry, marine, and mining, says Deneen.

"New oils, however, such as Solazyme's algal oils, offer oxidative stability never before seen in vegetable oils, providing increased oil and equipment life while continuing to be both biodegradable and now sustainable as well," Deneen adds.

Advances in technology have made these high-performing, cost-effective sustainable lubricants possible. In fact, today's biobased lubricants often offer additional performance advantages over conventional petrochemical products. The chemistry of biobased oils can also be adjusted to tailor performance to the specific needs of customers and their particular end-use applications.

Stability, reactivity, and stain resistance requirements can be controlled by the choice of vegetable oil, says Miller. The oils can be functionalized through hydrogenation, oxidation, polymerization, amidation, and esterification to impart certain performance characteristics. "There is definitely growing interest as people formulate with these new products and get familiar with their chemistry," he says.

Cargill sees the greatest interest in its biobased base oils for functional fluids such as hydraulic and transformers oils and crop protection adjuvants. Cargill is also looking at hydraulic fracturing fluid applications, and Miller expects to see big growth in this market in 2013. Renewable Lubricants, which manufactures biobased lubricants and markets more than 250 patented products, including biosynthetic engine, hydraulic, and gear oils, has seen more than 30% growth in recent years and expects to maintain that level.

Garmier sees growing interest across the globe and in the United States. She points to the US Department of Agriculture's biopreferred program and growing interest for equipment used by the food industry, since the products are derived from edible oils. She also points to recent legislation requiring the use of lubricants approved for indirect food contact in water-processing units as an additional driver for growth.

Drop-in automotive replacement

The greatest interest at LubriGreen, meanwhile, is being seen in its new drop-in biosynthetic lubricants for engine oil applications. Barbieri says the company has developed a process for the manufacture of biosynthetic oils that achieve test results equal to petroleum-derived synthetic base oils in GF-5 engine testing, and expects to offer these products at pricing competitive with group III and IV base oils.

He notes that in 2012, several finished passenger car motor oil products will be tested and certified [API (American Petroleum Institute) and otherwise] by LubriGreen's global manufacturing/distribution partners, and the company's pilot plant will be completed. Product launches are planned for 2013, and a full-scale manufacturing plant will be built in Houston, Texas (USA), in partnership with a global chemical company. LubriGreen is also in discussions with manufacturing partners in Europe and Asia.

Solazyme and Amyris start with a more basic feedstock—algae oil for Solazyme and plant sugars for Amyris—and convert them via microbial transformations into products that can be used as base oils for lubricants.

Solazyme has focused on developing oils with improved resistance to oxidation and better low-temperature properties. The oils can be produced with controlled chain lengths, saturation levels, and functional group additions and thus can have specific melting points, varying concentrations of desired fatty acids, and high concentrations of unusual fatty acids.

The technology benefits from the use of nonedible feedstocks and the ability to control the types of oils that are produced, thus eliminating any effects of the unpredictable supply-and-demand situation seen with vegetable oils, says Deneen.

In February 2011, Solazyme entered into a joint development agreement and a letter of intent with Dow Chemical for the commercialization of biobased dielectric insulating fluids for transformers and other electrical applications. Dow will contribute its formulation expertise and Solazyme's algal technology and oils. In 2012, the company plans to introduce a portfolio of products that can be used to meet industry performance requirements and represent an upgrade in performance.

Amyris has also formed partnerships to advance its biosynthetic base oils. Novvi, its 50:50 joint venture with leading Brazilian sugarcane biofuel producer Cosan, was formed in June 2011 to develop, produce, and commercialize renewable base oils made from Biofene, Amyris' renewable farnesene, which is produced from plant-sourced sugars via fermentation. Biofene is a pure C15 hydrocarbon with multiple sites of unsaturation that offer flexibility for chemical transformation.

The base oils Amyris makes from Biofene are fully saturated, branched-chain alkanes (iso-paraffins) with low volatility that, because of their branched structure, also have a good mix of cold flow properties, biodegradability, and oxidative and thermal stability.

US specialty chemical producer Albemarle, of Baton Rouge, Louisiana, has been selected as the manufacturing partner for the joint venture, which will market the synthetic base oils under trade name NovaSpec.

Amyris has also formulated its own line of renewable lubricants marketed under the name Evoshield. In 2012, the company expects to start scale production and sales. "The strongest demand for our lubricants is in the large automotive sector, which requires the high-performance characteristics that our NovaSpec base oils offer," Richardson notes.

The development of biobased lubricants is a natural part of the "greening" process in the industry. The first step, Richardson says, was increased efficiency and waste minimization. The second stage involves the re-refining of used oil, which Valvoline has recently made mainstream with its NextGen product and which will be a critical component of the lubricants market.

Using renewable feedstocks is the most recent phase. "It is only a matter of time before the economics drive the adoption of biobased lubricants," he concludes.

This article was reprinted with permission from ICIS, the world's leading information provider for the global energy, chemicals, and fertilizer markets. For more information visit icis.com/energy/base-oils-lubes.

Cynthia Challener is a freelance journalist based in Burlington, Vermont, United States. She is a regular writer for ICIS Chemical Business.

Gold, and Silver Corporate Members

AOCS CORPORATE MEMBER 2012

Platinum

Cargill Inc. | www.cargill.com

Monsanto Co. | www.monsanto.com

Gold

Canadian Grain Commission | www.grainscanada.gc.ca

Silver

CI SIGRA SA
www.sigra.com

Dallas Group of America Inc.
www.dallasgrp.com

Eurofins QTA
www.qta.com

French Oil Mill Machinery Co.
www.frenchoil.com

Procter & Gamble Co.
www.pg.com

Stratas Foods
www.stratasfoods.com

Viterra Inc.
www.viterra.com

AOCS provides the resources.

AOCS Since 1909
Your Global Fats and Oils Connection

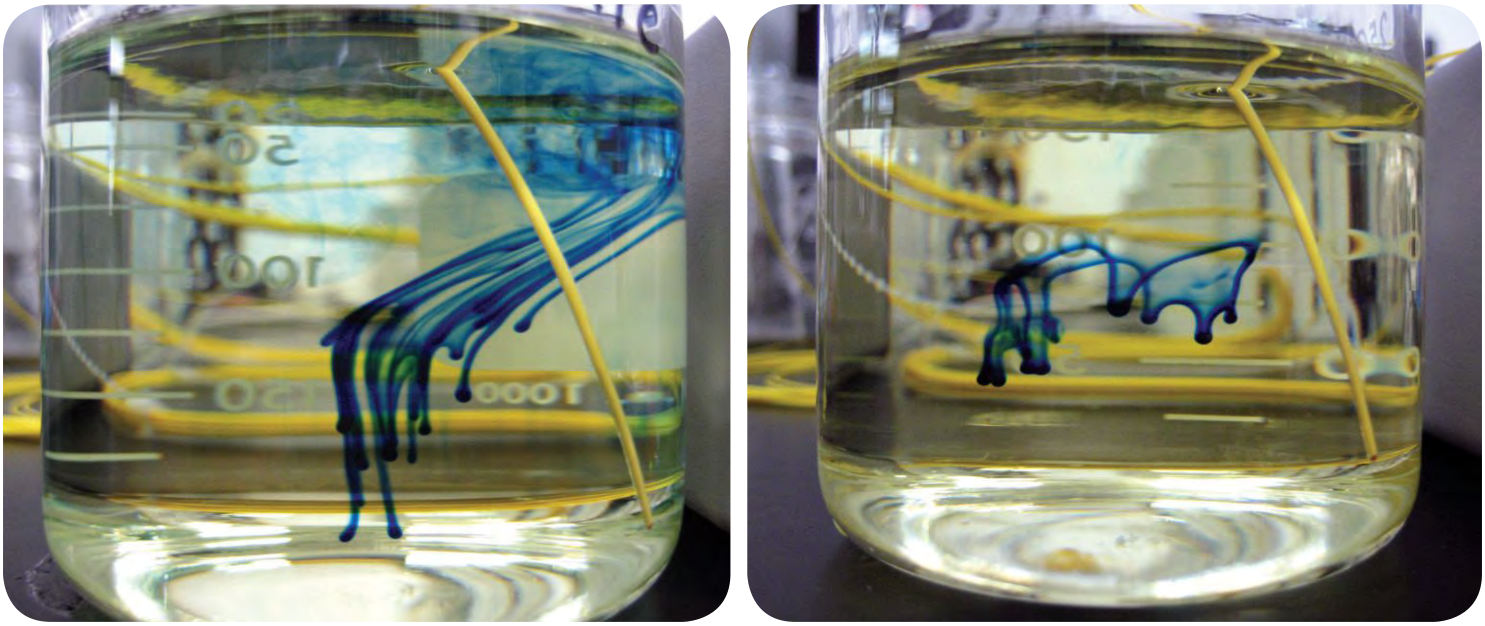


FIG. 1. *Beakers containing 300 mL of the same oil heated to 165°C on a hot plate (left) and in a household microwave oven (right).*

Microwave-based manufacturing for lower-cost biobased lubricants and chemicals

The development of microwave-based processes for manufacturing biobased grease is reviewed, and the economic impact these processes could have is presented.

Lou Honary

Since 1991, the University of Northern Iowa National Ag-Based Lubricants (UNI-NABL) Center in Waterloo (USA) has conducted applied research to advance the formulation of biobased lubricants and greases with vegetable oils. More than 30 formulations of such products are currently manufactured by Environmental Lubricants Manufacturing, Inc. (ELM), a commercial company that was formed in 2000 through the University's research foundation. It is through this commercial entity that researchers at UNI-NABL Center learn about field-related issues and develop research topics to address shortcomings.

One of the most noteworthy research developments in UNI-NABL history is the design and implementation of a new heating technique that uses microwaves to manufacture biobased greases. This idea came about as an outgrowth of a fire on March 20, 2007, that devastated the first fully biobased lubricants and grease manufacturing facility in the United States, owned by ELM. During manufacturing of biobased rail curve grease on that day, there was a spill of heat transfer oil at the point in the process where the temperature was highest. The heat transfer oil caught fire and damaged the production facility. This experience with hot heat transfer oil provided the motivation to look for safer ways to make grease.

Background

Grease is basically soap mixed with lubricating oil; the two components are not in chemical solution, but rather they "co-exist" in the same way that water retained in a sponge co-exists with the sponge. In general, grease-making involves neutralizing a fatty acid

TABLE 1. Microwave energy absorption by mineral oil, soybean oil, high-oleic soybean oil (HOBO), and mixtures of the two

	Temperature (°C)		
Sample	**At start**	**After 90 sec**	**Difference**
HOBO	22	109	98
Mineral oil	23	39	16
5:95 HOBO/mineral oil	23	44	21
10:90 HOBO/mineral oil	24	51	27
25:75 HOBO/mineral oil	24	60	36
50:50 HOBO/mineral oil	23	75	52
75:25 HOBO/mineral oil	23	96	73

such as stearic acid with a base such as lithium hydroxide to form lithium stearate soap. Then oil is added to the soap and homogenized into the grease. Completing the reaction process and removing by-product water require temperatures as high as 200–220°C. Typically, fuel oil, gas, or electric heating is used to warm a heat transfer oil, which is then pumped into the jackets of a vessel containing the products being reacted.

There are some greases that are made without the use of soap. Polyurea, organoclay, carbon black, and silica greases are examples of nonsoap-type grease.

Microwaves and oil

The idea that the household microwave could be used to heat oil with less risk of fire arose from a personal experience making homemade yogurt. Since making yogurt on the stovetop requires continual stirring to prevent the milk from scorching on the bottom of the pot, I put the milk into the microwave, which heated the milk quickly without stirring or scorching. The thought occurred to me that this same method could be used to heat vegetable oils more uniformly.

By using a small 1.75 kilowatt (kW) household microwave oven, one can efficiently heat 300 milliliter (mL) samples of various vegetable oils. A common household microwave works by passing microwave radiation, usually at a frequency of 2.45 gigahertz (GHz) and a wavelength of 122 millimeters (mm), through the substance being heated. Large industrial/commercial microwave systems, on the other hand, operate at a heating frequency of 0.915 GHz and a wavelength of 328 mm.

Heating vegetable oils with microwaves is different from heating mineral oils owing to their differences in polarity. In simple terms, vegetable oils are dipolar, having positive and negative charges like two poles of a magnet. Conceptually, as the dipoles try to align themselves with the magnetic fields of the electric current that is alternating 2.45 billion times per second, their movement results in added kinetic energy and heat due to their impact on each another. This does not apply to the nonpolar molecules of mineral (petroleum)-based oils. When mineral oils are exposed to microwaves, some heat is generated as the molecules rotate and occasionally impact each other, but most of this energy is reflected back and is not absorbed. One way to increase the heat absorption of mineral oil in microwaves would be to mix the oil with dipolar products.

When using microwaves for heating in chemical processing, three differences deserve consideration.

1. Microwaves heat different substances differently. Microwave heat absorption of 300 mL samples of a mineral oil and of a vegetable oil having similar viscosities is shown in Table 1. The samples were heated for 90 seconds, and the increase in temperature of each oil along with heat absorption by various mixtures of the two oils was recorded. The results indicate that the presence of dipolar materials in mineral oils improves heat absorption of the mixture.

CONTINUED ON NEXT PAGE

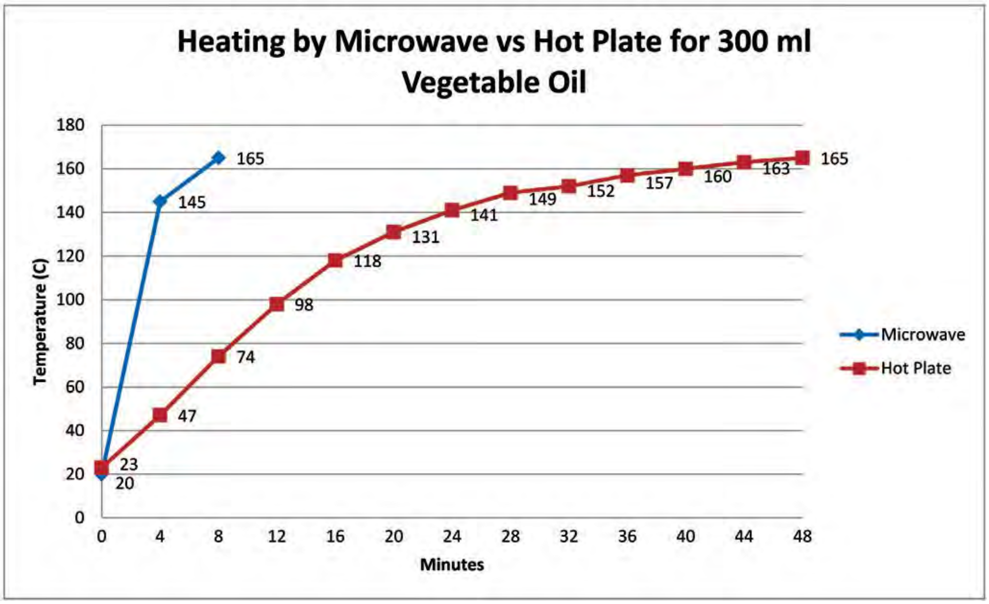


FIG. 2. *Heating by microwave vs. hot plate for 300 ml vegetable oil.*

2. Microwaves heat substances more uniformly. The hot surfaces and limited agitation of hot plates and jacketed kettles cause uneven heating of bulk oil in the vessel. This in turn can cause hot spots, scorching, and damage to the oil. Figure 1 on page 389 shows the results of heating 300 mL samples of the same oil to 165°C on a hot plate and in a household microwave. Injecting blue dye in the oils allows one to visualize the change in the temperature of the oil within the beaker. On the hot plate, the oil closer to the hot plate surface heats up, rises, and migrates toward the cool wall surfaces of the beaker. The blue dye in the oil heated in the microwave, on the other hand, does not move, which indicates that the temperature is the same throughout the product. This can be verified with the use of fiber optic-based temperature sensors, which can be used safely to monitor the heating of product within microwaves.

Eliminating hot spots and implementing uniform heating result in a more complete reaction and in another significant improvement in the processed oil. Vegetable oils are particularly susceptible to oxidation at temperatures above 150°C. To study the impact of heating methods on the oxidation property of the oil, two 300 mL samples of the same oil were heated to 165°C—one using a hot plate and the other in a microwave—and kept at that temperature for six hours.

TABLE 2. Impact of heating methods on oxidation degradation of vegetable oil

Vegetable oil (RBD-HOBO[a])	OSI (h)	Reduction in OSI (h)
OSI before heating	41.2	0
OSI after 6 h heating—hot plate	9.12	32.08
OSI after 6 h heating—microwave	23.28	17.92

[a]Abbreviations: RBD-HOBO, refined bleached deodorized high-oleic soybean oil; OSI, Oil Stability Index; h, hours.

(*Note*: For microwave heating, the oil was heated to 165°C first and then the microwave was pulsed by applying it for 1 minute every 5 minutes, thus maintaining the desired temperature.) The Oil Stability Index (AOCS Cd 12b-92/ EN 14112) of both samples was tested before and after the six hours of heating. The impact of the heating method on the sample is shown in Table 2.

The exposure of thin layers of the oil to the hot surface of the hot plate causes localized heating at much higher temperatures than the oil temperature of 165°C. This, in turn, results in more severe oxidation breakdown of the oil. Although both methods of heating result in thermal oxidation, damage due to heating with microwaves is less severe. This, in combination with the fact that microwave heating is faster and more uniform, results in a significantly more complete reaction, and in most cases a more economical final product than any of the other current heating methods.

3. Microwaves could eliminate the need for scraped surface agitation because there are no hot reactor wall surfaces to damage the product. Microwaves also speed up the heating process. The speed of heating when 300 mL of product is warmed on a hot plate and in a microwave is shown in Figure 2. Understandably, the beaker on the hot plate loses heat from its walls, and in an insulated beaker the result could be different. Nevertheless, this graph illustrates the benefits of directly exciting the molecules of the product and the rapid heating.

Since the dielectric property of substances impacts their performance in microwaves, the dielectric strengths of different oils were tested (Table 3).

Several experiments were performed using a household microwave in which selected vegetable oils were heated for four minutes and the rates of heat absorption were recorded. Table 4 shows the results of heating for each oil and the difference in the amount of heat absorption at different time intervals. This shows that the fatty acid makeup of the oil impacts its dielectric strength and also affects heat absorption due to exposure to microwaves. Hydroxy fatty acids present in castor oil, for example, are shown to result in faster and higher heat rise when exposed to the same period of microwave excitation.

Industrial microwaves

In the early 1970s, many industries began to explore the use of the new microwave technology for industrial and chemical processing. *Industrial Microwave Heating*, a book by A.C. Metaxas and R.J. Meredith (originally published in 1988 and reprinted 2008), lists numerous applications considered for heating by microwaves. In earlier days, the technology was relatively unknown, leading to safety fears. Large-scale use was considered expensive when compared with conventional methods of heating. Since then, the technology has progressed to the point of being reasonably foolproof. Many safety features have been incorporated, and the overall cost appears to be competitive.

Table 3. Dielectric breakdown voltage determined according to ASTM D877

Oil	Dielectric breakdown voltage (kV)	Oil	Dielectric breakdown voltage (kV)
High-oleic soybean oil	35.4	Corn oil	47.44
High-oleic canola oil	38	Grapeseed oil	48
Hempseed oil	38.08	Apricot kernel oil	48.18
Avocado oil	38.24	Sunflower oil	48.48
Rice bran oil	39.8	Walnut oil	50.13
Macadamia nut oil	41.78	Flaxseed oil	50.68
Olive oil	42.2	Jojoba refined	51.22
Methyl ester of HO[a] soy	43	Caprylic acid	52.9
Poppyseed oil	43.39	High-oleic canola oil	53
Castor oil	44.42	Jojoba golden oil	54.2
Sesame oil	45.08		

[a]HO, high-oleic.

TABLE 4. Heat absorption of selected vegetable oils heated in a microwave oven[a]

Oil	T_1	T_2	T_3	T_4	$T_1 - T_2$	$T_2 - T_3$	$T_3 - T_4$	$T_1 - T_4$
Castor oil	22	69.1	107.2	132	47.1	38.1	24.8	110
Corn oil	21.9	66.5	99.2	121	44.6	32.7	21.8	99.1
Estolide[b]	20.8	63.9	105.3	125.8	43.1	41.4	20.5	105
HOBO	19	62	96.7	124	43	34.7	27.3	105
Linseed oil	20.2	62.1	99.2	122		37.1	22.8	101.8
Castor oil/corn oilblend	21	65.5	105.5	128.4	44.5	40	22.9	107.4

[a]HOBO, high-oleic soybean oil; T_1, original oil temperature; T_2, oil temperature after 1 minute of heating; T_3, oil temperature after another 1 minute of heating; T_4, oil temperature after another 2 minutes of heating. All temperatures °C.
[b]Estolides are characterized by the secondary ester linkages in the molecule of one fatty acyl molecule to the alkyl backbone of another fatty acid fragment.

UNI-NABL researchers teamed up with AMTek Microwaves, a Cedar Rapids, Iowa-based industrial microwave manufacturer, to scale up to production-quantity reactions. In a first step, sample sizes were increased from 300 mL to 7.5 L batches of different oils. Using a 75 kW industrial microwave unit in these larger batches was as effective as the earlier results in household microwaves. These researchers have also investigated the impact of physical properties of oil, such as viscosity, and container conformations on the heat absorption of oil.

High-energy industrial microwaves at 75 kW each can be linked in series to apply as many kilowatts of microwave power to the reaction vessel as desired. Large microwave systems are commonly used in processing large volumes of food such as bacon and chicken meat running on conveyors under a flood of microwaves. But the approach proposed by the UNI-NABL research group can expand the use to liquid and semiliquid food processing such as those in baby food, ketchup, and soups.

The first microwave grease production vessel (Fig. 3, left, page 392) was a 3,000 L stainless steel vertical tank. Importantly, the metal structure of this vessel dispels the general misconception that microwaves cannot be applied to metal vessels. Microwaves can be applied to products in metal vessels as long as the mass of product and the intensity of microwaves are matched. Arcing takes places when too much energy is applied for a given mass of product in the vessel. Arc sensors are used to automatically shut off the power if arcing occurs, allowing the operator to adjust the power input. Figure 3 (right, page 392) shows two 75 kW microwave transmitters. The small footprint of these transmitters is advantageous, but the ability to use waveguides to transfer the microwaves to the vessel at distances of hundreds of feet can make the entire system more flexible.

As opposed to household microwave ovens, on which little or no adjustment is possible, industrial microwaves can be adjusted infinitely from 0 to the maximum power output, or 75 kW in the units used for this application. A programmable logic controller (PLC) is used in

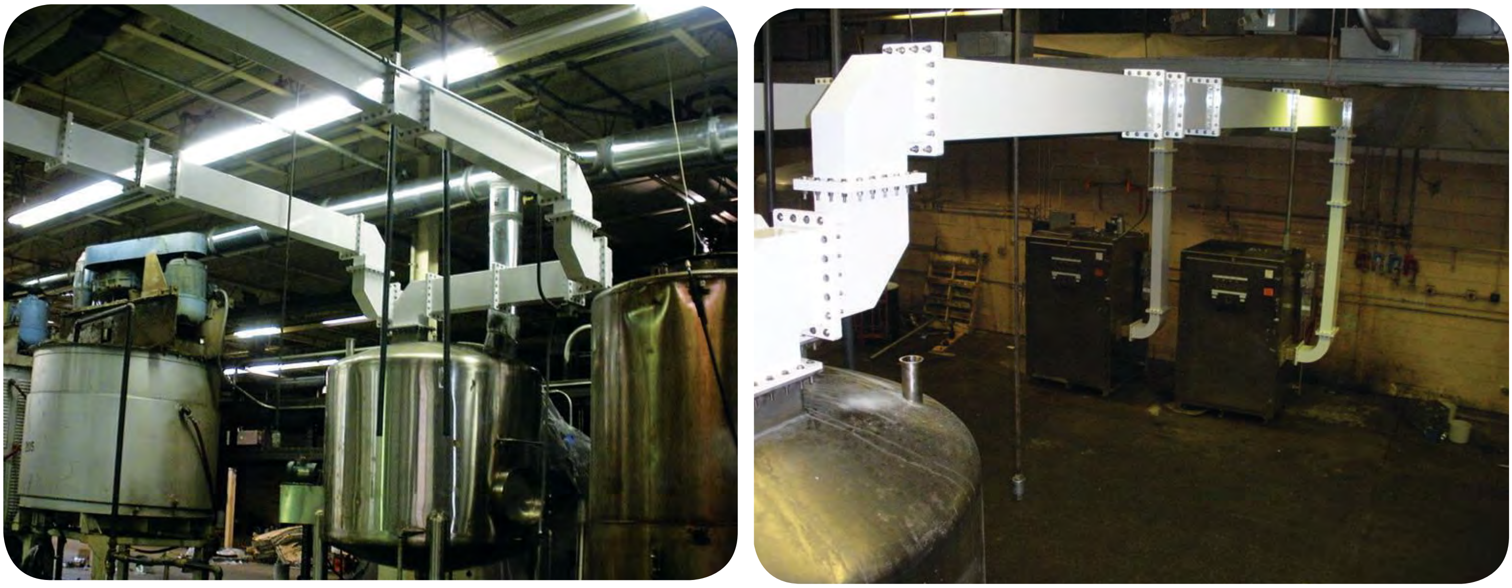


FIG. 3. *(Left) 3,000 liter reactor adapted to (right) two microwave transmitters via waveguides (white duct especially designed for transfer of microwaves).*

conjunction with temperature sensors to form a closed loop circuit and maintain the temperature of the product at the precise desired level.

The operator simply sets the desired temperature, and within a fraction of a degree before reaching that temperature the PLC ramps down the transmitters' settings to power levels of a few kilowatts. As the temperature of product in the vessel drops, the PLC continues to increase or decrease the power level to maintain the desired temperature. In this arrangement, chances of overshooting the heating of products are reduced greatly as opposed to hot oil heating.

The safety aspects of microwave heating are evident because as soon as the power is shut off the heating also stops, eliminating other sources of heat and danger. To determine the efficacy of heating, we heated 1,500 L of soybean oil in this system with the transmitter output setting at 60 kW each, for a total of 120 kW of microwave power. The temperature of the oil rose at approximately 3°C per minute. While many variables are involved and an accurate comparison is difficult, process time required with microwave heating is nearly one-third of the time needed when using an equivalent hot oil heater. Other benefits include a more uniform reaction process and less damage to the oil due to exposure to high-temperature walls of the vessel. In fact, soap and consequently the grease made with microwaves have much lighter colors, indicating that without the hotspots in conventional vessels to burn layers of the product, there is less change in the product color.

FIG. 4. *Large viewing ports in industrial microwaves allow observation of the process and addition of oil and other materials even as the microwaves are being applied.*

FIG. 5. *A complete system incorporating industrial microwave transmitter, horizontal mixing vessel, and the associated waveguides and the programmable logic controller panel.*

Site views can be installed the same way home microwave ovens have a screen placed on the glass window in the door of the microwave unit. Since microwaves can escape through glass, a metal screen is used to "choke" or prevent any escaping microwaves. The size of the holes of the viewing ports is dependent on the thickness of the metal plates they are on. For example, to have 2.5 cm × 2.5 cm viewing holes, the depth of the holes could be roughly 18–20 cm. By designing the size of the small viewing holes it is possible to design leak-free viewing ports that can also be used for adding additives, oil, and solid materials if needed (Fig. 4).

The reactor design had a goal of eliminating the need for scraped surface agitation and possibly eliminating the need for mechanical mixing altogether. This required the use of a circulating pump to draw the fluid from the bottom center of the tank and pump it back into the reactor from four jets placed on four sides of the reactor's straight wall. A small propeller built into the tank was left in the tank to aid mixing when the soap formed. The propeller is always kept below the surface of the oil to prevent acting as an antenna and causing microwave leakage. Circulating the product in this way is also necessary to prevent overheating of the top layers of the product, which are directly exposed to the waves. The circulating pump can be selected to serve as a homogenizer to puree products if needed.

Moving forward

To date, ELM is the first commercial entity to have successfully incorporated this method of heating for manufacturing biobased greases. Products such as lithium-based greases tend to liquefy completely when heated in the microwave-based reactor, making them easy to pump and circulate. On the other hand, some products such as aluminum- or calcium-based greases thicken during reaction and do not liquefy when heated further. Such products require mechanical mixing as well as circulation. To address this problem, the UNI-NABL group has also teamed up with Marion Mixers, which makes horizontal mixers for a diverse array of products in its Marion (Iowa) plant. The company

CONTINUED ON NEXT PAGE

information

- History Channel's *Modern Marvels*, episode entitled "Grease," first broadcast in the United States on January 21, 2011.
- Honary, L., A new wave in grease, *Lubes'n'Greases 16* (11):33–36, 2010.
- Honary, L., A status update on manufacturing biobased grease with microwaves, *EUROGREASE*, July/August/September, 20–28, 2011.
- Honary, L., and E. Richter, *Biobased Lubricants and Greases: Technology and Application,* John Wiley & Sons Ltd., Chichester, UK, 2011, 238 pp.
- Isbell, T.A., Chemistry and physical properties of estolides, *Grasas Aceites 62*:8–20, 2011.

can design tanks to process any type of product heated by microwaves, including solids, liquids, and grease-like semisolid materials.

Figure 5 on page 392 shows a complete skid-mounted system incorporating industrial microwave transmitter, vertical or horizontal mixing tank, and the associated waveguides and the PLC panel. The mixing vessel can be horizontal or vertical and have a volume of hundreds to thousands of gallons. For larger mixing tanks, several transmitters can be installed in series to match the desired speed of processing and the mass of products being heated. Waveguides can be hundreds of feet long, and the transmitter can be placed anywhere in the plant.

The eventual goal is to expand the use of this concept beyond bio-based lubricants and greases to food and chemical processing, so that it can be applied to any material that needs efficient and safe heating. If the process time and energy saving can be reduced to even half of the current energy and time requirement of some conventional processes, the overall impact on energy consumption could be a welcome development.

Lou Honary is professor and director of the National Ag-Based Lubricants Center at the University of Northern Iowa in Waterloo, Iowa, USA. He can be contacted at lou.honary@uni-nabl.org.

HEALTH & NUTRITION (CONTINUED FROM PAGE 363)

But eventually, understanding of membrane function grew more refined as scientists learned more about ion channels.

Ion channels—large proteins embedded in the relatively small lipid molecules forming the membrane—are responsible for conducting electrical impulses along nerve cells in the brain and throughout the body. By a few decades ago, the prevailing theory held that inhaled anesthetics directly interacted with these protein channels, affecting their behavior in some fashion. But no one could find a single type of ion channel that reacted to anesthetics in a way pivotal enough to settle the matter, and the question remained open.

"That's where we picked up the thread," says Nanda. "We had been looking at how different types of lipid molecules affect ion channels."

Whereas a cell membrane is a highly fluid film made of many different kinds of lipid molecules, the region immediately surrounding an ion channel often consists of a single type of lipid that forms a sort of "raft" that is more ordered and less fluid then the rest of the membrane. When the team heard other researchers had found that disrupting these lipid rafts could affect a channel's function, they brought their own experience studying the channels to bear.

"We decided to test whether inhaled anesthetics could have an effect on rafts in model cell membranes," Nanda says. "No one had thought to ask the question before."

Using the NCNR's neutron and X-ray diffraction devices, the team explored how a model cell membrane responded to two chemicals—inhaled anesthetic, and another that has many of the same chemical properties as anesthetic but does not cause unconsciousness. Their finding showed a distinct difference in the way the lipid rafts responded: Exposing the membranes to an anesthetic caused the rafts to grow disorderly, freely mixing their lipids with the surrounding membrane, but the second chemical had a much smaller effect.

Although Nanda says the discovery does not answer the question definitively, he and his co-authors are following up with other experiments that could clarify the issue. "We feel the discovery has opened up an entirely new line of inquiry into this very old puzzle," he says. The work appeared in *Langmuir* (doi:dx.doi.org/10.1021/la204317k, 2012). ■

TABLE 1. World production of coconut and oil in 2010[a]

Country	Coconut production[a] (MMT)	Coconut oil production[a] (MMT)	Coconut oil: Percentage of total production	Percentage of total used for food[b]	Percentage of country's total production of vegetable oil as coconut oil[c]
Philippines	15.540	1.433	41.1	11.0	92.9
Indonesia	20.655	0.857	24.6	25.1	4.73
India	10.824	0.413	11.8	5.7	5.1
Vietnam	1.179	0.157	4.5	75.2	74.8
Mexico	0.983	0.132	3.8	65.9	11.0
Papua New Guinea	0.902	0.052	1.5	—[d]	—
Sri Lanka	2.239	0.047	1.4	100	88.2
Malaysia	0.528	0.045	1.3	31.9	0.3
Thailand	1.298	0.032	0.9	90.9	3.2
Others	8.237	0.317	9.1		
TOTAL	62.452	3.486			

[a]FAOSTAT/@FAO Statistics Division 2012/24, February 2012.
[b]Calculated from data obtained through internet search for "Country+vegetable oil+coconut oil" production under FAOSTAT.
[c]Calculated from data obtained through internet search for "Coconut oil uses+country" under FAOSTAT.
[d]Abbreviations: MMT, million metric tons; —, data not available.

Coconut oil: science, technology, and applications

A.G. Gopala Krishna

The coconut (*Cocos nucifera*), which is one of the most important perennial sources of vegetable oil, has been consumed in tropical countries for thousands of years. Compared with all other oilseed crops, coconut is more productive, more consistently productive, and less susceptible to climatic variations. Of the 97 countries in which coconut palms are grown, Philippines, Indonesia, India, Vietnam, Mexico, Papua New Guinea, Sri Lanka, Malaysia, and Thailand produce almost 90% of the world's coconut oil.

The total world production in 2010 of edible-grade coconut oil was 3.49 million metric tons (MMT). The three top-producing countries were Philippines, Indonesia, and India (Table 1).

Worldwide, 54% of the coconut oil sold is used for food, while the other 46% goes toward other uses. Coconut oil represents only 2.7% of the vegetable oils produced in the world, but from to country to country it varies from 0.3% of total production in Malaysia to 92.9% in the Philippines.

The relative percentages of coconut oil produced in each country that are used domestically for food vary from 100% in Sri Lanka to 11.0% in the Philippines.

In India, 57% of the coconut oil produced in the eastern coastal belt is used for food purposes. Wet coconut and its water are considered sacred by Hindus and are used for worship. Foods containing wet or dry coconut gratings are commonly used in a variety of daily food preparations and during festivities throughout the country.

Various countries have their own specifications for coconut oil, and the International Codex Alimentarius standard appears in Table 2 on page 396.

CONTINUED ON NEXT PAGE

TABLE 2. Codex Alimentarius standards for coconut oil[a]

Characteristic	Coconut oil
Color—platinum cobalt scale (max)	50
Relative density at 40°C and 20°C	0.908 and 0.921
Refractive index at 40°C	1.448–1.450
Moisture and other volatiles at 105°C (%)	0.1
Free fatty acids, calculated as lauric acid (% by mass, max)	0.3
Peroxide value (mequiv of active oxygen/kg)	<15
Iodine value (cg I_2/g)	6.3–10.6
Saponification value (mg KOH/g)	248–265
Unsaponifiables (max, g/kg)	≤15
Reichert value	6–8.5
Polenske value	13–18

[a]Codex Alimentarius (FAO/WHO), Codex Standards for Named Vegetable Oils, Codex Standard 210-1999, Codex Alimentarius, v.8-2001, Rome, Italy, pp. 11–25.

Common methods of coconut oil production

Rotaries (rotating mortars and pestles) and expellers are used to crush dry coconuts (known as copra) and recover the oil. Different types of edible coconut oil are available: virgin coconut oil from wet coconuts (unrefined grade); coconut oil from dry coconuts (unrefined grade); and coconut oil that is produced by a solvent extraction method in which oil is extracted either from dry coconut or from the coconut expeller cakes and is refined, bleached, and deodorized. Virgin coconut oil is reported to have more health benefits than coconut oil extracted from copra.

Copra milling by traditional method. The extraction of oil from copra is one of the world's oldest seed crushing operations. In India and Sri Lanka, copra is still crushed for oil extraction by primitive *chekkus* (fixed stone or wooden mortars in which rotating wooden pestles are powered by humans or animals) or in rotary *ghanis* (mechanically driven

TABLE 3. Physicochemical characteristics of coconut oil

	Virgin coconut oil from wet coconut	Unrefined coconut oil from copra	Refined coconut oil
Appearance	Colorless	Slightly brownish	Colorless
Odor	Coconut smell	Coconut smell	Odorless
Melting point (°C)	24	24	24
Moisture (%)	<0.1	<0.1	<0.1
Iodine value (cg I_2/g)	9.1–15	7.5–15	7.5–12
Peroxide value (mequiv O_2/kg)	0–1	0–1	0–1
Saponification value (mg KOH/g)	245–255	245–255	250–255
Phospholipids (%)	0.1	0.1	0.0
Unsaponifiable matter (%)	—	0.42	0.19
Tocopherols (mg/kg)	150–200	150–200	4–100
Phytosterols (mg/kg)		400–1200	
Total phenolics (mg/kg)	640	618	20
Fatty acid composition (relative %)			
Saturates	92.0	92.0	92.0
Monounsaturates	6.0	6.0	6.0
Polyunsaturates	2.0	2.0	2.0

rotating mortars and pestles), expellers, and hydraulic presses. Conventionally, coconut oil is produced by expelling from dry copra, followed by refining during which the oil is heated to a high temperature. Both copra-based refined coconut oil and solvent-extracted, refined coconut oil have a bland odor and taste.

Wet coconut processing. In wet processing, wet coconuts are pressed to squeeze out the oil and coconut milk. The liquid is then processed further to produce virgin coconut oil.

Traditionally, virgin coconut oil is produced by a 24- to 36-hour fermentation of coconut milk that is expelled from freshly harvested coconuts. During this time, the oil phase separates from the aqueous phase. The resulting wet oil is then heated slightly for a short time to drive off the moisture and is finally filtered. The main disadvantages of this process are low oil recovery and fermented odor, which masks the characteristic coconut flavor of the oil.

In conventional methods for obtaining virgin coconut oil, freshly extracted milk is centrifuged to obtain cream, which is heated to 60–80°C (to coagulate the protein contained in the coconut milk) before centrifuging to obtain the oil.

At the Central Food Technological Research Institute in Mysore, India, virgin coconut oil is made by a new patented process of wet processing without heat, shear, or chemicals. The resulting oil is colorless, has a characteristic coconut flavor, and is used in several medicinal, cosmetic, and cooking applications. Philippines produces major quantities of virgin coconut oil, and it is also becoming popular in India, where an increasing number of processors produce it.

Comparison of oil produced by different processing methods

The fatty acid compositions of the oil extracted from copra via different extraction methods are similar.

Caffeic acid, *p*-coumaric acid, ferulic acid, and catechin have all been observed in coconut oil. The phenolic acid fraction of coconut oil prepared by boiling coconut milk (traditional coconut oil) is more complex than that of coconut oil prepared by pressing copra (commercial coconut oil).

The total phenol content of traditional coconut oil is nearly seven times higher than that of commercial coconut oil (618 ± 46 vs. 91 ± 11 mg kg^{-1}), suggesting that the phenol content varies with the extraction method. Coconut oil extracted under hot conditions (HECO) contains more phenolic substances (i.e., antioxidant activity) than that extracted under cold conditions (CECO). Therefore, the consumption of HECO may improve antioxidant-related health benefits compared with CECO.

Physicochemical characteristics of coconut oil

Coconut oil is insoluble in water. At temperatures above its melting point, it is completely miscible with most nonhydroxylic solvents

CONTINUED ON NEXT PAGE

TABLE 4. Fatty acid composition[a] (%) of coconut oil (MCFA) and some other vegetable oils (LCFA and TFA)

	Fatty acid chain length											
Vegetable oils	**C8:0**	**C10:0**	**C12:0**	**C14:0**	**C16:0**	**C18:0**	**C18:1**	**C18:2**	**C18:3**	**C20:0**	**C22:0**	**Others**
MCFA												
Coconut	7.0	5.4	48.9	20.2	8.4	2.5	6.2	1.4	—	—	—	
Palm kernel	—	1.2	51.6	22.9	12.2	1.3	10.8	—	—	—	—	—
LCFA												
Sunflower	—	—	—	—	6.3	3.0	43.7	47.0	—	—	—	
Rice bran	—	—	—	0.4	22.9	1.8	42.5	30.5	1.4	0.5	—	
Safflower	—	—	—	0.3	11.9	2.3	29.2	55.9	0.4	—	—	
Sesame	—	—	—	—	10.3	5.8	42.9	41.0	—	—	—	
Groundnut	—	—	—	—	14.0	3.8	41.9	34.7	1.0	1.2	3.4	
Palm	—	—	0.2	1.1	42.6	3.8	41.9	10.4	—	—	—	
Olive	—	—	—	—	12.0	2.5	75.7	7.9	0.5	—	—	1.4
Soybean	—	—	—	—	11.6	4.0	18.8	56.1	8.5	—	—	1.0
Grape seed	—	—	—	—	7.2	4.8	19.4	68.1	0.1	—	—	0.4
Linseed	—	—	—	—	7.1	2.0	19.9	17.3	53.7	—	—	0.4
TFA												
Hydrogenated fat	—	—	0.2	1.0—2.6	49.4—50.3	3.8	*t*7.2—14.4 *c*26.5—27.7	1.1—3.9	—	—	—	0.2

[a]MCFA, medium-chain fatty acids; LCFA, long-chain fatty acids; TFA, *trans* fatty acids, *t*, trans; *c*, cis.

such as light petroleum, benzene, carbon tetrachloride, and the like. In alcohol, coconut oil is more soluble than most common fats and oils.

The oil is highly stable with respect to atmospheric oxidation (see Table 3 on page 396). The oil is characterized by a low iodine value, low unsaponifiable matter, low tocopherols content, high saponification value, and high saturated fatty acid content. Yet it is liquid at room temperatures of 27°C. On the other hand, a normal fat comprising long-chain saturated fatty acids (LCT) [such as—in Table 4—a *trans* fatty acid (TFA) fat containing 50% palmitic acid, 7–14% TFA or a medium-chain fatty acid (MCFA)-containing fat like coconut oil, which contains more than 50% MCFA] would be a solid with a melting point above 60°C. This is the difference between coconut oil and an LCT-containing fat such as a hydrogenated fat or a fat of tree origin (Table 4).

Medium-chain triglycerides (MCT) in coconut oil

Coconut oil is a source of MCT (that is, glycerol esterified with three fatty acids, each having a carbon chain 6–12 carbons in length) and consists of trilaurin (20.7–25.8%), caprodilaurin (17.2–21.4%), myristodilaurin (13.6–17.2%), laurodimyristin (7.4–10.2%), lauromyristopalmitin (4.7–6.2%), and other minor triglycerides. MCT are a component of many foods, with coconut and palm oils being the dietary sources with the highest concentration of MCT.

Absorption and metabolism

MCT have a different pattern of absorption and utilization than the LCT that make up 97% percent of dietary fats. For absorption of LCT to occur, the fatty acid chains must be cleaved from the glycerol backbone by lipase. These fatty acids form micelles, are then absorbed and reattached to glycerol, and the resultant triglycerides travel through the lymph system en route to the bloodstream. Up to 30% of MCT are absorbed intact across the intestinal barrier and directly enter the portal vein. This allows for much quicker absorption and utilization of MCT compared to LCT. MCT are transported into the mitochondria independent of the carnitine shuttle, which is necessary for LCT-mitochondrial absorption. Oxidation of MCT provides 8.3 calories per gram, while LCT provides 9.2 calories per gram.

Edible applications of coconut oil

Coconut oil has a high content of saturated fatty acids and hence is highly resistant to oxidative rancidity. Adding coconut oil to other vegetable oils improves their oxidative stability, indicating that coconut oil can be used as a natural antioxidant through the blending process. Adding coconut oil to safflower oil, sunflower oil, or rice bran oil increases the oxidative stability of the resultant blend. MCT have excellent keeping qualities and therefore help to increase the shelf-life of finished products. Coconut oil, along with other fats, is used to mimic human milk, and infant milk powders containing coconut oil have been developed.

Coconut oil is extensively used in food industries as a confectionery fat, particularly in the preparation of ice creams. In imitation chocolates, coconut oil is used in place of cocoa butter along with cocoa powder.

MCT are ideal for treating the surfaces of crackers, as they act as a moisture barrier. They adhere well to surfaces, including metals. They are excellent release agents for surfaces that come into contact with food products or raw materials. These MCT can also be used as a glaze and polishing agent for confectionery products such as gummy-type candies. Solid MCT can help to enhance aeration properties in bakery products.

MCT are also available as a dietary supplement. They are essential nutrients for infants as well as for people with serious digestive problems such as cystic fibrosis because they are easily digested, absorbed, and put to use. Unlike LCT, they put little strain on the digestive system and provide a quick source of energy necessary to promote healing. Like other essential nutrients, one must get them directly from the diet.

Nonedible applications of coconut oil

One of the major nonedible applications of coconut oil is in the manufacture of soap; one important chemical derivative of coconut oil is methyl esters of coconut fatty acids, which are produced by treating coconut oil with methyl alcohol. These medium-chain fatty acid methyl esters (FAME) are important raw materials for the chemical industries, as they are easier to separate by fractional distillation than FAME comprising long-chain fatty acids.

Coconut oil has also been found useful for mixing with diesel. A 30:70 mixture provides excellent road performance in diesel vehicles. Methyl esters of coconut oil fatty acids are also being used as lubricants and biodiesel in the aviation industry.

Coconut oil has many other industrial uses in pharmaceuticals, cosmetics, plastics, rubber substitutes, synthetic resins, and the like.

Clinical applications of MCT and saturated fatty acids

The healing properties of coconut oil are due to antifungal and antibacterial activities. It kills bacteria that cause diseases such as pneumonia, sore throats, dental cavities, urinary tract infections, meningitis, gonorrhea, and food poisoning. It kills the causes of infections such as candida, ringworm, athlete's foot, thrush, jock itch, and diaper rash. It also kills viruses having a lipid coating, such as herpes, HIV, hepatitis C, influenza, and mononucleosis.

Certain medium-chain fatty acids, such as lauric acid, have adverse effects on other pathogenic microorganisms, including bacteria, yeast, and fungi. These fatty acids and their derivatives actually disrupt the lipid membranes of the organisms and thus inactivate them.

Studies have also shown that short-chain saturated fatty acids can be used in the treatment of dental caries, peptic ulcers, benign prostatic hyperplasia, genital herpes, and cancer.

The preceding material shows that coconut oil can provide many health benefits. The scientific evidence needs to be generated so that consumers will accept it as a good oil although it has 92% saturated fatty acids and is different from a normal fat (i.e., fats of tree origin, hydrogenated fats, or hydrogenated vegetable oil) with 92% long-chain saturated fatty acids.

A.G. Gopala Krishna has been with the CSIR-Central Food Technological Research Institute in Mysore, India, for the last 35 years. He is currently a chief scientist, specializing in lipid chemistry and technology, convenience foods, nutraceuticals, and health foods. He was awarded an AvHumboldt Fellowship (1995–1996) from the AvH Foundation, Bonn, Germany, and the S.D. Thirumala Rao Memorial Award (2009) for his outstanding contributions to the oleochemicals/ vegetable oil processing industries by the Oil Technologists Association of India, HBTI Campus, Kanpur. He has published 75 research papers, presented 60 papers in symposia and seven invited talks, and holds 19 patents. He can be contacted at aggk_55@yahoo.com.

SUSTAINABLE COATINGS (CONTINUED FROM PAGE 382)

When compared to standard self-crosslinking 100% acrylics, the new soy-based acrylic offers better gloss potential and depth of image or clarity. The soy oil enhances this, just as in the water-based soy polyurethane, achieving 88 sheen at 60° degrees compared to 80 sheen for the self-crosslinking 100% acrylic. The flow and leveling are much improved on the soy acrylic vs. the self-crosslinking acrylic. The chemical resistance is slightly improved over the soy-acrylic due to the oxidative crosslinking, via driers, to form a more chemically resistant coating. Another aspect to the soy-acrylic is the excellent warmth it imparts to wood. Typically, acrylics offer a cold and lifeless aspect to wood.

The Achilles heel to the soy-acrylic coating at this point is the cost. With this new technology, the soy-based components used to make up the finished resin are more expensive than traditional acrylic monomers.

These new soy-based products are found in Rust-Oleum's new Ultimate polyurethane wood-care product available at many home centers. The soy-polyurethane can be found in the Varathane Canadian Pro available in Canada, as well as the new NanoShield Amber.

While the greening of the coatings industry will not occur overnight, these initial steps discussed here, among others in the industry, will quickly solve some of the issues associated with water-based products. Many current developments in biobased and renewable resins, additives, and plastics will not only cut down on VOC emissions but also lead to lower costs. Finally, the renewable materials are grown and manufactured in the United States and Canada, furthering their economic growth.

John Schierlmann is applications manager at Specialty Polymers Inc. in Chester, South Carolina, USA. Prior to that, he was technology manager for wood care at Rustoleum. He can be contacted at jschierlmann@me.com. Madhukar (Duke) Rao is director of polymers and materials technology at the Sherwin Williams Co. He can be contacted at mkrao@sherwin.com.

PATENTS (CONTINUED FROM PAGE 377)

Compositions for treating and preventing hyperlipidemia

Liu, J., and S. Wu, Fenchem Enteprises, Ltd., US8084065, December 27, 2011

A composition for treatment and prevention of hyperlipidemia consists of phytosterols and phytostanols 30–50%, flavones derived from bamboo leaf 20–40%, procyanidins 10–25%, and β-glucan 5–20%. When applied in supplementary nutrient foods or medicaments, the present composition can effectively lower the levels of cholesterol and triglyceride in blood and therefore can be useful for treating and preventing hyperlipidemia, cardiovascular diseases, coronary heart disease, atherosclerosis, and the like.

Patent information is compiled by Scott Bloomer, a registered US patent agent with Archer Daniels Midland Co., Decatur, Illinois, USA. Contact him at scott.bloomer@adm.com.

Treat your clothes **right**

Clean, maintain, and restore clothes wash after wash with Novozymes' solutions. Include cellulases for brighter whites, more radiant colors, and improved fabric care that consumers soon will notice.

Learn more about how you can offer superior fabric care to restore worn-looking clothes at www.cottonspa.novozymes.com or visit www.novozymes.com/laundry.

Novozymes is the world leader in bioinnovation. Together with customers across a broad array of industries we create tomorrow's industrial biosolutions, improving our customers' business and the use of our planet's resources. Read more at www.novozymes.com

Rethink Tomorrow

novozymes®

Household Care