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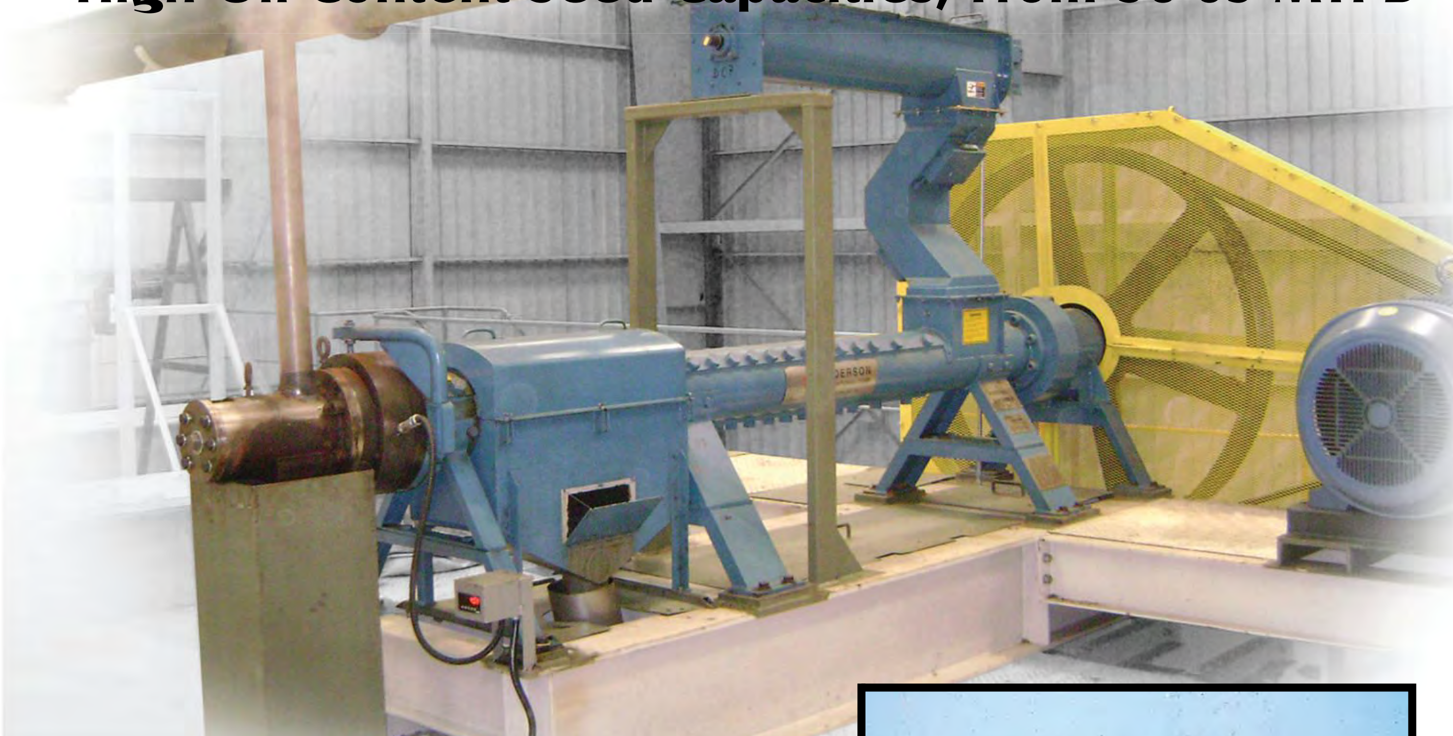

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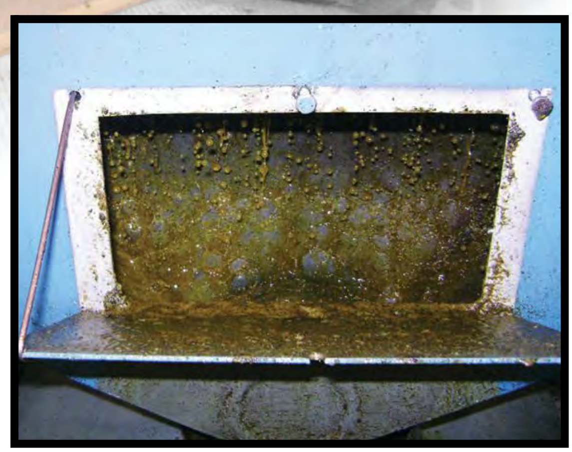

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Calendar

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

September

September 3–5, 2012. Household Auto Care 2012, São Paulo, Brazil. Information: www.freedom.inf.br

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

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

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

September 11–13, 2012. American Cleaning Institute Fall Meeting, Washington, DC, USA. Information: www.cleaninginstitute.org

September 12–13, 2012. The Chemistry and Formulations of Color Cosmetics, Newark, New Jersey, USA. Information: www.scconline.org

September 12–13, 2012. Cosmetic Formulations, Newark, New Jersey, USA. Information: www.scconline.org

September 12–14, 2012. Oils & Fats International Congress Asia 2012, Kuala Lumpur, Malaysia. Information: www.oilsandfats-international.com or rosalindpriestley@quartzltd.com

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

September 16–17,2012. Women in Agribusiness Summit, New Orleans, Louisiana, USA. Information: www.tinyurl.com/Women-Agri

September 17–19, 2012. International Conference on Obesity and Weight Management, San Antonio, Texas, USA. Information: www.omicsonline.org/obesity2012

September 17–19, 2012. World Toxicology Summit & Expo 2012, San Antonio, Texas, USA. Information: www.omicsonline.org/toxicology2012

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

September 17–21, 2012. 54th International Conference on the Bioscience of Lipids, Bari, Italy. Information: www.icbl.unibe.ch

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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.

May 3–6, 2015. 106th AOCS Annual Meeting & Expo, Rosen Shingle Creek, Orlando, Florida, USA. Information: phone: +1 217-693-4821; fax: +1 217-693-4865; email: meetings@aocs.org; aocs.org/meetings

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September 18–19, 2012. World Biofuels Markets Brazil, São Paulo, Brazil. Information: www.worldbiofuelsmarkets.com

September 18–20, 2012. Science & Standards Symposium: Function of Foods and Dietary Supplements—Global Opportunities and Challenges, Boston, Massachusetts, USA. Information: www.usp.org

September 19–21, 2012. Biocatalysis in Lipid Modification, Greifswald University, Greifswald, Germany. Information: www.sfel.asso.fr/fr/symposium-colloques-manifestations,30.html

September 19–21, 2012. International Dairy Foods Association Policy & Politics Conference, Washington, DC, USA. Information: www.idfa.org

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

September 23–28, 2012. Aquaculture Feed Extrusion, Nutrition, and Feed Management, College Station, Texas, USA. Information: www.tamu.edu/extrusion

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

September 24–27, 2012. Society of Environmental Toxicology and Chemistry (SETAC) Asia/Pacific 2012 Annual Meeting, Kumamoto, Japan. Information: www.setac-kumamoto2012.org

September 25–27, 2012. Marine Fuels: Specifications, Testing, Purchase, and Use, San Francisco, California, USA. Information: www.astm.org

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

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

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

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September 27–29, 2012. 21st South East Lipid Research Conference, Pine Mountain, Georgia, USA. Information: www.selrc.org

September 30–October 2, 2012. AOAC International Annual Meeting & Exposition, Las Vegas, Nevada, USA. Information: www.aoac.org

September 30–October 3, 2012. American Association of Cereal Chemists International Annual Meeting, Hollywood, Florida, USA. Information: www.aaccnet.org

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

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

October

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

October 3–5, 2012. Cleaning Products 2012, Baltimore, Maryland, USA. Information: www.cleaningproductsconference.com

October 7–11, 2012. Practical Short Course on Vegetable Oil Processing and Products of Vegetable Oil/Biodiesel, College Station, Texas, USA. Information: www.foodprotein.tamu.edu

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

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

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

October 23, 2012. Preservatives, Newark, New Jersey, USA. Information: www.scconline.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: www.acsmeetings.org/meetings

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

October 29–30, 2012. Basic Polymers (October 29) and Advanced Polymers (October 30), Newark, New Jersey, USA. Information: www.scconline.org

October 29–31, 2012. Singapore 2012: World Conference on Fabric and Home Care, Shangri-La Hotel, Singapore. Information: www.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; www.foodprotein.tamu.edu

November 5–9, 2012. WMF meets IUPAC: 7th Conference of The World Mycotoxin Forum and the XIIIth IUPAC International Symposium on Mycotoxins and Phycotoxins, Rotterdam, Netherlands. Information: www.wmfmeetsiupac.org

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

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

November 11–15, 2012. SETAC North America, Long Beach, California, USA. Information: www.longbeach.setac.org

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

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

November 14–15, 2012. Novel Sources for Omega-3 for Food and Feed, Copenhagen, Denmark. Information: www.eurofedlipid.org

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

November 20–23, 2012. 2012 European Federation of Food Science and Technology Annual Meeting, Montpellier, France. Information: www.effostconference.com ■

OILSEEDS
and food, water, and energy security

Kellyn Betts
Kellyn Betts is a freelance writer who has covered topics in environmental science, health, and technology for more than two decades. In 2005, she won an online reporting award from the Society of Environmental Journalists. She can be contacted at k_betts@nasw.org.

During the AOCS 103rd Annual Meeting and Expo, *inform* distributed a "Be Heard" survey in which attendees were asked to identify the most important challenges for fats and oils in the next 10 years. The majority of respondents indicated that the sustainable use of food, water, and energy by the world's growing population will be the most pressing challenge. Here, science writer Kellyn Betts explores the interrelatedness of these critical resources, how fats and oils are at the center of the choices and tradeoffs that will need to be made, and how some top companies are changing the way they do business to ensure the security of these resources.

The United Nations' Food and Agriculture Organization (FAO) predicts the world's farmers will need to produce 70% more food to feed more than 9 billion people by 2050 while simultaneously combating poverty and hunger and adapting to climate change (http://tinyurl.com/FAO-9-billion). The production, processing, and use of oilseed crops present additional challenges, because they are increasingly being used as feedstocks for fuel, chemicals, and other consumer products.

"We're moving toward a greater and greater reliance on agriculture to supply society's needs around food, fuel, and materials," says Dave McLaughlin, vice president of agriculture for the World Wildlife Fund (WWF), a nonprofit conservation organization that is working on sustainability issues with 10 high-profile multinational corporations, including Cargill, Procter & Gamble (P&G), and Unilever. "The key questions are whether we have the land and the water to support all this agricultural production, and how that production will affect biodiversity, natural forests, and habitat."

Only a tiny proportion of today's crops and products are intentionally raised or produced sustainably, says Barbara Bramble, senior program advisor for the International Climate and Energy program for the US-based National Wildlife Federation. Bramble chairs the Roundtable on Sustainable Biofuels (RSB; http://rsb.epfl.ch), the global initiative to certify biofuels that meet voluntary standards for social and environmental safeguards. RSB standards cover not only soil, water, and habitat conservation but also protection of local communities, land rights, and fair treatment of workers. "We need a lot of demand by companies asking for the right thing to cause overall improvements in the way crops are grown," she says.

Meanwhile, production of the four most important oilseeds—palm, rapeseed (canola), soy, and sunflower—is rising. The

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Food and Agricultural Policy Research Institute, a joint effort of the Center for Agricultural and Rural Development at Iowa State University (Ames, USA) and the University of Missouri-Columbia (USA), predicts that worldwide oilseed harvests will increase by 11% between 2011 and 2015 (http://tinyurl.com/FAPRI-CARD).

implement, says Jan-Kees Vis, the global director of Unilever's Sustainable Sourcing Development. In April 2012, Unilever announced that it was installing a €100 million palm oil refinery in Sumatra (Indonesia) to guarantee the sustainability of its palm oil supply, in support of the company's commitment to source all of its renewable raw materials from sustainable sources by 2020.

THE UNITED STATES, 27 NATIONS OF THE EU, AND MORE THAN 30 OTHER COUNTRIES IN THE AMERICAS, AFRICA, ASIA, AND ASIA-PACIFIC HAVE PASSED OR ARE IMPLEMENTING BIOFUEL BLENDING REQUIREMENTS.

While the United States, Brazil, China, Argentina, Indonesia, Malaysia, India, and the European Union (EU) are expected to continue to be the major producers of oil crops through the end of the decade, new plantings are projected to increase mostly in emerging and developing countries despite environmental constraints and competition for land (http://tinyurl.com/oilseeds-outlook).

The United States, 27 nations of the EU, and more than 30 other countries in the Americas, Africa, Asia, and Asia-Pacific have passed or are implementing biofuel blending requirements (http://tinyurl.com/mandates-biofuels). As a result, "all of the world's major oilseeds are being used in biofuels," McLaughlin says. The share of vegetable oil used for biodiesel is expected to increase from 10% in 2008 to 10–15% in 2020 (http://tinyurl.com/oilseeds-outlook).

It's already clear that shifts in the use of oilseeds for fuel have caused changes in food oil consumption patterns, points out Rosamond Naylor, director of the Center on Food Security and the Environment at Stanford University (California, USA). As the amount of rapeseed used for fuel in Europe has grown, China has imported lower amounts. Instead, Chinese citizens are using more soy and palm oil for cooking, she says.

A positive side effect of the food-price spike of 2007–2008 was that it inspired the World Bank as well as developed countries to double their investments in developing nations' farming. It also helped raise the status of agriculture in many developing countries (www.economist.com/node/14915144). Concerns about having enough domestic acreage devoted to food production led China's National Development & Reform Commission in April 2011 to limit alcohol, biofuel, and other nonanimal-feed projects that use grain and edible oils (http://tinyurl.com/China-limits).

Companies such as P&G and Unilever are leaders in planning for scarcity and in identifying the need for sustainable supplies. Forward-looking consumer goods manufacturers recognize that the market will demand products that are produced much more sustainably a decade from now, and the changes required to offer such wares take time to

In addition to committing to ensuring that the oilseed-based commodities used in its products are grown and produced sustainably, P&G has vowed to replace 25% of its petroleum-based raw materials, such as alkyl surfactants, alkyl ethoxylate surfactants, and linear alkylbenzene surfactants, with alternative formulations based on renewables by 2020, says Len Sauers, P&G's vice president for global sustainability. This is important because approximately one-fifth of the world's oilseeds are consumed for industrial products (*inform 20*:749, 2009), including soaps and detergents, biodiesel, lubricants, drying oils, inks, and hydraulic oils.

Pressure by ethical investment and banking organizations also moves consumer goods manufacturers, oilseed distributors, and retailers toward sustainability. P&G is one of the top holdings in Calvert Investment's Calvert Social Responsibility Index, which includes large companies that the firm judges to perform well on seven metrics. One is to "demonstrate good environmental compliance and performance records, develop and market innovative products and services, and embrace and advance sustainable development." Investors need to consider companies' abilities to secure resources in the future, explains Ellen Kennedy, manager of Environment, Water, and Climate at Calvert Investments. "If the land or labor or water or other resources aren't being used sustainably, there's a risk to that company that they may not be able to secure a fair price for that resource in the future."

Moving toward nonfood sources

To Bramble, the relatively small quantities of vegetable oil-based biofuels in current use increase the amount of flexibility that nations have in response to petroleum oil price shocks.

Vis says that Unilever is "concerned about the first-generation biofuels because they are in direct competition with food. . . . If a feedstock is a food, how can you not compete with food?" he asks. Although he is optimistic about the promise of second-generation biofuels in the longterm, "As long as the [governmental] subsidies are behind first-generation biofuels, such as biodiesel from vegetable oils, it is very difficult for the second-generation biofuels to actually enter the market," he points out.

Sauers says that although P&G is investigating some alternatives to food-based chemicals to meet its commitment to cut its use of petroleum-based chemicals, he believes that in the long run there will be more pressure to move toward nonfood sources, such as cellulosic sugars from grasses. Finding alternatives that do not increase the company's carbon footprint is a real challenge because petroleum is a very efficient source of carbon, he points out.

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Table 1. Productivity of vegetable oil sources

Source of feedstock	Achievable production of oil (MT/ha)		Source
	Estimated	Potential	
Oil palm	4 (average) 6–7 (optimal)	11	Malaysia Palm Oil Board http://bepi.mpob.gov.my/index.php/statistics/yield/81-yield-2011/365-oil-yield-july-december-2010.html, David McLaughlin of WWF
Soybeans	0.4 (average)		David McLaughlin of WWF, http://www.gardeningplaces.com/articles/oil-crops-compared1.htm
Canola	0.7	1.4	http://www.aocs.org/Membership/FreeCover.cfm?itemnumber=1102 http://www.gardeningplaces.com/articles/oil-crops-compared1.htm sez canola average is .7 MT/ha.
Algae	8.6	26–43	DARPA General Atomics
Jatropha curcas	.5-2.7	3.4	http://www.worldagroforestry.org/downloads/publications/PDFs/WP16542.PDF (for 0.5 to 2.7 estimate). Soil and Water Conservation Society, "Sustainable Alternative Fuel Feedstock Opportunities, Challenges and Roadmaps for Six US Regions." Proceedings of the Sustainable Feedstocks for Advance Biofuels Workshop. Edited by Ross Braun, Doug Karlen, and Dewayne Johnson. Table 3 from Chapter 8, Oilseed and Algal Oils as Biofuel Feedstocks, by John C. Gardner, Washington State University.
Camelina sativa	0.6 – 1.7	3.3	http://www.afpmt.com/research/camelina.pdf, http://www.gardeningplaces.com/articles/oil-crops-compared1.htm

Farming improvements

A positive side effect of the increased demand for edible oils has been to make farming more profitable and farmers more productive.

Of all the oilseed crops grown commercially, oil palms have the highest oil yield per hectare (see Table 1), and growers have been able to continually increase those yields, McLaughlin says. The average yields of oil palms is around 4 metric tons/hectare (MT/ha) in Malaysia, with slightly lower yields in Indonesia. In comparison, the global average yield of soybean oil is 0.4 MT/ha. However, the better oil palm producers are getting 6–7 MT/ha, and there are reports of planting materials that can increase yields to 11 MT/ha, he says. Better management practices, including improved harvesting and better plant nutrition of the existing cultivation base could increase yields by 15–30% while using practices that would enable growers to achieve certification through the Roundtable for Sustainable Palm Oil (www.RSPO; rspo.org), he says.

In a *Conservation Biology* article (25:1117–1120, 2011), McLaughlin points out that "palm oil can be a sustainable crop, have minimal effects on biological diversity, sequester carbon, produce jobs, and offer attractive financial returns." Most of the issues related to palm oil that have come to light are the result of how palm oil has been developed, he says.

New oil sources and modified oilseeds

Some promising nonfood or so-called second-generation and advanced agricultural sources of oil-based biofuels are jatropha, camelina, and algae. Algae has the potential to revolutionize the production of biofuel, but it will take the longest to develop as an energy source.

A number of governmental agencies as well as private and publicly held companies are attempting to bring oil derived from algae to market. Tests by the US Defense Advanced Research Projects Agency (DARPA) have shown algae can produce more than 1,000 gallons of oil per acre (9,354 liters/ha), far more than the 400-800 gallons/acre that palm generates. Many companies are working to develop algae as a source of biodiesel, such as OriginOil, Sapphire, ExxonMobil, Synthetic Genomics, Solix, Solena, Aurora Algae . . . and the list goes on. General Atomic (headquartered in San Diego, California, USA) considers claims that microalgae have the potential to produce 3,000–5,000 gallons of oil per acre to be credible. "It may be possible to produce enough biodiesel from microalgae to supply all US transportation fuel requirements," according to a recent company statement.

Algae's ability to grow on degraded land with poor-quality water while generating a net gain in energy and reduction in carbon dioxide makes it especially compelling, McLaughlin says. However, some of the most recent research into producing biodiesel from algae suggests that it may need to be done in conjunction with other processes, such as treating wastewater or producing other high-value commodities, in order to be cost-effective (http://tinyurl.com/algae-caveats).

The tropical shrub *Jatropha curcas* can yield 400 gallons of oil per acre from seeds containing 30–40% oil. Over the past decade, jatropha has been planted across Asia and sub-Saharan Africa, and more recently South America has also begun planting the crop. Bloomberg New Energy Finance predicts that by 2018 aircraft fuel from jatropha could be produced for $0.86 per liter, about the same price as conventional jet fuel today and far less than fuel made from soybeans or palm can be processed into biodiesel (http://tinyurl.com/Bloomberg-jatropha), and the residual materials can be used as a soil conditioner or processed as biomass to power electric facilities. Although jatropha has not thrived as well as expected when grown on wasteland and may require more water than initially believed, researchers are developing new hybrids and genetically modified strains to enhance yields (e.g., SG Biofuels Inc., at www.sg.com; JOil Singapore Pte Ltd., at www.joil.com.sg). Genetic engineering also has the potential to enhance the production of oil by other plants (*inform* 23:206–210, 2012).

Camelina, another oilseed-bearing plant, is able to withstand cold temperatures. It can be planted as a follow-along crop in wheat fields for harvest in the spring, thereby increasing the amount of useful material that can be grown on the same land. Bramble sees crops such as camelina as key to increasing the world's ability to expand its agricultural productivity. An article in the November/December 2011 issue of *inform* (22:604–616) discussed the potential of camelina seed for use in fuel, animal feed, and other applications.

RSPO and the chain of custody

Owing to the popularity of outsourcing over the past 20–30 years, large companies did not know until recently what others in the supply chain—farmers, processors, distributors, and others who collaborated to deliver commodities such as oilseeds—were doing, McLaughlin explains. Certification programs such as the RSPO and the Round Table for Responsible Soy (RTRS; www.responsiblesoy.org) target the farmers, distributors, and processors at every level of the supply chain for palm and soy because "the chain of custody is critically important," McLaughlin explains. The availability of certificate programs such as Green Palm [sponsored by the RSPO] helps companies publicly support growers who use sustainable practices before those companies can shift to segregated oil or shipments that can be tracked throughout the entire supply chain. Key commitments made by four global palm oil users are described in Table 2 on page 414.

Companies must be buying critical volumes before the segregation requirements for certification processes such as RSPO and RTRS become cost effective, Vis points out. "We understand that this is very, very challenging for companies because a lot of times commodities are blended," Kennedy says.

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Table 2. Key RSPO commitments

Bunge	Cargill	P&G	Unilever
Bunge only purchases palm oil from suppliers that are RSPO members and that have achieved RSPO certification or are committed to achieving RSPO certification and are working actively toward that end. Bunge will source RSPO-certified palm oil as available volumes increase and its customers begin to integrate it into their products.	Cargill announced in July 2011 that the palm oil products it supplies to its customers in Europe, United States, Canada, Australia, and New Zealand will be certified by RSPO and/or originated from smallholder growers by 2015 (this excludes palm kernel oil products). This commitment will be extended across all Cargill's oil and trading businesses to cover 100% of its palm oil products and all customers worldwide—including China and India—by 2020.	Procter & Gamble is committed to the sustainable sourcing of palm oil. By 2015 it intends to purchase and use palm oil that it can confirm to have originated from responsible and sustainable sources	Unilever recently announced that it will buy all its palm oil from traceable sources by 2020. The company will meet its earlier goal—to source palm oil through the Green Palm certificate scheme by 2015—three years early.

Source: Roundtable on Sustainable Palm Oil (RSPO), April 2012. Information obtained by communication with contacts at RSPO.

Traceability can also help buyer companies manage their reputations, Calvert Investment's Kennedy explains. Company and brand reputation are key to company performance, and companies that have very valuable brands can be easy targets, she says. "Even if it is unfair that a company is being blamed for something in its supply chain, with the lightning-fast communications now available in the world of social media, it doesn't matter," she says. Companies are increasingly realizing that they need to manage the risk of their suppliers, and even in some cases, their suppliers' suppliers, to protect their brands, she says.

Water and energy

In March 2012, the United Nations Educational, Scientific and Cultural Organization forecast that the world's farmers will need 19% more water by 2050 to meet increasing demands for food, much of it in regions already suffering from water scarcity (http://tinyurl.com/UNESCO-water). By that time, the FAO predicts that water scarcity will reach alarming levels in an increasing number of countries or regions within countries, particularly in the Near East/North Africa and South Asia. Using less water and at the same time producing more food will be the key to addressing water scarcity problems. Water scarcity could be made more acute by changing rainfall patters resulting from climate change.

Most of the water that a multinational company such as Unilever consumes is via the agriculture that produces the raw materials it uses, Vis says. For this reason, the company has standards that its farmers and suppliers must follow for irrigation and for controlling topsoil erosion and agricultural runoff.

Looking at the life-cycle impacts of oilseed crop growing is important, Bramble says. For example, oil palm trees are generally grown in very wet areas, such as swamps and rainforests, where rain provides all or most of the water they require. They are "huge users of water in the sense that they displace wetlands and peat lands," Bramble says. Soy, canola/rapeseed, and sunflower can also be grown on rain-fed lands, so they can all be fairly efficient users of water, Bramble points out.

The most common impact on water from oilseed agriculture is contamination from fertilizers and chemicals such as herbicides and insecticides, says Kishore Rajagopalan, an associate director at the University of Illinois' Sustainable Technology Center. This is why Vis says the field staff associated with Unilever's suppliers usually go out into the fields throughout the growing season to check that farmers adhere to the types of pesticides they're allowed to use on certain crops under certain conditions, and that they use the appropriate windows of spraying. Impacts can also arise when crops are planted or manufacturing facilities are sited without sufficient regard for their effect on local water resources, Rajagopalan says. He believes this is most likely to happen in the developing world.

An increasing number of companies throughout the world are taking steps to reduce their use of water during oilseed processing by reusing it, Rajagopalan says. For example, after biodiesel is washed with water to remove contaminants, the water can be cleaned and reused. Other companies recycle water from their cooling towers, rather than sending it down the sewer to water treatment plants, he says. He urges companies to consider what quality of water they need for different purposes and recommends shifts to use of lower-quality water when possible, as well as reusing contaminated water in situations where it is feasible. Another option is to clean up the water effluent before reusing the water.

Water and energy use tend to be interrelated because water is generally used for cooling in processing plants, Rajagopalan says. Efforts to reduce heat losses within processes by finding a different use for that heat can result in saving both water and energy, he says. "One of the things I look for is why companies are using water," he says. "If it is being used to remove heat, I ask if the heat can be used elsewhere or if you can avoid using water to cool it down."

Life- cycle assessments

Both P&G and Unilever extensively use life-cycle assessment (LCA), a tool for quantifying the environmental impact—in terms of water, energy and raw materials usage and releases to air, land, and water—that products, packages, and processes have across their entire life cycles, including producing or harvesting the raw materials, manufacturing, use by the consumer, and disposal or recycling. LCA "helps us identify where the biggest opportunities are," Sauers says.

P&G efforts to reduce water and energy use. LCA analysis helped P&G discover that a major point of energy use associated with the life cycle of laundry detergents is when consumers heat water to wash their clothes. The recognition inspired the creation of P&G's Tide Coldwater line of laundry detergents, as well as its sister products Ariel Cool Clean, which use oleo-based surfactants. The Coldwater and Cool Clean detergents are formulated to function optimally with unheated water. P&G advertises that Coldwater enables consumers to save up to 80% of the energy in each load of washing, as well as cutting the associated greenhouse gas emissions.

Kennedy of Calvert Investments calls Tide Coldwater's ability to impact how consumers use water to do laundry "a huge advance."

To help reduce the amount of water required to do laundry in the developing world, P&G sells a product called Downy Single Rinse. This fabric conditioner enables people to reduce the number of times they rinse laundered clothing from at least three to just once. "It helps sequester the suds," Sauers explains. Consumers who use the product can cut their water usage for laundering in half, which Sauers says is meaningful in areas of water scarcity such as the Philippines.

P&G is also using what Sauers calls "product compaction" to concentrate products such as detergents by two to six times. This reduces the amount of water used to produce the products and saves energy in transportation, he says. However, the company's policy is only to implement "no-tradeoff" solutions that do not incur a price premium.

Unilever efforts to reduce energy and water use. Unilever has completed life-cycle assessments on 1,600 of its products to calculate their carbon and water footprints. Only 3% of the carbon footprint is in the company's factories and offices, Vis says. Unilever has committed to halve the carbon and water imprints of its operations and products across their entire life cycles. About 68% of the carbon footprint of Unilever's products is during the consumer-use phase, mostly to heat water for things such as cooking and bathing. "This is a challenge because there is a limit to what we can influence in terms of consumer behavior," Vis says.

Bramble, Kennedy, McLaughlin, Rajagopalan, Sauers, and Vis all express optimism that the steps toward sustainability that they are observing or taking will have an important impact. As Bramble put it, "Our goal is that practices that were once exceptional will become the new business as usual."

News & Noteworthy

Briefs

The first validated direct method for the detection of glycidyl fatty acid esters in edible oils has been released by AOCS and the Japan Oil Chemists' Society (Joint AOCS/JOCS Official Method Cd 28-10). The method—which uses double solid-phase extraction and liquid chromatography-mass spectrometry—marks the first analytical collaboration between the two organizations. For more information, email AOCS Technical Director Richard Cantrill at rcantrill@aocs.org.

■■■

The first flight across the Pacific Ocean powered in part by biofuel took place on April 17, 2012. All Nippon Airways flew a Boeing 787 Dreamliner from Boeing's Delivery Center in Everett, Washington, USA, to Tokyo Haneda Airport. The biofuel was derived mainly from used cooking oil, and about 30% less CO_2 was emitted compared to similarly-sized airplanes. Of that reduction, one-third was attributed to the use of biofuel, and two-thirds to technology and efficiency advancements found in the Dreamliner.

■■■

On June 5, 2012, POET (Sioux Falls, South Dakota, USA) announced that 14 plants in its network had completed installation of technology that isolates corn oil in the process of producing ethanol. Annual production capacity totals about 235 million pounds (107,000 metric tons) per year, which as feedstock for biodiesel would yield about 31 million gallons (120 million liters).

■■■

Continuing work that originated in the US Department of Agriculture Agricultural Research Services's Bio-Oils Research Unit (Peoria, Illinois), Lubri-Green BioSynthetics (Irvine, California, USA) has acquired an exclusive license to patent rights for oleic estolides. These bio-based fluids are already being used as motor lubricants in race cars—a common opening move to introducing the product to the larger market (http://tinyurl.com/estolides, p. 22). LubriGreen intends to distribute the estolide lubricants to large oil companies, which will then provide additives and market their

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EFSA reports on mineral oil hydrocarbons in food

The European Food Safety Authority (EFSA) has published a scientific opinion on dietary exposure in humans to a diverse group of compounds known as "mineral oil hydrocarbons" (MOH; see tinyurl.com/EFSAhydro).

The potential health impacts of these all-but-impossible-to-characterize compounds vary. Aromatic MOH (MOAH) may be genotoxic carcinogens; some saturated MOH may cause adverse liver effects. Among the foods with the highest mean occurrence values of mineral oil saturated hydrocarbons (MOSH) were confectionery (nonchocolate), vegetable oils, canned fish products, and oilseeds, varying from 38–46 mg MOSH/kg), followed by animal fat, fish meat, tree nuts, and ices and desserts, varying from 14–24 mg MOSH/kg).

EFSA suggested there are several possible sources of MOH in food: mainly food packaging materials, food additives, processing aids, and environmental contaminants such as lubricants. The agency noted a lack of analytical methodology and insufficient information on both exposure and toxicology for MOAH even as it found that the temporary Acceptable Daily Intake levels of some MOSH warrant revision.

The EFSA report "does not identify any specific food safety concerns," said U.K.'s Food Standards Agency in a response (tinyurl.com/FSAhydro).

Neste Oil promotes its renewable diesel

The Finnish company Neste Oil Corp. has announced a number of accomplishments in the past three months:

The company intends to increase its use of waste as a feedstock for producing the company's NExBTL renewable diesel in 2012. In doing so, the company will expand its use of "sidestreams" generated during the production of palm oil, which to date has been the company's single largest raw material input. Sidestreams include such things as palm fatty acid distillate. Neste is also looking to increase its use of waste animal fat. The company has two plants at its Porvoo refinery in Finland, one in Singapore, and one in Rotterdam, the Netherlands. Total renewable diesel capacity for the company is around 2 million metric tons per year.

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individual brands to consumers sometime in the next few years.

■■■

Scientific Certification Systems (SCS; Emeryville, California) has become the first certification body in the United States to be accredited by the International Sustainability & Carbon Certification biofuel certification system. SCS can conduct biofuel certifications and "ISCC Plus" certification for food, animal feed, and derivative chemicals produced from any feedstock. ISCC certification qualifies biofuels sold into the European Union for recognition under the Renewable Energy Directive, which sets targets and minimum sustainability requirements for biofuel use through the EU. See www.scscertified.com for further information.

■■■

The American Medical Association (AMA) adopted a policy statement on June 20, 2012, that "trust but verify" is an appropriate approach to genetically modified (GM) foods. The statement also supports pre-market systematic safety assessments of bioengineered food. Among other conclusions, the statement indicated that assessing the risk of introducing GM organisms into the environment should be based on the nature of the organism and the environment into which it is introduced, not on the method by which it was produced.

The AMA found that there has been no scientific evidence yet justifying special labeling of bioengineered foods, as a class, and that voluntary labeling is without value unless accompanied by effective consumer education.

■■■

Five million Brazilian farmers are suing the Monsanto seed company, asking for a return of about €6.2 billion taken as royalties from them. A local Brazilian court ruled in April 2012 that Monsanto could not charge farmers for use of their genetically modified soy because patents relating to Monsanto's engineered crop had already expired in Brazil. The Brazilian Supreme Court ruled in June that the April decision, reached in the state of Rio Grande do Sul, should apply nationally. Monsanto has appealed. ■

In a company statement, Matti Lehmus, Neste Oil's executive vice president, oil products and renewables, said, "In addition to focusing on waste and sidestreams, we are continuing R&D on completely new types of raw materials. We are currently building Europe's first pilot plant [in Porvoo, Finland] to produce microbial oil from waste and residues-based raw materials." The company anticipates completing the new plant by the end of 2012.

In mid-May the company began producing NExBTL diesel from waste fat originating from the fish processing industry at its Singapore refinery. Farmed freshwater pangasius fish, a type of catfish originating in the Mekong Delta in Vietnam and the Chao Fraya basin in Thailand, are processed to yield fillets for human consumption. Neste processes the residual gutting fat.

Neste Oil announced in April its first shipment of NExBTL renewable diesel to the US market from its Porvoo refinery. The US Environmental Protection Agency has certified Neste's Singapore plant to export its renewable diesel to the United States. Company officials had indicated during construction of the Singapore plant that about one-third of its biodiesel would go to the United States and Canada, with the rest to Europe.

Dynamic Fuels LLC (Tulsa, Oklahoma, USA), a joint venture (JV) between the meat processor Tyson Foods (Springdale, Arkansas) and Syntroleum Corp. that makes renewable diesel from waste animal fat, was sued by Neste Oil on May 29, 2012, for infringement of its US patent no. 8,187,344—Fuel Composition for a Diesel Engine—granted that same day. Neste contends that the defendants, who formed their JV in 2007 and started producing renewable diesel in 2010, infringed at least one portion of its patent. Neste is seeking damages, interest, and attorney fees. Of course, Dynamic Fuels and Syntroleum rejected Neste's claims out of hand.

Funds for US military biofuels may be axed

On May 18, 2012, the US House of Representatives passed H.R. 4310: National Defense Authorization Act (NDAA) for Fiscal Year 2013. Within that budget bill, the Republican-led House Armed Services Committee incorporated language to ban the Department of Defense (DOD) from purchasing alternative fuels that cost more than "traditional" fossil fuels.

The implications of this language are far-reaching. In the past 18 months the Navy has reported successful trials of biofuels made from waste grease, camelina, and jatropha in drones, boats, ships, aircraft, and destroyers (*inform* 22:557; 23:22, 85, 191, 295). The fuels have also been used by the Navy's Blue Angels aerial demonstration team. The Air Force likewise has successfully tested biofuels in F-22s and C-17s (*inform* 22:209, 279), and its demonstration team Thunderbirds have flown without incident using biofuels.

A halt to biofuel purchases would particularly affect the Navy, which has spent the past year planning to launch its Green Strike Group, including both ships and aircraft, in its participation in the multinational Rim of the Pacific maritime exercise in the third quarter of 2012. The Strike Group is an intermediate step in moving the Navy toward being a Great Green Fleet.

Subsequently, the US Senate Armed Services Committee also included language in its version of the NDAA to prohibit the use of DOD funds for alternative fuels that exceed the cost of fossil fuels.

The Advanced Biofuels Association, the Algal Biomass Organization, Airlines for America, the American Farm Bureau Federation, the Biotechnology Industry Organization, Growth Energy, and the Pew Charitable Trusts released the following joint statement on May 24 (http://tinyurl.com/groups-ask-reconsider):

"Continued reliance on foreign oil puts US national security at risk. Oil market volatility has already wreaked havoc on military budgets, which came at the cost of new equipment and training for our troops and reduced military readiness. In fiscal years 2011 and 2012, DOD came up $5.6 billion short in its budget for military operations and maintenance because it spent more on fuel than anticipated. Moreover, the United States sends $1 billion overseas each and every day to pay for foreign oil, further draining resources from the US economy.

"U.S. advanced biofuel producers have made rapid progress toward cost-competitiveness. The per-gallon cost of test quantities of advanced biofuels under DOD contracts has declined more than 90% over the past two years and will continue to decline as these technologies scale to commercial production. DOD's efforts to reduce use of foreign oil and increase use of American biofuels can lead the nation's effort to achieve energy security."

At press time, the NDAA had not yet been voted on by the full Senate.

Jatropha on hold in India

As head of the Ministry of Rural Development, Jairam Ramesh, minister of rural development for the Government of India has put on hold the jatropha plantation program for biofuel developed by the Planning Commission.

The Ministry's decision not to proceed is based on a 2010 government-sponsored study by The Energy Research Institute (TERI; New Delhi), which found planting of jatropha was not financially viable and also posed a threat to food security. Subject to favorable reports based on jatropha plantations already extent in the country, the Ministry had planned to undertake 300,000 hectares of jatropha on degraded forest land. However, the TERI report found that the energy harvested from jatropha grown on wastelands or unirrigated lands did not exceed that which had gone into planting and harvesting the crop.

The negative recommendation rendered by the TERI report has cast doubts on the proposed National Mission on Biofuels, which is aimed at promoting the crop as an alternative to fossil fuels. The Rural Development Ministry decided to declare a moratorium on proceeding and referred it to the Cabinet for further decision. Thus, provision for the demonstration phase of the project was eliminated from the 2012–2013 budget, according to the New Delhi *Daily Pioneer* newspaper (www.tinyurl.com/jatropha-India).

Effects of ethanol incorporation on US gasoline prices

The Center for Agricultural and Rural Development at Iowa State University (ISU; Ames, USA) released an update in May of an ongoing study of the impact of ethanol production on US and regional gasoline markets. The work is being carried out by Xiaodong Du and Dermot J. Hayes, the former with the University of Wisconsin-Madison and the latter with ISU.

Results from the period January 2000 to December 2011 showed that the growth in ethanol production and blending with gasoline to create E10 (10% ethanol plus 90% gasoline) reduced wholesale gasoline prices by \$0.29 per gallon on average across all regions, or a 17% reduction over what gasoline prices would have been without ethanol production. The Midwest region experienced the largest negative impact—\$0.45/gallon—while the West Coast, East Coast, and Gulf Coast regions experienced negative impacts of similar magnitudes, about \$0.20/gallon.

Based on the data of 2011 only, the marginal impacts on gasoline prices were much higher, given the increasing ethanol production and higher crude oil prices. The average effect across all regions increased to \$1.09/gallon, and the regional impact ranged from \$0.73/gallon in the Gulf Coast to \$1.69/gallon in the Midwest.

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Discussing the 2011 results, Du and Hayes wrote: "The surge in ethanol production in recent years has essentially added 10% to the volume of fuel available for gasoline-powered cars and in so doing it has allowed the US to switch from being a major importer of finished gasoline to a major exporter of both gasoline and ethanol. Countries that switch trade patterns in this way will see dramatic price impacts because internal prices switch from world prices *plus* transportation costs to world prices *minus* transportation costs."

The report is available at www.tinyurl.com/CARD-EtOH-pdf.

GM on the ballot in California

A group called California Right to Know presented petitions—containing 971,126 signatures—in early May to California (USA) state officials proposing that foods containing genetically modified (GM) ingredients should be labeled as such. Enough of those signatures have been validated that, as required by state law regarding voting referenda, the measure will go to voters on November 6, 2012, as "The Right to Know Genetically Engineered Food Act." If it passes, most processed foods containing GM ingredients would need to be labeled as such by 2014.

This issue has arisen before in California, but proposed laws never made it out of legislative committees. The current situation is different because voters, not politicians, will decide. If companies in California are made to change their labels, the implications are nationwide. California is not only the most populous state in the country, but also its leading agricultural state. Thus, companies would likely decide to change their labels throughout the United States, rather than maintain an expensive two-tier packaging and distribution system.

According to *The Guardian* (http://tinyurl.com/California-GM-label), biotech and food industries are gearing up to spent $60 million to $100 million on advertising to persuade state residents that labeling is unnecessary, hurts farmers, increases food prices, and contributes to world hunger.

If the referendum should pass, the food industry will doubtless challenge the state's right to mandate its own labeling requirements. This function is usually reserved for the Food and Drug Administration at the federal level.

According to the lobbying organization Stop the Co$tly Food Labeling Proposition (http://tinyurl.com/GM-labeling-California), "Beef, chicken, pork, eggs, and dairy like milk and cheese are exempt from the labeling requirements even though most animals are fed GE [genetically engineered] ingredients. Foods sold in restaurants are exempt even though the exact same foods sold in a grocery store would require labeling. The exact wording of the law is available (http://tinyurl.com/proposedCalif-law).

GMO detection method for field use

UK researchers at the Cardiff School of Biosciences, Cardiff University, and Lumora Ltd., Ely, Cambridgeshire recently announced the development of a new method, suitable for field use, to detect genetically modified organisms (GMO).

According to their paper (*BMC Biotechnol.* 12:15, doi: 10.1186/1472-6750-12-15), conventional molecular diagnostics using real-time polymerase chain reaction (RT-PCR) and fluorescence-based determination of amplification require temperature cycling and relatively complex optics.

In their method, though, isothermal amplification coupled to a bioluminescent output produced in real-time (BART) can be carried out at a constant temperature and only requires a simple light detection and integration device.

The researchers report that loop-mediated isothermal amplification (LAMP) and BART reactions can detect GM corn target DNA at low levels of contamination (0.1–5.0% GM) using certified reference material. The authors pointed out that conventional DNA extraction methods developed for PCR may not be optimal for LAMP-BART quantification.

The LAMP technology is more tolerant to plant sample-derived inhibitors, allowing the test to be used to develop rapid extraction techniques for simple field-based qualitative tests for GM status determination.

Food ingredients most prone to adulteration

The top seven food ingredients most prone to economically motivated adulteration are olive oil, milk, honey, saffron, orange juice, coffee, and apple juice.

This conclusion is based on research published in the *Journal of Food Science* (doi:10.1111/j.1750-3841.2012.02657.x, 2012) in which scientists collected information about adulteration from articles in scholarly journals and general media, organized the information into a database, and reviewed and analyzed the data to identify trends.

The database was created by the US Pharmacopeial Convention (USP; Rockville, Maryland), a nonprofit scientific organization that develops standards to help ensure the identity, quality and purity of food ingredients, dietary supplements, and pharmaceuticals. USP's food ingredient standards are published in the Food Chemicals Codex (FCC) compendium. The new database provides baseline information to assist interested parties in assessing the risks of specific products. It includes a total of 1,305 records for food fraud based on a total of 660 scholarly, media, and other publicly available reports. Records are divided by scholarly research (1,054 records) and media reports (251 records).

For more information, see tinyurl.com/USP-fraud.

Sheep, pigs genetically modified to produce healthful fat

Yutao Du, of the Beijing Genomics Institute (BGI) in Shenzhen, southern China, announced that a male sheep named Peng Peng, which was genetically modified (GM) to produce fat containing high levels of omega-3 fatty acids, was born at a laboratory in Xinjiang, western China, on March 26, 2012. The lamb weighed 5.74 kg at birth (http://tinyurl.com/sheep-omega3).

The process began in September 2009 when techniques were developed to transfer an omega-3 desaturase gene from *Caenorhabditis elegans*, a roundworm, into a donor cell taken from a Chinese Merino sheep. Procedures were then developed to implant an embryo containing the gene into the uterus of a surrogate ewe in October 2011.

At present there are no plans to commercialize the production of GM sheep for human food. Rather, the procedure seems to have been a proof of concept.

BGI scientists also cloned eight piglets containing genes needed for producing omega-3 fatty acids in 2010. According to the GlobalTimes.com (http://tinyurl.com/GMpigs), the pigs are still alive on a farm in Guangdong Province, and their tissues contain higher levels of omega-3 fatty acids than ordinary pigs.

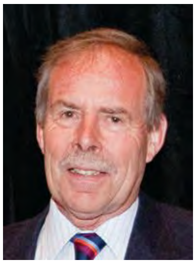
What's new with you?

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

People News/ Inside AOCS

Lipid Library has new co-editors-in-chief

The AOCS Lipid Library announced in March 2012 the appointment of **John Harwood** and **Randall Weselake** as co-editors-in-chief, succeeding the Lipid Library's founder, **William Christie**.



Harwood

Harwood is professor and deputy director of the School of Biosciences at Cardiff University, Wales. He was the 2011 recipient of the Supelco/Nicholas Pelick-AOCS Research Award and serves on the editorial board of several peer-reviewed journals. Harwood is also a member of the leadership team of the AOCS European Section and was elected as a Fellow of the Learned Society of Wales in 2011.

Weselake

Weselake is professor and Canada Research Chair in Agricultural Lipid Biotechnology at the University of Alberta. He is a member of the editorial board of The AOCS Lipid Library and serves as an associate editor for *Lipids*. Weselake is a former president of the Canadian Section of the American Oil Chemists' Society and was technical chairperson for the 2002 AOCS Annual Meeting & Expo.

Coupland elected to board of directors of IFT

John Coupland, professor of food science in the College of Agricultural Sciences of Penn State University (University Park, Pennsylvania, USA), has been elected to the Board of Directors of the Institute of Food Technologists. He will assume his position on September 1, 2012. Coupland teaches food chemistry and conducts research on emulsion science and fat crystallization.

In the announcement released by Penn State, Coupland said, "The single most important issue facing food science as a profession is a lack of faith in our work from the public. The sense that 'industrial food' is the source of many of our problems as a society is prevalent." He added, "This is a dangerous belief, because the need to produce more food from fewer resources is already critical in much of the developing world and soon will become pressing for all of us."

A man of many talents

Michael Eskin, a faculty member of the Department of Human Nutritional Sciences at the University of Manitoba (Winnipeg, Canada), is internationally known for his research in the areas of food carbohydrates, food enzymes, and canola oil. In 2011, he was co-editor of the AOCS Press publication *Canola: Chemistry, Production, Processing and Utilization*.

Eskin has been branching out into other fields, as well. In April 2012 he published a science fiction novel, entitled *Flight 684*, through Xlibris (www2.xlibris.com). The story revolves around a pilot/aeronautical specialist who becomes enmeshed in the results of the destabilization of a shift in the earth's orbit, resulting from nuclear tests and depletion of the planet's resources of oil and water. The playing-out of the near-apocalypse takes up the rest of the book.

Dumancas takes new position

Gerard G. Dumancas recently completed his Ph.D. in analytical chemistry at Oklahoma State University (Stillwater, USA) and has assumed a position as associate research scientist at Oklahoma Medical Research Foundation (Oklahoma City, USA). He will be working in the area of statistical genetics of lupus erythematosus, sarcoidosis, and Sjogren's syndrome. He will be applying partial least squares in mining for genotype and phenotype relations and gene mapping, principal component-based regression techniques for genetic association of risk-factor diseases, and genetic algorithms for the simultaneous mapping of multiple interacting quantitative trait loci.

Dumancas

Dumancas is presently a member of the AOCS USA section and of the Editorial Advisory Committee for *inform* magazine. As a graduate student, he was recognized by AOCS for the quality of his research, including the Analytical Division Student Award for Excellence in analytical chemistry research (2009, 2010), Honored Student Award (2010), and Hans Kaunitz Award for outstanding research, academics, and leadership involvement (2010).

Fellows of the IAFosT

The International Union of Food Science and Technology (IAFosT) has selected its eighth class of food scientists to be Fellows of the organization. They will be recognized at the 16th World Congress of Food Science and Technology in Iguassu Falls, Brazil, in August 2012. Among the 22 are three AOCS members: **Levente Diosady** (University of Toronto, Canada), **Richard Hartel** (University of Wisconsin-Madison, USA), and **Francis Xavier Malcata** (Instituto Superior da Maia, Avioso S. Pedro, Portugal).

Diosady

Hartel

"E" Star Award presented

The **French Oil Mill Machinery Co.** was awarded the Presidential "E" Star Award for Exports by US Department of Commerce Secretary John Bryson at the White House in Washington, DC, on May 17, 2012. US companies are nominated for the "E" Awards through the US Commercial Service office network. The primary criterion for the "E" Star Award is three years of successive export growth. Forty-one US companies and organizations received this award, which was initiated in 1961.

AOCS member **Daniel P. French**, chairman and president of the company, commented, "Over the past three years, export sales grew to 65% of our total sales, enabling us to hire over 35 additional employees. . . ."

The French Oil Mill Machinery Co. is a Silver Level corporate member of AOCS.

French employees Tayte French Lutz, Marketing Coordinator, and Dennis Bratton, Vice President-Finance & Treasurer, accept the "E" Star Award from U.S. Commerce Secretary John Bryson. Daniel P. French, President & Chairman, and Jason P. McDaniel, EVP & COO, could not attend the ceremony because they were both traveling abroad to promote additional export sales.

Shih and SRRC recognized

On June 12, 2012, **Edward B. Knipling**, administrator of the Agricultural Research Service (ARS) of the US Department of Agriculture, announced that the Southern Regional Research Center (SRRC) in New Orleans, Louisiana, had received a 2011 ARS Technology Transfer Award for outstanding work in transferring technology to the marketplace.

The award was presented for the development of Choice Batter®, a rice-based frying batter sold nationwide. Team members included ARS scientists **Kim Daigle** and AOCS member **Fred Shih** (retired), both with the center's Food Processing and Sensory Quality Research Unit, and outside partners **Wayne Swann, Ron Friedman, Roch Kallmyer, John Howell,** and **Ray Jones**, all of CrispTek, Columbia, Maryland.

IN MEMORIAM

Thomas H. Applewhite

Former AOCS President Thomas H. Applewhite died May 22, 2012, in Austin, Texas, USA. He was 87 years old. He joined AOCS in 1959 while working at the US Department of Agriculture's Western Regional Research Laboratory (now the Western Regional Research Center) in Albany, California.

Applewhite

Applewhite served as associate editor of the *Journal of the American Oil Chemists' Society* from 1968 to 1985 and as editor from 1986 to 1989. He also was chairperson for the first AOCS world conference, the World Conference on Oilseed and Vegetable Oil Processing, held in Amsterdam, Netherlands, in March 1976. The technical and commercial success of that conference greatly enhanced the international reputation of AOCS and led to expansion of the organization's international activities.

In 1990, Applewhite became the founding editor for *INFORM* (International News on Fats, Oils and Related Materials) when AOCS introduced that monthly publication, guiding its development during its first four years. He also edited the proceedings for five AOCS world conferences held from 1988 through 1994.

Applewhite was elected to the AOCS Governing Board as a member-at-large in 1975, served as vice-president in 1976–1977, and president in 1977–1978. His tenure on the Board continued until 1982. He also served as general chairperson for the 1969 AOCS meeting in San Francisco, California, as well as an officer in the former geographic sections in the United States.

In 1982, Applewhite received the Alton E. Bailey Award for service for his distinguished work as a researcher and his service to AOCS and to the fats and oils industry. In 1991, he received the A. Richard Baldwin Distinguished Service award, presented for continued distinguished service to AOCS in positions of high responsibility. He was elected an honorary member of AOCS in 1994, later becoming a distinguished Fellow in 1998 when AOCS created that membership category.

Thomas Hood Applewhite was born December 30, 1924, in the family tent near Imperial, California, USA, according to an obituary that appeared the *Austin American-Statesman* newspaper. Survivors include his daughter Pam, his son Ted, two grandchildren, and three great-grandchildren. His wife Harriet died in 2009. They had been married for 63 years.

Professional life. Applewhite served in the US Navy from 1942 to 1945. He did undergraduate work at Pasadena City College, and he received from the California Institute of Technology (Pasadena, USA) both his BS in chemistry (1953) and his Ph.D. in organic chemistry and plant physiology (1957) under the direction of Carl Niemann and James Bonner.

His first position out of graduate school was as a research chemist at the Western Division of the Dow Chemical Co. (1957–1959). Then he moved to become a research chemist and head of a laboratory at the Western Regional Research Laboratory. His work there resulted in several patents. In 1967, he took a position as research director and manager with the Pacific Vegetable Oil Corp. (Richmond, California).

In 1969, Applewhite moved to Kraft, Inc. (Glenview, Illinois, USA) as the manager of the Edible Oil Products Laboratory. He remained with Kraft, assuming increasing responsibilities, until his retirement in 1986. During his tenure with Kraft, he provided leadership in the development of Parkay margarines and reduced-calorie mayonnaise as well as pourable dressings. He served as Kraft's representative on the Technical Committee of the National Association of Margarine Manufacturers (NAMM), chaired that group, and received its Service Award in 1980. Applewhite also was a member of the Technical Committee of the Institute of Shortening and Edible Oils, a US trade group of refiners of edible fats and oils.

After retiring from Kraft, Applewhite started a consulting career that continued until he retired in 2001.

George Willhite, who joined the AOCS staff in 1976 and worked under Applewhite's direction as staff editor of *INFORM* from 1990 to 1993, remarked, "Dr. Applewhite's technical knowledge of all aspects of fats, oils and related materials, as well as his savvy for the commercial side, were invaluable to INFORM during those early years."

Harry E. Snyder

Retired researcher and educator Harry Snyder died on February 21, 2012, in Longview, Texas, USA, at the age of 82 years. He is survived by his wife, Elizabeth; daughter, Janice; sons Daniel and Edward; and two grandchildren.

Snyder received his A.B. from the University of California-Berkeley (Cal-Berkeley; USA) in 1951, then served in the US Navy for four years as the chief gunnery officer aboard the Cruiser USS Los Angeles. He completed his Ph.D. at Cal-Berkeley in 1959.

He was hired by what was then the Departments of Food Science and of Biochemistry at Iowa State University (Ames, USA), where he worked in the areas of fermentation, myoglobin, and soybeans.

Snyder left Iowa State in 1979, the same year he joined AOCS, for a position in the Department of Food Science with the University of Arkansas-Fayetteville. He continued his work on soybeans, and is especially remembered there for his contributions in the development of 1992 US patent No. 5,085,808, a process for efficiently extracting high quality oil from soybeans and other oil-bearing seeds. He retired from the University of Arkansas in 1992.

Among Snyder's publications were 23 papers in the *Journal of the American Oil Chemists' Society* (*JAOCS*), and a well-cited text, *Soybean Utilization*, which he wrote with T.W. Kwon. It was published in 1987 by Van Nostrand Reinhold Co.

JAOCS Senior Associate Editor Andrew Proctor, who received his Ph.D. under the direction of Snyder, remembers him as "a thoughtful and thorough researcher and outstanding teacher and mentor." Proctor added, "He was . . . generally regarded as the best teacher in the department, by far, by graduate students during my years in graduate education."

Both Iowa State and the University of Arkansas awarded Snyder the title of professor emeritus.

Hai Ching Ong

Hai Ching Ong died on September 29, 2011, at the age of 57 in Port Klang, Malaysia. He is survived by his wife and family.

Ong was technical laboratory manager for SGS Laboratory Services (M) Sdn. Bhd., a testing laboratory accredited by the Malaysian government in the field of chemistry. As well as being an AOCS member, Ong was a member of the Malaysian Oil Scientists' and Technologists' Association (MOSTA), and at the time of his death was a council member of MOSTA.

Extracts & Distillates

Production of human milk fat analogue containing docosahexaenoic and arachidonic acids

Turan, D., *et al., J. Agric. Food Chem. 60*:4402–4407, 2012.

Human milk fat (HMF) analogue containing docosahexaenoic acid (DHA) and arachidonic acid (ARA) at *sn*-1,3 positions and palmitic acid (PA) at *sn*-2 position was produced. Novozym 435 lipase was used to produce palmitic acid-enriched hazelnut oil (EHO). EHO was then used to produce the final structured lipid (SL) through interesterification reactions using Lipozyme RM IM. Reaction variables for 3 h reactions were temperature, substrate mole ratio, and ARASCO/DHASCO (A/D) ratio. After statistical analysis of DHA, ARA, total PA, and PA content at *sn*-2 position, a large-scale production was performed at 60°C, 3:2 A/D ratio, and 1:0.1 substrate mole ratio. For the SL, those results were determined as 57.3 ± 0.4%, 2.7 ± 0.0%, 2.4 ± 0.1%, and 66.1 ± 2.2%, respectively. Tocopherol contents were 84, 19, 85, and 23 μg/g oil for α-, β-, γ-, and δ-tocopherol. Melting range of SL was narrower than that of EHO. Oxidative stability index (OSI) value of SL (0.80 h) was similar to that of EHO (0.88 h). This SL can be used in infant formulas to provide the benefits of ARA and DHA.

Profile of *trans* fatty acids (FAs) including *trans* polyunsaturated FAs in representative fast food samples

Tyburczy, C., *et al., J. Agric. Food Chem. 60*:4567–4577, 2012.

The content of *trans* fat in foods is most commonly determined by summing the levels of individual *trans* fatty acids (FAs), analyzed as FA methyl esters (FAME) by gas chromatography. Current Official Methods of the American Oil Chemists' Society (AOCS) enable quantification of total *trans* fat in foods but were not designed for the determination of *trans* FA isomeric compositions. In the present study, the content of *trans* fat in 32 representative fast food samples ranged from 0.1 to 3.1 g per serving, as determined according to AOCS Official Method Ce 1j-07. Further analysis of FAME using the 200 m SLB-IL111 ionic liquid column yielded quantitative results of total, *trans*, saturated, and *cis* unsaturated fat that were comparable to those of Method Ce 1j-07 and also allowed for the complementary determination of individual *trans* 18:1, *trans* 18:2, and *trans* 18:3 FA isomeric compositions under conditions suitable for routine sample analysis.

Plant sterols and antioxidant parameters in enriched beverages: storage stability

González-Larena, M., *et al., J. Agric. Food Chem. 60*:4725–4734, 2012.

Plant sterols (PS) stability, antioxidant parameters, and color were studied during six months of storage at 4, 24, and 37°C in three PS-enriched functional beverages. Beverages were skimmed milk with fruit juice and PS (MFJPS), fruit juice and PS (FJPS), and skimmed milk with PS (MPS). No loss in total PS content occurred during storage, observing the same values at any given storage time point. Total carotenoids decreased 36% with storage at two months and then remained stable. Total polyphenols showed fluctuations throughout the storage, remaining stable at six months and reaching initial values. The antioxidant capacity (TEAC [Trolox equivalent antioxidant activity] method) increased 18% at six months, and there was an increase in color over time and temperature, probably owing to Maillard reaction compound formation. The increase in total antioxidant capacity might have helped PS maintenance throughout storage, these beverages being a good PS source even after six months of storage.

Accelerated solvent extraction of alkylresorcinols in food products containing uncooked and cooked wheat

Holt, M.D., *et al., J. Agric. Food Chem. 60*:4799–4802, 2012.

This research focuses on the overall extraction process of alkylresorcinols (AR) from uncooked grains and baked products that have been processed with wheat, corn, rice, and white flour. Previously established extraction methods developed by Ross and colleagues, as well as a semi-automated method involving accelerated solvent extraction (ASE), were applied to extract AR within freshly ground samples. For extraction of AR, nonpolar solvents such as ethyl acetate have been recommended for the extraction of uncooked foods, and polar solvents such as 1-propanol/water (3:1 vol/vol) have been recommended for the extraction of baked foods that contain rye, wheat, or other starch-rich grains. A comparison of AR extraction methods has been investigated with the application of gas chromatography and a flame ionization detector (GC-FID) to quantify the AR content. The goal of this research was to compare the rapid ASE of AR (ASE-AR) method to the previous manual AR extraction methods. Results for this study as well as the investigation of the overall efficiency of ASE-AR extraction with the use of a spiking study indicated that it can be comparable to current extraction methods but with less time required. Furthermore, the extraction time for ASE (approximately 40 min) is much more convenient and less tedious and time-consuming than previously established methods, which range from 5 h for processed foods to 24 h for raw grains.

Supplementation of laying-hen feed with palm tocos and algae astaxanthin for egg yolk nutrient enrichment

Walker, L.A., *et al., J. Agric. Food Chem. 60*:1989–1999, 2012.

Adding supplements to hen feed can increase egg nutritional value. Astaxanthin, tocotrienols, and tocopherols are potent antioxidants that provide health benefits to humans. We hypothesized that the addition of these nutrients to hen feed would result in an increased nutrient content in egg yolk with minimum changes in functional properties. Laying hens (Hy-Line W-36 breed) were fed four diets with different supplementation levels of palm toco concentrate and algae biomass containing astaxanthin for eight weeks. Egg yolks were analyzed for physical, chemical, and functional properties. The feed with the highest nutrient concentration was also studied for stability of these antioxidants using the Arrhenius approach. No significant differences were observed in functional properties except for emulsification capacity and sensory characteristics among eggs from different diet treatments. Changes in egg yolk color reached the maximum values at day 8. Incorporation of tocopherols and tocotrienols increased until day 8, astaxanthin incorporation increased until day 10, and all

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AOCS Journals

Journal of the American Oil Chemists' Society (June)

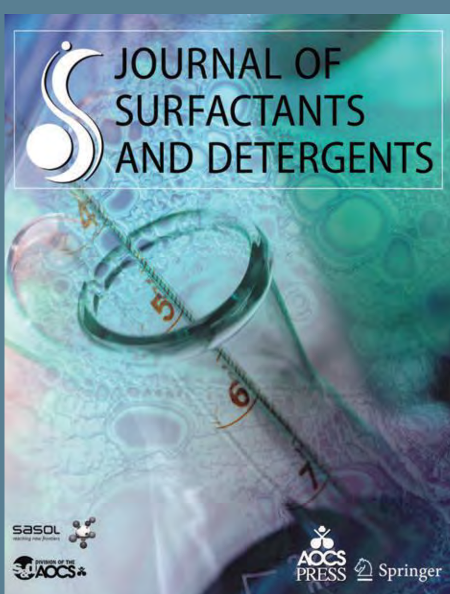
- Potential of *Jatropha curcas* as a biofuel, animal feed and health products, Nithiyanantham, S., P. Siddhuraju, and G. Francis
- Determination of unsaponifiable constituents of deodorizer distillates by GC–MS, Naz, S., S.T.H. Sherazi, F.N. Talpur, M.Y. Talpur, and H. Kara
- Determination of CLA *trans,trans* positional isomerism in CLA-rich soy oil by GC–MS and silver ion HPLC, Shah, U., A. Proctor, J.O. Lay Jr., and K. Moon
- Evidence contrary to the accepted Diels–Alder mechanism in the thermal modification of vegetable oil, Arca, M., B.K. Sharma, N.P.J. Price, J.M. Perez, and K.M. Doll
- Discriminant analysis of sunflower seeds for fatty acid composition using NIR spectroscopy, Grunvald, A.K., C.G.P. de Carvalho, R.S. Leite, J.M.G. Mandarino, J.L. Gonçalves, *et al.*
- FTIR spectroscopy and chemometric class modeling techniques for authentication of Chinese sesame oil, Deng, D.-H., L. Xu, Z.-H. Ye, H.-F. Cui, C.-B. Cai, *et al.*
- HPLC analysis of seed sesamin and sesamolin variation in a sesame germplasm collection in China, Wang, L., Y. Zhang, P. Li, X. Wang, W. Zhang, *et al.*
- Characterization of the composition of *Caesalpinia bonducella* seed grown in temperate regions of Pakistan, Sultana, R., R. Saleem, N. Sultana, F. Afshan, and T. Gulzar
- Sophorolipid production by *Starmerella bombicola* (ATCC 22214) from virgin and waste frying oils, and the effects of activated earth treatment of the waste oils, Wadekar, S., S. Kale, A. Lali, D. Bhowmick, and A. Pratap
- Lipase induction in *Yarrowia lipolytica* for castor oil hydrolysis and its effect on γ-decalactone production, Braga, A., N. Gomes, and I. Belo
- Ionic liquid-assisted solubilization for improved enzymatic esterification of phenolic acids, Yang, Z., Z. Guo, and X. Xu
- Enzymatic production of monoacylglycerols (MAG) and diacylglycerols (DAG) from fish oil in a solvent-free system, Feltes, M.M.C., P. Villeneuve, B. Baréa, N. Barouh, J.V. de Oliveira, *et al.*
- Structural effect of lignans and sesamol on polymerization of soybean oil at frying temperature, Hwang, H.-S., J.K. Winkler-Moser, and S.X. Liu
- Oxidative stability of chia (*Salvia hispanica* L.) seed oil: effect of antioxidants and storage conditions, Ixtaina, V.Y., S.M. Nolasco, and M.C. Tomás
- Elastohydrodynamic study of blends of bio-based esters with polyalphaolefin in the low film thickness regime, Bantchev, G.B., G. Biresaw, and S.C. Cermak
- Waste rapeseed oil used as a binder for masonry units: NMR spectroscopic analysis, Heaton, T., J. Fisher, and J.P. Forth
- Rh-based biphasic isomerization of carbon–carbon double bonds in natural oils, Quirino, R.L., and R.C. Larock
- Aminolysis reaction of glycerol carbonate in organic and hydroorganic medium, Nohra, B., L. Candy, J.-F. Blanco, Y. Raoul, and Z. Mouloungui
- Time fractionation of minor lipids from cold-pressed rapeseed cake using supercritical CO_2, Uquiche, E., X. Fica, K. Salazar, and J.M. del Valle
- Aqueous extraction of oil and protein from soybeans with subcritical water, Ndlela, S.C., J.M.L.N. de Moura, N.K. Olson, and L.A. Johnson
- Purification of L-α-glycerylphosphorylcholine from the enzyme reaction solutions by resin column chromatography, Zhang, K., X. Wang, and Y. Liu

Lipids (June)

- Low docosahexaenoic acid content in plasma phospholipids is associated with increased non-alcoholic fatty liver disease in China, Zheng, J.-S., A. Xu, T. Huang, X. Yu, and D. Li
- Exogenous arachidonate restores the dimethoate-induced inhibition of steroidogenesis in rat interstitial cells, Astiz, M., G.H. de Catalfo, M.J.T. de Alaniz, and C.A. Marra
- Chylomicron formation and secretion is required for lipid-stimulated release of incretins GLP-1 and GIP, Lu, W.J., Q. Yang, L. Yang, D. Lee, D.'Alessio, *et al.*
- Beta-glucosylceramide administration (i.p.) activates natural killer T cells *in vivo* and prevents tumor metastasis in mice, Inafuku, M., C. Li, Y. Kanda, T. Kawamura, K. Takeda, *et al.*
- Three new fatty acid esters from the mushroom *Boletus pseudocalopus*, Kim, K.H., S.U. Choi, and K.R. Lee
- A novel fatty acid, 12,17-dimethyloctadecanoic acid, from the extremophile *Thermogemmatispora* sp. (strain T81), Vys-

sotski, M., J. Ryan, K. Lagutin, H. Wong, X. Morgan, *et al*.

- The composition of the cuticular and internal free fatty acids and alcohols from *Lucilia sericata* males and females, Gołębiowski, M., M.I. Boguś, M. Paszkiewicz, W. Wieloch, E. Włóka, *et al*.
- Lipid class and fatty acid content of the leptocephalus larva of tropical eels, Deibel, D., C.C. Parrish, P. Grønkjær, P. Munk, and T.G. Nielsen
- Proximate and fatty acid composition of some commercially important fish species from the Sinop region of the Black Sea, Kocatepe, D., and H. Turan
- Oral supplementation with dihomo-γ-linolenic acid (DGLA)-enriched oil increases serum DGLA content in healthy adults, Tanaka, T., S. Kakutani, C. Horikawa, H. Kawashima, and Y. Kiso



Journal of Surfactants and Detergents (July)

- Application of oxidized cornstarch as a nonphosphoric detergent builder, Sheng, Y., X. Xu, W. Jiang, Y. Song, S. Gan, and H. Zou
- A search for ecofriendly detergent/dispersant additives for vegetable-oil-based lubricants, Singh, A.K., and R.K. Singh
- Synthesis and characterization of anionic polymeric surfactants based on sulfonated styrene, El Menam Eissa, A., M. El Hefnawy, S. Bader, M. Radwan, and M. Deef Allah
- Surface activities, foam properties, HLB, and Krafft point of some *n*-alkanesulfonates (C14–C18) with different isomeric distributions, Fekarcha, L., and A. Tazerouti
- Environmentally friendly nonionic surfactants derived from tannic acid: synthesis, characterization and surface activity, Negm, N.A., A.F.M. El Farargy, D.E. Mohammed, and H.N. Mohamad
- Synthesis and properties of sodium monoalkylamide phthalate surfactants, Han, F., B. Xu, Z. Qu, Y. Zhou, and G. Zhang
- Synthesis and properties of x-type alkyl sulfonate Gemini surfactants derived from cyanuric chloride, Li, P., Q. Chen, J. Zhao, H. Wang, C. Li, Z. Hu, and D. Cao
- Synthesis and physicochemical investigation of novel quaternary ammonium salt cationic gemini surfactant derived from cyanuric chloride, Wang, H., T. Zhang, Z. Hu, C. Xue, and D. Cao
- Synthesis, surface-active properties, and anthelmintic activities of new cationic gemini surfactants against the gastrointestinal nematode, *Heligmosomoides polygyrus bakeri*, in vitro, Sánchez, V.G., C.J. Giudici, A.R. Bassi, and M.C. Murguía
- Application of the Taguchi method in analyzing the impact of modified gemini surfactants on TiO_2 nano-suspension, Kuo, C.-F.J., and M.-Y. Dong
- Experimental and QSPR studies on the eff ct of ionic surfactants on *n*-decane–water interfacial tension, Fallah Fini, M., S. Riahi, and A. Bahramian
- Water solubilization using nonionic surfactants from renewable sources in microemulsion systems, Szumała, P., and H. Szeląg
- The HLD-NAC model for extended surfactant microemulsions, Acosta, E.J., S.K. Kiran, and C.E. Hammond
- Characterization of water/sucrose laurate/*n*-propanol/allylbenzene microemulsions, Fanun, M., Z. Ayad, S. Mudalal, S. Dahoah, D. Meltzer, *et al.*
- The adsorption layer in the system: carboxymethylcellulose/surfactants/NaCl/MnO_2, Grządka, E.

And the winner is...

Bill Morphew, a project engineer for Crown Iron Works, Co., in Minneapolis, Minnesota, USA, won *inform* magazine's crossword puzzle drawing, which could be entered only by visiting the digital edition of the May 2012 issue featuring chocolate science. As the winner, Morphew received a gift of Belgian chocolates and Volume 6 of the AOCS Monograph Series on Oilseeds: *Cocoa Butter and Related Compounds*, edited by Nissim Garti and Neil R. Widlak, 2012.

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decreased thereafter. Feed nutrients resulted in a dose–response relationship of these compounds in the egg yolk. The transfer efficiency ranged from 0 to 9.9% for tocotrienols and tocopherols and from 7.6 to 14.9% for astaxanthin at their peak values. Results of the Arrhenius accelerated stability study showed significant differences in the shelf life of various nutrients, and these results can be used to properly formulate and store the feed materials.

Fish oil sensory properties can be predicted using key oxidative volatiles

Sullivan, J.C., and S.M. Budge, *Eur. J. Lipid Sci. Technol. 114*:496–503,2012.

The high level of polyunsaturated fatty acids in fish oil, primarily eicosapentaenoic acid and docosahexaenoic acid, results in rapid oxidation of the oil. Current methods used to assess oxidation have little correlation with sensory properties of fish oils. Here we describe an alternative method using solid-phase microextraction combined with gas chromatography-mass spectrometry to monitor volatile oxidation products. Stepwise discriminant function analysis was used to classify oils characterized as acceptable or unacceptable based on sensory analysis; a cross-validated success rate of 100% was achieved with the function. The classification function was also successfully validated with tasted samples that were not used to create the method. A total of 14 variables, primarily aldehydes and ketones, were identified as significant discriminators in the classification function. This method will be useful as a quality control method for fish oil manufacturers.

Engineering flax plants to increase their antioxidant capacity and improve oil composition and stability

Zuk, M, *et al.*, *J. Agric. Food Chem. 60*: 5003–5012, 2012.

The composition of polyunsaturated fatty acids in the tissues is very important to human health and strongly depends on dietary intake. Since flax seeds are the richest source of polyunsaturated acids, their consumption might be beneficial for human health. Unfortunately, they are highly susceptible to auto-oxidation, which generates toxic derivatives. The main goal of this study was the generation of genetically modified flax plants with increased antioxidant potential and stable and healthy oil production. Since among phenylpropanoid compounds those belonging to the flavonoid route have the lowest antioxidant capacity, the approach was to inhibit this route of the pathway, which might result in accumulation of other compounds more effective in antioxidation. The suppression of the chalcone synthase gene resulted in hydrolyzable tannin accumulation and thus increased antioxidant status of seeds of the transgenic plant. This was due to the partial redirecting of substrates for flavonoid biosynthesis to the other routes of the phenylpropanoid pathway. Consequently, transgenic plants produced more (20–45%) polyunsaturated fatty acids than the control and mainly α-linolenic acid. Thus, increasing the antioxidant potential of flax plants has benefits in terms of the yield of suitable oil for human dietary consumption.

Simultaneous quantification of serum phytosterols and cholesterol precursors using a simple gas chromatographic method

García-Llatas, G., *et al., Eur. J. Lipid Sci. Technol. 114*:520–526, 2012.

Determination of the main phytosterols (Ps, β-sitosterol and campesterol) and cholesterol precursors (desmosterol and lathosterol) in human serum using a simple gas chromatography (GC)–flame ionization detection method has been validated. Direct saponification, without lipid extraction, sterols extraction, and further derivatization was applied to samples prior to GC analysis. To evaluate the method, a pool of serum samples from eight healthy women was used. Good linearity ($r > 0.99$) was found in the assay range: β-sitosterol (0.99–17.82 µg/mL), campesterol (0.14–10.8 µg/mL), desmosterol (0.17–2.6 µg/mL), and lathosterol (0.6–5.97 µg/mL). Limits of detection (ng/mL) were: 86 (β-sitosterol), 42 (campesterol), 4 (desmosterol), and 44 (lathosterol). Accuracy, estimated by recovery assays (%), were: 113 (β-sitosterol), 114 (campesterol), 111 (desmosterol), and 102 (lathosterol). Within and between precision values (%), expressed as the relative standard deviation, were: 2.6 and 8.1 (β-sitosterol), 1.6 and 7.2 (campesterol), 2.1 and 7.9 (desmosterol), and 4.1 and 5.8 (lathosterol), respectively. The developed methodology allowed fast (1-day analysis) and reliable quantification of sterols in serum, required a small volume of sample and reduced use of solvents. It therefore could be used in clinical assays for the determination of serum sterols, as in evaluating the pharmacological response to lipid-lowering agents, and in assessing biological responses to Ps-enriched diets.

Wax, policosanol, and long-chain aldehydes of different sugarcane (*Saccharum officinarum* L.) cultivars

Asikin, Y., *et al., Eur. J. Lipid Sci. Technol. 114*:83–591, 2012.

Sugarcane (*Saccharum officinarum* L.) wax that contains policosanol (a mixture of long-chain alcohols) is widely known to have beneficial effects on human health. In order to investigate differences in the composition and content of sugarcane wax in different sugarcane cultivars, the wax, policosanol, and long-chain aldehyde composition of eight sugarcane cultivars were examined. The wax composition of sugarcane was analyzed using high-performance liquid chromatography coupled with an evaporative light-scattering detector (ELSD). Sugarcane waxes were comprised of 55–60% aldehyde and sterol esters, 32–40% alcohol, and small amounts of TAG, acid, and plant sterols. Additionally, the composition of policosanol and long-chain aldehydes was determined using gas chromatography (GC)-flame ionization detection and their mass fragment compounds were identified using GC-mass spectrometry. The highest content of policosanol and long-chain aldehyde compounds (500 mg and 600 mg/100 g rind, respectively) was found in the hand-peeled rind of the Ni 22 sugarcane cultivar. The content of these compounds increased up to 72% during sugarcane maturation from October to January. This study indicated that the composition and content of

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wax, policosanol, and long-chain aldehydes may vary depending on the cultivar of the sugarcane and the specific part of the sugarcane analyzed, as well as on the degree of sugarcane maturity.

Simultaneous analysis of free phytosterols/phytostanols and intact phytosteryl/phytostanyl fatty acid and phenolic acid esters in cereals

Esche, R., *et al.*, *J. Agric. Food Chem.* *60*:5330–5339, 2012.

An approach based on solid-phase extraction for the effective separation of free phytosterols/phytostanols and phytosteryl/phytostanyl fatty acid and phenolic acid esters from cereal lipids was developed. The ester conjugates were analyzed in their intact form by means of capillary gas chromatography. Besides free sterols and stanols, up to 33 different fatty acid and phenolic acid esters were identified in four different cereal grains via gas chromatography–mass spectrometry. The majority (52–57%) of the sterols and stanols were present as fatty acid esters. The highest levels of all three sterol and stanol classes based on dry matter of ground kernels were determined in corn, whereas the oil extract of rye was 1.7 and 1.6 times richer in fatty acid esters and free sterols/stanols than the corn oil. The results showed that there are considerable differences in the sterols/stanols and their ester profiles and contents obtained from corn compared to rye, wheat, and spelt. The proposed method is useful for the quantification of a wide range of free phytosterols/phytostanols and intact phytosteryl/phytostanyl esters to characterize different types of grain.

Lipid, lipoprotein and apolipoprotein profiles in European adolescents and its associations with gender, biological maturity and body fat—The HELENA Study

Spinneker, A., *et al.*, *Eur. J. Clin. Nutr.* *66*:727–735, 2012.

The study provides a detailed lipid profile of a European adolescent population considering age, gender, biological maturity, body mass index (BMI), fat mass (FM), and percentage body fat (BF). Within Healthy Lifestyle in Europe by Nutrition in Adolescence (HELENA), a cross-sectional study was conducted to determine fasting serum concentrations of lipids, lipoproteins, and apolipoproteins in 1,076 adolescents aged 12.5–17.49 years from 10 European centres. All serum lipid concentrations were significantly higher in girls than in boys. In boys, age was negatively correlated with high-density lipoprotein (HDL)-cholesterol and total cholesterol (TC), and positively associated with triacylglycerides (TAG) ($P < 0.01$) whereas no significant associations were observed in girls. Biological maturity was negatively associated with TC, HDL-, low-density lipoprotein (LDL)-, and non-HDL cholesterol in boys (all $P < 0.05$) and negatively correlated with HDL-cholesterol in girls ($P < 0.05$). BMI, FM, and BF were significantly correlated with HDL-cholesterol, LDL-cholesterol, non-HDL cholesterol, apolipoprotein (apo) A1, apoB, and TAG in both boys and girls. The lipid profile in adolescents is strongly determined by gender. Biological maturity, FM, and percentage BF contribute to the variance in lipid concentrations and should be considered in future evaluations of lipid status. ■

Patents

Published Patents

Delivery of active agents using a chocolate vehicle

Lang, K.W., Delavau LLC, US8105640, January 31, 2012

This invention provides edible compositions comprising pharmaceutically or nutraceutically active agents in particulate form homogeneously dispersed in a fat matrix, such as chocolate or chocolate compound coating.

Method for producing peroxycarboxylic acid

DiCosimo, R., *et al.*, E.I. DuPont de Nemours Co., US8105810, January 31, 2012

Disclosed herein are two-component enzymatic peracid generation systems and methods of using such systems wherein the first component comprises a formulation of at least one enzyme catalyst having perhydrolysis activity, a carboxylic acid ester substrate, and a cosolvent and wherein the second component comprises a source of peroxygen in water. The two components are combined to produce an aqueous peracid formulation useful as, e.g., a disinfecting or bleaching agent. Specifically, organic cosolvents are used to control the viscosity of a substrate-containing component and to enhance the solubility of the substrate in an aqueous reaction formulation without causing substantial loss of perhydrolytic activity of the enzyme catalyst.

Lipase powder, methods for producing the same and use thereof

Suzuki, J., *et al.*, Nisshin OilliO Group, Ltd., US8110386, February 7, 2012

A lipase powder which is a granulated substance containing a lipase and a solid content of animal milk, a lipase composition wherein said lipase powder is immersed or impregna ted in fatty oil, and a method for producing the lipase powder which comprises the step of adding animal milk or cream derived from the animal milk to an aqueous solution containing a lipase, and the step of spray-drying, freeze-drying, or solvent-precipitating the mixture thereof are provided. According to the present invention, a lipase powder of which lipase activity and stability are improved can be provided.

Bile acid or bile salt fatty acid conjugates

Gilat, T., Galmet International Ltd., US8110564, February 7, 2012

The present invention relates to the use of a bile acid or bile salt fatty acid conjugate of general formula II W--X-G in which G is a bile acid or bile salt radical, which, if desired, is conjugated in position 24 with a suitable amino acid, W stands for one or two fatty acid radicals having 14–22 carbon atoms, and X stands for a suitable bonding member or for a direct C=C bond between said bile acid or bile salt radical and the fatty acid(s) or of a pharmaceutical composition comprising same for the reduction of cholesterol in blood, for the treatment of fatty liver, hyperglycemia, and diabetes.

Degradable diverting agents and associated methods

Luo, H., and D.D. Fulton, Halliburton Energy Services, Inc., US8109335, February 7, 2012

Methods and compositions that include a method comprising: providing a treatment fluid comprising at least a plurality of degradable diverting agents that comprise at least one degradable material selected from the group consisting of a fatty alcohol, a fatty acid salt, a fatty ester, a proteinaceous material, and a combination thereof; and introducing the treatment fluid into a subterranean formation during a subterranean operation via a well bore.

Process for continuous preparation of high molecular weight polyesters by esterification of dicarboxylic acids and/or transesterification of dicarboxylic acids with diols and/or mixtures thereof and an apparatus therefor

Schulz van Ednert, E., Uhde Inventa-Fischer GmbH, US8110149, February 7, 2012

The present invention relates to a method for the continuous production of high-molecular polyesters by esterification of dicarboxylic acids and/or transesterification of dicarboxylic acid esters with diols and/or mixtures thereof in the presence of catalysts with formation of a prepolymer in a tower reactor and polycondensation thereof to form a high-molecular polyester in a polycondensation reactor, a prepolymer with >40 to 70 repeat units (DP) being produced in the tower reactor and this prepolymer being polycondensed in only one further reactor to form a polyester with >150 to 205 DP.

Methods for making molding resins

Nava, H., and L. Chen, Reichold, Inc., US8110650, February 7, 2012

Methods of making unsaturated polyester compositions are provided and include reacting: (i) plant and animal oil triglycerides, an alkyl ester of a saturated or unsaturated fatty acid or mixtures thereof; (ii) a difunctional or polyfunctional glycol or mixtures thereof; (iii) a difunctional or polyfunctional acid, their anhydrides or alkyl esters and mixtures thereof; (iv) a strained cycloolefin; (v) a component(s) that function as a compound capable of initiating polymerization at high temperature and which is stable at room temperature; and (vi) low-profile additives, fillers, and reinforcements.

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.

CALL FOR NO

A. Richard Baldwin Distinguished Service

This is the Society's highest service award. It recognizes long-term, distinguished service to AOCS in positions of significant responsibility.

Nature of the Award: $2,000, a travel-and-expense allowance, and a plaque provided by Cargill.

Deadline: November 1

AOCS Award of Merit

This award recognizes productive service to AOCS: leadership in committee activities; service that has advanced the Society's prestige, standing, or interests; and service not otherwise specifically recognized.

Nature of the Award: A plaque.

Deadline: November 1

AOCS Fellow

The status of Fellow is awarded to members of AOCS whose achievements in science entitle them to exceptionally important recognition or to those who have rendered unusually important service to the Society or to the profession.

Nature of the Award: Fellow membership status and a plaque.

Deadline: December 1

CALL FOR NOMINATIONS

Each award has its own specific and unique nomination requirements. For award consideration, it is essential that all paperwork be complete and received at AOCS by the nomination deadline. Self-nominations are welcomed and encouraged. Please refer to the website for the nomination requirements and submission deadlines.

ELECTRONIC SUBMISSIONS ONLY!

AOCS is accepting nomination material only by electronic communication. Window based programs (WORD) and PDF material emailed to AOCS must include the award name and candidate name in the email subject line.

Supelco/Nicholas Pelick-AOCS Research

This award recognizes outstanding original research of fats, oils, lipid chemistry, or biochemistry. The recipient must have published the research results in high-quality technical papers regarding fats, oils, lipid chemistry, or biochemistry.

Nature of the Award: $10,000, a travel-and-expense allowance, and a plaque. The award is sponsored by Supelco, a subsidiary of Sigma Aldrich Corp, and Nicholas Pelick, past president of AOCS.

Deadline: November 1

Stephen S. Chang

This award recognizes a scientist, technologist, or engineer whose distinguished accomplishments in basic research have been used by industries for the improvement or development of products related to lipids.

Nature of the Award: A cash prize and a jade horse, provided by the Stephen and Lucy Chang endowed fund.

Deadline: October 15

AOCS Young Scientist Research

This award recognizes a young scientist who has made a significant and substantial research contribution in one of the areas represented by the Divisions of AOCS.

Nature of the Award: $1,000, a plaque, and a travel-and-expense allowance provided by the International Food Science Center A/S.

Deadline: November 1

Corporate Achievement

This award recognizes industry achievement for an outstanding process, product, or contribution that has made the greatest impact on its industry segment.

Nature of the Award: A plaque.

Deadline: November 1

ACI/NBB Glycerine Innovation

The Industrial Oil Products Division initiated this award to recognize outstanding achievement for research in new applications for glycerine with particular emphasis on commercial viability.

Nature of the Award: $5,000 and a plaque provided by the American Cleaning Institute and the National Biodiesel Board.

Deadline: November 1

Samuel Rosen Memorial

Milton Rosen and the Surfactants and Detergents Division initiated this award to recognize a surfactant chemist for significant advancement or application of surfactant chemistry principles.

Nature of the Award: $2,000 and a plaque.

Deadline: November 1

Herbert J. Dutton

The Analytical Division initiated this award to recognize an individual who has made significant contributions to the analysis of fats and oils and related products or whose work has resulted in major advances in the understanding of processes utilized in the fats and oils industry.

Nature of the Award: $1,000 and a plaque.

Deadline: November 1

Timothy L. Mounts

The Edible Applications Technology Division initiated this award to recognize research relating to the science and technology of edible oils or derivatives in food products, which may be basic or applied in nature.

Nature of the Award: $1,000 and a plaque provided by Bunge North America.

Deadline: November 1

OMINATIONS

Edible Applications Technology Outstanding Achievement

This award recognizes a scientist, technologist, or leader who has made significant contributions to the Division's field of interest, or made contributions to the advancement of edible oils.

Nature of the Award: $500 and a plaque.

Deadline: November 1

Ralph Holman Lifetime Achievement

The Health and Nutrition Division established this award to annually recognize an individual who has made significant contributions to the Division's field of interest, or whose work has resulted in major advances in health and nutrition.

Nature of the Award: $500, a travel-and-expense allowance, and a signed orchid print.

Deadline: November 1

Alton E. Bailey

This award is supported by the USA Section and recognizes research and/or service in the fields of fats and oils and related disciplines.

Nature of the Award: $750 and a plaque.

Deadline: November 1

AAOCS Award for Scientific Excellence in Lipid Research

This award recognizes a scientist from within the Australasian region that has made a significant research contribution towards fats and oils research, either cumulative or one major advancement.

Nature of the Award: Travel-and-expense allowance to attend the 2013 AAOCS Section meeting and a plaque.

Deadline: Varies

Thomas H. Smouse Fellowship

This award was established by the Archer Daniels Midland Foundation and the family and friends of Thomas H. Smouse. The purpose of this graduate fellowship is to encourage and support outstanding research by recognizing a graduate student pursuing an M.S. and/or Ph.D. degree in a field of study consistent with the areas of interest of AOCS.

Nature of the Award: The Fellowship level is up to $15,000 ($10,000 Fellowship, $5,000 for travel and research expenditures related to the student's graduate program).

Deadline: February 1

Ralph H. Potts Memorial Fellowship

This award recognizes a graduate student working in the field of chemistry of fats and oils and their derivatives. Qualifying research will involve fatty acids and their derivatives, such as long-chain alcohols, amines, and other nitrogen compounds.

Nature of the Award: $2,000, a plaque, and travel-and-expense allowance. The award is supported by AkzoNobel, Inc.

Deadline: October 15

Honored Student

This award recognizes graduate students in any area of fats and lipids. To receive the award, a candidate must remain a registered graduate student and must not have received a graduate degree or have begun career employment prior to the Society's Annual Meeting.

Nature of the Award: Travel-and-expense allowance to attend and present a lecture at the Society's Annual Meeting.

Deadline: October 15

Kalustian and Manuchehr Eijadi

Each award recognizes outstanding merit and performance of one Honored Student award recipient and includes a scholarship of $1,000.

Hans Kaunitz

This award is supported by the USA Section and encourages studies in the sciences relating to fats, oils, and detergent technology. This award is open to graduate students within the geographical boundaries of the USA Section.

Nature of the Award: $1,000, travel-and-expense allowance, and a certificate.

Deadline: February 1

AOCS Division Awards for Students

These awards recognize students at any institution of higher learning, who are studying and doing research towards an advanced degree in fats, oils, proteins, lipids, surfactants, detergents, and related materials.

The following student awards are currently being offered by these AOCS Divisions:

- Analytical Division Student Award
- Biotechnology Student Excellence Award
- Edible Applications Technology Division Student Award
- Health and Nutrition Division Student Excellence Award
- Industrial Oil Products Division Student Award
- Lipid Oxidation and Quality Division Student Poster
- Processing Division Student Excellence Award
- Protein and Co-Products Division Student Poster
- Surfactants and Detergents Division Student Travel Award

Nature of the Award: Awards can consist of $100 to $1,000 and a certificate.

Deadline: Varies from October 15 to January 15

The award recipient must agree to attend the AOCS Annual Meeting & Expo and present an award address.

The 104th AOCS Annual Meeting & Expo will be held in Montréal, Québec, Canada from April 28–May 1, 2013.

AOCS Awards contact ➤ awards@aocs.org • **www.aocs.org/awards**

Reformulated meeting a success

The new meeting schedule and a heightened focus on content were a success according to attendees at the 103rd AOCS Annual Meeting & Expo (AM&E).

"My objective as chair of the Annual Meeting Program Committee was to upgrade the scope of the technical presentations and focus on emerging science," said Dilip Nakhasi, director of innovation at Bunge Oils North America. "The AOCS AM&E should be on the top of everyone's list of meetings to attend."

One person who approved of the changes was Bill Holmes, director of mass spectrometry and instrument development at Mississippi State University (USA).

"Replacing the hot topic sessions with five focused forums on emerging technology was a great change," he said. "The quality of talks improved and the entire conference was more organized as a result."

Holmes also gave a thumbs-up to moving the annual business meeting from breakfast on Tuesday to lunch on Monday. "Beginning the presentations on Monday with the forums, followed by the business meeting luncheon, allowed for a better flow of information throughout the meeting," he noted.

Keynote speech

Jackie Frieberg (above), an author and consultant based in San Diego, California, USA, delivered the keynote address following the business meeting on Monday, April 30. "The future belongs to those who innovate," she said. "Those who don't will be among those who perish."

The key to innovation lies in leading effectively, noticing, and disrupting the norm, she continued. "Leadership is a choice: choosing to draw the best out of people even in the toughest of circumstances."

Global Gallup data suggest that 74% of employees are not engaged in the workplace, Freiberg noted. It takes leadership to "wake up and shake up those people who have chosen to check out." The journey of leadership is threefold, she said: "Know yourself, grow yourself, and draw others up."

Freiberg delivered a challenge to her audience, suggesting they take out a blank sheet of paper and list the three qualities they most admired in their own bosses as well as the three managerial flaws they have witnessed in their careers that caused them to say, "I will never treat anyone that way."

"Write them down," she counseled, "and keep that list front and center when you are gearing up for each day in the office."

Frieberg also reviewed some startling if unsourced statistics on the $20 trillion global "She-Economy." Women control 85% of spending in the United States, she asserted, and 65% of global spending.

Women in general are other-oriented, Frieberg said, and so will pay more for products connected with causes. "Connect your product to something that will make a difference," Frieberg suggested.

More complete photographic coverage of the meeting can be found in the supplementary photo tour.

More than 1,600 professionals from 49 countries attended the 103rd AOCS Annual Meeting & Expo in Long Beach, California, USA. This year's meeting featured a fast-track for business professionals, five Forum on Emerging Technologies sessions with a total of 25 presentations, and a separate Award Lectures and Recognition Plenary Session.

Returning to the idea that the future belongs to those who innovate, Frieberg finished by saying that what matters are "the ideas, insights, hopes, dreams, and desires that are untapped inside people who have not been led."

Looking ahead to 2013

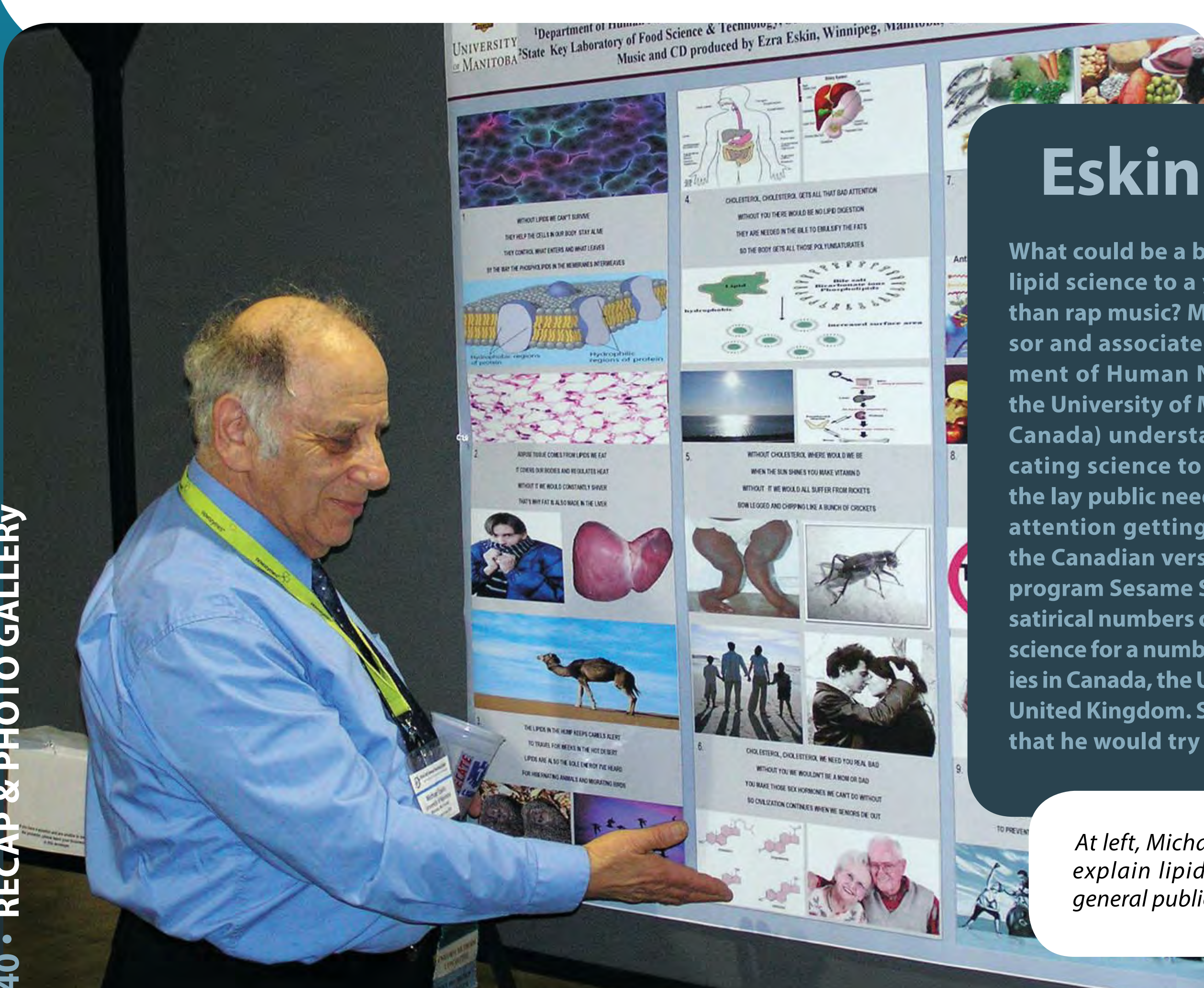
On April 28–May 1, 2013, the AOCS Annual Meeting & Expo will return to Montréal, Québec, Canada. Greg Hatfield of Bunge Canada will be general chair of the event.

As for the 2013 program, Nakhasi says the focus will continue to be on new technology. Possible Forum on Emerging Technologies topics include food security/traceability, the challenge of algal oils for both edible and nonedible applications, and the future of edible ester technology and how to avoid hydrogenation.

"Feedback to the Program Committee from the 2012 attendees about the meeting reformulation was uniformly positive," he said. "Which makes sense, because change—when it leads to progress—is invigorating." ■

The annual meeting was the first opportunity many members had to meet AOCS' new CEO, Patrick Donnelly (right), pictured here with the 2012 Supelco/Nicholas Pelick-AOCS Research Award winner, Casimir C. Akoh (back to camera).

Processing, food technology, and health and nutrition were well represented when AOCS Press book editors signed copies of their recent books. Pictured from left to right are Alejandro G. Marangoni, Richard F. Wilson, Nissim Garti, Neil Widlak, Oi-Ming Lai, Chin-Ping Tan, and Andrew Proctor.



Eskin raps for

What could be a better way to explain lipid science to a young person today than rap music? Michael Eskin, professor and associate dean in the Department of Human Nutrition Science at the University of Manitoba (Winnipeg, Canada) understands that communicating science to schoolchildren and the lay public needs to be creative and attention getting. He has written for the Canadian version of the television program Sesame Street and presented satirical numbers on nutrition and food science for a number of scientific societies in Canada, the United States, and the United Kingdom. So, it was only natural that he would try something different

At left, Michael Eskin raps to explain lipid science to the general public.

The gavel was passed to incoming AOCS President Deland Myers, who addressed members as their president for the first time during the Annual Business Meeting/Luncheon.

lipid science

at the poster session on communicating lipid science: presenting it to rap.

Eskin's son, Ezra, agreed to write the music, and he and his dad recorded it before the elder Eskin left for the AOCS Annual Meeting & Expo. Eskin's presentation at the Professional Educators' Common Interest Group, "Lipids get a real bad rap: It's just not fair," was such a hit that meeting attendees requested repeat performances, and the video ended up on youTube (www.youtube.com/watch?v=6lrG65DdBI8).

Is this the beginning of a trend?

Stay tuned. Eskin says he's already working on his poster presentation for next year.

AOCS' new You Can *video made its debut at the Business Meeting/Luncheon. The video emphasized AOCS' importance as an organization in which there are virtually no limits on the things members can do and the ways in which they can become involved.*

AOCS Latin American Section President Ángela Orlando presents plans to members at the Latin American Section Breakfast.

Latin American Section unveils plans for future

The Latin American Section unveiled its plans for the future during the Latin American Section Breakfast, where Ángela Orlando, executive officer of Greenlab and the Board of Directors for the Argentine Society of Fats and Oils (Asociación Argentina, de Grasas y Aceites, or ASAGA), took office as AOCS' Latin American Section President.

Outgoing President Roberto Berbessi unveiled the section's action plan for the future, and Orlando elaborated on the section's plans to actively collaborate with the Chilean Corporation of Oils and Fats (Corporación Chilena de Grasas y Aceites—CORCHIGA) in connection with different aspects of the XV Congress of LA-AOCS in Chile in 2013. Orlando also explained the section's new emphasis on a higher level of communication that will include a survey about the needs and suggestions of all LA-AOCS members and an effort to develop food quality and safety criteria. The breakfast concluded with the creation of a working committee that will provide input on various technical and scientific meetings and events that should be developed for oils and fats specialists in Latin America.

The opening mixer, networking receptions, AOCS Press social hour, and division, newcomer, student, and other social events offered numerous opportunities for attendees to make valuable connections with people who share similar interests.

The Expo featured exhibits from 81 companies.

The computer lab offered free tutoring in social media and a photography studio, where attendees could get a souvenir photo of themselves in Hollywood or on the beach without even leaving the convention center. Here, Pierluigi Delmonte (left) and Ali Reza Fardin Kia (right) pose before the famous Hollywood sign.

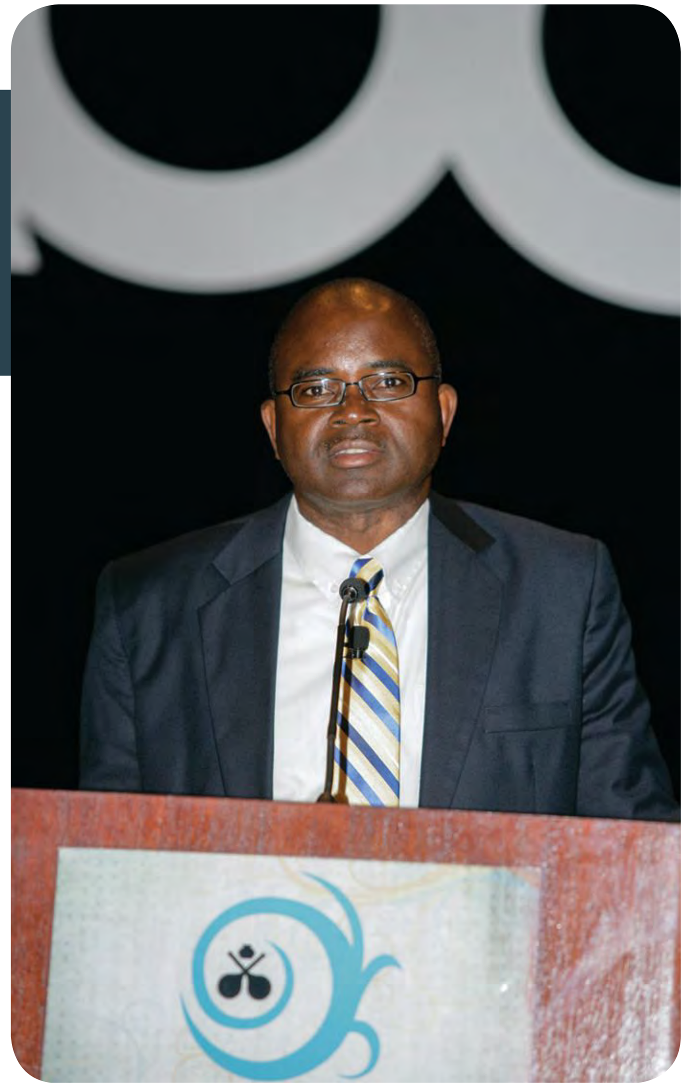
Attendees were challenged by a daily brain teaser, sponsored by the Student Common Interest Group (CIG).

The placement center connected job seekers with employers who had job openings.

Sixty-five donors contributed more than 135 items to the 17th Annual Silent Auction. Robust bidding raised a record $7,000 to support AOCS student programs.

Attendees could choose from among 440 oral presentations and 242 poster presentations on topics covering everything from frying stability to making biobased surfactants from modified activated sludge oil.

Biocatalysis: modifying lipids to advance the food industry and human health



The following article is based on a presentation by Casimir C. Akoh, the 2012 Supelco/Nicholas Pelick-AOCS Research Award winner. Akoh delivered this address on May 1 at the 103rd AOCS Annual Meeting & Expo in Long Beach, California, USA.

Lipases and phospholipases are powerful catalysts used in post-processing lipid modifications to produce functional, healthful, and nutraceutical lipids with potential benefits to the food industry and human health. These two enzymes belong to the acyl hydrolase group. Other acyl hydrolases, such as esterases and proteases, are not commonly used to modify lipids commercially.

Microbial lipases produced through recombinant DNA technology in food-grade host microorganisms such as *Aspergillus oryzae* or *A. niger* are often used for biocatalysis. In these cases, the enzyme itself is not genetically modified but is overexpressed in the host organism from where it is separated and purified for commercial applications. Plant and animal sources of lipases can also be used, but the cost of producing such lipases in sufficient quantities precludes their use on an industrial scale.

Powdered and immobilized enzymes are preferred over liquid enzyme solutions because they contain less water and support synthetic reactions better. However, for hydrolytic reactions, either form of the enzyme can be used. Lipases operate under mild reaction conditions of temperature (room temperature to 90°C or more, if immobilized) and pH. Immobilized enzymes are reusable and cost effective. The benefit of biocatalysis to the food industry and human health can be classified into two groups (Table 1, page 446), which are by no means exclusive or exhaustive.

Structured lipids (SL) are lipids that have been chemically or enzymatically modified from their natural biosynthetic form by alteration in the structure of the naturally occurring lipids to yield novel structure and composition. SL designed for nutritional, medical, or nutraceutical use—otherwise known as healthful lipids—may enhance absorption, reduce calories, address a specific disease condition, boost immune function, reduce cholesterol, deliver enteral and parenteral nutrition, help balance the n-3/n-6 ratio, or reduce *trans* fats. Those designed for functionality in foods may influence physicochemical and functional properties such as melting behavior, rheology, plasticity, oxidative and frying stability, and emulsification, or provide *trans*-free alternatives to *trans* fats.

Examples of enzymatically produced and commercially available specialty functional and healthful lipids are infant formula fat or human milk fat (HMF) analog, such as Betapol™ (Loders Croklaan and Lipid Nutrition BV), and diacylglycerols. Diacylglycerols may benefit obese individuals by reducing body weight and fat accumulation. Betapol is produced by Lipozyme® RM IM lipase (*sn*-1,3-specific)-catalyzed acidolysis of tripalmitin and oleic or vegetable oils in free fatty acids (FFA) form, with major triacylglycerol (TAG) species being oleic-palmitic-oleic, OPO (54.1%) with up to 60% palmitic acid at the *sn*-2 position of the TAG. Oleic or unsaturated fatty acids are at the *sn*-1,3 positions. Betapol was designed to improve calcium and fat absorption and to soften infant stools, much like what occurs with breast feeding. There are many reports on the enzymatic modification of fats and oils to produce HMF analogs for infant formula (1–10). A representative approach for producing HMF fat analogs for infant formula use is shown in Figure 1 on page 446.

CONTINUED ON NEXT PAGE

TABLE 1. Benefits of biocatalysis in producing lipids for food industry and human health

Type of lipid	Product	Uses[a]
Functional	Plastic fats	*trans*-free structured lipids (SL) for spreads shortenings and margarines
	Emulsifiers	Monoacylglycerols, sugar esters, alkyl glycoside esters, lysoglycerophospholipids
	Flavor and fragrance	Small molecule alicyclic flavor esters, terpene-based esters, and fragrance compounds such as menthol and geranyl acetate
Healthful	Infant formula fat analogs	Modified fats and oils that contain palmitic acid at the *sn*-2 position and unsaturated fatty acids (FA) at the *sn*-3 positions of the glycerol backbone. Examples of FA that can be incorporated in SL for infant formulas include DHA, GLA, ARA, EPA, and SDA
	Nutraceutical lipids	Designed SL that contain a good balance of n-3/n-6 PUFA, such as LA, ALA, SDA, GLA, ARA, EPA, DHA, or CLA

[a]Abbreviations: ALA, α-linolenic acid; ARA, arachidonic acid; CLA, conjugated linoleic acid; DHA, docosahexaenoic acid; EPA, eicosapentaenoic acid; GLA, γ-linolenic acid; LA, linoleic acid; SDA, stearidonic acid.

Margarine fats have traditionally been produced by a partial hydrogenation process. However, this process leads to the formation of *trans* fatty acids (TFA) in amounts of 10–36% of total fatty acids. TFA are a risk factor for coronary disease. Therefore, enzymatically produced SL are good alternatives to partially hydrogenated fats in margarine formulations. Figure 2 shows the process we use to produce fat analogs in kilogram quantities for use in margarine formulations as well as the technologies we use to characterize their physical, chemical, and sensory properties. Before the scaled-up process, we optimize the reaction on a milligram scale with response-surface methodology followed by gram-scale synthesis.

In designing margarine fat analogs, diversity in fatty acid composition helps to ensure the presence, in a greater amount, of desirable β′ crystals, which are responsible for the smooth texture of the margarine. Kim *et al.* (11) interesterified a mixture of canola oil, palm stearin, and palm kernel oil with Lipozyme TL IM lipase to achieve a diversity of fatty acids that provided desirable crystal structure, solid fat index, and melting and crystallization properties for use as *trans*-free margarine fat analogs. Other reports on enzymatically produced *trans*-free margarine, spreads, and shortenings are available (12–16).

A sustainable plant source of omega-3 (n-3) polyunsaturated fatty acids (PUFA) is desirable to increase the n-3 PUFA intake of consumers and provide relief to overfishing (marine fish are presently the predominant source of long-chain PUFA for human consumption). Stearidonic acid (SDA) soybean oil is a good source of SDA, which is converted to EPA in human systems by bypassing the rate-limiting Δ-6 desaturase step (17). One gram of dietary SDA converts to 0.30 g EPA while 1 g dietary α-linolenic acid (ALA) converts to approximately 0.07 g EPA. Omega-3 (n-3) PUFA in TAG

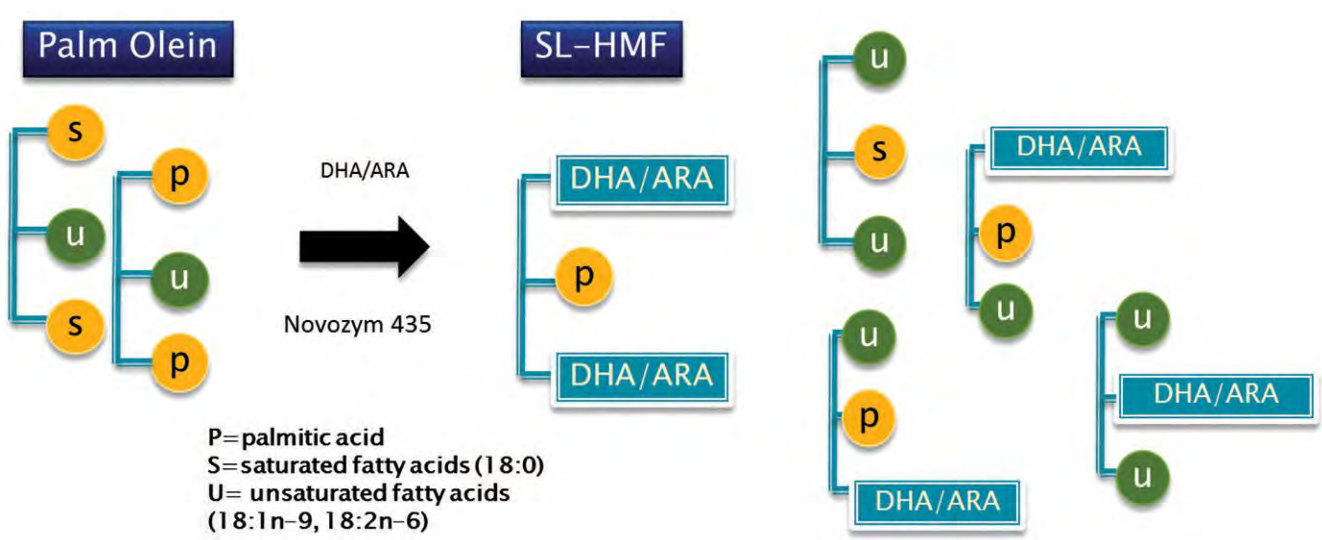


FIG. 1. *Representative approach to producing human milk fat (HMF) analogs for infant formula. Palm olein, containing palmitic acid at the sn-2 position as well as other physiologically important fatty acids such as docosahexaenoic acid (DHA) and arachidonic acid (ARA), serves as substrate. The acidolysis reaction between palm olein and a mixture of free DHA and ARA is catalyzed by Novozym® 435, a nonspecific lipase. Abbreviations: S, saturated fatty acids (14:0, 18:0); U, unsaturated fatty acids (18:1n-9, 18:2n-6); P, palmitic acid.*

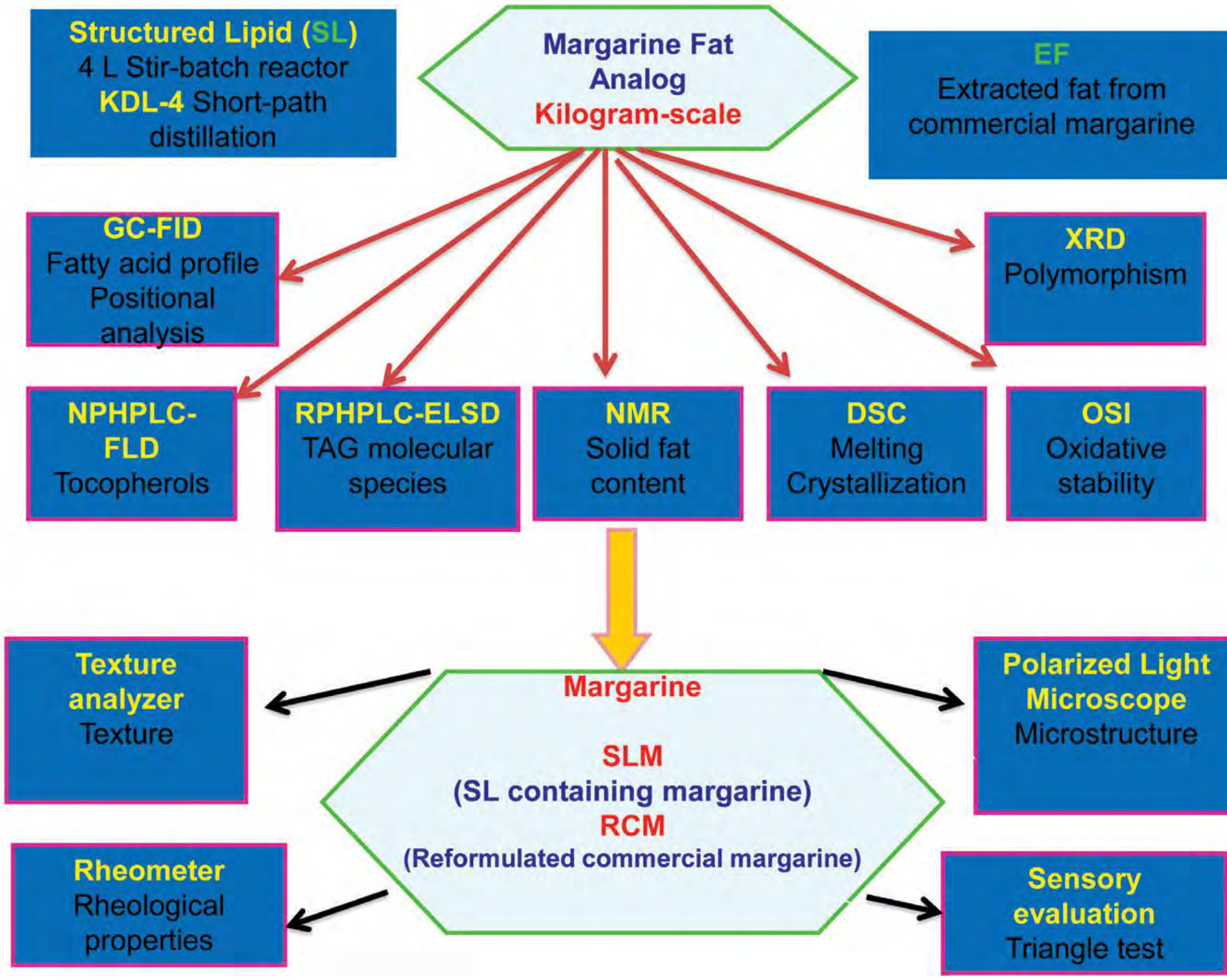


FIG. 2. *Scheme for producing fat analogs for use in margarine formulations; technologies to characterize the resultant margarines. Abbreviations: GC-FID, gas chromatography-flame ionization detection; XRD, X-ray diffraction; NP-HPLC-FLD, normal-phase-high-pressure liquid chromatography (HPLC)-fluorescence detector; RP-HPLC-ELSD, reversed-phase-HPLC-evaporative light scattering detection; NMR, nuclear magnetic resonance; DSC, differential scanning calorimetry; OSI, oxidative stability index.*

forms are more bioavailable than their ethyl ester (EE) forms. Both chemical (urea complexation) and enzymatic (lipase) methods can be used to concentrate n-3 PUFA. We used low-temperature crystallization to increase the concentration of SDA from 23% in original oil to SDA-FFA at 59.6% purity, SDA-TAG at 45.2% purity, and SDA-EE at 97% purity (18,19). A lipase-catalyzed acidolysis reaction was used to further increase SDA content to 54% with 38% at the *sn*-2 position as SL (20). Selective lipase-catalyzed esterification of SDA-FFA with dodecanol produced TAG with 58% SDA purity (21). These forms of SDA-containing lipids can be used as nutraceuticals, in food fortifications, or as substrates for producing modified lipids for various food applications.

We have successfully used these enzymes to produce functional lipids, such as *trans*-free plastic fats (spreads, margarines, shortenings, confectionery) and emulsifiers (sugar and alkyl glycosides esters, lysoglycerophospholipids) (22,23). We produced healthful lipids, such as HMF analogs containing EPA, DHA, γ-linolenic acid, SDA, arachidonic acid, and nutraceutical lipids (with desirable n-3/n-6 ratios, n-3 PUFA in TAG) and glycerophospholipids. We have also produced enriched SDA in modified soybean oil.

Flavor and fragrance compounds also have been modified to produce flavor esters and resolve racemic mixtures, which have potential food and pharmaceutical or cosmetics applications. Desirable attributes of fats and oils for functionality in foods include oxidative stability, fatty acid profile, crystal and polymorphic form, melting property, solid fat content, n-3/n-6 ratio, emulsification property, and flavor. Healthful or nutraceutical lipids may play a role in improving immune function and blood lipid profiles. They may enhance absorption of *sn*-2 fatty acids or physiologically important fatty acids and reduce the risk of diabetes, cancer, and heart disease in adults. Expectant mothers will benefit from n-3 PUFA, especially DHA or SL fortifications as nutraceuticals, which will eventually be passed on to their developing babies through the placenta. For infants, improved absorption of calcium, proper growth, and visual and mental development of preterm and term infants, neuronal and cognitive developments are the goal, whereas a reduction of the incidence of attention deficit hyperactivity disorder by consumption of EPA are the desired outcomes in growing children.

The use of enzymes to construct a specific lipid structure is an art that also requires proper understanding of the biochemical, metabolic, physiological, nutritional, and functional properties of lipids. The use of enzymes to modify lipids for functionality and

CONTINUED ON NEXT PAGE

to improve human health will play a major role in the near future. Producers of enzymes and the food industry know this already, as more companies are acquiring enzyme companies or developing new enzymes for biocatalysis applications in the food, chemical, and pharmaceutical industries.

Casimir C. Akoh is the distinguished research professor of food science and technology and an adjunct professor of foods and nutrition in the Department of Food Science and Technology, University of Georgia, Athens, USA. He can be reached via phone at +1 706-542-1067 and email at cakoh@uga.edu.

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Hydrogenation: Is there any future?

The following article is based on a presentation by Gary R. List, the 2012 Stephen S. Chang Award winner. List delivered this address on May 1 at the 103rd AOCS Annual Meeting & Expo in Long Beach, California, USA.

Gary R. List

History has a strange way of repeating itself. Early in my career we looked at copper chromite catalysts for improving soybean salad oils because nickel catalysts would not completely remove linolenic acid at IV (iodine values) of 110 needed for optimal liquid oil yields. Such a product was marketed in1961 by Procter & Gamble (Cincinnati, Ohio, USA) under the Crisco label. Packaged in brown glass bottles under nitrogen to protect it from light and oxygen, it was considered the epitome of soybean oil processing technology. However, sufficient linolenic acid (3–3.5%) remained to cause deceased frying stability and objectionable room odors.

At the National Center for Agricultural Utilization Research (NCAUR) in Peoria, Illinois, USA, which was and still is under the Agricultural Research Service within the US Department of Agriculture (USDA), Herbert Dutton, along with others from academia (Lyle Albright) and industry (R.R. Allen), began to search for more selective hydrogenation catalysts of which copper catalysts showed much promise. A major concern was whether catalyst residues could be removed during processing, so we developed atomic absorption spectroscopy techniques that satisfactorily monitored catalyst residues.

One major food company was so interested that some plant-scale runs were made in their plant. Not all runs were successful due to contamination of the copper catalyst with residual nickel, but the technology was demonstrated satisfactorily, and the company built a new plant as did companies based in France and Holland. Although we did not see any problems with catalyst activity in the plant-scale runs, lot-to-lot variations in activity were a serious problem in maintaining production schedules. Eventually, the plant returned to nickel.

From 1950–1980, hydrogenation became the backbone of the soybean oil processing industry. Originally, a base stock system employing two or three oils hydrogenated to different IV was used to prepare margarine and shortenings. Eventually, soybean oil (IV of 65 and 80) along with hard stock and liquid oil provided a way to make any spread or baking shortening that customers desired. Unfortunately, under these conditions, commercial hydrogenation produced high levels of *trans* fats.

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In 1990, when the US Congress passed the Nutrition Labeling and Education Act and the report of R.P. Mensick and M.B. Katan (*New England Journal of Medicine* 323:439–445, 1990) showed that *trans* fats alter the HDL/LDL [high-density lipoprotein/low-density lipoprotein] ratio in humans, *trans* fats became a rallying point for the popular press and consumer groups. Thus, after many years of research and development, hydrogenation began to lose its popularity as a fat modification method. Catalyst sales have since dropped considerably, some hardening plants have closed, and many have been operating at reduced capacity for lack of demand.

Beginning around 2003, when *trans*-fat labeling became mandatory in the United States, food companies began to reformulate their products to meet the January 1, 2006, effective date. From that point on there has been a shift from heavily hydrogenated fats to lightly hardened or liquid oils. Moreover, much of the *trans* fat has been replaced by saturated acids from oils such as palm, palm kernel, and fractions thereof.

Before my retirement from USDA, we looked at developing low-*trans* fats via hydrogenation. Today, I would like to review some of these studies, many of them conducted by my colleagues in Peoria (namely, Jerry King, Fred Eller, Michael Jackson, and Russell Holliday).

In the late 1990s, when our research group was conducting work on supercritical fluid extraction of oilseeds, reports from Europe indicated that the technology showed promise in the oleochemical industry by the use of noble metal catalysts in continuous systems. Whether hydrogenation under supercritical conditions would occur in stirred batch reactors using conventional nickel catalysts was unknown.

Our initial results were very discouraging. At 2,000 psi hydrogen, no hydrogenation occurred with supercritical carbon dioxide in the system—probably because of mass transfer effects from the gas to liquid phase. However, as the pressures were lowered, hydrogenation occurred at a slow rate. As we collected more data, it became apparent that under conditions of high pressures saturation rather than isomerization was the predominant reaction. Analysis of the products by HPLC [high-performance liquid chromatography] showed that, at 500 psi, considerable amounts of trisaturates were formed and selectivity was lost. By lowering pressures to 50 psi, no trisaturates were formed. This suggested that a window of pressure exists where nonselective hydrogenation becomes selective, and that significant lowering of *trans* fatty acids might be achieved.

Studies conducted by Fred Eller showed that increasing hydrogen pressures to 200 psi and raising temperatures to 140–170°C increased reaction rates and reduced *trans* fatty acids by more than 50%. Moreover, blends of these hydrogenated oils with liquid soybean had desirable physical properties (solid fat, melting points) along with *trans* fatty acid contents that were below the minimum amount of 0.5 g/serving required under labeling under the US guidelines. However, the pressures needed were too high for commercial hydrogenation converters.

Historically, the industry has used selective conditions to reduce polyunsaturated acids preferentially. Under conditions of high temperature, low hydrogen pressure, and moderate agitation, *trans* acids may reach 40–45%. For example, soybean oil (IV 130) reduced to IV 80 will contain about 32% *trans* while at about IV 70, *trans* reaches a maximum of about 45%. For many years these products have performed well for production of a wide variety of spreads, frying fats, and baking shortening. In fact, nearly every fat product can be made with three hydrogenated oils (IV 65, IV 80, fully hydrogenated) and liquid oil. A blend of 25–50% IV 65 oil with 50–75% liquid oil produces soft and stick margarines, respectively. IV 80 oil represents a shortening base that, when blended with hardstock and/or liquid oil, meets the requirements for a number of shortenings (all-purpose, pie, cake, icings). Thus, after blending, commercial products contain about 11–25% *trans* fatty acids.

Another approach to *trans*-fat reduction involves low IV oils. In this case, instead of using the left-hand side of the bell-shaped curve where high *trans*/low saturates (IV 130–70) occur, the approach was to take a look at the back side, where *trans* acids begin to hydrogenate and saturates start to increase markedly. Thus, functionality from both *trans* and saturates might be possible. The initial results showed that IV 45 soybean oils blended with large amounts of liquid oil produce products having low *trans* and solid fat needed for spreads and shortenings.

Michael Jackson of NCAUR extended this concept by a catalyst-switching strategy in which oils are reduced to a maximum *trans* level (IV 70) and a second hydrogenation is carried out with a platinum catalyst. This approach proved to be superior with regards to *trans* reduction, but the high cost of platinum deters its industrial use.

Other researchers have explored *trans* reduction via hydrogenation by the use of higher pressures, lower temperatures, or catalyst modification. In 1995, the late John Hasman (United Catalysts) published an extensive article in *inform* (6:1206–1213) titled, "*trans* suppression in hydrogenated oils." The higher pressures and catalyst loadings he described were unattractive to the industry. In retrospect, this work was about 10 years ahead of its time. Since then, commercial products have appeared based on modified hydrogenation technologies. Several innovations need mentioning. Catalyst manufacturers have developed nonselective products designed to minimize *trans* isomerization. The modification of existing nickel catalysts with inorganic acids has been patented by several processors.

In the late 1990s, Peter Pintauro (Tulane University, New Orleans, Louisiana, USA) began work on electrochemical hydrogenation. The laboratory results were encouraging with respect to *trans* suppression but were not very selective. Also, flat solid-fat-content curves resulted from high-melting triglycerides formed in the reactions. In addition, scale-up from laboratory to pilot-scale runs was a major challenge.

Other approaches to *trans* reduction involve the use of completely hydrogenated oils blended with liquid oil. These products reportedly perform well as doughnut frying and all-purpose baking shortenings. In 2004, consultant and AOCS Fellow Walter Farr commented, "There will always be a need for hydrogenation for many products, but the volume of oils to be hydrogenated is certain to decrease." This statement is borne out by the fact that *trans*-fat labeling has had a pronounced effect on consumption patterns. A decade ago soybean oil commanded over 80% of domestic consumption, but this has since shrunk to about 65%. In addition there has been a shift from heavily hydrogenated frying/baking fats to lightly hydrogenated or liquid oils.

In summary, the edible oil processing industry has always been flexible and able to change and innovate with new improved technologies and products tailored to consumer needs. Rearranged fats, trait-modified oils, and tropical fats have changed the competitive landscape. Even so, while not thriving, hydrogenation is not dead.

Gary List is currently working as a consultant after retiring from the US Department of Agriculture, Agricultural Research Service, National Center for Agricultural Utilization Research in Peoria, Illinois, USA, where he made numerous contributions to the field of edible oils, including the preparation of margarine and shortening, the detection of trans fatty acids, and the development of alternative methods to produce fats and oils having desirable properties and lacking trans fatty acids. In 2011, List received AOCS' highest service award, the A. Richard Baldwin Award, as well as an honorary doctor of science degree at the University of Illinois (Urbana-Champaign USA). He can be contacted at grlist@telestar-online.net.

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Key Focus Areas

The following have been identified as key focus areas by the AOCS Program Committee, based in part on survey results from the 2012 Annual Meeting & Expo registration brochure recipients. Complete descriptions are available on the website under Program.

- **Advanced Biobased Products: Fuels and Chemicals**
- **Algal Technology—Opportunities and Challenges**
- **Food Security**
- **Future Edible Ester Technologies**
- **Nutrition**

The AOCS Program Committee has found these areas worthy of consideration due to their current impact within the oils and fats community.

Six receive highest honors from AOCS

Michael J. Haas joined an elite group of recipients of the A.R. Baldwin Distinguished Service Award when he accepted the award at the AOCS Annual Business Meeting in Long Beach, California, USA, on Monday, April 30, 2012.

The award recognizes distinguished service to AOCS, and the list of Haas' activities is lengthy. He was president of AOCS (2005–2006), following stints on the AOCS Governing Board as a member-at-large, secretary, and vice president. His moving acceptance speech at the meeting mentioned his weekend and evening time spent editing journal articles; he currently is a senior associate editor of the *Journal of the American Oil Chemists' Society* (*JAOCS*), having served in various editorial capacities for more than 15 years.

"Sometimes you wonder why you are spending so much time on other people's research, and less on your own because of it," Haas noted. "But I think I channeled Dick Baldwin's spirit this spring. I realized that you do it for something bigger than you or your evening: You do it so that you can help build kind of a structure of science and technology that will be reliable, educational, and thus of value to someone else somewhere. It really is like building a strong house for friends or family. I hope that I am a good part of a good construction crew."

The list of Haas' service does not end with his years of editing, however. He also is a founding member of the Biotechnology Division, has organized sessions on biodiesel at various AOCS meetings, and served as the general chairperson of the International Congress on Biodiesel in 2007 and 2009.

Haas is a lead scientist at the US Department of Agriculture–Agricultural Research Service's (USDA–ARS) Eastern Regional Research Center (ERRC) in Wyndmoor, Pennsylvania. He is an AOCS Fellow (2007) and has also received the AOCS Alton E. Bailey Award (2003) and the USB Industrial Uses of Soybean Oil Award (2011).

Michael J. Haas accepts the A.R. Baldwin Distinguished Service Award at the 103rd AOCS Annual Meeting & Expo.

2012 AOCS Fellows inducted

Five new AOCS Fellows were honored at the 103rd AOCS Annual Meeting & Expo: Sevim Z. Erhan, Richard W. Hartel, Steven E. Hill, Jerry W. King, and Luis Spitz.

The distinction of Fellow is given to "veteran AOCS members whose achievements in science entitle them to exceptional recognition, or who have rendered unusually important service to the society or to the profession," according to the AOCS Bylaws. Candidates must have been a member for a minimum of 15 years. For more information, see http://tinyurl.com/AOCSFellows.

Sevim Z. Erhan is an international authority on the industrial uses of vegetable oils, with more than 200 publications to her credit. Her research on soy-based printing inks, hydraulic fluids, greases, lubricating oils, and plastics has led to new uses and markets for oils.

Erhan currently serves as a member-at-large on the AOCS Governing Board, a position she also held from 2007–2010. Her term as secretary ran from 2010–2012. She has also served as chair of the Industrial Oil Products Division (2008–2010) and as program chair of the World Conference on Oilseed Processing, Fats & Oils Processing, Biofuels & Applications (2011) and Technical Program Committee member for the World Conference and Exhibition on Oilseed and Vegetable Oil Utilization (2006).

Erhan is the director of the USDA–ARS' ERRC in Wyndmoor, Pennsylvania. She received the Outstanding Achievement Award from the National Biodiesel Board in 2009.

Richard W. Hartel—a professor of food engineering at the University of Wisconsin (Madison, USA)—is a world-renowned scientist in the area of the crystallization of fats, ice, and sugars. His research deals with practical aspects of food production and helps to address difficult challenges faced by industry.

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As editor-in-chief of *JAOCS*, Hartel has significantly increased the impact factor of the journal. He also serves on the editorial boards of other technical food science journals. He is a fellow of the Institute of Food Technologists (IFT; 2005), and has received the Timothy Mounts Award (AOCS, 2005), and the W. Cruess Teaching Award (IFT, 1998).

Steven E. Hill has been a tireless volunteer during all 25 years of his membership in AOCS. His participation began in the North Central Section (now part of the USA Section) and as an associate editor of *inform* (1992–2001). From there, he became involved with AOCS governance, the AOCS Foundation, and as a meetings and short course organizer. He served on the Governing Board (1999–2009) as member-at-large, treasurer, and secretary. His tenure as treasurer was particularly helpful in guiding changes that ensured AOCS' fiscal health.

Hill is also a proponent of student mentoring programs within AOCS and a passionate advocate for enhanced AOCS membership services. He received the Award of Merit from the College of Agricultural, Consumer and Environmental Sciences' Alumni Association at the University of Illinois, Urbana-Champaign in 2012. He is a director at Kraft Foods Inc. in Glenview, Illinois, USA.

Jerry W. King is a professor at the University of Arkansas in Fayetteville (USA). As an international authority on supercritical fluid extraction technology and its applications to agricultural products, King has been active in AOCS for well over two decades. He has organized many technical sessions, served as an associate editor of *JAOCS* and on the Editorial Advisory Committee of *inform*, as well as holding leadership positions in the Analytical Division, including as chairperson (2006–2008). With co-editor Gary List, he has contributed to AOCS Press books on *Supercritical Fluid Technology in Oil and Lipid Chemistry* and *Hydrogenation of Fats and Oils: Theory and Practice*, 2nd edition. He has also presented at several AOCS-sponsored short courses.

King has received the Harvey W. Wiley Award (AOAC, 1997), Keene P. Dimick Award for Chromatography (American Chemical Society, 2000), and the Herbert J. Dutton Award (AOCS, 2003). Currently, he is serving as chairman of the 10th International Symposium on Supercritical Fluids (ISSF–2012).

Luis Spitz, a consultant who has given more than three decades of service to AOCS, is an icon of the soaps industry. His appreciation for the technology and history associated with soaps is well documented, and his personal soap museum—which AOCS has featured on more than one occasion—is extraordinary.

Spitz has published four books through AOCS Press and has chaired seven conferences and one short course. The overarching goal of all his involvement is to bring together scientists from the United States, Latin America, and elsewhere for a technology exchange to better serve the needs of the Soaps, Detergents, Oleochemicals, and Personal Care Products (SODEOPEC) industries.

He received the AOCS Award of Merit (1998) and the Surfactants and Detergents Division Distinguished Service Award (AOCS, 2004). ■

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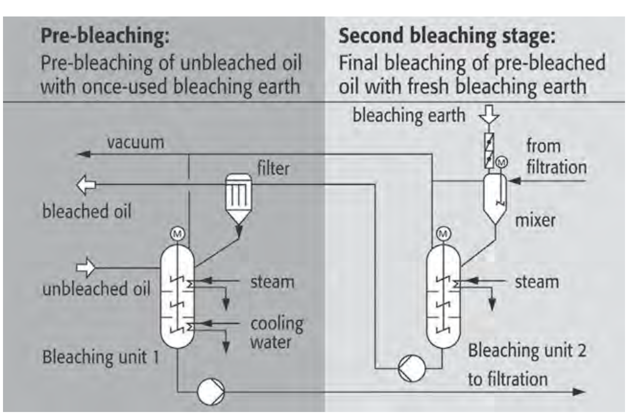

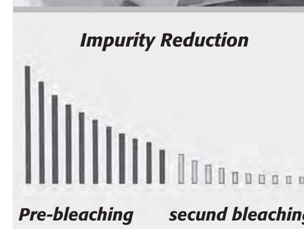

■ ***Licenses***
■ ***Engineering***
■ ***Equipment***
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References
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Award recipients 2012

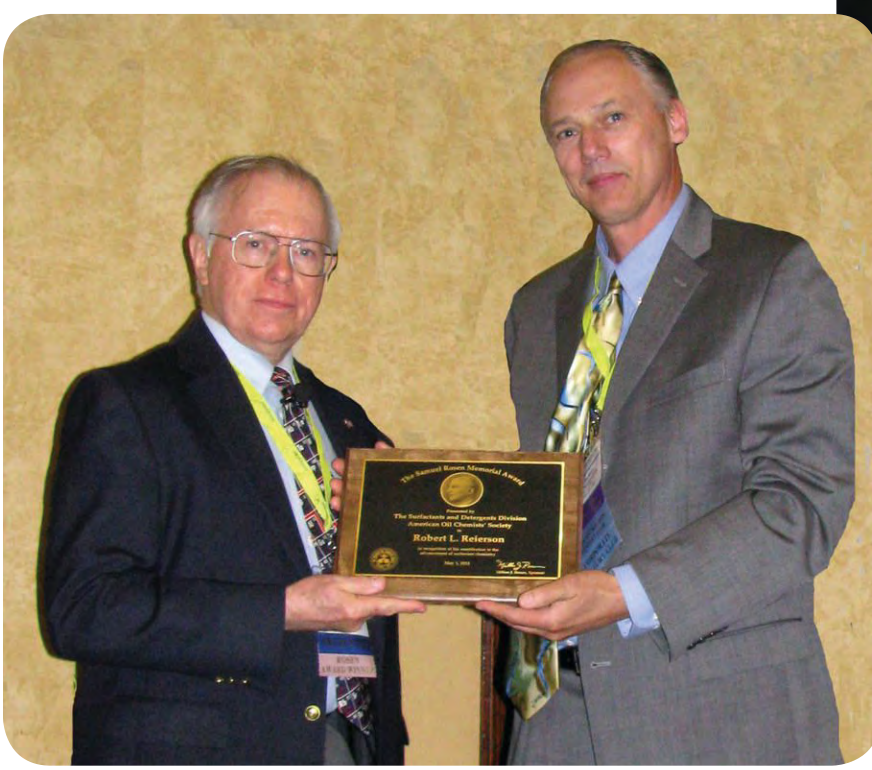
This year's top scientific award winners were honored during a special Awards Plenary and Recognition Session held May 1, 2012, during the Annual Meeting & Expo (AM&E). Dozens of other individuals were honored with awards during the AOCS Annual Business Meeting/Luncheon and various division and other events. What follows is a sampling.

AOCS Fellow Steven E. Hill (right) presented Gary R. List (left) with the jade galloping horse, a symbol of progress presented each year to the winner of the Stephen S. Chang Award. List, who retired from the US Department of Agriculture and now works as a consultant, is the 21st recipient of the award, established by AOCS Past President Stephen S. Chang and his wife, Lucy D. Chang. List has made numerous contributions to the field of edible oils, including the preparation of margarine and shortening, the detection of trans *fatty acids, and the development of alternative methods to produce fats and oils that lack trans fatty acids but have desirable properties. His award presentation, "Hydrogenation: Is there any future?" appears on page 451.*

Richard P. Bazinet (left) received the 2012 Young Scientist Research Award. The award recognizes a scientist who has made significant and substantial research contributions in the fats and oils field and is sponsored by the International Food Science Centre. Bazinet, an assistant professor from the University of Toronto in Canada, has significantly advanced the understanding of brain fatty-acid metabolism and the effect of docosahexaenoic acid on neuroinflammation. His research could provide much-needed information for studying the role of fatty acids in neurodegenerative diseases. He is pictured here with outgoing AOCS President Erich Dumelin.

Outgoing AOCS President Erich Dumelin (right) congratulates Michael R. Waterman, a professor at Vanderbilt University, Nashville, Tennessee, USA. Waterman was this year's recipient of the Schroepfer Medal, which recognizes significant and distinguished accomplishments in the steroid field, defined to encompass sterols and other natural and synthetic compounds incorporating the tetracyclic gonane ring system. Waterman's laboratory has made fundamental discoveries on the biochemistry and biology of steroid hormone and sterol biosynthesis. He is an authority on sterol 14α-demethylases, an enzyme of much medical significance; and his studies on the soluble prokaryotic form of CYP51 from Myobacterium tuberculosis *have contributed significantly to the knowledge of steroid metabolism and function.*

Bingcan Chen (center) was awarded the Thomas H. Smouse Memorial Fellowship Award. The award was established by the Archer Daniels Midland Foundation, AOCS, the AOCS Foundation, and the family and friends of Dr. Smouse to encourage and support outstanding graduate research. Chen, a postdoctoral research associate at the University of Massachusetts—Amherst, USA, developed a novel model for lipid oxidation that provided the first detailed characterization of physical structures in food oil. He is pictured with incoming AOCS President Deland Myers (left) and outgoing President Erich Dumelin (right).



Robert Reierson (left) from Rhodia Inc., USA, received the Samuel Rosen Memorial Award during the Surfactants and Detergents luncheon. He is pictured with Steve Bolkan (right), last year's chair of the Surfactants and Detergents Division. An article based on Reierson's award presentation, "Super phos esters: the key to higher performance products," will appear in a future issue of inform.

Casimir C. Akoh, distinguished research professor from the University of Georgia, Athens, USA (right), was this year's winner of the Supelco/Nicholas Pelick–AOCS Research Award. The award—given to honor significant original contributions in fats and oils research—is sponsored by Pelick and Supelco, Inc., a subsidiary of Sigma-Aldrich Corp. Akoh is internationally recognized for his research based on the use of enzymes, specifically lipases and phospholipases, as biocatalysts for the modification of fats and oils for better health and functionality in foods. His award presentation appears on page 445, and he recently coauthored an article on structured lipids in nutraceuticals for the January 2012 issue of inform *(23:50-64). He is pictured with Leonard Sidisky of Supelco, Inc.*

From left to right: Industrial Oil Products (IOP) Division glycerine award winners Dorith Tavor and Adi Wolfson, both professors of chemical engineering from Sami Shamoon College of Engineering in Israel, pose with the director of technical and regulatory affairs of the American Cleaning Institute (ACI), Kathleen Stanton; Douglas Root, chairman of AOCS' IOP Division; and Kyle Anderson, technical project manager at the National Biodiesel Board (NBB).

Israeli researchers receive ACI/NBB Glycerine Innovation Award

The 2012 ACI/NBB Innovation Award was presented to Dorith Tavor and Adi Wolfson from the Green Processes Center at Israel's Sami Shamoon College of Engineering. They were selected for their research into how glycerol and its derivatives can be used as sustainable solvents in industrial applications.

"The sustainability of a chemical process is derived from its materials and energy consumption, reaction performance, and separation procedures," said Wolfson. "As organic chemistry is traditionally carried out in solution, and as solvents are responsible for a large part of the waste and pollution generated by chemical processes, a key factor to enabling a sustainable chemical process is solvent selection."

Wolfson noted that glycerol is known to be a nontoxic, nonhazardous, nonvolatile, biodegradable, and recyclable liquid produced as a by-product in the transesterification of oil from renewable sources.

"Glycerol has been successfully employed as a sustainable solvent in a wide variety of organic reactions and synthesis methodologies, showing its versatility as a solvent for organic synthesis," said Wolfson. "Success in utilizing glycerol as a solvent for industrial process—such as production of fine chemicals for the pharmaceutical and cosmetic industries, and a variety of additional industrial processes—can lead to processes that are environmentally sustainable yet economically efficient.

"Our research may lead to cleaner industrial processes and reduced pollution. Use of glycerol-based solvents can reduce the environmental footprint of chemical processes and may replace solvents that are not manufactured."

The annual award, which recognizes outstanding achievement for research into new applications for glycerine, with particular emphasis on commercial viability, is sponsored by the ACI (formerly The Soap and Detergent Association) and the NBB. This year's award, which included a plaque and a $5,000 honorarium, was presented at the AOCS IOP Division luncheon on May 1, 2011.

Craig Byrdwell (left), US Department of Agriculture, Beltsville, Maryland, received the Herbert J. Dutton Award during the Analytical Division dinner on May 1. He is pictured with Vishal Jain.

Roman Przybylski (left), University of Lethbridge, Alberta, Canada, received the Timothy L. Mounts Award during the Edible Applications and Technology Division dinner on April 30. He is pictured with Dennis Kim.

Marcel Lie Ken Jie (right) receives the Alton E. Bailey Award from Gary List (left) during the USA Section luncheon on May 1.

More than 20 students were honored in Long Beach. Incoming AOCS President Deland Myers (far left) and outgoing AOCS President Erich Dumelin (far right) flank AOCS Honored Students (center, from left to right): Kollbe Ahn, who also won the Manuchehr Eijadi Award; Utkarsh Shah; Albert Zhou, who also won the Peter and Clare Kalustian Award; Anna Frisenfeldt Horn; and Seong-Chea Chua.

Honored Student Tanushree Tokle (left), University of Massachusetts-Amherst, USA, received the Hans Kaunitz Award from Richard Ashby (right) during the USA Section luncheon on May 1.

Minutes of the 2012 Annual Business Meeting

AOCS' Valorie Deichman welcomed participants to the 103rd AOCS Annual Business Meeting on Monday, April 30, 2012, at the Long Beach Convention Center in Long Beach, California, USA. She thanked several people responsible for the meeting including the Annual Meeting General Chairperson, Nurhan Dunford; the Education and Meetings Steering Committee Chairperson, Rick Della Porta; the Annual Meeting Program Committee Chairperson, Dilip Nakhasi; the past Education and Meetings Steering Committee Chairperson, Deland Myers; and the rest of the committee members. Deichman also thanked Oil-Dri Corp. for its sponsorship of the luncheon.

Participants then directed their attention to an AOCS video promoting volunteer involvement. Following the video, Deichman introduced the new AOCS chief executive officer, Patrick Donnelly, who offered his appreciation to the AOCS Search Committee and the Governing Board for selecting him and expressed his pleasure in having the opportunity to meet the many participants in and members of AOCS.

The meeting was called to order by AOCS President Erich Dumelin at 12:25 p.m.

Dumelin gave his retiring president's address, noting that AOCS continues to focus on a strategy to: (i) extend its network to match the global nature of its business and technological developments (ii) adapt its programs to address the increasing emergence of global challenges (iii) reorganize the Annual Meeting & Expo Program to better meet the participants' expectations and (iv) implement a more streamlined and focused AOCS Board governance structure. Dumelin said this focused strategy has already created positive results in the growth and future outlook of AOCS.

President Dumelin called AOCS Secretary Sevim Erhan to the podium to present the minutes from the 2011 business meeting—unless someone were to make a motion to approve the minutes as published in the October 2011 issue of *inform*. The motion to approve the minutes as published was made, seconded, and approved by a voice vote.

President Dumelin noted that changes to the AOCS bylaws had been presented to the membership for a vote during the last Board election and the changes were approved. Dumelin also gave the attendees a chance to vote in person for the bylaw changes as presented. After a show of hands, the changes were approved.

AOCS Foundation Chairperson Mike Boyer took the podium to discuss upcoming Foundation activities and initiatives and encouraged participants to consider making an investment in the AOCS Foundation.

President Dumelin passed the AOCS gavel to incoming President Deland Myers, and Dumelin was presented with the past president's key.

Following the presentation of the AOCS Fellows and the A. Richard Baldwin Award, incoming President Deland Myers thanked the AOCS members for providing him with the opportunity to be president of AOCS, which he stated "is one of the greatest honors I have received in my professional career." Myers said he will seek to continue the AOCS mission to be the primary source of information for fats, oils, soaps, detergents, and related materials. He acknowledged that this mission comes with tremendous responsibility as there are major global issues facing the fats and oils community including the global economy, the environment and sustainability, diet and health, product quality, and the identification of new chemical feedstocks. Addressing these issues comes with additional challenges such as identifying new communication technologies, meeting the needs of AOCS' constituents, and expanding markets for AOCS products and services. Myers stated that working together with AOCS members and constituents dedicated to addressing these issues and challenges will be key to the overall continued health and growth of AOCS.

With no further business, President Myers adjourned the meeting at 1:05 p.m. Valorie Deichman took the podium to introduce the keynote speaker, Jackie Freiberg.

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Phytochemicals and Phytopharmaceuticals	134	~~$165~~	$70		$
Practical Handbook of Soybean Processing and Utilization	082	~~$118~~	$80		$
Proceedings of the 5th World Conference on Detergents: Reinventing the Industry	176	~~$241~~	$50		$
Trans *Fats Alternatives*	213	~~$110~~	$50		$
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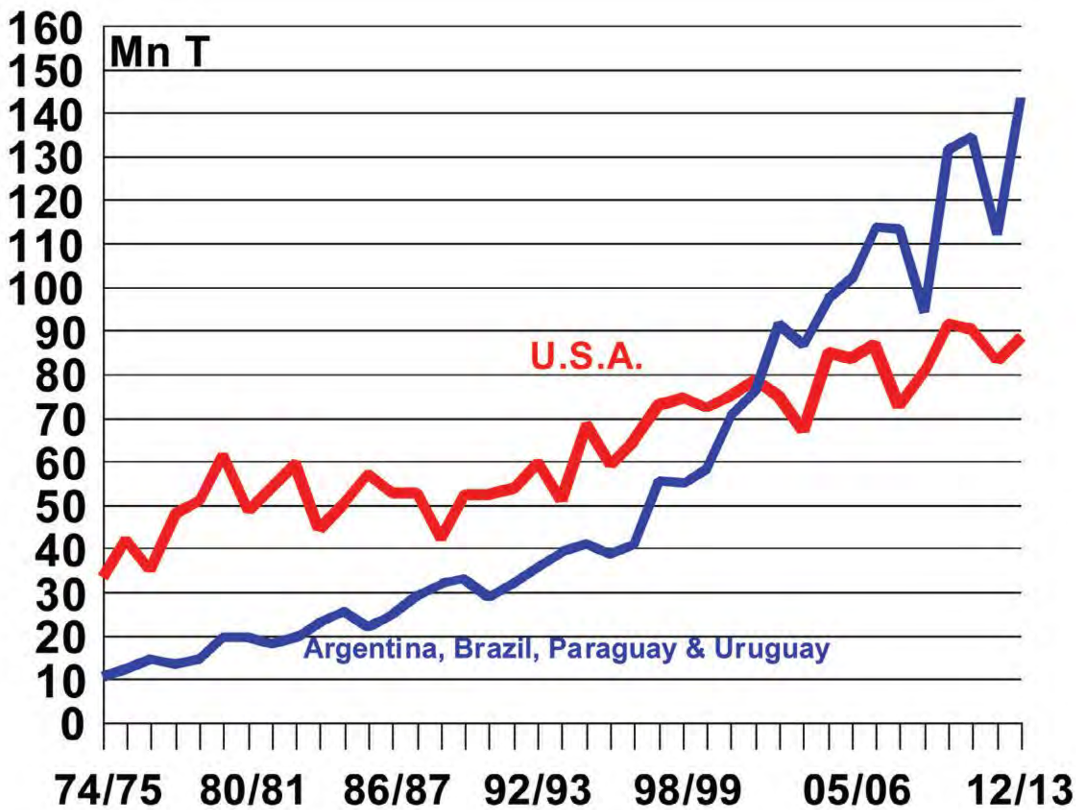

FIG. 1. *Soybean crop trend since 1974/75. Abbreviation: Mn T, million metric tons.*

Major challenges ahead: world soybean supply and demand outlook for 2012/13

Thomas Mielke

In the 2012/13 season and beyond, consumers worldwide will become increasingly dependent on further expansion in South American soybean plantings and production. In North America, there is only limited scope for higher acreage, so additional growth in soybean production has to come from higher yields, but the quantitative impact is going to be relatively limited. However, in Argentina, Brazil, and Paraguay there is considerable potential for an increase in soybean cultivation in new areas, although environmental concern and application of sustainability criteria will gain importance and limit future acreage expansion.

2012/13 production outlook

Oil World estimates prepared at the end of May 2012 and released in the *Oil World Annual 2012* (www.oilworld.de) point to a significant boost in world soybean production by 37.4 million metric tons (MMT), or 16% from the reduced level of a year earlier, to a new high of 274 MMT in 2012/13. This is based on the assumption of a boost in the world harvested area by 4.0 million hectares (Mn ha) to a record 107.4 Mn ha; 3.0 Mn ha of that increase will occur in South America (Fig. 1).

In the Northern Hemisphere, soybean production will increase by probably only about 6 MMT or 5% from last year's reduced level. This means that only about 15% of the anticipated increase in next season's world production will occur in the Northern Hemisphere. But with the prospective steep decline in world opening stocks by 21 MMT as of early September 2012, world soybean supplies will decline steeply by approximately 15 MMT from a year earlier in September/February 2012/13, the first half of the new season.

However, a big boost in soybean production is likely to occur in the Southern Hemisphere in early 2013 with production projected to recover strongly and increase by 31–32 MMT or 27% to a new high of 147 MMT. The tentative Oil World estimates point to record crops of 78.0 MMT in Brazil in early 2013, of 55.0 MMT in Argentina, 8.5 MMT in Paraguay, 2.0 MMT in Uruguay, and 3.7 MMT in other Southern Hemisphere countries.

It is therefore obvious that the forthcoming world crop season from September 2012 until August 2013 will be split into a tight supply period in the first half and into an ample period in the second half. How will the market accomplish the transition from tightness to ample soybean availabilities? Will weather cooperate and facilitate the prospective boost in South American soybean production? What will be the Chinese import policy during this transition period? Will China reduce stocks of imported soybeans in the first half of the season and become a more active importer only from March 2013 onward, thus running the risk of having a dangerously short position in case of weather problems in South America?

TABLE 1. World exports of soybeans[a]

	September/February				
	12/13F	11/12	10/11	09/10	08/09
USA	33.50*	24.18	31.88	31.54	23.68
Canada	2.10*	1.84	2.10	1.49	1.33
Ukraine	0.84*	0.69	0.62	0.13	0.21
South America	6.53*	15.49	6.99	5.22	10.47
Brazil	*5.30**	*10.02*	*4.05*	*3.70*	*5.70*
Argentina	*0.20**	*3.72**	*1.89*	*0.18*	*3.22*
Paraguay	*1.00**	*1.70**	*0.98**	*1.32*	*1.54**
Uruguay	*0.03**	*0.05*	*0.07*	*0.02*	*0.01*
Oth. countries	0.43*	0.42	0.37	0.36	0.45
World	43.40*	42.62	41.96	38.74	36.14

[a]MMT, million metrictons.

Impacts on US soybean exports and stocks

US soybeans will experience a demand-pull market in the months ahead. In September/February 2012/13 the shortfall of South American exports will make it necessary to boost US soybean exports by 9–10 MMT. Our current export estimate for US soybeans is 33.5 MMT in the first half of the US crop season, up 9.3 MMT or 39% from a year earlier. This is a significant increase and must be seen against the background of a substantial decline in Argentine, Brazilian, Paraguayan, and Uruguayan soybean exports by 9.0 MMT from a year earlier.

Will available logistics be able to facilitate such a big US soybean export program? Much will depend on US exports of grains and the competition for available shipping capacity.

We forecast world soybean exports at 43.4 MMT in September/February 2012/13 (up only 2% from last year), assuming higher shipments also from Ukraine and Canada (Table 1).

Also US soybean crushings are likely to be boosted in response to the reduced processing in South America, probably reaching 25.5 MMT in September/February 2012/13. This would be up 2.1 MMT from a year ago. However, considering the prospective declines to 14.4 MMT in Argentina and 15.3 MMT in Brazil, combined soybean crushings of the four major exporting countries would still decline to 56.2 MMT in September/February 2012/13.

This plus the estimated exports would result in soybean disposals by the top four soybean-producing and -exporting countriesof

CONTINUED ON NEXT PAGE

TABLE 2. US soybean supply and demand over 2007–2013 (MMT)

	September/August						March/Aug			Sept/Febr		
	12/13F	11/12F	10/11	09/10	08/09	07/08	2013F	2012F	2011	12/13F	11/12	10/11
Op. stocks	4.60*	5.85	4.11	3.76	5.58	15.62	31.50*	38.70*	36.36*	4.60*	5.85	4.11
Crop	88.70*	83.17	90.61	91.42	80.75	72.86	—	—	—	88.70*	83.17	90.61
Imports	0.50*	0.42*	0.42	0.43	0.38	0.29	0.30*	0.25*	0.18	0.20*	0.17	0.24
Exports	40.90*	36.55*	40.88	40.83	34.84	31.57	7.40*	12.37*	9.00	33.50*	24.18	31.88
Crushings	46.00*	45.17*	44.85*	47.67	45.23	49.08	20.50*	21.79*	21.08*	25.50*	23.38*	23.77
Other use	3.20*	3.12*	3.55*	3.00	2.88	2.54	0.20*	0.19*	0.61*	3.00*	2.93*	2.94*
End. stocks	3.70*	4.60*	5.85	4.11	3.76	5.58	3.70*	4.60*	5.85	31.50*	38.70*	36.36*
Stocks/usage	*4.1%*	*5.4%*	*6.6%*	*4.5%*	*4.5%*	*6.7%*						

only 96.2 MMT in September/February 2012/13, down 2.9 MMT from a year earlier.

We expect US soybean crushings and exports to total 59 MMT in September/February 2012/13. This is a record high and up 11.4 MMT or 24% from a year earlier.

Insufficient South American export supplies of soybeans, soya meal, and oil will shift world demand to US origin in September/February 2012/13. Such a huge shift has never been experienced before.

With our current US soybean crop estimate of 88.7 MMT, we consider it necessary that total US soybean stocks will be reduced to a multiyear low of only 31.5 MMT as of the end of February 2013. This is an unusually low inventory and sharply down from 38.7 MMT a year ago (Table 2, page 469).

The three major South American soybean exporting countries are expected to significantly reduce their soybean disposals by 14.4 MMT from a year earlier in September/February 2012/13, notably, Argentina 6.9 MMT less, Brazil 6.7 MMT less, and Paraguay 0.8 MMT less.

As explained above, record consumption of the US soybean exports and crushings will materialize in September/February 2012/13, which will be more than offset by year-on-year reductions in South America. World soybean crushings have already slowed considerably since April 2012 and will only stagnate or decline slightly from a year earlier in the first half of the world crop season September/August 2012/13. A detailed analysis with global supply and demand forecasts of soybeans, oil, and meal has been published in the new *Oil World Annual 2012*, which can be obtained from www.oilworld.de

World soybean demand will shift considerably more than usual to South America from February or March 2013 onward. US soybean stocks will be historically low as of the end of February 2013, enforcing a substantial decline in soybean disposals. In fact, we currently estimate US soybean exports to plummet to only 7.4 MMT in March/August 2013 and crushings to only 20.5 MMT. In South America, inland transportation and export facilities as well as the risk of strike actions (which occasionally happen at the start of the season) could be limiting factors and jeopardize timely exports and satisfaction of consumer demand in the importing countries. In any case, the depleted US soybean stocks will make it almost impossible to offset any temporary shipment reductions in South America.

Although physical world soybean supplies are likely to become adequate in the world crop season September/August 2012/13, timing and logistics will be major issues. The concentration on US supplies in the first half of the season and on South American supplies in the second half of the season provides several risk factors, primarily for consumers.

Thomas Mielke is executive director of ISTA Mielke, GmbH of Hamburg, Germany (oilworld.de), an independent source of global market research and analysis. He can be contacted at thomas.mielke@oilworld.de.

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Modifying vegetable oil for encaustic painting

The work depicted in this article results from collaboration among lipid scientists and an artist. The collaboration started seven years ago when Barbara Walton, an art professor at Iowa State University (ISU) in Ames, USA, read a news story about soywax candles with clean-burning properties characterized by a lipid professor at ISU, Tong Wang.

Linxing yao, Barbara Walton, and Tong Wang

Encaustic painting, an ancient form of art, uses wax as the base medium. This art form has been experiencing a renaissance for the last 10–15 years, partly because of the availability of more effective equipment and encaustic art supplies. The fascination with the luminous and jewel-like quality of wax, as well as the exploration of contemporary encaustic painting techniques, continues to expand the field of encaustic painting.

Beeswax has been used as a painting medium since approximately 500 C.E. More recently, microcrystalline wax has also been used. Both waxes have excellent pliability, color compatibility, and the stability required by contemporary painters. The physical and textural property of the paint medium determines the technique and the support material to use. For example, beeswax should be applied to a rigid support, such as a wood panel; whereas, microcrystalline wax can be painted on a flexible support, such as canvas. Hydrogenated and structurally modified vegetable oil can provide an alternative to the short supply and/or high cost of beeswax and offer improved functionalities.

The researchers, led by Wang, developed a vegetable oil-based "wax" in which the triacylglycerol (TAG) structure was modified to

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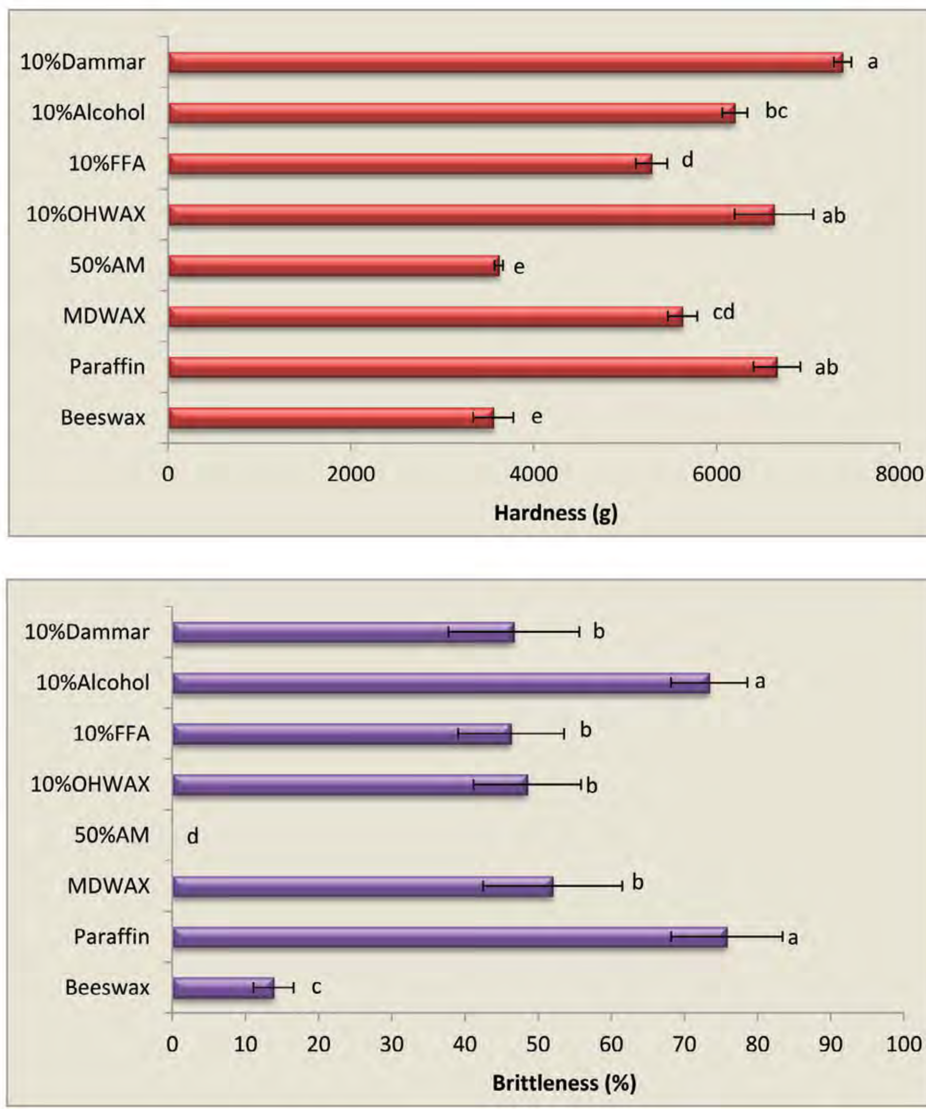

FIG. 1. *A textural evaluation of vegetable oil-based wax.*

FIG. 2. *An encaustic painting of a soybean made using vegewax.*

information

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provide versatile textural properties similar to that of beeswax and microcrystalline wax. Walton tests the wax by heating, adding colorants to the medium, and applying it to a wood panel or canvas with various brushes and metal tools. The textural evaluation can be seen in Figure 1 on page 473.

Hardness is defined as the peak force in the penetration test. Brittleness is the difference between the peak force and the valley force in a compression test divided by the peak force as a percentage. Bars represent standard deviations. Different letters denote a significant difference at $p = 0.05$. MDWAX is a mixture of partial acylglycerides. Other waxes are based on MDWAX with various amounts of additives including dammar resin, fatty alcohol, free fatty acid (FFA), dihydroxy TAG (OHWAX), acetylated monoacylglycerides (AM). The detailed description of the composition of each wax can be found in the reference of Yao and Wang (2012).

Soywax, a partially hydrogenated soybean oil, cannot be directly used as a painting medium because of its hard and brittle texture, which results from the ordered TAG molecular packing. To change the crystalline pattern of fat molecules and enhance the cohesiveness of the wax, mixtures of lipid molecules with various structures are needed. To achieve this, the scientists modified the TAG structure by adding branches and hydrophilic groups on the acyl chains and also used shorter acyl chains. Their first-generation wax (G1), with modifications on the double bonds to produce dihydroxy TAG, has a greatly improved cohesiveness when compared with unmodified soywax. However, this material is too soft for painting. The second-generation wax (G2) is based on a mixture of mono- and diacylglycerols. These partial glycerides with lipid-based modifiers provide high melting points as well as excellent cohesiveness. The development of third-generation wax (G3) will ensure the long-term physical stability of the artwork (e.g., avoid fine lines of cracking). The G3 wax will have either shorter acyl chains or a molecular makeup similar to that of beeswax, to provide a glossy surface, high plasticity, and physical stability. Currently, Wang's research group is developing a variety of vegewaxes that not only will allow the creation of high-quality artwork but may also be used in various coating applications.

Art exhibits and workshops have been given at ISU's Brunnier Art Museum and the Octagon Center for the Arts in Ames. The vegewax encaustic paintings (see Fig. 2) are currently on permanent display in the new Biorenewable Laboratory Building and the Center for Crops Utilization Research on the ISU campus.

The displays and conversation with the students and general public have created great interest and inspiration for green chemistry and innovations in art creation that may result from the interaction between art and science. You can visit a gallery of the paintings.

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TABLE 1. Key advantages and disadvantages for enzymatic preparation of biobased surfactants

Advantages
Lower energy use (lower temperature) → reduced CO_2 production
Lower amounts of waste products and by-products
Absence of toxic metal catalysts or acids /bases → improved safety for the workplace and the environment
Can result in lower solvent usage

Disadvantages
High cost of enzymes
Low rate of reaction, frequently
Concerns for the supply of enzymes on a large-scale
Need to used highly purified starting materials
Limitations on operating conditions, such as temperature range and pH

Using enzymes to prepare biobased surfactants

Douglas G. Hayes

Surfactants and detergents are major commodities employed within several industries, including pharmaceuticals, personal care products, cleaners, laundry detergents, paints and coatings, foods, lubrication, and mining. In 2010, the worldwide market for surfactants reached $24.3 billion, and 10 million metric tons were produced. Unlike soaps and detergents produced before the early 1900s, most of which were made with animal fats or vegetable oils, surfactants produced during the past 100 years have become increasingly dependent on petroleum. More recently, concerns about the long-term economic and ecological sustainability of fossil fuels have led to renewed interest in biobased feedstocks.

The biobased resource most often used to make surfactants is the fatty acyl group derived from seed oils, which are becoming more readily available to manufacturers due to the growth of biodiesel, which provides an abundant and consistent supply of fatty acid methyl esters as chemical intermediates. The hydrophilic moiety of surfactants can also be derived from renewables that readily occur in a biorefinery operation, such as sugars, glycerol (a low-value co-product derived from biodiesel), amino acids, and their derivatives. Other biorefinery-derived chemicals, such as phospholipids, sterols, and glycols, can also be used as source materials.

Surfactants are traditionally manufactured using chemical processes that consume large quantities of energy, such as temperatures that exceed 100°C, involve high acidity or alkalinity, and/or use organic solvents. Bioprocessing approaches, particularly replacing chemical processes with those that use enzymes, are receiving attention as examples of "green manufacturing" that can lead to an enhanced sustainability profile (Table 1).

Moreover, enzymatic processes proceed at lower temperatures and in the absence of highly acidic or alkaline conditions, leading to improved process safety and reduced production of CO_2 and other "greenhouse gases." Milder operating temperatures also reduce unwanted side reactions involving labile groups, such as the degradation of double bonds that occur in unsaturated fatty acyl groups. Replacing metallic or acid/base catalysts with biocatalysts reduces the release of heavy metals and other potentially harmful chemicals to the environment as well as their occurrence in the final product.

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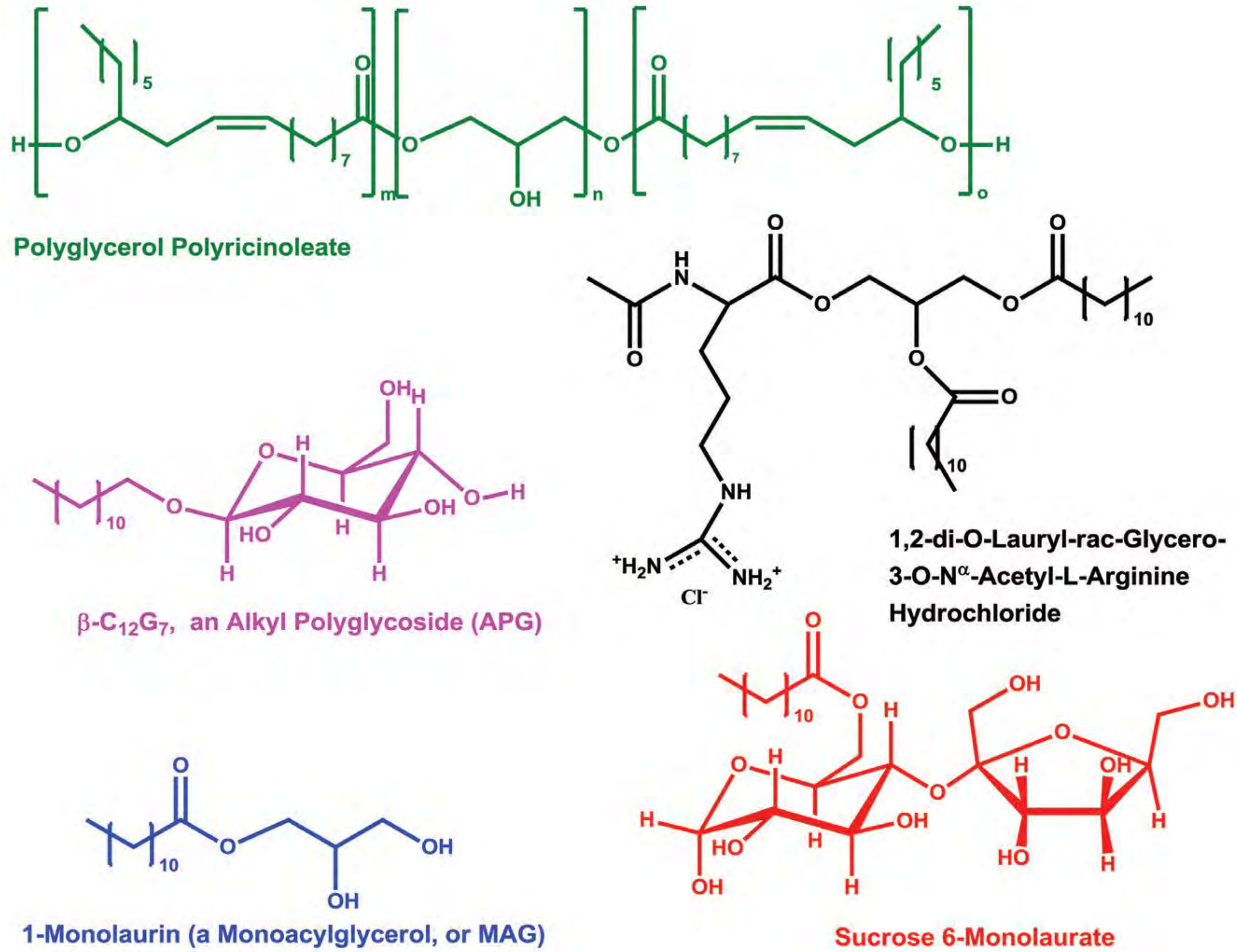

FIG. 1. *Molecular structure of biobased surfactants prepared using enzymes.*

Furthermore, owing to the high selectivity of enzymes (e.g., the preference of enzymes for specific functional groups, or regioselectivity, of a starting material), the product distribution is frequently narrowed compared to chemical syntheses. For many enzymatic processes involving two or more starting materials, stoichiometric proportions of these substrates can be employed, leading to reduced amounts of unused substrates in the final product, hence to a reduced burden for downstream purification.

The advantages of enzymatic processes must be weighed against several inherent disadvantages, the most significant of which include the relatively high cost of enzymes, a frequently lower rate of reaction, and uncertainty of a consistent supply (Table 1). Other disadvantages include the susceptibility of enzymes to inhibition by minor components that occur in oleochemicals, such as peroxides, aldehydes, ketones, and heavy metals. These disadvantages deter the current use of enzymatic processes, as they require prepurification processes and create operational limitations, such as temperatures below 100°C to avoid enzyme denaturation. Scientific progress may change this trend. For example, developments in enzyme immobilization technology, recombinant DNA technology, and discovery of extremophiles are yielding more active and stable enzyme preparations, making it possible to increase their operational lifetime. Such developments will make enzymatic bioprocessing increasingly attractive for high-value specialty surfactants, such as structured phospholipids for use in lung surfactant preparations and drug delivery vehicles, and fatty acid ester-based surfactants in nutraceuticals and pharmaceuticals.

Examples of enzymatic preparation of biobased surfactants

The molecular structures of biobased surfactants prepared using enzymes are depicted in Figure 1, while the enzymes used to prepare them are listed in Table 2. The enzymes most commonly used for biobased surfactant synthesis—lipases—catalyze the formation of ester bonds between fatty acyl groups and polyhydric alcohols, or polyols, to prepare several biocompatible and biodegradable nonionic surfactants for use in foods, cosmetics, pharmaceuticals, and personal care products. Examples include sugar or sugar alcohol esters, monoacylglycerols (MAG), fatty acid ethoxylates, and polyglycerol polyricinoleate. The development of several commercial lipases in free and immobilized form that are highly thermophilic and possess good catalytic activity has accelerated interest in and performance of these reactions. Lipase-catalyzed formation of ester bonds requires nearly anhydrous reaction media to prevent the hydrolysis of ester bonds. Lipases are typically employed as a dispersed solid that is suspended in the reaction medium or else placed within a packed column, with the reaction medium transported through the column using low-pressure pumping to allow for their recovery and reuse.

TABLE 2. Enzymes useful for synthesis of biobased surfactants

Enzyme	Surfactant or precursor
Alcohol dehydrogenase	Aldehyde or ketone (from fatty alcohol)
α-Amylase	Alkyl polyglucosides
Glucosidase	Alkyl glucosides
Glucosyl transferases	Alkyl polyglucosides
Lipases	Fatty acid esters (polyol, polyglycerol), fatty amide-based, lysophospholipids, carbonates, amino acid-based
Papain	Amino acid surfactants
Phospholipases	Tailor-made phospholipids

Most lipases possess regioselectivity, thereby limiting the number of hydroxyl groups of polyols that can serve as acyl acceptors. For example, in Figure 1, lipase-catalyzed esterification of fatty acid and sucrose occurs mainly at the primary hydroxyl of the glucose monomeric unit of sucrose, that is, the 6 position. Therefore, lipase-catalyzed reactions often result in a narrower product distribution than chemical catalytic approaches.

Lipase-catalyzed synthesis of polyol-fatty acid esters is hindered by the poor miscibility of the lipophilic fatty acyl group and the hydrophilic polyol, leading to poor mass transfer and hence low reaction rates. Several approaches have been taken to address this deficiency, such as using polar organic solvents or ionic liquids and derivatizing or complexing the hydroxyl groups of the polyols to achieve cosolubilization. Alternatively, the use of small amounts of polar solvent as adjuvant has been successful. Adjuvants solubilize sufficient amounts of substrate to enable esterification to occur, but at low overall amounts and lower temperatures to promote precipitation of monoester upon its formation. Another approach to minimizing the use of solvent is to suspend particles of polyol immobilized onto a solid support, or in case of saccharides crystals of acyl acceptor directly, in solvent-free reaction medium. The fatty acyl substrate/ester product mixture serves as solvent, with the capacity for suspended particles increasing with time resulting from the formation of biobased surfactant. The author of this article has used this approach to prepare mono- and disaccharide–fatty acid esters under solvent-free conditions at 65°C, achieving 85–95% yields and requiring a minimal level of further purification. Lipases can also form biobased surfactants via hydrolysis; for example, lysophospholipids are readily formed via lipolysis of phospholipids, yielding a surfactant frequently possessing a higher HLB [hydrophilic lipophilic balance] value, lower surface and interfacial tension, and decreased sensitivity to pH than its parent. MAG are readily formed during lipolysis of triacylglycerols using 1,3-positional selective lipases in systems enriched in calcium, leading to irreversible soap formation for the released free fatty acids. Lipases can also form amide bonds between a hydrophile and a lipophile. Examples reported in the literature include N-acylated derivatives of ethanolamine and N-methyl glucamine.

Lipases and proteases (e.g., papain) have been used to prepare amino acid surfactants. Most of the successful biotransformations occur using the carboxylate moiety of amino acids as acyl donor. Either ester or amide bonds are then formed using fatty amines or fatty alcohols as cosubstrate, respectively. The amino acid substrates are typically acylated (protected) at their α-amino group using acetate or carboxybenzyl (Cbz) groups. Amino acid surfactants have been prepared enzymatically using arginine, aspartate, (Cbz-S-derivatized) cysteine, glycine, phenylalanine, serine, and tyrosine. The only successful enzymatic conversions of free amino acids have been the esterification of the ε-OH group of homoserine and amide bond formation at the ε-amino group of lysine, using several different acyl donors.

One example of an arginine-based amino acid surfactant is given in Figure 1. The surfactant was synthesized in a two-step process. First, the N^{α}-acetylated amino acid hydrochloride was esterified with glycerol using either lipase or papain. Subsequently, the product from the first step was reacted with two mole equivalents of lauric acid, leading to ester bond formation at the two free hydroxyls of the glycerol moiety. Amino acid surfactants are very effective emulsifiers that have been used frequently in cosmetics and personal care products. Arginine-based surfactants have excellent antimicrobial activity and biodegradability.

Alkyl glycosides and polyglycosides (AG and APG, respectively) have also been synthesized enzymatically. Glycosidases catalyze the formation of acetal bonds between monosaccharides and fatty alcohols in low-water medium, yielding a mixture of α- and β-pyranoside isomers. When lactose, a disaccharide, was used as glycosyl donor in the presence of 1-hexanol, hexyl galactoside and glucoside were formed, owing to the enzymatic hydrolysis of the β-1,4 glycosidic bond occurring between the monosaccharide units of lactose. A recent report demonstrated the ability of cyclodextrin glycosyl transferase from *Bacillus macerans* to form APG, to transform dodecyl-β-D-maltoside ($C_{12}\alpha G_2$) into $C_{12}\alpha G_7$ using α-cyclodextrin as glycosyl donor, with the latter present at an eightfold molar excess. The conversion was 50%. Although not competitive with chemical synthetic approaches, these recent results suggest the potential ability to enzymatically produce AG and APG under mild conditions with further technological development.

Other examples of enzymatic synthesis include the ability of phospholipases to tailor-make "structured" phospholipids through selection of the fatty acyl group (via phospholipases A1 and A2, or lipases) and head group attached to phosphatidic acid via

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phospholipase D-catalyzed transphosphatidylation, including novel, nonnatural head groups. In addition to employing enzymes, microorganisms frequently have been used to form biobased surfactants (referred to as biosurfactants) such as rhamnolipids, sophorolipids, mannosylerythritol lipids, trehalose lipids, and liposaccharides. The latter topic is beyond the scope of this short review.

Although not yet cost competitive with chemical synthetic approaches, enzyme-catalyzed syntheses possess many intriguing advantages as green-manufacturing approaches to prepare biobased surfactants, including milder and less energy-intensive processing conditions and the reduction of by-products that can harm the environment or the user of the product. Further development of more active and stable biocatalysts, and new bioprocessing technology, will improve the viability of this approach.

Douglas G. Hayes is a professor of biosystem engineering at the University of Tennessee, Knoxville, USA, and serves as an associate editor for the Journal of the American Oil Chemists' Society and the Journal of Surfactants and Detergents. He co-edited the book Biobased Surfactants and Detergents: Synthesis, Properties, and Applications, published by AOCS Press (2009), and has co-organized the symposium "Biobased Surfactants and Detergents" during the past five years at AOCS annual meetings. His research interests span enzymatic reactions in nonaqueous media, surfactant-based complex fluids, and biobased polymers and products from biomass. He can be reached at dhayes1@utk.edu.

information

- Hayes, D.G., D. Kitamoto, D.K.Y. Solaiman, and R.D. Ashby (eds.), *Biobased Surfactants and Detergents: Synthesis, Properties, and Applications*, AOCS Press, Urbana, Illinois USA, 2009.
- Gunstone, F.D. (ed.), *Phospholipid Technology and Applications*, The Oily Press, Bridgwater, UK, 2008.

Milking it in Saharan Africa

Humans in prehistoric Saharan Africa used cattle for their milk nearly 7,000 years ago. A recent analysis of fatty acids extracted from unglazed pottery excavated from an archaeological site in Libya showed that dairy fats were processed in the vessels. The identification was based on the δ13C and Δ13C values of the major alkanoic acids found in milk fat. (First dairying in green Saharan Africa in the fifth millennium bc, Dunne, J., *et al.*, *Nature:* 486: 390-394, 2012 doi:10.1038/nature11186)

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SUPPLEMENT

2012 AOCS Annual Meeting & Expo photo tour

Did the photo coverage of the Annual Meeting & Expo in Long Beach, California, in the print edition leave you hungry for more? Visit our supplementary photo tour.

A celebration of soy

The soy wax paintings in this virtual gallery are the result of a unique collaboration among an artist and lipid scientists.

Latin American Section unveils plans for future

The Latin American Section unveiled its plans for the future during the Latin American Section Breakfast. Read the full report in Spanish.

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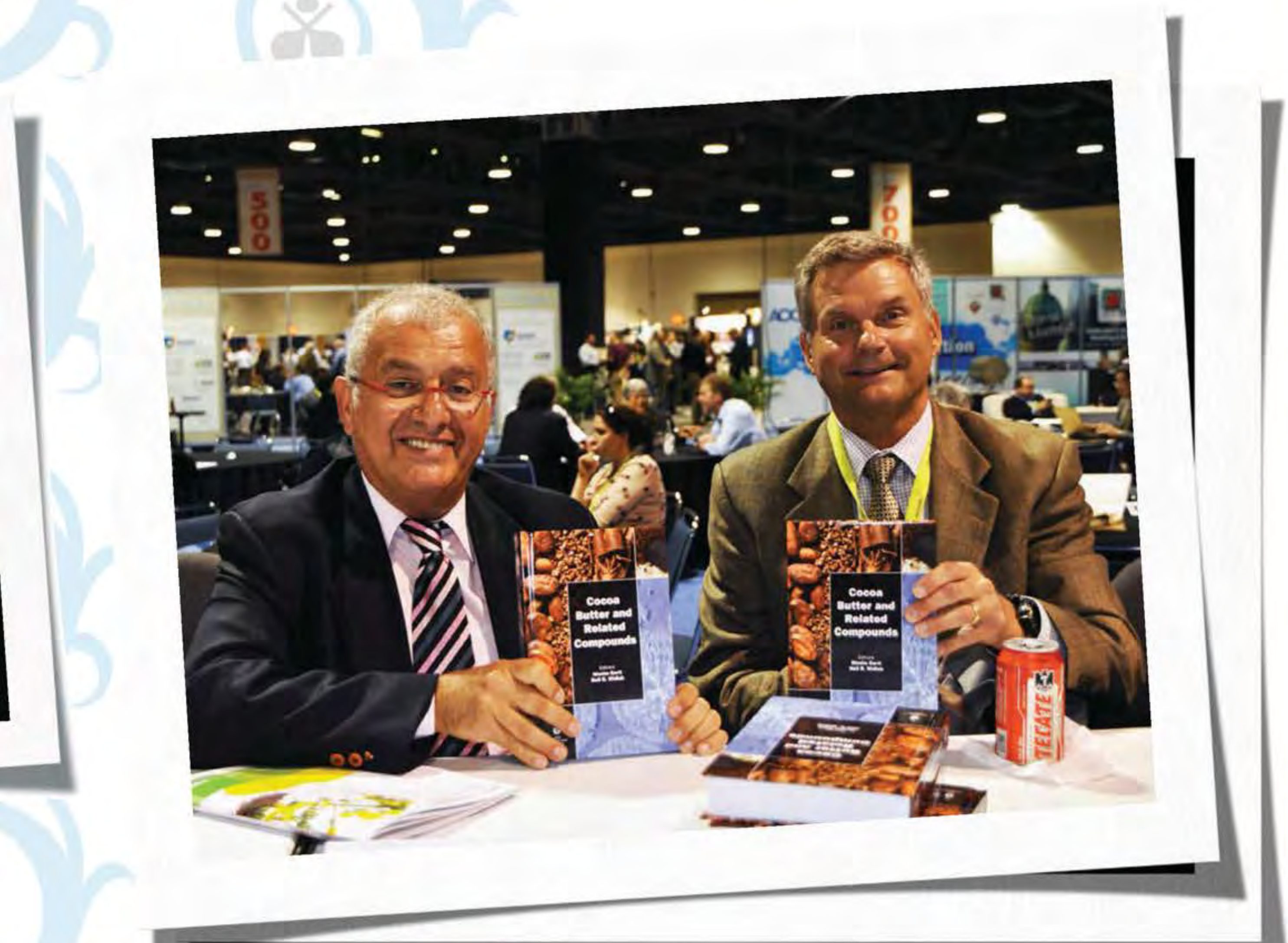
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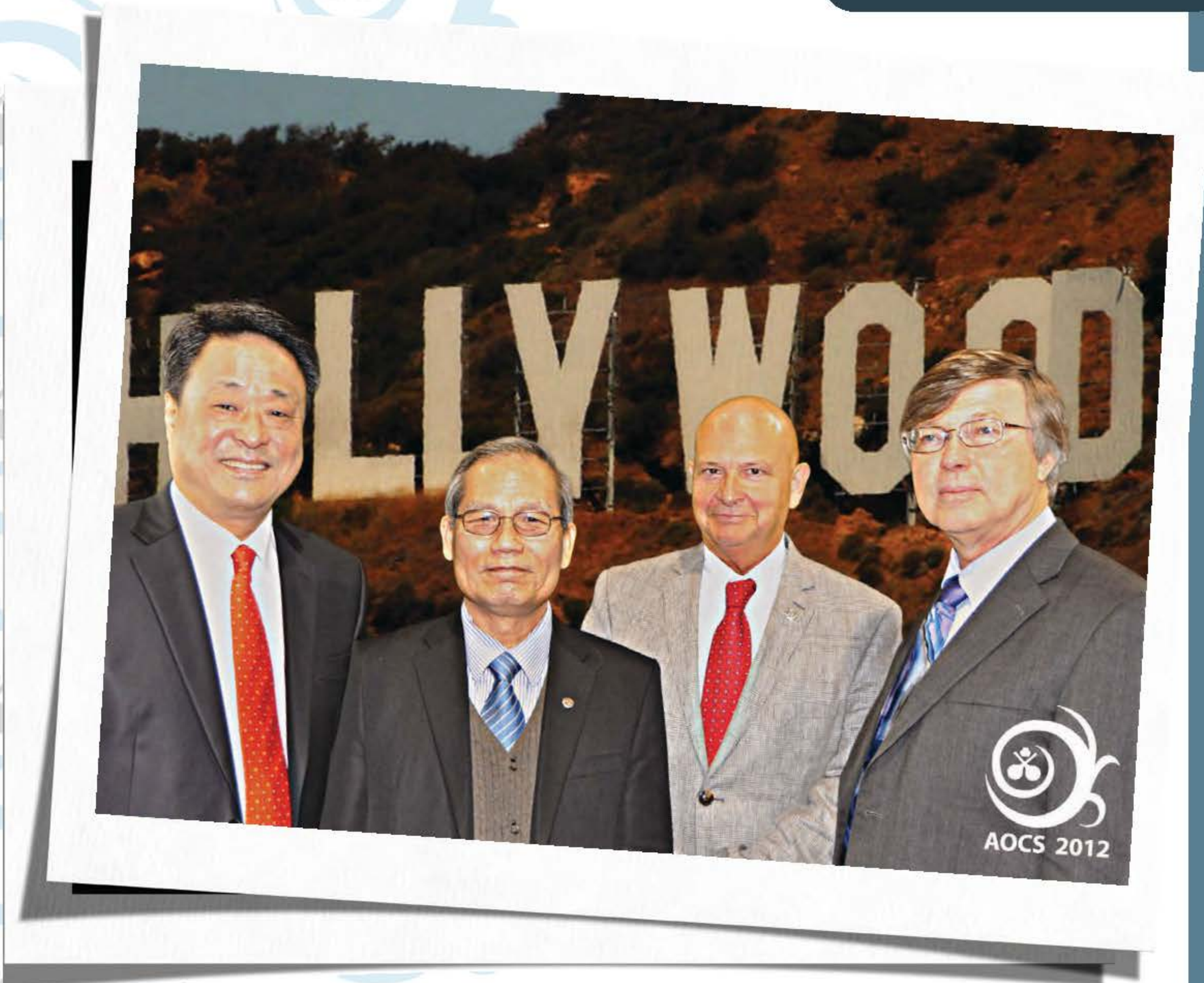
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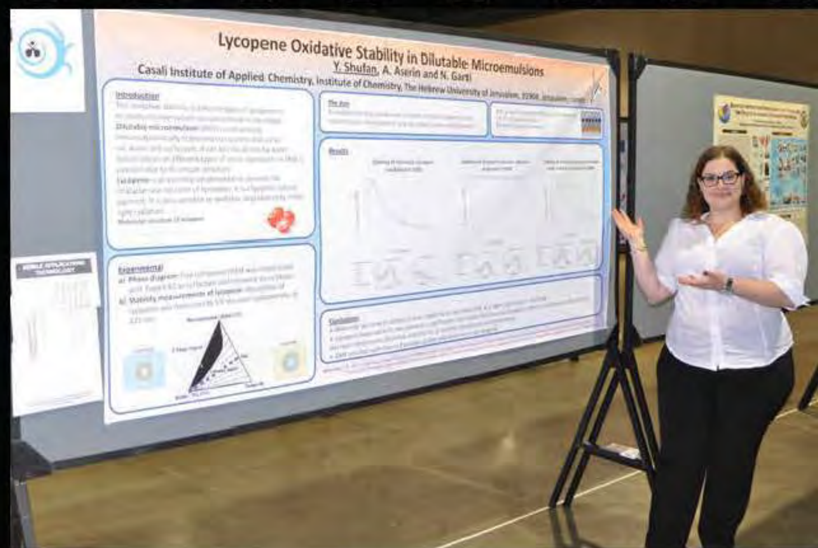
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A celebration of soy

The paintings in this gallery were created by Associate Professor Barbara Walton. Walton has been teaching painting and drawing classes in the College of Design at Iowa State University (ISU) in Ames, Iowa, USA, since 1993. She maintains her own studio in downtown Ames, and has been painting with encaustic techniques using beeswax for more than 10 years. In 2005, she approached Tong Wang, a professor of food science and human nutrition at ISU and a member of AOCS, with a proposed idea to experiment with soy wax (see article on page 473). The paintings shown here are the result of the unique collaboration between art and lipid science that developed. For more information, Walton can be contacted at bewalton@iastate.edu, 515-294-1046 (office phone); 515-460-5135 (studio phone).

La Dra. Ángela Orlando asumió la Presidencia de LA AOCS

El primero de mayo de este año, durante el 103rd AOCS (American Oil Chemists' Society) Annual Meeting & Expo en Long Beach, California (USA), se desarrolló el Desayuno de la Sección Latinoamericana, asumiendo la Presidencia de la misma la Dra. Ángela Orlando, Directora General de Greenlab y miembro de CD de ASAGA.

El temario de dicho desayuno de trabajo, abarcó el Informe de la Gestión del Presidente saliente, Roberto Berbessi, representante de Colombia y también el Plan de Acción futuro de la Presidenta electa.

El Informe del Presidente saliente versó sobre las acciones llevadas a cabo durante su gestión, centrando su resumen en el balance del Congreso de la Sección Latinoamericana realizado en Cartagena Colombia, el año pasado.

Por otra parte, **en la exposición del Plan de Acción a futuro de Ángela Orlando, quedó claro que se fundará en una fuerte estrategia comunicacional, que intentará potenciar la relación entre los miembros de la sección, los cuales son muchos y se encuentran dispersos en diferentes países:**

"Somos aparte de USA que cuenta con 836 miembros, la sección más numerosa. Tenemos membresías de países como Grecia, Irán, República Checa, Holanda, Sudáfrica, Francia, Alemania, USA, Canadá e Inglaterra", aseguró la ahora Presidenta de la Sección, quien a su vez expuso la conformación de las diferentes Secciones de AOCS, India (45 miembros); Australia (61 miembros; Asia (146 miembros); Europa (172 miembros); Canadá (198) y LA-AOCS (231).

En relación a su próxima gestión, mencionó: "Pensamos a la Sección Latinoamericana como§una institución técnica y profesional§que a través de mejorar los lazos entre sus miembros deberá impactar positivamente en el sector de grasas y aceites en nuestros diferentes países, mejorando la productividad de nuestras empresas, impulsando las investigaciones aplicadas al sector, intentando trabajar en armonía con la protección ambiental".

Respecto al punto jerárquico del Plan de Acción señaló: "**La Sección colaborará activamente con la Corporación Chilena de Grasas y Aceites (CORCHIGA) en los distintos aspectos del XV congreso LA-AOCS en CHILE,** también enfatizará sus acciones hacia un mayor nivel de comunicación, que incluirá en una primera etapa una encuesta base sobre necesidades y sugerencias de todos los miembros de LA-AOCS y en una segunda etapa el intento de desarrollar desde la sección Criterios de Calidad y Seguridad Alimentaria, con una colaboración activa en todos aquellos foros e instancias relacionados".

Finalmente, la Dra. Orlando agradeció todas las expresiones de apoyo y colaboración manifestadas para con el proyecto presentado por parte de§representantes de Brasil, Uruguay, Perú, Colombia, USA, Canadá, Ecuador, México y de Argentina, culminando el Desayuno con la creación de una Comisión de Trabajo atenta a los diferentes encuentros y eventos§técnico- cientíÿcos de la especialidad de Grasas y Aceites a desarrollarse en Latinoamérica.