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INFORM
International News on Fats, Oils, and Related Materials
ISSN: 0897-8026 IFRMEC 24 (1) 1–64

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

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

Subscriptions to *Inform* for members of the American Oil Chemists' Society are included in the annual dues. An individual subscription to *Inform* is $190. Outside the U.S., add $35 for surface mail, or add $120 for air mail. Institutional subscriptions to the *Journal of the American Oil Chemists' Society* and *Inform* combined are now being handled by Springer Verlag. Price list information is available at www.springer.com/pricelist. Claims for copies lost in the mail must be received within 30 days (90 days outside the U.S.) of the date of issue. Notice of change of address must be received two weeks before the date of issue. For subscription inquiries, please contact Doreen Berning at AOCS, doreenb@aocs.org or phone +1 217-693-4813. AOCS membership information and applications can be obtained from: AOCS, P.O. Box 17190, Urbana, IL 61803-7190 USA or membership@ aocs.org.

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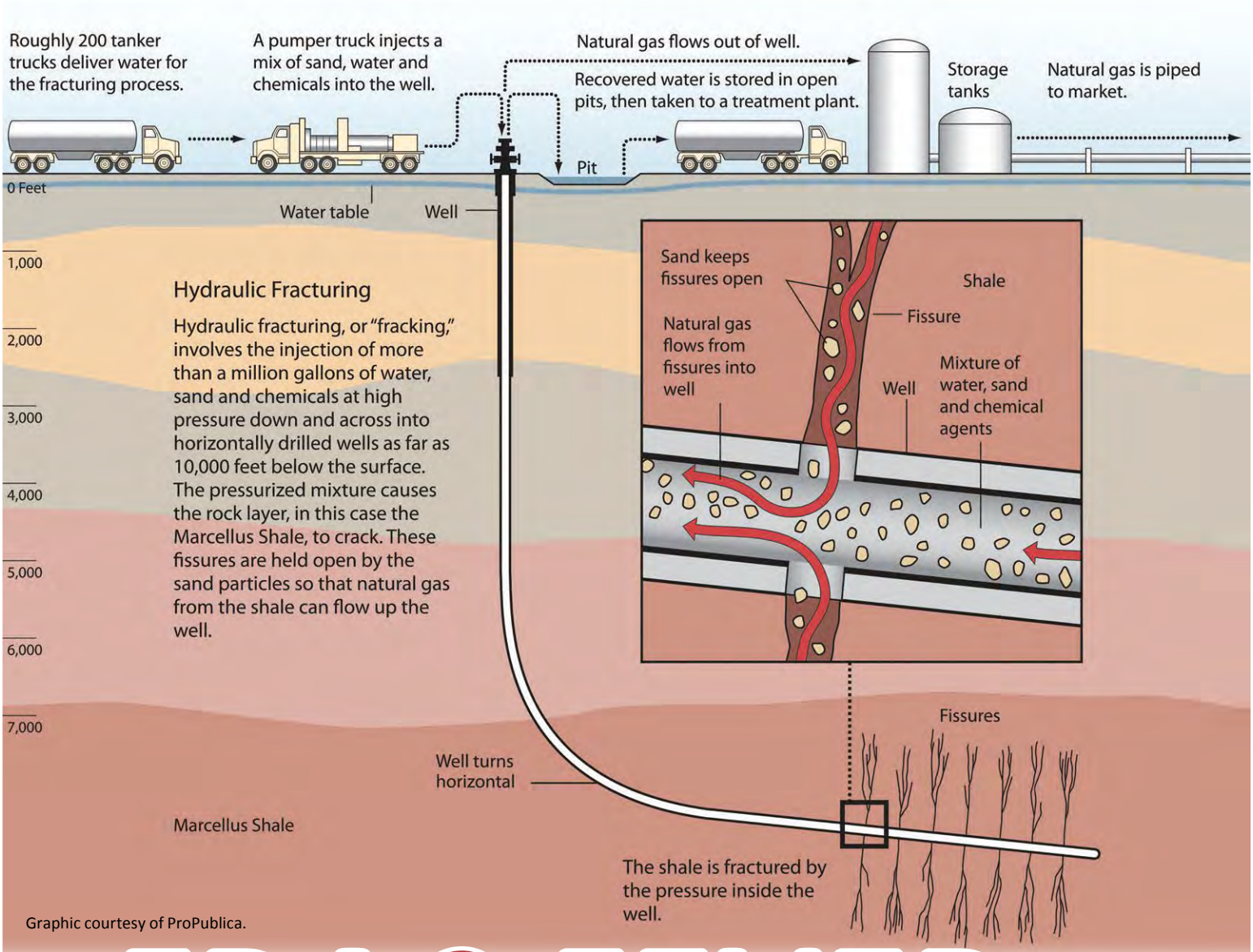

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FRAC FEVER HEATS UP

- **A 21st-century global oil and gas boom has resulted from new technology that allows previously unrecoverable resources in tight shale and sandstone formations to be mined.**
- **The process—known as hydraulic fracturing, or "fraccing"—forces pressurized fluid containing surfactants and other additives into rock, fracturing it, and thereby allowing gas and oil to flow.**
- **This boom is a source of great opportunity for surfactant researchers and manufacturers.**

Catherine Watkins

The local economy is flourishing in Midland, a small city in the middle of the large oil- and natural gas-producing area in west Texas (USA) known as the Permian Basin.

It isn't difficult to figure out why: An online search in April 2013 found that Midland had 801 telephone listings for companies that provide services for hydraulic fracturing (or fraccing)—the activity at the heart of the city's success. In fact, a 21st-century shale oil and gas boom (or "frac fever") is occurring all over the

world, thanks to new technology and the identification of numerous vast formations of fine-grained black shale and sandstone in which oil and natural gas were trapped millions of year ago. Because surfactants are an important component of the fluid used to fracture (frac) the oil- and gas-bearing rock, the boom is a source of great opportunity for surfactant researchers and manufacturers.

HOW IT WORKS

Since the 1940s, an estimated one million mainly vertical wells have been fracced in the United States alone. Most of this work, however, was done to stimulate existing wells. Beginning in the 1980s, a new technique for horizontal drilling developed by Mitchell Energy & Development allowed previously unrecoverable resources to be mined and has resulted in today's frac fever.

Gas and oil in shale are trapped in individual pores about half the width of a human hair. Pumping pressurized water through the well fractures the rock and creates a network of interconnected spaces that allow natural gas and oil to flow, but many of the fractures snap shut as soon as the pumps are turned off. Mitchell solved that problem by adding proppant (a contraction of "propping" and "agent"; usually sand or ceramic beads) to the water, along with a cocktail of chemicals—and by drilling the well horizontally once the vertical well-bore hit the bed of gas- and oil-bearing rock. Fracced wells can reach a vertical depth and horizontal distance of up to two miles in both directions (more than 3,000 meters). This new high-volume hydraulic fracturing method not only allowed access to previously unrecoverable fossil fuels, it also used much more fluid than previous methods, at around 5 million gallons (almost 19 million liters) per well per frac.

After fracturing, the internal pressure of the shale or other formation forces the injected fraccing fluid to the surface where it is stored in tanks or pits prior to disposal or recycling. These recovered fluids are referred to as "flowback." Disposal options for flowback include discharge into surface water or underground injection.

HOW MUCH IS THERE?

Estimates of the amount of shale gas and oil—known as unconventional resources—available for recovery using today's technology vary widely. The most recent (2011) guesstimate by the US Energy Information Agency (EIA) of "technically recoverable shale gas resources" in 33 countries including the United States was 6,622 TCF (trillion cubic feet), or 188 trillion cubic meters. To put that in perspective, the EIA estimated that the US consumption of natural gas in 2011 was about 24 TCF. Similarly, the International Energy Agency (IEA) suggested at the end of 2011 that the global reserves of recoverable global shale oil may be more than 3 trillion barrels (480 billion cubic meters). By comparison, IEA in 2011 estimated remaining global conventional oil reserves at almost 2.3 trillion barrels.

Investment money is flowing along with shale oil and gas. Goldman Sachs Group Inc. reported that in 2011, the US oil and gas industry invested $138 billion into exploration and production of shale oil and gas. (See http://tinyurl.com/Goldman-Sachs-boom.) That compares to $35 billion in China, $10 billion in Russia, and $5 billion in Saudi Arabia. Testimony by the Dow Chemical Co. in February 2013 before the US Senate Energy and Natural Resources Committee attributed more than 100 new US chemical industry projects and $95 billion in new investments to frac fever. Dow itself is investing $4 billion in new US facilities related to fraccing, the company said (see http://tinyurl.com/Dow-Testimony).

MARKET REALITIES

To date, hydraulic fracturing has involved mostly brute force as gas and oil producers used more and more horsepower, fraccing fluid, and proppant to drive hydrocarbons out of the earth. Unlike chemically enhanced oil recovery, which is a slow and relatively expensive process, fraccing is quick and comparatively inexpensive. A further push for speed on the part of oil and gas producers is that mineral leases revert back to the owners if drilling isn't accomplished within a defined period of time.

"Many oil and gas producers have been playing the odds," noted one industry observer, who asked to remain anonymous. "They could drill 10 wells, and if they got several with decent returns, it would cover the ones without good returns."

CONTINUED ON NEXT PAGE

Is it frac, frack, frac' or ?

Anyone writing about hydraulic fracturing is faced with a consuming question at the outset—how to spell the shortened and gerund forms. Should they be frack/fracking, frac/fraccing, frac/fracing, or frac/frac'ing?

The answer depends largely on whether you are involved in the activity or not. The popular press and anti-drilling activists both use "frack/fracking." As Andrew Maykuth of the *Philadelphia Inquirer* newspaper pointed out in 2011, frack sounds "harsh, threatening, and vaguely profane." In fact, Maykuth reported that a local public relations firm tested "frack" against other resource-extraction terms and found that it scored even lower in positive characteristics than "strip mining."

Critics of the frack/fracking form of abbreviation also point to the faux curse invented in 2004 (per Wikipedia) by writers of the science-fiction television series "Battlestar Galactica": frak. All in all, many of those in the oil and gas recovery industry prefer any spelling other than frack.

So why did *Inform* relegate "frac/fracing" to the editorial scrapheap despite its frequent use in the industry? Whereas "frac" is fine, its gerund form—"fracing"—is confusing to anyone with a rudimentary knowledge of phonetics. The single consonant leads readers to believe the word rhymes with "racing" or "facing."

Will Brackett, managing editor of the *Powell Shale Digest*, a trade weekly published in Fort Worth, Texas, USA, coined "frac'ing." He wrote that he "take[s] exception to the fact that drilling opponents have taken to using frack as a euphemism for a curse word I can't print in this family newsletter." We find the apostrophe unsettling, though, which took frac/frac'ing out of the running.

All things considered, "frac/fraccing" was the clear winner and has duly been entered into the official *Inform* stylebook.

An FTS International drilling pad in Washington County, Pennsylvania, USA, in the Marcellus Formation shows fluid tanks, multiple truck-mounted pumps, and personnel trailers. Photo courtesy of FTS International.

Baker Hughes AquaStar™ surfactant-based fracture fluid, a visco-elastic surfactant gel (US No. 20120241153 A1, patent pending).

As with any new technology, the market for fraccing surfactants and additives is still very fragmented, according to consultant Neil Burns of Neil Burns LLC in Freehold Township, New Jersey, USA. "It is really the oilfield service companies that are at the nexus of this whole industry," he said. "They are the ones that will be selecting and deploying the surfactants and other additives that will be used." The largest service companies include Baker Hughes, Halliburton, and Schlumberger. But hundreds of small firms (remember the Midland phone listings?) able to conduct basic fraccing using simple fluid systems also exist.

Then, there are what Burns calls "satellites" around the service companies: specialty chemical manufacturers (Solvay, Clariant, and Huntsman, for example); a "host" of distributors; and secondary formulators such as FTS International (formerly Frac Tech Services), who buy surfactants and additives and sell them to the service companies. In the background, watching all the frantic activity with great interest, sit the suppliers of basic surfactant feedstocks such as Chevron/Phillips, Shell, SABIC, and Sasol.

WHAT IS IN FRACCING FLUID?

The precise formulation of fraccing fluid (which varies from well to well) is a trade secret held by the service companies that supply fluid to the oil and gas producers. However, chemicals commonly found in fraccing fluid are listed in Table 1.

A subcommittee of the Energy and Commerce Committee of the US Congress reported in 2011 that the 14 leading oil and gas service companies used more than 780 million gallons (almost

TABLE 1. Purpose and percentages of product types found in hydraulic fracturing fluid[a]

TYPE OF ADDITIVE	PURPOSE	REPRESENTATIVE COMPOUND	% BY MASS
Carrier/base fluid	Fracture the rock	Fresh water	90%
Proppant	Holds fractures open after flowback	Silica, quartz sand	9.5%
Diluted acid (15%)	Helps dissolve minerals and initiate cracks in the rock	Hydrochloric acid	0.5%
Anti-bacterial agent	Eliminates bacteria in the water that produces corrosive by-products	Glutaraldehyde	
Breaker	Allows a delayed breakdown of the gel	Ammonium persulfate	
Clay stabilizer	Prevents formation clays from swelling	Choline chloride	
Corrosion inhibitor	Prevents corrosion of the pipe	Methanol and/or propargyl alcohol	
Crosslinker	Maintains fluid viscosity as temperature increases	Methanol and/or boric acid	
Friction reducer	"Slicks" the water to minimize friction	Hydrotreated light petroleum distillate	
Gelling agent	Thickens the water to suspend the sand	Guar gum	
Iron control agent	Prevents precipitation of metal oxides in the pipe	Citric acid	
pH adjusting agent	Maintains the effectiveness of other components, such as the crosslinker	Potassium hydroxide	
Scale inhibitor	Prevents scale deposits in the pipe and in surface equipment	Ethylene glycol and/or diethylene glycol	
Surfactant	Increases the viscosity of the fracture fluid	Seldom listed in material safety data sheets	

[a]Sources: US Department of Energy and fracfocus.org.

3 billion liters) of hydraulic fracturing products—not including water—between 2005 and 2009 in US fraccing activities. Overall, the companies employed more than 2,500 products containing 750 different components.

Of those products, 279 contained at least one chemical or component that was deemed to be proprietary. As a result, the oil and gas production companies injecting the fluids often do not know what they are injecting because they purchase the fluids from service companies such as Halliburton or Baker Hughes, who regard select ingredients as confidential business information.

Surfactants constitute the largest chemical component by weight in fraccing fluid, according to the Environmental and Energy Study Institute, a nonprofit organization founded in 1984 by a bipartisan US Congressional caucus. According to a spokesperson for Houston, Texas-based Halliburton Co., which performed two of the first commercial hydraulic fracturing treatments in 1949 and is one of the largest oilfield service providers: "The surfactant functionality is widely variable . . . . [Surfactants] can be used as emulsion breakers, emulsion formers, foamers, defoamers, surface-modifying agents, suspension aids, viscosifiers, [and for] contact angle modification, surface tension modification, [as a] mobilization aid, and [for] other functions. The applicable functionality of the surfactant used will depend on the individual well characteristics and needs of the enhanced oil recovery or stimulation treatment."

VISCOELASTIC SURFACTANT GELS

Unlike smaller oilfield service companies and surfactant manufacturers, the larger companies have been working for some time on

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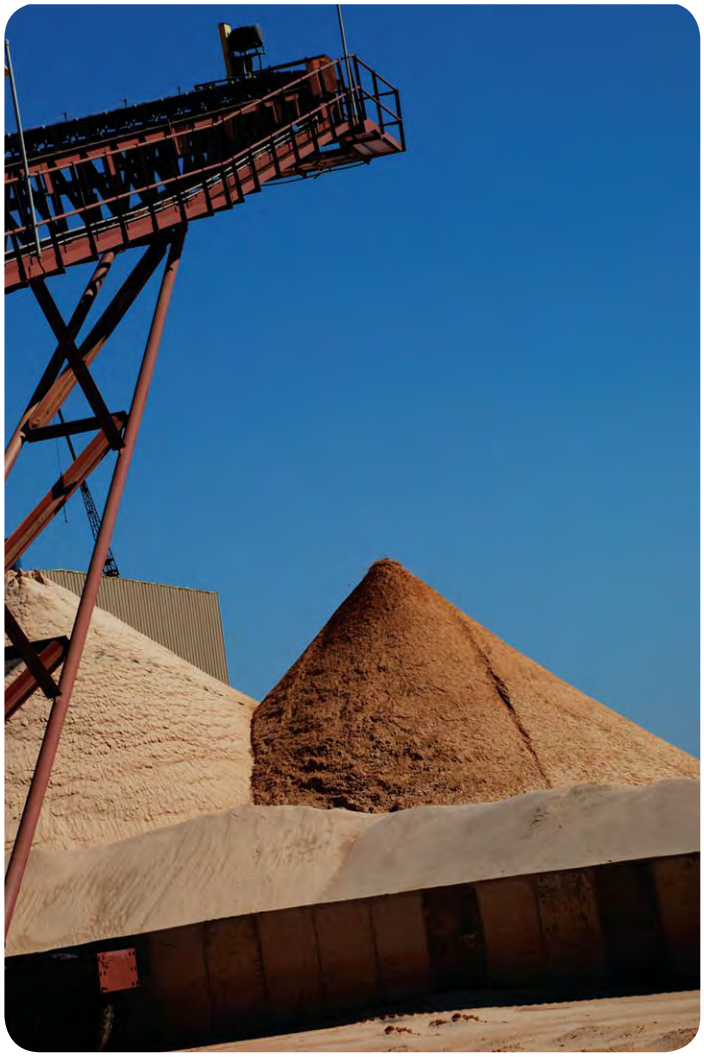

Mounds of sand that will be used as proppant at an FTS International frac site. Photo courtesy of FTS International.

how to enhance shale oil and gas recovery. At Baker Hughes, D.V. Satya Gupta has been researching both conventional and unconventional fracturing fluids as business development director for production enhancement technology at the company's Pressure Pumping Technology Center in Tomball, Texas, USA.

"Traditionally, surfactants have been used to lower surface tension, modify the contact angle [a quantitative measure of the wetting of a solid by a liquid], and to recover the fluid after the operation is completed," noted Gupta. Guar or guar derivatives are added to traditional fraccing fluid (normally water) to increase viscosity to carry the proppant inside the fracture. Natural polymers, however, tend to leave residue (and serve as a food source for bacteria, necessitating the use of biocides), which blocks the pathway and reduces conductivity, hence the need for alternative surfactants.

Gupta and his team have been looking at viscoelastic surfactant (VES) gel systems to replace natural polymers in fraccing. "In principle, these gels are like the gels you see in shampoos. They are of low molecular weight and do not leave residue. They also have better suspension properties for the proppant," he said. Further, VES gels can withstand higher temperatures, remaining stable to 275°F (135°C), and can be made with seawater or produced water (water from the formation that is brought to the surface with oil or gas).

According to Gupta, the technology of VES systems can be classified based on the structures they create: worm-like micelles, lamellar structures, or vesicles. "As the concentration of surfactant increases in water, micelles start to form," he noted. "Further increasing the concentration exceeds the critical micelle concentration for the surfactant in water; these molecules start interacting with each other. These interactions are based on ionic forces and can be amplified by adding electrolytes (salts) or other ionic surfactants. Depending on the ionic charges, and the size and shapes of

INFORMATION

Some fast facts about fraccing

- The main sources of information about the components found in fracturing fluid are FracFocus.org and FracFocus.ca. These websites are a joint project of the Ground Water Protection Council and the Interstate Oil and Gas Compact Commission. Most of the major oil and gas producers have voluntarily submitted data from more than 40,000 US and Canadian wells, although most information about surfactant usage has been deemed to be proprietary. According to ExxonMobil, oil and gas producers are "pursuing similar disclosure approaches in Europe and other areas where we are exploring internationally."
- The Society of Petroleum Engineers hosts a wiki (a website developed collaboratively by a community of users) at PetroWiki.org. The site contains a wealth of information on fraccing fluid formulation.
- Research announcements: General Electric said in April 2013 that it will build a $110 million research center in Oklahoma to study hydraulic fracturing. FTS International (formerly Frac Tech Services) is opening a new technology center in Houston to develop new fraccing fluids and proppants.
- In 2005, hydraulic fracturing was exempted by the US Congress from any regulation under the Safe Drinking Water Act. In 2014, the US Environmental Protection Agency is scheduled to deliver a report on the potential impact of fraccing on drinking water and groundwater. In March 2013, the agency selected 31 experts to review the report. (See www2.epa.gov/hydraulicfracturing.)
- Ecolab, the industrial and institutional cleaning company based in St. Paul, Minnesota, USA, has been building its holdings in water remediation and fraccing additives. It merged with Nalco, a leading water treatment company, in 2011. In 2012, Ecolab acquired oilfield additives producer Champion Technologies (Houston, Texas, USA). In a deal with the US Department of Justice reached in April 2013, Ecolab agreed to divest certain assets, patents, and licenses to Swiss chemical producer Clariant, another supplier of oilfield chemicals, in order to maintain the competitiveness of the marketplace.
- For *Inform*'s look at chemically enhanced oil recovery, see http://tinyurl.com/CEOR-2009.

the surfactants and these counter ions, ordered structures start to form, which increase viscosity and elasticity."

Gupta noted that the structures can be disrupted by adding other surfactants, ionic additives, and hydrocarbons (from the rock formation or mutual solvents or other solvents) or can be diluted by additional formation water. "The most common commercial systems use cationic surfactants with inorganic salts or with anionic surfactants," said Gupta. "Anionic surfactants with inorganic salts are also common. Zwitterionic and amphoteric surfactants in combination with inorganic salts have also been used."

THE LAW OF UNINTENDED CONSEQUENCES: GUAR GUM

The ever-increasing need for guar gum in fraccing fluids—and the resulting price volatility—has led to problems for the food industry. Guar gum is a hydrocolloid that is eight times more viscous than cornstarch and is produced from the endosperm of the guar bean. It is used as a thickener in everything from ice cream to baked goods to salad dressings . . . and hydraulic fracturing fluid.

India produces 80% of the world's supply of guar gum. Normally, 60% of its exports go to the oil industry and 40% to the global food industry, according to *The Wall Street Journal* (*WSJ*) newspaper. Talk about volatility: In May 2012, the export price of a metric ton (MT) of guar gum was $27,000, the *WSJ* noted, plunging to $7,000/MT in December 2012.

In 2012, high prices meant that only 20% of India's exports went to the food industry, which is trying to find alternatives to guar, along with the oil and gas industry.

SHALE IMBIBITION RESEARCH AT UND

All signs point to a future in which oil and gas producers as well as oilfield service providers make better use of research and technology for more focused fraccing efforts in order to maintain profitability.

Several US universities have active research programs, including the University of Texas in Austin, Texas A&M in College Station, and the University of North Dakota (UND) in Grand Forks. Dongmei Wang and her team at UND are studying the Bakken shale formation that lies under a good portion of North Dakota for clues about optimal surfactant formulation for shale oil recovery. They plan to investigate shale gas recovery in future studies.

Wang is a recent transplant from China, where she was a noted petroleum engineer with that country's largest oil producer, PetroChina Co. Ltd. At UND, she and her team are determining which surfactant formulations can stimulate shale oil recovery through "imbibition," or displacement of one fluid by another. She estimates that every 1% increase in recovery could lead to an increase of 2 to 4 billion barrels of oil production.

In an initial study presented at the Society of Petroleum Engineers (SPE) Annual Technical Conference and Exhibition (doi:10.2118/145510-MS, 2011), Wang's group found that an

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A boom goes bust

In 1969, the US Atomic Energy Commission (the predecessor to today's Department of Energy, or DOE) detonated a 40-kiloton nuclear device 8,426 feet (2,568 meters) below the ground surface in western Colorado in an attempt to release commercially marketable quantities of natural gas. The production of natural gas stimulated by the detonation was "less than anticipated," the DOE notes in a fact sheet. Further, "although approximately 455 million cubic feet [12.9 million cubic meters] of natural gas was produced, elevated levels of radioactivity in the gas made it unacceptable for use at that time."

DOE continues to monitor groundwater in the area for radioactive contamination. None has been detected.

ethoxylated nonionic surfactant, internal olefin sulfonated anionic surfactants, and an amine oxide cationic surfactant were more stable than the other surfactants studied for temperatures at 105–120°C. Further, for any given surfactant, "oil recovery can be maximized by identifying an optimal surfactant concentration, brine salinity, sodium metaborate concentration, and divalent cation content."

A second study, published in *SPE Reservoir Evaluation & Engineering* (doi: 10.2118/153853-PA, 2012), refined the team's initial work. "Positive results were generally observed with all four surfactants: amphoteric dimethyl amine oxide, nonionic ethoxylated alcohol, anionic internal olefin sulfonate, and anionic linear α-olefin sulfonate," Wang and her team write. "From our work to date, no definitive correlation is evident in surfactant effectiveness vs. temperature, core porosity, core source (i.e., Upper Shale or the Middle Member), or core preservation (sealed) or cleaning before use."

Industry observers note that one issue with transferring university-based research into widespread use is the lack of good public field data correlated to laboratory studies because producers and service companies consider oilfield data to be confidential.

WHAT'S NEXT?

Brian Mueller agrees that the days of fraccing using mainly brute force are coming to an end. Mueller is director of research and development at CorsiTech, a specialty chemicals manufacturer in Houston, Texas. CorsiTech's primary focus is chemical additives for drilling fluids, but the company also develops specialty chemicals for mining, personal care, and asphalt additives.

"Producers and service companies are looking for technology that gives price performance in addition to enhanced recovery," said Mueller. Another key concern to producers, he noted, is environmental friendliness, given the public furor surrounding fraccing.

"Clearly, we are heading toward a future in which the industry will be interested in customizing surfactants to specific conditions in specific formations," he noted. "In the end, the companies that will do well are the ones with surfactant laboratories who are doing the research."

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

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COURTESY OF ROTHSAY

Fat fight: Catch-22 for Western oleochemicals?

Doris de Guzman

The American Cleaning Institute (ACI), which represents producers and consumers of oleochemicals in North America, has long requested government policies that limit the use of animal fats for biofuel production. But such requests have intensified as competition and prices for these historically low-cost raw materials continue to rise. Most recently, the trade group urged the US Congress and the US Environmental Protection Agency (EPA) to remove animal fats from all biofuel tax credit schemes as well as the EPA's Renewable Fuel Standard (RFS) Program.

CONTINUED ON NEXT PAGE

- **Animal fats have historically allowed Western oleochemical producers to remain competitive in the global market by providing them with a cost-competitive raw material.**
- **Increasing use of fats and grease for biofuel worldwide has led to higher animal fats prices and curtailed supply for oleochemical production. Meanwhile, suppliers cannot expand production of animal fats, because they are a by-product of meat processing.**
- **Government policies and subsidies designed to help biofuels compete with petrofuels continue to stimulate biofuel production, which increases the competition for animal fats and continues to erode the competitive raw material edge Western oleochemical producers say they need to compete globally.**

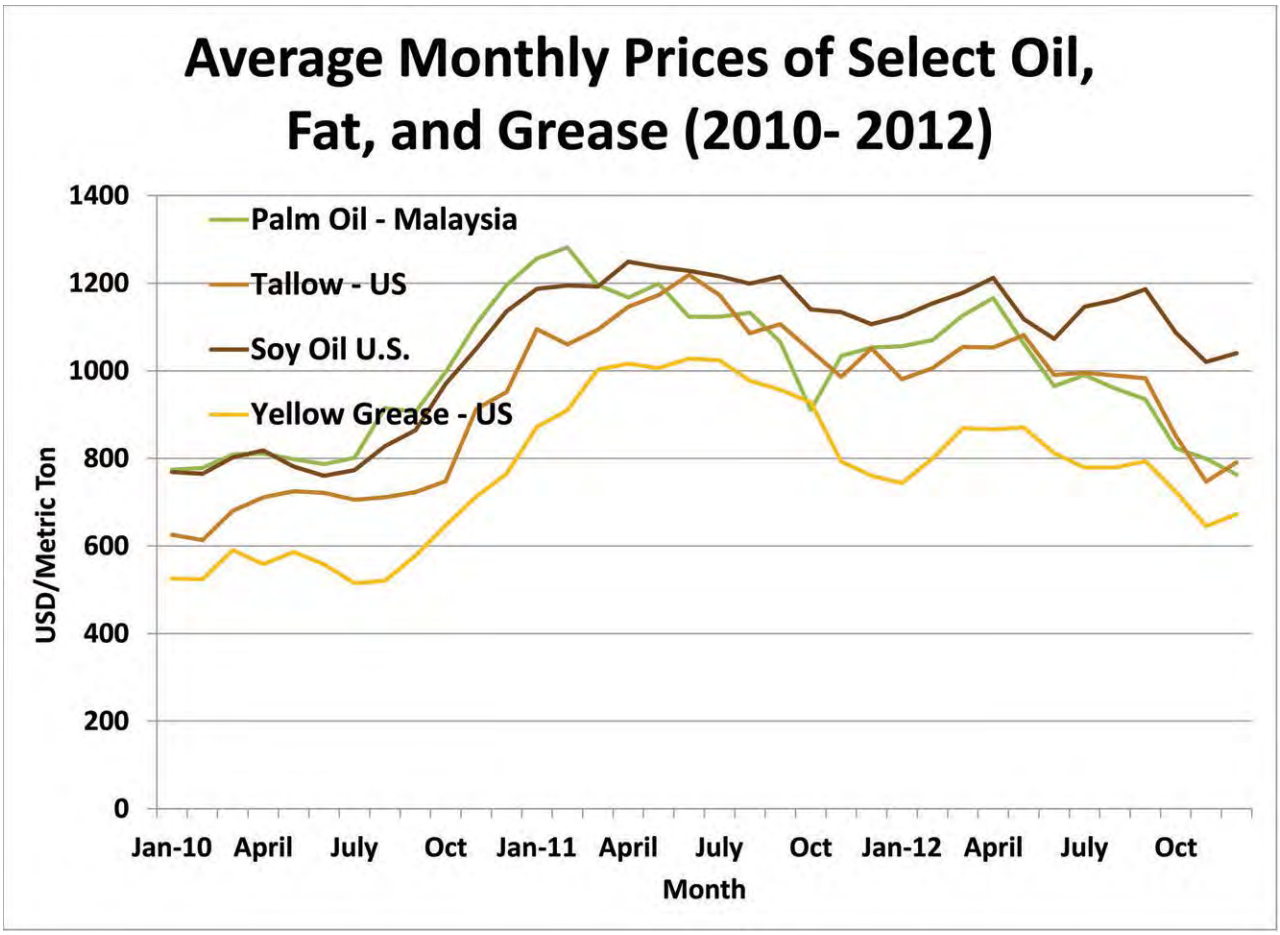

FIG. 1. Average monthly prices of select oil, fat, and grease (2010–2012).

"We are not opposed to biofuels. We are opposed to misguided government subsidies that negatively affect the price and availability of animal fats, a key feedstock for the oleochemical industry," said Douglas Troutman, ACI Vice President and Counsel, Government Affairs, in a recent statement.

"Energy tax credits, if used, should encourage the development and use of new raw materials that do not compete with established uses such as oleochemical production," he added.

According to ACI, members of the US House Ways and Means Committee are currently examining ideas to reform the tax code. ACI hopes that the unintended consequences of energy tax incentives for using tallow as a feedstock will come up in these discussions.

For example, the American Jobs Creation Act of 2004 included a $1 per gallon ($0.26 per liter) tax incentive for production and use of biodiesel to make biofuel competitive with traditional diesel fuel. Additionally, the Energy Independence and Security Act of 2007 (EISA) established a requirement for blending of a minimum volume of biodiesel into traditional diesel fuel under the EPA's RFS, beginning in 2010.

The EPA specifies the RFS volume on an annual basis depending on biofuel market fundamentals and energy-related factors. For 2013, the EPA boosted the RFS volume requirements for biomass-based diesel to 1.28 billion gallons (4.84 billion liters) from 1 billion gallons required in 2012 and 800 million gallons in 2011. Biofuels that use animal fats for feedstock are included in the biomass-based diesel category.

"Since passage of the American Jobs Creation Act of 2004, government policy has increasingly driven and subsidized the diversion of animal fats to biofuel production via tax credit supports," said ACI's Troutman.

"The use of animal fats for oleochemical production has historically allowed the domestic industry to compete in the global market by providing a cost-competitive raw material. That competitive raw material edge is now being profoundly eroded," he added.

Historically, the oleochemical industry consumed about 10% of the production of tallow and grease in the United States, according to the National Renderers Association (NRA). Domestic tallow production in 2012 fell 5% to 2.65 million metric ton from 2011 production.

CONTINUED ON PAGE 352

Animal fats around the world

SOUTH AMERICA

Brazil's rendering association SINCOBESP estimated that 1.9 metric tons of animal fats were produced in Brazil in 2011 and were primarily used domestically. Around 42% was used for cleaning products/soap, 32% in animal feed, and 18% for biodiesel. Tallow in Brazil is mostly used for soaps (56%), biodiesel (25.6%) and animal feed (12.5%)

The Latin American rendering association, La Asociación Latino Americana de Plantas de Rendimiento (ALAPRE), reports that the rendering industry in Brazil consists of 512 registered plants under federal inspection with meat packers and recyclers comprising the largest segment. About 34% of the processors are independent processors, with 343 integrated to slaughterhouses. Biodiesel production focused on animal fat in Brazil is concentrated in four states: São Paulo, Mato Grosso, MatoGrosso do Sul, and Rondonia.

In Argentina, about 60% of the rendering industry is concentrated among five companies. In 2011, production of protein meals and animal fats reached 800,000 metric ton, according to ALAPRE.

AUSTRALIA

The Australian Renderers Association indicated that total animal fats production in the region was 546,700 metric ton in 2011, of which 362,000 metric ton was exported. Tallow production in 2011 was 487,000 metric ton valued at A$483.1 million (US$503.7 million). Domestic use of tallow for oleochemical and industrial use was pegged at 50,000 metric ton in 2011, and biodiesel and fuel use was at 15,000 metric ton.

Tallow exports to China, Australia's largest market, were disrupted in 2012 as consumers found industrial tallow from Chinese food factories, the association said. In 2011, sales to Singapore expanded to almost 100,000 metric ton from a mere 35 metric ton in 2010 mostly due to demand from Neste Oil's biodiesel plant. Demand from the Neste Oil plant, however, weakened at the end of 2011 as Neste Oil also sourced its tallow from North America and South America to round out supply and quality issues.

Australia is said to be looking to export tallow to the EU for biodiesel use, but EU authorities are concerned over Australian cattle being treated with growth hormones. Australian renderers are working with the EU government and are waiting for the market to open.

CANADA

According to the US Department of Agriculture's Foreign Agricultural Service report on Canada Biofuels published in June 2012, Canada's share of biodiesel production using animal fats was expected to fall to 38% from 60% share in 2011 as new biodiesel plants started using other feedstocks primarily canola oil.

The report estimated 2012 animal fats use for Canadian biodiesel production was at 84,000 metric ton, down from 105,000 metric ton of animal fats consumed for biodiesel in 2011.

The share of animal fats-based biodiesel production is expected to fall further in 2013 to 32% with the expected completion of two biodiesel plants in Canada, one having a capacity for 265 million liters of canola oil and the other with a capacity for 170 million liters of canola/soybean oil.

Projected canola-based biodiesel production is estimated to increase from 63 million liters in 2012 to 188 million liters in 2013, and even further in 2014. Key competitors facing canola oil for use in biodiesel are tallow, yellow grease, imported palm oil, and soybean oil.

On top of this decline from the biodiesel sector, the Canadian Renderers Association (CRA) continues to face challenges with tallow export to China and grease theft.

Canadian tallow export to China has been open since mid-2012 but so far no product has been shipped due to a the presence of a box on the importation certificate that requires a Chinese import permit number, and according to renderers, China does not issue import permits.

The Chinese government's concern is there is no control over the tallow once it arrives. China has closed its market to Canadian tallow for several years because of concern about mad cow disease.

TABLE 1. US biodiesel raw material usage 2010–2012 (metric tons)

U.S. Biodiesel Raw Material Usage 2010 - 2012 (metric tons)									
	Soybean Oil	Corn Oil	Canola Oil	Poultry	Tallow	White Grease	Yellow Grease	Other Recycled	TOTAL
2010	517,549	50,802	112,491	44,906	77,111	151,046	110,677	19,051	1,083,632
2011	1,883,769	138,346	384,193	108,862	194,591	241,765	213,642	88,904	3,254,072
2012	1,824,802	259,001	356,977	77,111	173,272	185,519	278,052	130,181	3,284,916

According to the NRA, the use of animal fats in biodiesel production increased by 98% between 2010 and 2011 as the RFS mandate ramped up its volume requirements (see Table 1, page 351).

TALLOW IN RED

Consumption of tallow for biodiesel production in Europe has also risen with the implementation of the Renewable Energy Directive (RED) of the European Union (EU), which set a target for the EU to reach a 20% share of energy from renewable sources by 2020 and to achieve up to a 10% share for biofuels in its energy transport use.

Under RED, tallow receives double tax benefits because it is considered a waste product not directly obtained from agriculture. This makes it a more attractive feedstock for biofuel producers. In addition, the European Commission proposed to amend RED late in 2012 with the stipulation that food crop-based biofuels will be capped at 5%, which could lead to more use of biomass-based feedstock that includes animal fats.

The proposal only allows Categories 1 and 2 tallow to be counted twice under RED. Category 1 tallow is only used for energy purposes and is not allowed to enter the human or animal food chains. Category 2 tallow can be used for technical purposes such as oleochemical products and specialty chemicals, whereas Category 3 tallow can be used for animal feed and cosmetics.

When products of different categories are mixed, the entire mix is classified according to the lowest category in the mix. For example, if Categories 1 and 3 tallow are mixed then this blend is classified as Category 1.

According to the European Fat Processors and Renderers Association (EFPRA), demand for animal fats for biodiesel remained strong in 2011, particularly for Categories 1 and 2 fats. About 280,000 metric tons of fat from Categories 1 and 2 material was used in biodiesel production last year, up from 218,000 metric tons in 2010.

Consumption of animal fats for soap and oleochemicals manufacture in the EU was steady at 547,000 metric tons of animal fats or about 22% of total fats consumed in 2011. EFPRA plans to release its 2012 statistics in the second quarter of 2013.

ANIMAL FATS GAIN

Given the supply inelasticity of animal fat, its increased consumption in the energy sector led to historic price rises in 2011 for tallow and greases (Fig. 1, page 350).

Tallow suppliers cannot respond to higher prices by expanding output since tallow is a by-product of meat processing. Tallow, previously a discount commodity, has now been commanding higher prices than palm stearin, especially in Europe. Palm stearin is increasingly being used to fill the hole

CONTINUED ON PAGE 384

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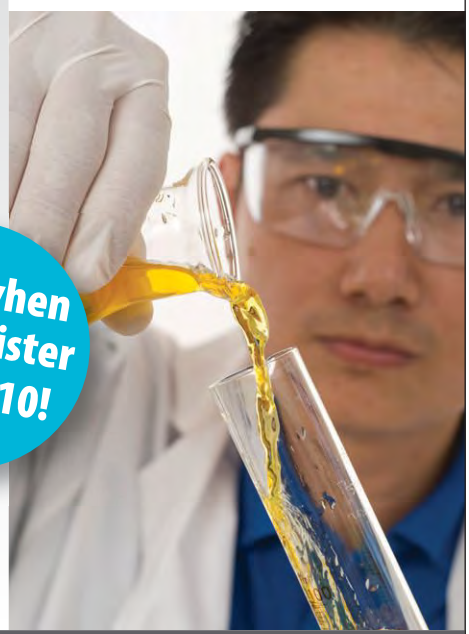

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Another quality meeting organized by AOCS **www.aocs.org/labworkshop**

NEWS & NOTEWORTHY

BRIEFS

DSM Nutritional Products (Columbia, Maryland, USA) and Monsanto (St. Louis, Missouri, USA) are collaborating to deliver the first SDA (stearidonic acid; an omega-3 C18 fatty acid) soybean oil for use in foods in North America. Monsanto had previously teamed up with DuPont's Solae soy ingredient company on what was to be branded as Soymega SDA soybean oil. That partnership is no longer in effect, according to a DuPont spokesperson. According to a joint news release by DSM and Monsanto, DSM will have the "exclusive global rights to brand, market, package and sell the SDA soybean oil to the food industry."

■■■

In April 2013, Raisio sold its US esterification plant to Avoca Inc., a Kearny, New Jersey-based subsidiary of Pharmachem Laboratories Inc. Production of plant stanol ester, an ingredient in Raisio's portfolio of Benecol-brand cholesterol-lowering products, will now be centralized at Raisio's factory in Finland. Net sales of the Benecol business totaled €45 million ($59 million) in 2012, according to Raisio.

■■■

Richardson Oil Seed (Winnipeg, Manitoba, Canada) will begin expansion of its canola processing plant in Lethbridge, Alberta, in early 2014. The project is scheduled to be completed by the end of 2015. The expansion will increase processing capacity to 820,000 metric tons of canola oil per year and improve plant efficiency, according to the company.

■■■

Canola oil is now generally recognized as safe (GRAS) by the US Food and Drug Administration (FDA) for use as an ingredient in infant formula sold in the United States. The oil can be used at levels up to 31% of the total fat content, FDA said. ■

Recent Codex meetings have implications for oils and fats

Two Codex Alimentarius Commission (CAC) committees met recently: the Codex Committee on Fats and Oils and the Codex Committee on Methods of Analysis and Sampling. Several actions taken by the committees have ramifications for the global fats and oils industries. (See http://tinyurl.com/Codex-2013 to access both reports.)

CAC was formed in 1962 by two agencies of the United Nations—the Food and Agriculture Organization (FAO) and World Health Organization (WHO). Work has continued since then to develop internationally recognized standards, codes of practice, guidelines, and other recommendations relating to trade in foods, food production, and food safety.

CCFO MEETING

The Codex Committee on Fats and Oils (CCFO) met in Langkawai, Malaysia, from February 25–March 1, 2013. The committee forwarded three items to CAC for action: (i) a proposed draft amendment to parameters for rice bran oil in the Standard for Named Vegetable Oils, (ii) amendments to the standards for fats and oils not covered by individual standards, for named animal fats, and for olive and olive pomace oils; and (iii) amendments to the lists of acceptable previous cargoes.

The US proposal for including high-oleic soybean oil in the Standard for Named Vegetable Oils was put on hold in lieu of more detailed production and export forecasts. A proposal by Australia, the United States, and Argentina to raise the limit for campesterol in extra virgin olive oil from 4.0 to 4.8% was shelved by CCFO. The official CAC report on the meeting noted that some delegations advocated waiting for the results of a three-year survey of campesterol levels by the International Olive Council (IOC; Madrid, Spain). The IOC did not attend the Codex meeting, citing budget problems.

In other work, the proposed standard on fish oils was sent back for redrafting, comments, and further discussion at the next meeting of CCFO in 2015. CCFO also requested CCMAS to look into a method of

CONTINUED ON NEXT PAGE

analysis for relative density and requested the Codex Committee on Contaminants in Foods to reevaluate the level of lead and arsenic in fish oils.

Additionally, CCFO agreed to a proposal by Canada that the working group should review the category of white mineral oils in the Codex List of Acceptable Previous Cargoes. The goal is to check which accepted daily intake levels of white mineral oils are acceptable and which could be of a food safety concern.

CCMAS MEETING

The Codex Alimentarius Committee on Methods of Analysis and Sampling (CCMAS) met from March 4–8, 2013, in Budapest, Hungary. Among other items, CCMAS worked on methods of analysis for *trans* fatty acids (TFA) and for relative density.

Several entities are working on TFA, including the WHO Nutrition Guidance Expert Advisory Group, which is reviewing the definition of TFA. The observer from the International Dairy Federation (IDF) informed CCMAS that IDF is working with the Institute of Food Technologists to develop a method for fatty acids, including TFA, for milk products, infant formulae, and adult nutritionals. The method is expected to be published in 2014 and will also be published by AOAC. Richard Cantrill, AOCS chief science officer and director of Technical Services, noted that AOCS has developed a method (AOCS Ce 1j–07) for fatty acid analysis including TFA, with full collaborative study data for complex food and feed matrices.

Further, AOCS will reinstate a previously archived method for relative density and then submit it for endorsement by CCMAS, per a request by CCFO.

In other work, CCMAS decided to replace the current IUPAC (International Union of Pure and Applied Chemistry) method for erythrodiol + uvaol content with COI/T.20/doc. No 30-2011, as proposed by the CCFO. With regard to the use of this method for the determination of sterol composition and total sterols, CCMAS questioned whether the IOC method was equivalent to ISO 12228:1999 (current method) and agreed to ask CCFO for clarification.

CCMAS agreed with the conclusion of the Inter-Agency Meeting (IAM) that analytical ranges in commodity tables should only be changed in response to the availability of the uncorrected results of analysis. (IAM organizes regular summits of international organizations working in the field of methods of analysis and sampling of food products and associated quality assurance measures prior to CCMAS meetings.)

On another topic, IAM presented a discussion paper to CCMAS concerning the evolution of sampling in the framework of Codex that detailed earlier discussions on measurement and sampling uncertainty. At issue: In some cases, Codex committees simply refer to the Codex General Guidelines on Sampling instead of selecting specific sampling plans.

The IAM report considered four possibilities: (i) acceptance sampling, (ii) the estimation of the total uncertainty from both analysis and sampling, (iii) representative/pragmatic uncertainty, and (iv) auto-control. After discussion, participants agreed that IAM will develop a new discussion paper for consideration at the next session of CCMAS. This report will review existing and possible new approaches to the establishment of sampling plans within Codex. Interested parties wishing to participate in this work may do so by providing their contribution directly to IAM through AOCS, which serves as the IAM secretariat, or through a web-based platform that will be provided by the New Zealand delegation.

The next CCMAS meeting will be in 2014.

FDA asks for fees from industry to fund FSMA

In April 2013, the US Food and Drug Administration (FDA) released a budget request that called for industry "user fees" to fund 94% of the agency's proposed budget increase over the previous fiscal year, including new fees to support the Food Safety Modernization Act (FSMA) and strengthen the FDA's ability to oversee imported food. FSMA was signed into law in January 2011 and is still in the process of being implemented.

The budget includes spending cuts in several areas, the agency said, including a $15 million decrease in budget authority for human drug, biologics, and medical device programs.

"These investments will provide industry with consistent and transparent food and feed safety guidance to assure the safety of America's food and feed supply," the agency states in its budget proposal. It also asserts the price "is modest compared to the economic value it can deliver: reduced costs to industry, government, and the health care system due to less foodborne illness."

There are 48 million food-borne illnesses each year, FDA said, which lead to 128,000 hospitalizations and 3,000 deaths, at a total estimated cost of more than $78 billion.

The six new fees, according to the proposal, are:

- Food import user fee: This fee will support food and feed safety efforts and will have exemptions for small importers and a maximum charge for large importers. The number of food and feed imports has been growing by 10% each year, according to the agency. With more than 100,000 food and feed manufacturers in 130 countries exporting products to the United States, FDA is "hard-pressed to ensure safety."
- Food facility registration and inspection user fee: This fee will support food and feed safety modernization activities under FSMA, the proposal said. The revenue will allow the agency "to increase the effectiveness of inspections through adoption of preventive controls, training of personnel to inspect against the new prevention standards, and developing new ways to educate and inform industry," according to the agency.
- Food contact substance notification user fee: The FDA Modernization Act of 1997 established a premarket notification process for food contact substances known as the Food Contact Notification (FCN) program. The legislation requires that the FCN program can operate only if it is adequately funded; thus, this suggested new fee.
- The final three new user fees are not related to food and feed safety. Rather, they involve cosmetics, medical product reinspections, and the need to fund increased surveillance of FDA-regulated commodities,

CONTINUED ON PAGE 356

SUSTAINABILITY WATCH

Seven international organizations have introduced a practitioner's guide to sustainable sourcing of agricultural raw materials. "[The guide] provides a user-friendly, step-by-step roadmap to building and rolling out sustainable agriculture sourcing strategies," the groups said in a statement. The collaborating partners are: the Sustainable Agriculture Initiative (SAI) Platform, the CSL Learning Platform of IMD's Global Center for Sustainability Leadership, the International Trade Centre, and the Sustainable Trade Initiative. Furthermore, BSR, the Sedex Information Exchange, and the Sustainable Food Laboratory also contributed to the development of the guide and are supporting its outreach. Read about the SAI Platform at www.saiplatform.org and download the Sustainable Sourcing Guide at http://www.saiplatform.org/sustainable-sourcing-guide.

■■■

Forty-five (or reportedly about one-third) of Procter & Gamble's (P&G) facilities now send zero manufacturing waste to landfill, the company announced in April 2013. The company, which is based in Cincinnati, Ohio, USA, said that 99% of all material entering all of its plants leaves as finished product or is recycled, reused, or converted to energy. Some uses of recycled P&G waste include turning paper sludge from a Charmin toilet tissue plant into low-cost roof tiles for homes in Mexico and turning scrap from US wipe manufacturing processes into upholstery filling.

■■■

Cargill, BASF, and the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH are collaborating on a program to develop a certified coconut oil supply chain to enhance sustainability and improve the livelihoods of 2,500 Phillipine coconut growers. The program focuses on smallholder coconut growers on the island of Mindanao. It aims to raise farmers' incomes by improving productivity and coconut oil quality. It also will introduce the Sustainable Agricultural Network (SAN) standards as a basis for Rainforest Alliance Certification™ for coconut production. ■

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The agency expects these new fees to generate $269 million to support its efforts.

For the complete budget document, visit http://tinyurl.com/FDA-Budget.

IMACE sets tougher *trans* standards

Industry self-regulation of *trans* fatty acid (TFA) content in margarines and vegetable fat spreads has worked in Europe, a trade group says, but food and ingredient manufacturers can do still more to lower TFA content in foods.

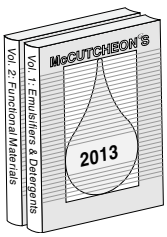
The International Margarine Association of the Countries of Europe (IMACE; Brussels, Belgium) says that since 2004, TFA content in margarine and spreads sold as ingredients has been reduced from 7.1% to 1.7%. Nonetheless, the group has toughened its Code of Practice on *trans* fats for the third time since the code's adoption in 1995. Updates were also issued in 2003 and 2007.

The 2013 code repeats the suggestion from the 2007 Code of Practice that retail margarines and fat spreads should limit TFA to 2% of total fat content. Further, all IMACE member companies should "even more actively encourage" buyers of margarines used as ingredients in food products to use margarines with no more than 2% TFA. Finally, retail blends and blended spreads made of butter and vegetable oils should limit TFA to 5% of total fat content. Manufacturers should take care, IMACE said, to ensure that the combined saturated fatty acid and TFA content does not increase as a result of reformulation.

OSHA Hazard Communication deadline

The US Occupational Safety and Health Administration's (OSHA) Hazard Communication Standard is now aligned with the United Nations' Globally Harmonized System of Classification and Labeling of Chemicals. This update to the Hazard Communication Standard (HCS) provides a common and coherent approach to classifying chemicals and communicating hazard information on labels and safety data sheets.

The first deadline in the implementation phase is December 1, 2013, which is the date by which employers must train workers on the new label elements and safety data sheet. OSHA has prepared a number of additional materials that explain the changes to the requirements of the HCS, including QuickCards, fact sheets, a list of frequently asked questions, and a brief (www.osha.gov/Publications/OSHA3636.pdf) on labels and pictograms. These and other materials are available on OSHA's Hazard Communications page at www.osha.gov/dsg/hazcom/index.html. ■



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BRIEFS

DuPont and farmers in the state of Iowa (USA) working with the company have shown that removing corn stover (the dried leaves and stalks remaining after harvest) from the field is beneficial to the soil (http://tinyurl.com/Iowa-stover). Advances in corn genetics have allowed farmers to plant more seeds per acre today than 10 years ago (34,000 vs. 25,000 per acre, or 13,600 vs. 10,000 per hectare). Yield per acre has increased, but so has the amount of stover. Farmers in the field are finding that if they can remove 30–40% of the stover, the growth of soil bacteria that reduce the effectiveness of nitrogen fertilizer and hinder seed emergence in the next season is reduced. The removed stover, which is used as a feedstock for cellulosic ethanol, brings about $15 per ton.

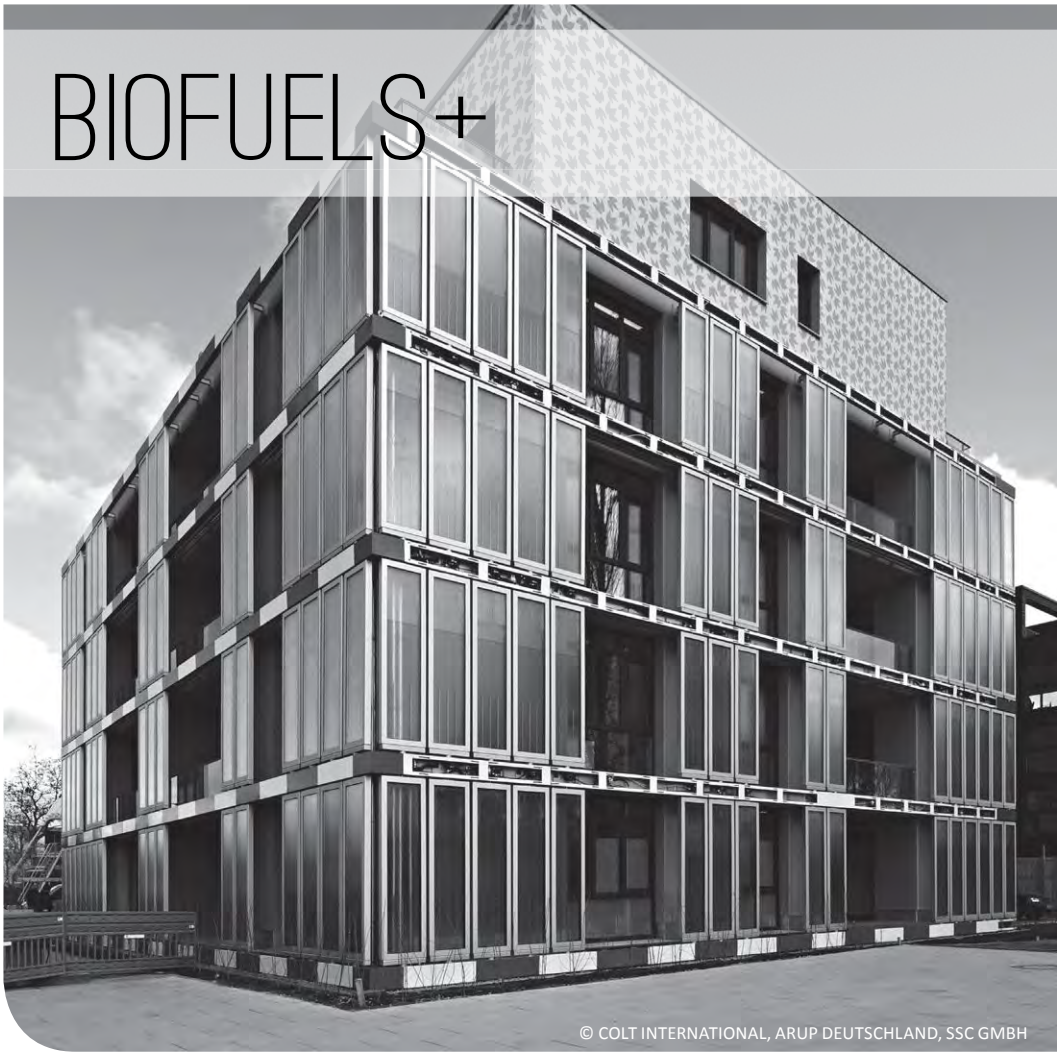
■■■

The amount of biodiesel blended into diesel in the state of Iowa (USA) rose from 7.4 million gallons in 2010 to 23.3 million gallons in 2012. Biodiesel was blended into 42.6% of all Iowa diesel sales in 2012, an increase of more than 10% since 2010. In 2012, the average biodiesel content was 8.1% of the blend, up from 3.1% in 2010 (http://tinyurl.com/Usage-up).

■■■

After more than a decade of growth for conventional biofuels such as ethanol and biodiesel, the next wave of advanced biofuels is nearing commercialization, according to Navigant Research (Boulder, Colorado, USA; http://tinyurl.com/NavRes2023). The pool of commercially available biomass-derived fuels is expanding to include advanced fuels derived from nonfood feedstocks and drop-in synthetic substitutes for gasoline, diesel, and kerosene-based jet fuel. Navigant estimates that worldwide production will grow from 33.6 billion gallons per year (BGY), or 127 billion liters, in 2013 to 61.6 BGY in 2023, replacing as much as 6% of global transportation fuel presently generated from petroleum sources. ■

BIOFUELS+



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Algae-powered building

Algae-powered BIQ [Bio Intelligent Quotient] House, a four-storey apartment building designed by the architectural firm Splitterwerk (Graz, Austria), opened on April 25, 2013, in Hamburg, Germany, as part of the International Building Exhibition. The building is a pilot project for sustainable energy production in urban areas.

A system of 129 movable flat-panel glass louvers, filled with microalgae, covers about 200 square meters of the southwest- and southeast-facing façades of BIQ House. These are re-oriented throughout the day to follow the sun. Nutrients and carbon dioxide are supplied continuously to the louvers, which act as photobioreactors for algal growth as the sun shines on them. The algae can be harvested and then transferred to the technical room of BIQ House, where they are fermented and converted into biogas to heat the apartment building.

Growing algae on the façades provides additional green benefits to the building. With bright sunlight, the algae grow faster, providing shading to the building. And the sunshine warms the nutrient solution—and that solar heat can be captured to generate hot water for the building.

Besides Splitterwerk, SSC Ltd., international design firm Arup, and Germany's SSC Strategic Science Consultants were involved in the three-year project culminated in BIQ House. More information is available at http://tinyurl.com/c3sug6x. A photograph of the algae can be viewed in the supplement to the digital edition. Log in to read the June 2013 at www.aocs.org/login.

Sugar to vegetable oil

On April 15, 2013, Sweetwater Energy, Inc. (Rochester, New York, USA), a cellulosic

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sugar producer, announced a project to provide the company Naturally Scientific with customized industrial sugars over the course of 15 years in a transaction valued at $250 million.

Sweetwater will use its patented, decentralized process to convert locally available cellulosic material, such as crop residues, energy crops, and wood waste, into sugar. Naturally Scientific will then process the sugar into vegetable oils.

"We'll be accepting in excess of 50,000 tons [45,000 metric tons] of cellulosic sugar annually, which adds a new, greener dimension to the oils we produce." says Geoff Dixon, CEO of Naturally Scientific.

"Sweetwater's sugar is an ideal feedstock—not just for biofuel production, but also ideal for biochemicals," says Arunas Chesonis, chairman and CEO of Sweetwater Energy. "We're looking forward to helping Naturally Scientific expand new markets for biobased oils."

Naturally Scientific created its modular, rapid-growth, and high-yield bio-manufacturing platform over the past five years. The company's demonstration plant in Nottingham, UK, has been fully operational for two years, producing oils. The demonstration plant uses full-sized equipment that proves the technology, automated process control systems, yields, and unit economics at a commercial scale.

Naturally Scientific plans to locate its facility in an as-yet unnamed location in the eastern United States. Sweetwater will place its cellulosic facilities near the Naturally Scientific site and will deliver clarified sugars directly to Naturally Scientific.

Treating wastewater with biodiesel by-product

The American Council of Engineering Companies presented its National Recognition Award for 2013 to the 26th Ward Wastewater Treatment Plant (WTP) in the borough of Queens, New York City (USA) for its use of crude glycerin to remove nitrogen from its wastewater discharges to Jamaica Bay, an inlet of the Atlantic Ocean. This is the first facility in the United States to use glycerin to treat wastewater (http://tinyurl.com/glycerine-wastewater).

During primary and secondary treatment of municipal wastewater, solid matter is separated out and much of the carbonaceous oxygen demand in the water is removed through oxidation, whether through activated sludge, surface-aerated lagoons, or other means. At the same time, proteinaceous nitrogen in the wastewater is oxidized to nitrite and nitrate ions. Discharge of wastewater that has not been treated to reduce or remove these oxidized forms of nitrogen can lead to downstream issues such as dead fish, algal blooms, and noxious odors.

Denitrification, or the reduction of nitrate and nitrite to N_2 gas, can be used to remove the oxidized forms of nitrogen. It requires the presence of an electron donor, and processes are already available that use added methanol as a donor in sewage treatment. However, methanol is toxic, flammable, and available through a limited number of vendors.

The 26th Ward WTP ran its first trials in 2012 using by-product crude glycerin from biodiesel production as an electron donor in place of methanol. The plant has been running for over a year now with glycerin, locally produced at several locations in the neighboring borough of Brooklyn.

Incorporation of glycerin into the treatment process has resulted in a 67% reduction in effluent nitrogen, or a drop from 5,800 lb (2,600 kg)/day of total inorganic nitrogen in December 2011 to 1,900 lb/day in the first quarter of 2013. As a result, New York City is planning to use glycerin at all its sewage treatment plants, not only because glycerin is easier to handle than methanol but also because the supplemental glycerin storage and feed system is an order of magnitude less costly to install than a more classic ammonia recovery process for removing nitrogen ions.

Tall oil pitch for transportation fuel

Neste Oil Corp., headquartered in Espoo, Finland, announced in April 2013 that it has added tall oil pitch, a residue produced by tall oil refiners, to its list of feedstocks for the manufacture of renewable diesel.

Tall oil is a viscous yellow-black liquid obtained as a by-product of the Kraft process of wood pulp manufacture when pulping mainly coniferous trees. Tall oil pitch is a nonvolatile residue resulting from the fractional distillation process of crude tall oil (Holmbom and Erä, *JAOCS* 55:342–344, 1978). Among the useful components in tall oil are unsaturated fatty acids, esterified acids, and unsaponifiable neutral compounds (*Inform 11*:580–588, 2000).

Neste began to distribute fuel refined from tall oil pitch to service stations in Finland during the second quarter of 2013. Tall oil refiners in Finland produce around 100,000 metric tons of by-product tall oil pitch annually.

Malaysia increases use of palm oil for biodiesel

Two large oil palm plantation companies in Malaysia—Felda Global Ventures (FGV) Holdings Bhd. and Sime Darby Bhd.—announced at the end of March 2013 their formation of a consortium that they are calling Biodiesel Malaysia Sdn. Bhd. The consortium expected to be operational by the end of May.

Its purpose is to reduce the nation's stockpile of palm oil and support crude palm oil prices. At the end of March, Malaysia had a stock of 2.4 million metric tons (MMT) of crude palm oil. The consortium expects to use 1 MMT of that surplus for biodiesel production.

According to the *Business Times* (http://tinyurl.com/Malaysia-Biodiesel), Malaysian Plantation Industries and Commodities Minister Bernard Dompok said, "Biodiesel Malaysia is also part of the government's plan to implement the use of B10 biodiesel (90% diesel and 10% palm oil) nationwide by the middle of next year."

Dompok indicated that the Malaysian government will subsidize Biodiesel Malaysia from as little as RM80 million ($26 million) to as high as RM1.1 billion ($362 million) annually, depending on prevailing prices of crude palm oil.

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A review of all interventions taken globally from 2005–2012 to lower *trans* fatty acids in the food supply—including mandatory labeling and industry self-regulation—shows that all were more or less successful and did not generally result in an increase in the level of saturated fats in food products. The exceptions were baked goods and popcorn. Further, levels of mono- and polyunsaturated fats in products tended to increase while levels of total fats tended to remain the same. The review appeared in the April 2013 issue of the *Bulletin of the World Health Organization* (see http://tinyurl.com/WHO-transfat).

■■■

A cohort study led by Dariush Mozaffarian of the Harvard School of Public Health in Boston, Massachusetts, USA, found that higher plasma levels of omega-3 fatty acids had a protective effect against cardiovascular disease (CVD) and mortality in patients 65 and older participating in the Cardiovascular Health Study (CHS). Plasma levels of fatty acids were measured in 3,941 participants during 1992–1993. Measurements included total omega-3 polyunsaturated fatty acids (PUFA), as well as eicosapentaenoic acid, docosapentaenoic acid, and docosahexaenoic acid. After excluding patients with CVD and those taking omega-3 PUFA supplements, 2,692 CHS participants remained for the analysis. Outcomes of interest were cause-specific mortality and total CHD (fatal and nonfatal) and stroke through 2008. Comparison of the highest and lowest quintiles of total omega-3 PUFA yielded a hazard ratio of 0.73 for total mortality, representing a 27% lower risk of death. The study appeared in the *Annals of Internal Medicine* (*158*:515–525, 2013).

■■■

In related work, a study in mice may help clarify how long-chain polyunsaturated fatty acids in fish oil affect immune function. Rather than reducing inflammation (the prevailing assumption), researchers led by Eric Gurzell of the College of Osteopathic Medicine in East Lansing, Michigan, USA, found docosahexaenoic acid from fish oil enhances B cell activity in mice. B cells are a type of white blood cell that produces antibodies. The research was published in the *Journal of Leukocyte Biology* (doi:10.1189/jlb.0812394, 2013). ■

HEALTH & NUTRITION

Just weight until menopause

Women tend to carry excess fat in their hips and thighs, while men tend to carry it on their stomachs. But after menopause, things start to change: Many women's fat storage patterns start to resemble those of men. This indicates that there is a link between estrogen and body fat storage. This connection is well documented, but the underlying mechanisms remained poorly understood until now.

Research conducted by Sylvia Santosa, assistant professor at Montréal's Concordia University's Department of Exercise Science, provides a new look at the connection between fat storage and estrogen. By examining the fat storage process at a cellular level, Santosa and co-author Michael D. Jensen of the Mayo Clinic in Rochester, Minnesota, USA, found that certain proteins and enzymes are more active in postmenopausal women. These proteins correspond with fat storage. Their findings were published in *Diabetes* (*62*:775–782, 2013).

"The fat stored on our hips and thighs is relatively harmless," explains Santosa. "But the fat stored around the abdomen is more dangerous. It has been associated with diabetes, heart disease, stroke, and even some cancers. When postmenopausal women put on more abdominal fat, they dramatically increase their risk for these health problems. Given these dangers, it is very important to understand how the lower levels of estrogen associated with menopause change where fat is stored."

Santosa and Jensen's research compared fat storage in pre- and postmenopausal women. The 23 women who participated in the study were in the same age range and had similar body mass indices and body fat composition. These similarities allowed Santosa to isolate the effects of estrogen on fat absorption and storage.

She and Jensen were able to examine the activity of certain enzymes and proteins that regulate fat storage in postmenopausal women's abdomens and thighs. By considering these factors together rather than in isolation, the researchers determined conclusively that the overall fat storage "machinery" is more active in postmenopausal women. In

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other words, these cells now store more fat than they did before menopause.

In addition, postmenopausal women burned less fat than their premenopausal colleagues did. These changes mean that their cells not only are storing more fat but also are less willing to part with it. This combination is a recipe for rapid weight gain. "Taken together, these changes in bodily processes may be more than a little surprising—and upsetting—for women who previously had little trouble managing their weight," comments Santosa.

Though the increased cellular activity revealed by this study was not specific to the abdominal region, more fat stored overall means more abdominal fat. Evidence of changes in the fat storage pathways after menopause is an important contribution to understanding why postmenopausal women begin to put on more visceral fat.

Says Santosa: "The information revealed by our study is valuable not only to post-menopausal women and their doctors, but to obesity studies more generally. A clearer picture of which proteins and enzymes increase fat storage makes those productive targets for future medical advances in the fight against obesity."

High-soy diet before lung cancer improves survival

An observational study by researchers at Vanderbilt University Medical Center (VUMC), the Shanghai Cancer Institute, and the US National Cancer Institute found that Chinese women who ate more soy foods prior to a diagnosis of lung cancer lived longer than those who consumed less.

"To our knowledge, this is the first study to suggest an association between high soy consumption before a lung cancer diagnosis and better overall survival," said lead author Gong Yang, research associate professor at VUMC in Nashville, Tennessee, USA.

Lung cancer is the No. 1 cause of cancer death among women worldwide, with a five-year survival rate of only about 15%.

Previous research has suggested that postmenopausal hormone supplements, which typically contain estrogen and/or other hormones, may promote lung cancer progression. Studies have also shown that soy food, rich in isoflavones that have chemical structures similar to estrogens, may have anti-cancer effects.

The new study revealed that those who ate the most soy food prior to being diagnosed with lung cancer survived longer than women who ate the least. The researchers adjusted for demographic and lifestyle characteristics and other clinical factors such as tumor stage and treatment.

"Women who ate the most soy food lived longer than those who ate the least, with 60% of patients in the highest consumption group still alive 12 months after lung cancer diagnosis, while 50% in the lowest consumption group were alive at the same point," said Yang.

The highest intake levels were equivalent to 4 ounces (about 113 grams) or more of tofu per day, whereas the lowest levels were equivalent to approximately 2 ounces or less of tofu. Researchers found that the association of soy food intake with lung cancer survival appears to follow a dose-response pattern until soy food intake reaches the 4-ounce tofu equivalent per day. No additional benefits were observed for women who ate more soy food than the 4-ounce tofu equivalent.

The association between soy food and lung cancer survival was more pronounced among women who never smoked, and approximately 92% of the lung cancer patients in this group were never smokers.

The investigators followed 444 women diagnosed with lung cancer, 318 of whom died during follow-up. The patients were among 74,941 adult women who enrolled in the Shanghai Women's Health Study (SWHS) between 1997 and 2000. Participants were asked about their dietary habits at the time of enrollment, and again two to three years later. The food-frequency questionnaire assessed soy foods commonly consumed in Shanghai, including soy milk; fresh. fried, dried, or pressed tofu; fresh green or dry soy beans; soy sprouts; and other soy products.

Researchers also asked the women about their smoking history, lifestyle habits, medical history, demographic characteristics, and other exposures.

"This study assessed soy consumption prior to the lung cancer diagnosis, and it is not clear if a diet rich in soy foods would have any impact on survival after patients have already been diagnosed with lung cancer," said Yang.

The investigators also noted that the study was limited to women in China and the findings may not necessarily apply to patients in other parts of the world. Because researchers studied soy food intake, inferences should not be made about the benefits or risks of dietary supplements that contain soy.

This study builds on previous work by these researchers, which found that nonsmoking women who ate higher amounts of soy food were less likely to develop lung cancer.

The study was published online ahead of print in the *Journal of Clinical Oncology* (doi:10.1200/JCO.2012.43.0942, 2013).

Carnitine in red meat causes atherosclerosis

A compound abundant in red meat and added as a supplement to energy drinks has been found to promote atherosclerosis—or the hardening or clogging of the arteries—according to research from the Cleveland Clinic that was published in the journal *Nature Medicine* (doi:10.1038/nm.3145, 2013).

The study shows that bacteria in the human digestive tract metabolize the compound carnitine, forming trimethylamine-*N*-oxide (TMAO), a metabolite the researchers previously linked in a 2011 study to the promotion of atherosclerosis in humans. Further, the study finds that a diet high in carnitine promotes the growth of the bacteria that metabolize carnitine, compounding the problem by producing even more of the artery-clogging TMAO.

The study tested the carnitine and TMAO levels of omnivores, vegans, and vegetarians, and examined the clinical data of 2,595 patients undergoing elective cardiac evaluations. The researchers also examined the cardiac effects of a carnitine-enhanced diet in normal mice compared to mice with suppressed levels of gut microbes and discovered that TMAO alters cholesterol metabolism at multiple levels, explaining how it enhances atherosclerosis.

The research team was led by Stanley Hazen and Robert Koeth, a medical student at the Cleveland Clinic Lerner College of Medicine of Case Western Reserve University. ■

BRIEFS

Two services are now offering to verify that a food does not contain any ingredients derived from genetically modified organisms (GMO). The Non-GMO Project (www.nongmoproject.org) was founded in 2005 to create a standardized meaning for non-GMO products in the North American food industry. The Non-GMO Project standard allows for a combination of testing methods, with a focus on quantitative PCR (polymerase chain reaction) by ISO 17025-accredited laboratories. Testing is required on all inputs at risk for GMO contamination and is not required on finished products. Products successfully passing the certification process are issued a Non-GMO Project verified label.

The second organization, Natural Food Certifiers (NFC; http://nfccertification.info), started to offer a product called the NFC GMO Guard Verification Program in March 2013. NFC already offers US Department of Agriculture organic certification, kosher, vegan, and gluten-free certification. It says its certification is more cost effective than the Non-GMO Project. According to Rabbi Reuven Flamer, who started NFC in 1997, "Our program verifies that the percentage of GMOs detectable in the food does not exceed 0.05%. Any program that says that it can guarantee that there is no trace of GMOs in any given product is false in its claim" (http://tinyurl.com/NFC-0-05percent).

■■■

A genetically engineered apple developed by Okanagan Specialty Fruits of Summerland, British Columbia, Canada, is close to achieving approval for sale in US groceries (http://tinyurl.com/CENews-apples). Genes that are designed to prevent the reaction responsible for browning in cut apples and bruised apple tissues have been inserted into Arctic® apples.

Okanagan initiated the process for receiving approval from the US Food and Drug Administration (FDA) in 2011. The FDA notified Okanagan in October 2012 that it had no more questions, but final approval has not yet arrived.

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BIOTECHNOLOGY NEWS

DSM, Monsanto to commercialize n-3 SDA from soybeans

In April, Monsanto and DSM Nutritional Products announced they will work together to commercialize a genetically engineered soybean oil producing a high content of the n-3 fatty acid called stearidonic acid (SDA), or 6,9,12,15-octadecatetraenoic acid, for use in foods in North America. Monsanto says that the long-chain SDA is naturally converted in the human body to another n-3 fatty acid, eicosapentaenoic acid (EPA), one of the two main long-chain n-3 polyunsaturated fatty acids (LC-PUFA) that have been shown to promote heart health.

According to Food Navigator.com, Monsanto developed the high-SDA soybeans by inserting genes from a primrose (*Primula juliae*) and a red bread mold (*Neurospora crassa*) (http://tinyurl.com/highSDA-soybeans).

As part of the agreement, Monsanto is developing SDA soybean varieties and will sell the seeds to farmers for production. DSM will license SDA from Monsanto and have exclusive global rights to brand, market, package, and sell SDA soybean oil to the food industry. No date has been established when SDA-enriched soybean oil will be available.

It is anticipated that SDA can be used in dressings, sauces, spreads, bakery products, soups, snack bars, and dairy-based products as well as other applications. One advantage of SDA soybean oil is that it can be a dietary source of a LC-PUFA without the accompanying unpleasant fishy taste of fish oil, the best-known source of health-promoting LC-PUFA. Also, SDA has a better shelf life and stability than EPA or DHA (docosahexaenoic acid), the major LC-PUFA found in fish oil.

The US Food and Drug Administration (FDA) issued a positive response letter to Monsanto's Generally Recognized as Safe (GRAS) notification for the oil from these soybeans. The completion of the FDA consultation process supports the use of oil from SDA soybeans under the intended conditions of use. Monsanto has completed the key regulatory processes in the United States, Canada, and Mexico and has also made submissions for import approval in key export markets.

Engineering plant cell walls for biofuel

Researchers at the US Department of Energy's Joint Bioenergy Institute (JBEI; Berkeley, California) are investigating ways to extract sugars more effectively from lignocellulose, the most

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Barring complications, US buyers will likely be able to purchase young Arctic apple trees from Okanagan by the end of 2013.

The US Apple Association, the national trade association representing all segments of the apple industry, has objected to Okanagan's filing for approval (http://tinyurl.com/AppleAssocn-comment). It bases its objection in part on its belief that "deregulation could lead to significant and unnecessary costs to the industry in the form of labeling and marketing efforts that would be required to differentiate conventional apples from the genetically engineered apples." It also points to the potential impact on export markets.

■■■

Two industrial biotechnology companies being shepherded into existence by Kapyon Ventures, a global technology incubation firm (San Diego, California, USA), announced receipt of funding to further their progress toward commercialization in early April. The first, Algenetix, received $2 million to aid in commercializing its PhotoSeed platform. The company's technology improves oil productivity in microbes by accelerating oil accumulation and subsequently preventing its degradation in the cell. Intended markets for the oil include fuels and chemicals. Janet Donaldson of Mississippi State University is furthering the research.

The second company, ZeaKal, has received $3.8 million to enhance the production of biomass in crops such as soybeans and rice. The company is developing technology that lets C3 plants store oil in other places than seeds, for example, in soybean leaves as well as seeds. (C3 plants represent about 95% of earth's plant biomass; C4 plants developed much later in the geologic record and represent 5% of plant biomass.) Results to date show that ZeaKal's HME technology can increase crop yield and oil content up to 50% and 34%, respectively. ZeaKal will develop the biotechnology in collaboration with Henry Nguyen and Zhanyuan Zhang at the University of Missouri. ■

abundant organic material on Earth. "Working with the model plant, *Arabidopsis*, as a demonstration tool," said Dominique Loque, who directs the cell wall engineering program for JBEI's Feedstocks division, "we have genetically manipulated secondary cell walls to reduce the production of lignin while increasing the yield of fuel sugars" (http://tinyurl.com/JBEI-cell-wall).

Loque and his research group have focused on reducing the natural recalcitrance of plant cell walls to give up their sugars. Unlike the starch-based sugars in corn and other grains, the complex polysaccharide sugars in plant cell walls are locked within lignin, an aromatic polymer. Traditionally, freeing these sugars from their lignin cage has required the use of expensive and environmentally harsh chemicals at high temperatures, making the costs of bioethanol from these sugars prohibitive.

"Unfortunately, most efforts to reduce lignin content during plant development have resulted in severe biomass yield reduction and a loss of integrity in vessels, a key tissue responsible for water and nutrient distribution from roots to the above-ground organs," says Loque.

The researchers tinkered with lignin biosynthesis in *Arabidopsis,* creating an artificial positive feedback loop to enhance secondary cell wall biosynthesis, lowering cell wall recalcitrance, and boosting polysaccharide content, without affecting plant development.

"After various pretreatments, these engineered plants exhibited improved sugar releases from enzymatic hydrolysis as compared to wild-type plants. In other words we accumulated the good stuff—polysaccharides—without spoiling it with lignin."

Loque and his colleagues believe that the strategy they used to enhance polysaccharide deposition in the fibers of their *Arabidopsis* plants could be rapidly implemented into other vascular plant species as well. This could increase cell wall content to the benefit of the pulping industry and forage production as well as for bioenergy applications.

For further information see "Engineering secondary cell wall deposition in plants" (Yang, F., *et al.*, *Plant Biotechnol. J. 11*:325–335, 2013; DOI:10.1111/pbi.12016).

Monsanto cross-licenses with DuPont, Bayer

DuPont. On March 26, 2013, Monsanto Co. and DuPont Co. reached an agreement in which DuPont will pay Monsanto at least $1.75 billion in royalties over 10 years in a patent-licensing deal for Monsanto's technology for genetically engineered soybeans that are resistant to the herbicide glyphosate, or Roundup.

In a joint news release, Brett D. Begemann, Monsanto's president and chief commercial officer, said, "This signals a new approach to our companies doing business together, allowing two of the leaders in the industry to focus on bringing farmers the best products possible."

Monsanto sued DuPont in May2009 for combining its RoundupReady trait, for which DuPont already had a license, with DuPont's own glyphosate-resistant trait, Optimum GAT. The GAT trait was designed to make soybeans containing it tolerant to so-called ALS-herbicides, on top of tolerance to Roundup (*Inform 23*:579, 2012). The verdict in that suit, announced August 1, 2012, went against DuPont; and as part of the decision Monsanto was awarded $1 billion. The agreement announced March 26 wipes away that verdict. Also, DuPont has agreed to drop an antitrust lawsuit against Monsanto that had not yet gone to trial.

Bayer CropScience. Monsanto and Bayer CropScience announced on April 16, 2013, that they have signed a series of cross-licensing deals giving Bayer access to Monsanto's herbicide-tolerant soybean technology, sold under the name Genuity Roundup Ready 2 Yield. According to the *St. Louis Post-Dispatch* newspaper, Bayer will also gain access to Roundup Ready 2 Extend technology, which has not yet received regulatory approval (http://tinyurl.com/Monsanto-Licensing). Roundup Ready 2 Extend enables crops to survive applications of Roundup (glyphosate) as well as dicamba.

Bayer will be able to stack the Monsanto traits with those it has developed (under certain circumstances) and market these products in both the United States and Canada.

As part of the agreement, Bayer will also have access to Monsanto's Intacta RR2 Pro soybeans, which have a trait making the crops resistant to lepidopteran insects, particularly the soybean looper and velvetbean caterpillar. The latter are particularly troublesome in Brazil, where the soybean market is growing rapidly. ■

Call for Nominations

Stephen S. Chang Award

The Stephen S. Chang Award recognition shall consist of a jade galloping horse symbolizing the award and an honorarium. The late Stephen S. Chang, an AOCS past president, and his wife, Lucy D. Chang, sponsor the award.

The Award

The Stephen S. Chang Award recognizes a scientist, technologist, or engineer who has made significant and distinguished accomplishments in basic research that must have been utilized by industries for the development or improvement of products related to lipids. The awardee may be recognized for either one major breakthrough or an accumulation of publications.

A prospective recipient must agree to be present for acceptance of the award and to deliver an award address at the 105th AOCS Annual Meeting & Expo. The award is made without regard for national origin, place of residence, race, color, creed, or gender.

Nomination Procedures

Nominations for the 2014 award must be submitted before October 15, 2013.

Candidate material should be sent to the AOCS Awards Program at awards@aocs.org.

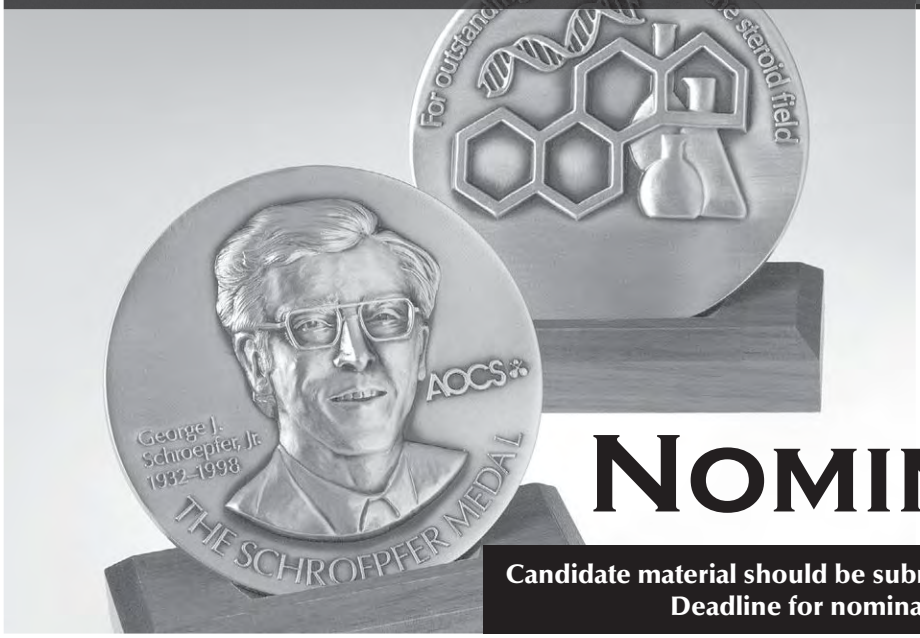
The suggestions listed below may be helpful to nominators in addressing the mandatory criteria of industrial utilization.

1. Documentation of the application of research
   a. Patents received, licensing arrangements
   b. Specific examples of industrial use
2. Documentation for the development or improvement of products related to lipids
   a. Listing of new products, manufacturers, sales history
   b. Manufacturers' testimonials regarding product improvement resulting from their direct utilization of the basic research in specific products with comparative figures on sales or consumer acceptance

The nomination must include a letter from the nominator, at least three supporting letters, the nominee's curriculum vitae, and a list of major relevant publications, including patents.

www.aocs.org/awards

The Schroepfer Medal



Call for Nominations

Candidate material should be submitted by e-mail to awards@aocs.org.
Deadline for nominations: October 15, 2013

AOCS is accepting nominations for the 2014 Schroepfer Medal. The Schroepfer Medal is sponsored by AOCS and is presented every two years at the AOCS Annual Meeting & Expo. The award, which consists of an honorarium and a medal, was established to honor the memory of George J. Schroepfer, Jr., a leader in the sterol and lipid field for more than 40 years. The award aims to foster Schroepfer's ideals of personal integrity, high scientific standards, perseverance, and a strong spirit of survival, tempered by charm and wit.

The purpose of this award is to recognize scientists who have made significant and distinguished advances in the steroid field. The work may represent a single major achievement or a cumulative body of work. Preference will be given to accomplishments in biochemistry and physiology with biomedical applications and to interdisciplinary research in which rigorous chemical and analytical methods were applied to elucidate the physiological roles of steroids in animals, plants, or microorganisms. However, fundamental advances that are primarily chemical, pharmacological, or analytical will also be considered.

Call for nominations

1. A prospective recipient must agree to be present for the acceptance of the award and must agree to deliver an award address at the 105th AOCS Annual Meeting & Expo.

2. The award shall be made without regard for national origin, place of residence, race, color, creed, sexual orientation, gender, or religion. Failure of a nominee to receive the award in one year shall not bar him or her from consideration for the award in a subsequent year.

3. Completed nominations should include a 300- to 1000-word summary describing the significance of the nominee's accomplishments in the steroid field, a current curriculum vitae including a full list of publications, and two supporting letters from individuals who are familiar with the nominee's accomplishments. Optionally, the nomination package may also include copies of three publications illustrating the nominee's most important work in the steroid field.

BRIEFS

Denmark's Novozymes A/S reports that although more and more people around the world are acquiring automatic dishwashers, the global market for manual dishwashing detergent remains significant: At the retail level, consumers spent an estimated $11.5 billion in 2012 and are forecasted to spend $14.4 billion in 2017, according to Euromonitor. Emerging markets in particular have an enormous growth potential, Novozymes said in its quarterly newsletter.

■■■

Procter and Gamble (P&G; Cincinnati, Ohio, USA) is working with the American Academy of Pediatrics (AAP) to develop and distribute information to pediatricians across the United States regarding the correct use and storage of household cleaning and fabric care products. For more information, see P&G's Safe Home website (http://tinyurl.com/pg-safe-home) or the AAP child safety website at www.healthychildren.org. The action comes in part because a number of children have eaten single-dose detergents such as P&G's Tide Pods, thinking they were candy.

■■■

AkzoNobel (Amsterdam, Netherlands) announced in March 2013 that it will invest a further €$65 million in its specialty surfactant facilities in China's Shandong province. In addition, the company will close two of three fatty acid plants at its site in Boxing, China, thereby exiting the merchant fatty acid business. It will then convert the Boxing site into an amine production plant and build an alkoxylation unit at its plant in Ningbo.

■■■

The US Food and Drug Administration (FDA) has updated its information for cosmetics importers. The updated information answers frequently asked questions regarding the relationship between the FDA and Customs and Border Protection, highlighting factors businesses need to consider before shipping goods into the United States. To view the update, go to http://tinyurl.com/FDA-import-cosmetics. ■

SURFACTANTS, DETERGENTS, & PERSONAL CARE NEWS

Biobased product introductions

In honor of Earth Day (April 22), the Green Chemicals Blog (http://greenchemicalsblog.com) featured news about biobased product introductions. Among the product categories highlighted were cosmetics and specialty chemicals.

The blog noted that Germany's Evonik Industries has a number of biobased ingredients for cosmetics. They include:

- *TEGO® Feel Green.* This ingredient is a sensory additive based on natural cellulose particles from renewable sources for use in light and/or gel formulations.
- *TEGOLON® ECO 10–10.* Evonik bills this product as being the "world's first fully vegetable-based polyamide." It reportedly improves tactile properties in cosmetic formulations.
- *TEGOSOFT® AC.* The company says this product is a "100% vegetable-based emollient based on a unique, low-energy enzymatic technology."
- *ABIL® ME 45.* Evonik's "easy-to-use, multiple benefit silicone conditioning agent" is a patent-protected polyethylene glycol- and preservative-free microemulsion for hair-care products.

The blog also featured Sonneborn's SonneNatural emollients; Clariant's Plantasens plant-based actives, emulsifiers, and emollients manufactured from vegetable oils and natural butters; Dow Chemical's EcoSense 3000 surfactant based on coconut and palm oil for use in shampoos and body washes; and Inolex's LexFeel N range of fluids made with succinate emollients from BioAmber.

EPA to assess 1,4-dioxane in 2013

The US Environmental Protection Agency (EPA) will undertake a full risk assessment in 2013 of 1,4-dioxane, a solvent found in some household cleaning products.

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Procter & Gamble Co. (P&G; Cincinnati, Ohio, USA) recently agreed to reduce the level of 1,4-dioxane in its laundry detergents to less than 25 parts per million, according to the *Chemical Regulation Reporter* (*CRR*) newsletter. P&G's action came after an environmental group alleged that sale of the detergents was in violation of a California (USA) state law requiring products containing chemicals listed as known carcinogens to feature a warning label, *CRR* said.

Growth seen for personal care ingredients

Market research company Kline and Co. (Parsippany, New Jersey, USA) released its annual Global Personal Care Ingredients Database in March 2013, along with positive predictions for the global specialty surfactant and conditioning polymers markets.

The report indicates that the combined consumption of specialty surfactants used in personal care products by manufacturers in the United States, China, Japan, the EU-27, India, and Southeast Asia was 507 million pounds (230,000 metric tons) in 2012, and it predicts a 2.6% compound annual growth rate (CAGR) for specialty surfactants in those regions through 2017. Reasons for this growth include an increase in the use of the biodegradable surfactant alkyl polyglucoside in Europe and increased use of alkanolamides and lauryl glucosides in India.

The global conditioning polymers market is projected to grow rapidly through 2017 and reach 5% CAGR over the next five years. The Southeast Asian and Indian sectors are expected to be the biggest contributors to this growth, owing in part to the adoption of more sophisticated body washes in those areas as well as the introduction of cationic guar products as alternatives to Polyquaternium–10—a polymeric quaternary ammonium derivative of hydroxyethyl cellulose.

Ecolab introduces NPE-free chemistry

Ecolab, the industrial and institutional cleaning products manufacturer based in St. Paul, Minnesota, USA, has introduced its Performance Industrial Program (PIP)—a blend of surfactants, conditioner, and soil suspension agents. The program aims to address the "high-performance cleaning needs of industrial laundries while helping to minimize environmental impact," Ecolab said in a news release.

PIP is a patented, three-product system that Ecolab said removes the "heaviest industrial soil" without any nonylphenol ethoxylates (NPE). In addition to its enhanced cleaning performance and "more sustainable" formulation, the company claims that the products deliver operational savings to industrial laundries through first-pass cleaning and easier rinsing, shortening wash cycles, reducing rinse steps and helping customers to conserve water and energy. "The program is projected to save one industrial laundry customer three million gallons [about 11.4 million liters] of water a year," Ecolab said.

NPE are nonionic surfactants that are used in a wide variety of industrial applications and consumer products. They have been restricted in the European Union as being hazardous to human and environmental safety. Directive 2003/53/EC limits the marketing and use in Europe of products and product formulations that contain more than 0.1% of NPE or nonylphenol (by weight). The US Environmental Protection Agency has set two types of standards for freshwater and saltwater ecosystems. Also, through its Design for the Environment program, EPA released a final alternatives assessment identifying eight safer alternatives to NPE (see http://tinyurl.com/EPA-NPE).

In related news, Limited Brands and the Benetton Group reportedly agreed in January 2013 to eliminate NPE and other presumably hazardous chemicals from their supply chains and products by 2020 after the release of a Greenpeace report in November 2012. In the report, the international conservation group called on major international manufacturers, consumers, and regulators to ban NPE and its broader chemical family of alkylphenol ethoxylates in manufacturing and products and to enforce the ban worldwide.

New nonanimal test for skin sensitization

Portuguese scientists are describing a new, highly accurate nonanimal method for testing allergies to new cosmetics and product ingredients. (For *Inform*'s examination of nonanimal testing , see the November/December 2012 issue.)

Bruno Miguel Neves and colleagues at the University of Aveiro in Portugal explain that concerns about the ethics and costs of animal-based tests for skin sensitizers, plus regulations in the European Union, are fostering a search for alternative tests. Testing product ingredients prior to marketing is important,

because allergic contact dermatitis is the most prevalent form of immunotoxicity in humans.

The research team describes development of a cell-based alternative test that enlists genes and signaling pathways in mouse skin cells growing in the laboratory. Exposure to skin sensitizers triggers characteristic responses, activating genes and making cells release substances that communicate with adjacent cells. Evaluation of the test on 18 compounds showed that it had a sensitivity of 92% in correctly identifying actual sensitizers. It had a specificity of 100% and did not produce any false positive results—indicating that a substance caused sensitization when, in fact, it did not. The approach could be "extremely valuable" in revealing the interaction of skin cells with sensitizers, the scientists say.

The study appeared in *Chemical Research in Toxicology* (doi:10.1021/tx300472d, 2013).

P&G expands in South Africa

Procter & Gamble (P&G; Cincinnati, Ohio, USA) recently confirmed that it will create a new $170 million manufacturing hub in South Africa.

The new facility will produce a range of products, including detergents and feminine hygiene goods, for local and export markets. Construction is scheduled to begin in 2014; the facility is expected to open in late 2016 or early 2017.

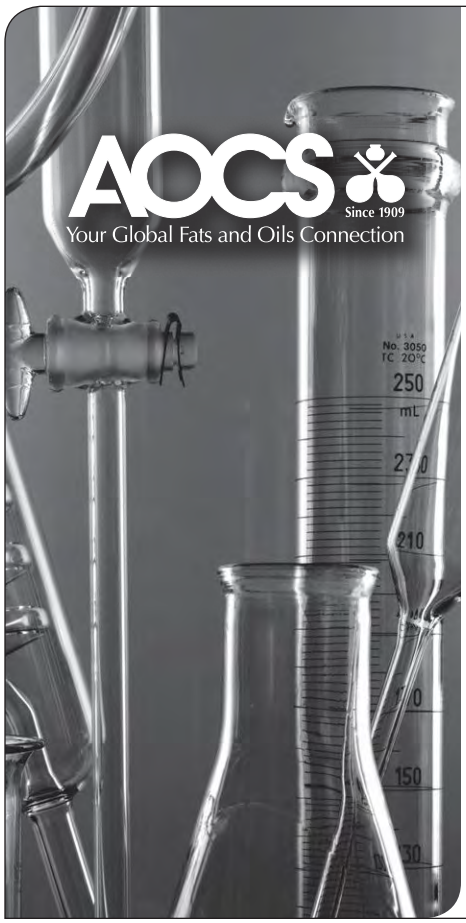
"The investment comes as part of P&G's global drive to tap the growing opportunity of developing markets, where a huge population base, coupled with an emerging middle class and a steadier economic environment, offer a potentially lucrative mix," Cable Network News (CNN) noted.

"We are in Africa because of the size," P&G Global Business Unit Vice-President Dmitri Panayotopoulos told CNN. "It's about a billion people, that's the size of China and India for example, just under, and the population is growing, the economies are getting more and more stable, so [there are] huge opportunities here," he added.

New EO and ethoxylation units in Singapore

Shell Chemicals has begun construction of a high-purity ethylene oxide purification column and two ethoxylation units in Singapore.

"The demand for alcohol ethoxylates in Asia is expected to increase at approximately 6–7% annually over the next five years," noted Graham van't Hoff, executive vice president at Shell. "The key driver for this is the move by consumers from laundry powder and soap bars to liquid detergent and liquid soaps, especially in major markets like China, India, and Southeast Asia," he said, as reported by *ICIS News*. ■



Supelco/Nicholas Pelick—AOCS Research Award

Since 1964, AOCS has recognized scientists, researchers, engineers, and others for their original research in fats, oils, lipid chemistry, or biochemistry.

Candidates must be individuals who are actively associated with research, and who have made discoveries that have influenced his or her field of endeavor. In addition, candidates must have published technical papers of high quality.

Award recipient will receive:

- $10,000 honorarium
- a plaque
- travel-and-expense allowance to attend the AOCS Annual Meeting & Expo to present the award address

For nomination procedures, deadlines, and full award details, visit: **www.aocs.org/awards.**

Sponsored by Supelco, a subsidiary of Sigma Aldrich Corp, and Nicholas Pelick, a past president of AOCS.

PEOPLE NEWS

Hammond joins CESI Chemical


Hammond

Charles Hammond joined CESI Chemical, a Flotek company, in March 2013 as IOR (improved oil recovery) Fellow and Operations Manager. He will be working with CESI's patented suite of green chemicals used to facilitate easier movement of petroleum reservoir fluids in tight rock formations. CESI Chemical is located in The Woodlands, Texas, USA.

Before joining CESI Chemical, Hammond worked with Champion Technologies R&D (Fresno, Texas) on produced fluids from unconventional oil fields. And before that he was with Sasol North America Inc. (Lake Charles, Louisiana, USA) where he was developing surfactants for chemical-enhanced oil recovery.

Burton moves to MARC-IV

Rachel Burton has joined MARC-IV Consulting, which is headed by AOCS member **Steve Howell**. The company is headquartered in Kearney, Missouri, USA. In her new position as a senior associate, Burton serves as the diesel technician training manager for the National Biodiesel Board (NBB).


Burton

She is the founder and has served as research director at Piedmont Biofuels, in Pittsboro, North Carolina, USA. From 2010 to 2012, she was principal investigator for a US Department of Energy Small Business Innovation and Research project investigating the use of enzyme catalysis in biodiesel production.

The NBB recognized Burton as Biodiesel Researcher of the Year in 2011.

She is an active AOCS member and has presented the results of her research at AOCS Annual Meetings. In her new position, Burton is continuing her research efforts in new bio-based materials.

Daun receives Canadian honor


Daun

In March 2013 former AOCS President **Jim Daun** received the Queen's Diamond Jubilee Medal. He was nominated for this recognition by the Canola Council of Canada, who cited his work in establishing the identity of canola and

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AOCS CORPORATE MEMBER PROFILE

This profile has been provided by the following Bronze Level AOCS Corporate Member:

Novozymes AS
Krogshoejvev 36
2880 Bagsvaerd, Denmark

Web: www.novozymes.com
E-mail: info@novozymes.com
Phone: +45 46467272

Novozymes' business is industrial enzymes, microorganisms, and biopharmaceutical ingredients. Founded in 1925 as the Novo Terapeutisk Laboratorium by brothers Harald and Thorvald Pedersen, the company got its start extracting insulin from animal pancreases for human use. The brothers developed trypsin crystals, Novozymes' first enzyme product, by extracting trypsin from pancreases left over after insulin extraction.

Today, Novozymes' portfolio contains more than 700 products sold in 130 countries. The company holds more than 7,000 patents and employs more than 6,000 globally, including more than 1,100 in North America. Well-known products include Lipolase, Maltogenase, and Alcalase. Novozymes also set up the Novo Foundation, now called the Novo Nordisk Foundation, in 1951 to support scientific, social, and humanitarian causes, a goal the company continues to pursue.

Novozymes continues to manufacture enzymes for different industries, offering solutions to save energy and raw materials and to reduce waste. Its biological solutions are used in manufacturing numerous products including biofuels, detergents, food, and animal feed. Gene technology, microbial techniques, and fermentation technology are some of the biotechnological tools that form the base of the business.

Combining industrial insight with its technology platform, Novozymes partners with customers across more than 30 industries to create safe industrial biosolutions for a variety of needs.

As a benefit of corporate membership, companies are entitled to provide a 250-word profile for inclusion on a space-available basis in Inform *magazine. For more information, contact Nicole Philyaw at nicolep@aocs.org.*

IN MEMORIAM

MORRIS KATES

Morris Kates, an internationally known researcher in the field of lipid biochemistry, died at the age of 89 on March 7, 2013, in Ottawa, Ontario, Canada. He is survived by his wife Pirkko, his daughters Anna-Lisa, Marja, and Ilona; seven grandchildren; a sister, brother, and sister-in-law.

Kates was born in Galati, Romania, and came to Canada with his parents in 1924. He received a degree in physics and chemistry in 1945 and his Ph.D. under Erich Baer in 1948 from the University of Toronto, Canada. His doctoral thesis described the first synthesis of L-α-lecithins.

Following his graduation from the University of Toronto, Kates joined the National Research Council (NRC) in Ottawa as a post-doc, studying the chemical structure of alkaloids. He then received a permanent position in the Plant Physiology section of the NRC, where he worked from 1951 to 1968. During those years he initiated his research on the importance of lipids in cell membranes.

In 1968 he moved to the University of Ottawa, where he taught organic chemistry and biochemistry, served as vice-dean of the Faculty of Science and Engineering (1975–1979), and chaired the Department of Biochemistry (1982–1985). His research covered a number of areas relating to lipids, including their structure and synthesis, metabolism, enzymology, and physical chemistry. At the university, he mentored more than 40 graduate students and post-docs and hosted more than a dozen visiting professors. He was awarded emeritus status in 2001.

Kates served a term as president of the Canadian Biochemical Society and was co-editor of the *Canadian Journal of Biochemistry* from 1973 to 1984. He became a Fellow of the Royal Society of Canada in 1973 and was awarded the Society's Excellence in Research award in 1981. In 1974, nine years after he joined AOCS, he received its Supelco Research Award. The results of his research appeared in the *Journal of the American Oil Chemists' Society* and *Lipids*, among others. In his later years, he developed interests in biodiesel and published the results of his work in *Bioresource Technology.*

Besides publishing about 220 papers based on his research results, Kates wrote six books, including *The Biochemistry of Archaea (Archaebacteria)*; his study of the lipids in these organisms showed that they were not bacteria. His most recent was *Techniques of Lipidology*, third edition, which was reviewed recently in *Inform* (*24:*37, 2013).

Less well-known to his fats and oils colleagues is that Kates was an accomplished musician and composer. He began his musical studies with violin lessons at the age of 11 and started composing at 16. While he was a student at the University of Toronto, he continued with music (harmony, counterpoint, and composition) as a hobby, as well as playing orchestral and chamber music in the University of Toronto Orchestra and later in chamber orchestras and string quartets in Ottawa. According to the Canadian Music Centre (www.centremusique.ca/node/37468 or http://tinyurl.com/Bio-Kates), "His early compositions show the influence of impressionism and twelve-tone technique, but his later works are neoclassic and neoromantic in structure and harmony."

His first formal composition, in 1946, was *Theme and Variations for Piano*, which he revised for strings in 1964. He also wrote compositions for voice and orchestra, for string quartets, for wind instruments, and for piano. Further information about his compositions appears at the web site http://tinyurl.com/Kates-compositions.

SEBASTIEN T. DJENONTIN

On March 11, 2013, Sébastien Tindo Djènontin died at his home in Abomey-Calavi, in Benin. He joined AOCS at the Annual Meeting, held in Long Beach, California, USA in April 2012.

Djènontin received his Ph.D. in 2006 under the supervision of Daniel Pioch from the University Montpellier II (France) and from the University of Abomey-Calavi (Benin) in physical chemistry and chemical engineering, based on work performed at the Process Engineering and Bioproducts research unit of CIRAD (The French Research Center to Tackle International Agricultural and Development Issues; France). He was very active in investigating new sources of oils for valorizing the biodiversity of Benin, his home country and had already authored 11 publications in international journals. At the time of his death Djènontin was teaching chemistry and physical chemistry of interfaces at the University of Abomey-Calavi, where he had been on staff since 2007. He had been planning to attend the AOCS meeting in Montréal.

His wife and two children survive him. ■

AOCS MEETING WATCH

July 16–17, 2013. AOCS Technical Services Workshop: Laboratory Methods, Des Moines Ankeny, Iowa, USA. www.aocs.org/labworkshop

August 8–10, 2013. International Conference on Emerging Trends in Oleochemicals & Lipids Expo 2013, Hyderabad, India. www.aocs.org/oleo2013

August 20–23, 2013. XV Latin American Congress and Exhibition on Fats and Oils, Sheraton Santiago Hotel and Convention Center, Santiago, Chile. http://lacongress.aocs.org

November 6–8, 2013. Australasian Section AOCS Biennial Meeting and Workshops, NOAH's on the Beach, Newcastle, New South Wales, Australia. www.aocs.org/australasian

May 4–7, 2014. 105th AOCS Annual Meeting & Expo, Henry B. Gonzalez Convention Center, San Antonio, Texas, USA. http://aocs.org/meetings

October 6–9, 2014. World Conference on Fabric and Home Care: Montreux 2014, Montreux Music & Convention Centre, Montreux, Switzerland. http://Montreux.aocs.org

For in-depth details on these and other upcoming meetings, visit http://aocs.org/meetings or contact the AOCS Meetings Department (email: meetings@aocs.org; phone: +1 217-693-4821; fax: +1 217-693-4865).

Also, be sure to visit AOCS' online listing of industry events and meetings at http://tinyurl.com/industry-calendar. Sponsoring organizations can submit information about their events to the web-based calendar by clicking a link and completing a web form. Submission is free. No third-party submissions, please. If you have any questions or comments, please contact Valorie Deichman at valoried@aocs.org.

in establishing methods to measure canola quantity The medal was created in 2012 to mark the 60th anniversary of the accession Queen Elisabeth II to the throne as Queen of Canada and to honor significant contributions and achievement by Canadians.

Daun also received the Queen's Golden Jubilee Medal in 2002, when he was nominated by the Canadian Grain Commission for his work in establishing international standards for oilseeds.

RJASET appoints new editor in chief

Dumancas

The new editor- in-chief of the *Research Journal of Applied Sciences, Engineering and Technology (RJASET)* is AOCS member **Gerard Dumancas**. *RJASET* is published by the Maxwell Scientific Organization, a general-science community founded in 2008. Appearing both in print and online, *RJASET* is an open access, peer-reviewed, interdisciplinary journal focusing on theories, methods, and applications in applied science, engineering, and technology. The journal reports research and development activities in applied science related to agricultural engineering, biotechnology, food science and technology, and industrial and manufacturing engineering.

Bunge appoints vice president

Bunge North America, the North American operating arm of Bunge Limited (White Plains, New York, USA), announced the appointment of **George Allard** as vice president and general manager of its oils business effective April 1, 2013. Allard replaces **Rodney Perry** who is transferring to Bunge's European office as vice president, food and ingredients for Europe, the Middle East, and Africa. **Wade Ellis** replaces Allard as vice president and general manager of Bunge's North American milling business.

Allard joined Bunge in 2004 as treasurer of Bunge North America, and also served as chief financial official for the company's Canadian operations and for Bunge Latin America before assuming his most recent position as head of North America's milling business. ■

PATENTS

Structured food products with low content of saturated and *trans* unsaturated fats

Cleenewerck, B., Fuji Oil Co., Ltd., US8304010, November 6, 2012

The present invention relates to a structured food product with a hard texture, containing between 20 and 100% of a fat phase and between 0 and 15% of water, whereby the fat phase contains at least one fat composition containing between 10 and 55 wt% of at least one liquid oil with a saturated fatty acid content of less than 25 wt% with respect to the weight of the liquid oil between 45 and 90 wt% of a hard fat component with a StOSt/POP ratio of at least 2, preferably at least 2.5, most preferably at least 3.0, wherein St is stearic acid, P is palmitic acid, and O is oleic acid. The present invention also relates to a process for producing such a structured food product.

Method for refining vegetable oils and additive therefore, and their use as substitute of diesel fuel

Hatziemmanouil, E., Aristotle University of Thessaloniki Research Committee, US8333811, December 18, 2012

This invention relates to a method for refining vegetable oils, in particular cottonseed oil or a possible mixture of it with others, as substitute of diesel fuel remarkable in that a sequence of treatment steps to be performed on crude vegetable oil, including: (i) a pre-treatment thereof consisting of the removal of oil-insoluble impurities from the crude oil, (ii) removal of oil-soluble impurities therefrom, (iii) a free acid neutralization thereof, and (iv) a drying, bleaching, and filtration thereof. This invention also relates to an additive of organic basis, containing ether, ketone, toluene, hexane, turpentine, alcohols in specific concentrations.

Nanoparticle additives and lubricant formulations containing the nanoparticle additives

McLaughlin, M.J., and N. Mathur, Afton Chemical Corp., US8333945, December 18, 2012

A method for making a self-dispersing cerium oxide nanoparticles additive for lubricants, a lubricant composition containing the nanoparticles, and a method for reducing boundary friction using the nanoparticles. The nanoparticles are made by an improved process of reacting a mixture of organo-cerium salt, fatty acid, and amine in the substantial absence of water and organic solvent at a temperature ranging from about 150° to about 250°C, the improvement comprising reacting the organo-cerium salt, fatty acid, and amine in a molar ratio ranging from about 1:1:1 to about 1:2:2 in the reaction mixture to provide the reaction product comprising from about 20 to about 40% by weight of the nanoparticles in a substantially organic medium.

Perhydrolases for enzymatic peracid generation

DiCosimo, R., *et al.,* E.I. du Pont de Nemours and Co., US8334120, December 18, 2012

Disclosed herein are variants enzymes that are structurally classified as CE-7 enzymes and have perhydrolysis activity. Also disclosed herein is a process for producing peroxycarboxylic acids from carboxylic acid esters using the aforementioned variant enzymes as well as methods and compositions comprising the variant enzymes. Further, disinfectant formulations comprising the peroxycarboxylic acids produced by the processes described herein are provided.

Process for the manufacture of saturated fatty acid esters

Papadogianakis, G., *et al.,* Cognis IP Management GmbH, US8334396, December 18, 2012

Disclosed is a process for the manufacture of saturated fatty acid esters by subjecting unsaturated fatty acid esters to hydrogenation in the presence of a catalyst suitable for catalyzing the saturation of double bonds in the esters, which is characterized in that said catalyst represents a homogenous complex of a Group VIII metal and a sulfonated phosphite as the polar ionic ligand.

Methods of manufacturing derivatives of β-hydroxycarboxylic acids

Tsobanakis, P., *et al.,* Cargill, Incorporated, US8338145, December 25, 2012

Preparation of derivatives of β-hydroxycarboxylic acid, including β-hydroxycarboxylic acid esters, α,β-unsaturated carboxylic acid, esters of α,β-unsaturated carboxylic acid, and alkoxy derivatives.

Lubricant composition

Kamano, H., Idemitsu Kosan Co., Ltd., US8338342, December 25, 2012

A lubricating oil composition according to the present invention is used in an internal combustion engine. The internal combustion engine uses a fuel that contains at least one fat and oil selected from a group consisting of natural fat and oil,

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EXTRACTS & DISTILLATES

Effects of environmental factors on edible oil quality of organically grown *Camelina sativa*

Kirkhus, B., *et al., J. Agric. Food Chem. 61*:3179–3185, 2013.

The aim of the present study was to evaluate the potential for the production of edible oil from organically grown camelina (*Camelina sativa* L. Crantz), focusing on the influence of environmental factors on nutritional quality parameters. Field experiments with precrop barley were conducted in Norway in the growing seasons 2007, 2008, and 2009. Trials were fully randomized with two levels of nitrogen (N) fertilization, 0 and 120 kg total N ha^{-1}, and two levels of sulfur (S) fertilization, 0 and 20 kg total S ha^{-1}. Weather conditions, that is, temperature and precipitation, were recorded. Additional experiments were performed in the years 2008 and 2009 to evaluate the effects of replacing precrop barley with precrop pea. Seed oil content was measured by near-infrared transmittance, and crude oil compositions of fatty acids, phytosterols, tocopherols, and phospholipids were analyzed by chromatography and mass spectrometry. Results showed significant seasonal variations in seed oil content and oil composition of fatty acids, tocopherols, phytosterols, and phospholipids that to a great extent could be explained by the variations in weather conditions. Furthermore, significant effects of N fertilization were observed. Seed oil content decreased at the highest level of N fertilization, whereas the oil concentrations of α-linolenic acid (18:3n-3), erucic acid (22:1n-9), tocopherols, and campesterol increased. Pea compared to barley as precrop also increased the 18:3n-3 content of oil. S fertilization had little impact on oil composition, but an increase in tocopherols and a decrease in brassicasterol were observed. In conclusion, organically grown camelina seems to be well suited for the production of edible oil. Variations in nutritional quality parameters were generally small, but significantly influenced by season and fertilization.

Time course analysis of fractionated thermoxidized virgin olive oil by FTIR spectroscopy

Tena, N., *et al., J. Agric. Food Chem. 61*:3212–3218, 2013.

FTIR [Fourier transform infrared] spectroscopy has been used to examine the spectral changes taking place in the polar fraction of thermoxidized virgin olive oil, and those changes have

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PUBLICATIONS

JOURNAL OF SURFACTANTS AND DETERGENTS

Journal of Surfactants and Detergents (May)

- Synthesis and surface active properties of 1,1,1,1-tetra-(2-oxypropyl sulfonate-3-alkylether-propoxy) neopentanes, Zhou, M., X. Zhong, J. Zhao., and X. Wang
- Ethoxy carboxylate extended surfactant: surface charge of surfactant-modified alumina, adsolubilization and solubilization of phenylethanol and styrene, Arpornpong, N., J. Lewlomphaisan, A. Charoensaeng, D.A. Sabatini, and S. Khaodhiar
- Effect of additives on the cloud point of the octylphenol ethoxylate (30EO) nonionic surfactant, Rocha, S.A.N., C.R. Costa, J.J. Celino, and L.S.G Teixeira
- One-step synthesis of W/O and O/W emulsifiers in the presence of surface active agents, Sadecka, E. and H. Szelag
- A direct synthesis of renewable sulfonate-based surfactants, Kraus, G.A., and J.J. Lee
- Preparation of comb-like amphiphilic styrene maleic anhydride copolymer derivatives and their modification to surface of chrome-tanned collagen fiber, Qiang, X., L. Ma, Z. Yan, and H. Zhang
- Synthesis and surface tension study of the spacer chain length effect on the adsorption and micellization properties of a new kind of carboxylate gemini surfactant, Chen, M., L. Luo, X. Hu, and J. Yang
- Synthesis, surface and thermodynamic properties of substituted polytriethanolamine nonionic surfactants, Negm, N.A., A.F. El-Farargy, S.M Tawfik, A.M. Abdelnour, H.H. Hefni, and M.M. Khowdiary
- Micellization and adsorption behaviors of new reactive polymerizable surfactants based on modified nonyl phenol ethoxylates, Atta, A.M., A.K.F. Dyab, and H.A. Al-Lohedan
- Experimental study of CMC evaluation in single and mixed surfactant systems, using the UV-vis spectroscopic method, Tanhaei, B., N. Saghatoleslami, M.P. Chenar, A. Ayati, M. Hesampour, and M. Mänttäri
- Determination of critical aggregation concentration in the poly(vinylpyrrolidone)–sodium dodecyl sulfate system by capillary electrophoresis, Öztekin, N., and F.B. Erim
- Alkyl polyglucosides as components of water-based lubricants, Sułek, M.W., M. Ogorzałek, T. Wasilewski, and E. Klimaszewska
- Some sugar fatty ester ethoxylates as demulsifiers for petroleum sludge, Abdul-Raheim, M.A., M.E.-S. Abdel-Raouf, N.E.-S. Maysour, A.F. El-Kafrawy, A.Z. Mehany, and A. Abdel-Azim
- Erratum to: Some sugar fatty ester ethoxylates as demulsifiers for petroleum sludge, Abdul-Raheim, M.A., M.E.-S. Abdel-Raouf, N.E.-S. Maysour, A.F. El-Kafrawy, A.Z. Mehany, and A. Abdel-Azim
- Determination of sodium dodecyl sulfate in toothpastes by a PVC matrix membrane sensor, Devi, S., and M.C. Chattopadhyaya
- Suspensions of iron oxide nanoparticles stabilized by anionic surfactants, Wang, Z., A. Lam, and E. Acosta

- Biosurfactants as alternatives to chemosynthetic surfactants in controlling bubble behavior in the flotation process, Li, Y., L.Yang, T. Zhu, J. Yang, and X. Ruan
- Improvement in the cleaning performance towards protein soils in laundry detergents by protease immobilization on the silica nanoparticles, Soleimani, M., A. Khani, N. Dalali, and G.R. Behbehani
- Formulation and evaluation of an automatic dishwashing detergent containing
- T1 lipase, Rahman, I.A., R.N.Z.R.A. Rahman, A.B. Salleh, and M. Basri
- Application of lipase from marine bacteria *Bacillus sonorensis* as an additive in detergent formulation, Nerurkar, M., M. Joshi, S. Pariti, and R. Adivarekar
- Validation of a UV spectrophotometric method for determination of proteolytic activity of enzymatic detergents, Lopes, L.S., F.S.Q. Silva, A.S. Silva., and I.F. Delgado

Lipids (May)

- Impact factor and science publishing: What impact should it have on selecting journals in which we publish? Murphy, E.J.
- Liver fatty acid binding protein gene-ablation exacerbates weight gain in high-fat fed female mice, McIntosh, A.L., B.P. Atshaves, D. Landrock, K.K. Landrock, G.G. Martin, S.M. Storey, A.B. Kier, and F. Schroeder
- Down-regulation of hepatic stearoyl-CoA desaturase-1 expression by fucoxanthin via leptin signaling in diabetic/obese KK-A^y mice, Beppu, F., M. Hosokawa, M.-J. Yim, T. Shinoda, and K. Miyashita
- Up-regulation of stearoyl-CoA desaturase 1 increases liver MUFA content in obese Zucker but not Goto-Kakizaki rats, Karahashi, M., F. Ishii, T. Yamazaki, K. Imai, A. Mitsumoto, Y. Kawashima, and N. Kudo
- Mammary uptake of fatty acids supplied by intravenous triacylglycerol infusion to lactating dairy cows, Stamey Lanier, J., J.K. Suagee, O. Becvar, and B.A. Corl
- Maternal dietary fat affects milk fatty acid profile and impacts on weight gain and thermogenic capacity of suckling rats, Priego, T., J. Sánchez, A.P. García, A. Palou, and C. Picó
- Variability in associations of phosphatidylcholine molecular species with metabolic syndrome in Mexican-American families, Kulkarni, H., P.J. Meikle, M. Mamtani, J.M. Weir, C.K. Barlow, J.B. Jowett, C. Bellis, T.D. Dyer, M.P. Johnson, D.L. Rainwater, L. Almasy, M.C. Mahaney, A.G. Comuzzie, J. Blangero, and J.E. Curran
- *trans*-10,*cis*-12 Conjugated linoleic acid improved growth performance, reduced lipid deposition and influenced CPT I kinetic constants of juvenile *Synechogobius hasta*, Tan, X.-Y., Z. Luo, Q. Zeng, Y.-H. Zhao, and X. Liu
- The spectrophotometric sulfo-phospho-vanillin assessment of total lipids in human meibomian gland secretions, McMahon, A., H. Lu, and I.A. Butovich
- Production, purification and partial characterization of four lipases from a thermophile isolated from Deception Island, Muñoz, P.A., D.N. Correa-Llantén, and J.M. Blamey
- Non-methylene interrupted and hydroxy fatty acids in polar lipids of the alga *Grateloupia turuturu* over the four seasons, Kendel, M., G. Barnathan, J. Fleurence, V. Rabesaotra, and G. Wielgosz-Collin

Journal of the American Oil Chemists' Society (May)

- LC–ESI–QTOF–MS, MS/MS analysis of glycerophospholipid species in three Tunisian *Pistacia lentiscus* fruit populations, Trabelsi, H., J. Renaud., W. Herchi, M.L Khouja., S. Boukhchina, and P. Mayer
- Evaluation of physico-chemical and sensory quality during storage of soybean and canola oils packaged in PET bottles, Fuentes, P.H.A., A.C.P. do Prado, P. Ogliari, F.C. Deschamps, D. Barrera Arellano, H.M.A. Bolini, and J.M. Block
- Microstructure and thermal profile of structured lipids produced by continuous enzymatic interesterification, da Silva, R.C., A.P.B. Ribeiro, F.A.S. De Martini Soares, I.R. Capacla., M. Hazzan, A.O. dos Santos, L.P. Cardoso., and L.A Gioielli
- Rapid detection and quantification by GC–MS of camellia seed oil adulterated with soybean oil, Xie, J., T. Liu, Y. Yu, G. Song, and Y. Hu
- Changes in olive and olive oil characteristics during maturation, Yorulmaz, A., H. Erinc, and A. Tekin
- Antioxidant activity of sesamol in soybean oil under frying conditions, Hwang, H.-S., J.K Winkler-Moser., E.L Bakota, M.A Berhow, and S.X. Liu
- Examination of the modified Villavecchia test for detecting sesame oil, Lee, W.-J., N.-W. Su, M.-H. Lee, and J.-T. Lin
- Screening and profiling of hydrocarbon components and squalene in developing Tunisian cultivars and wild *Arachis hypogaea* L. species, Cherif, A.O., M. Ben Messaouda, I. Pellerin, S. Boukhchina, H. Kallel, and C. Pepe
- Phytostanol supplementation through frying dough in enriched canola oil, Aydeniz, B., and E. Yılmaz
- New vinyl ester bio-copolymers derived from dimer fatty acids: preparation, characterization, and properties, Li, S., J. Xia, M. Li, and K. Huang
- Destabilization of yellow mustard emulsion using organic solvent, Tabtabaei, S., V.M. Ataya Pulido, and L.L. Diosady
- Transfer of phenolic compounds from olive mill wastewater to olive cake oil, Boudissa, F., and H. Kadi
- Carbonation of epoxidized soybean oil improved by the addition of water, Mazo, P., and L. Rios
- Optimization of enzymatic hydrolysis of sacha inchi oil using conventional and supercritical carbon dioxide processes, Prado, G.H.C., and M.D.A. Saldaña
- Minor constituents in canola oil processed by traditional and minimal refining methods, Ghazani, S.M., G. García-Llatas, and A.G. Marangoni

been compared to those occurring in the neat oil and the nonpolar fraction. It was demonstrated that examination of the polar fraction provides additional and substantially better information of the chemical changes taking place as oxidation proceeds because this fraction concentrates the oxygenated compounds formed. Of particular interest is the enhancement of the OH component of the spectrum (3600–3200 cm^{-1}) as well as tertiary alcohol formation (~1167 cm^{-1}), including the region associated with epoxides. Time course spectral changes for neat virgin olive oil and its polar and nonpolar fractions are illustrated, compared, and contrasted, demonstrating that the interpretation of neat oil spectra is greatly enhanced by fractionation and may in fact be a preferred means of studying thermoxidation processes.

Anticancer activity of olive oil hydroxytyrosyl acetate in human adenocarcinoma Caco-2 cells

Mateos, R., *et al.*, *J. Agric. Food Chem. 61*:3264–3269, 2013.

The anticancer activity of hydroxytyrosyl acetate (HTy-Ac) has been studied in human colon adenocarcinoma cells. Gene expression of proteins involved in cell cycle (p21, p53, cyclin B1, and cyclin G2) and programmed cell death (BNIP3, BNIP3L, PDCD4, and ATF3), as well as phase I and phase II detoxifying enzymes CYPA1 and UGT1A10, were evaluated by reverse transcription polymerase chain reaction after 24 h of exposure of Caco-2/TC7 cells to 5, 10, and 50 μM of HTy-Ac. The results show that HTy-Ac inhibited cell proliferation and arrested cell cycle by enhancing p21 and CCNG2 and lowering CCNB1 protein expression. HTy-Ac also affected the transcription of genes involved in apoptosis up-regulating of BNIP3, BNIP3L, PDCD4, and ATF3 and activating caspase-3. In addition, HTy-Ac up-regulated xenobiotic metabolizing enzymes CYP1A1 and UGT1A10, thus enhancing carcinogen detoxification. In conclusion, these results highlight that HTy-Ac has the potential to modulate biomarkers involved in colon cancer.

Optimization of palm oil physical refining process for reduction of 3-monochloropropane-1,2-diol (3-MCPD) ester formation

Zulkurnain, M., *et al.*, *J. Agric. Food Chem. 61*:3341–3349, 2013.

The reduction of 3-monochloropropane-1,2-diol (3-MCPD) ester formation in refined palm oil was achieved by incorporation of additional processing steps in the physical refining process to remove chloroester precursors prior to the deodorization step. The modified refining process was optimized for the least 3-MCPD ester formation and acceptable refined palm oil quality using response surface methodology with five processing parameters: water dosage, phosphoric acid dosage, degumming temperature, activated clay dosage, and deodorization temperature. The removal of chloroester precursors was largely accomplished by increasing the water dosage, while the reduction of 3-MCPD esters was a compromise in oxidative stability and color of the refined palm oil because some factors such as acid dosage, degumming temperature, and deodorization temperature showed contradictory effects. The optimization resulted in 87.2% reduction of 3-MCPD esters from 2.9 mg/kg in the conventional refining process to 0.4 mg/kg, with color and oil stability index values of 2.4 R and 14.3 h, respectively.

Storage stability and physical characteristics of tea-polyphenol-bearing nanoliposomes prepared with milk fat globule membrane phospholipids

Gülseren, I., and M. Corredig, *J. Agric. Food Chem. 61*:3242–3251, 2013.

The objective of this work was to better understand the functional properties of milk phospholipids when used as ingredients to prepare liposomes. Liposomal dispersions (10%) were prepared using high-pressure homogenization, and their physical properties as well as their ability to encapsulate tea polyphenols were investigated. The extent of encapsulation, measured by HPLC [high-performance liquid chromatography], increased with tea polyphenol concentration up to about 4 $mg{\cdot}mL^{-1}$. At polyphenol concentrations ≥6 $mg{\cdot}mL^{-1}$, the liposome dispersions were no longer stable. The influences of pH (3–7), storage temperature (room temperature or refrigeration), and addition of sugars (0–15%) were studied for liposomes containing 4 $mg{\cdot}mL^{-1}$ polyphenols. The liposomal dispersions were also stable in the presence of peptides. The storage stability of the systems prepared with milk phospholipids was compared to that of liposomes made with soy phospholipids. Soy liposomes were smaller in size than milk phospholipid liposomes, the encapsulation efficiency was higher, and the extent of release of tea polyphenols during storage was lower for milk phospholipid liposomes compared to soy liposomes. The results suggest that milk phospholipids could be employed to prepare tea-polyphenol-bearing liposomes and that the tea catechins may be incorporated in the milk phospholipid bilayer more efficiently than in the case of a soy phospholipid bilayer.

Butein is a novel anti-adipogenic compound

Song, N.-J., *et al.*, *J. Lipid Res. 54*:1385–1396, 2013.

Rhus verniciflua Stokes (RVS) has been used as a traditional herbal medicine for its various biological activities including anti-adipogenic effects. Activity-guided separation led to the identification of the anti-adipogenic functions of butein. Butein, a novel anti-adipogenic compound, robustly suppressed lipid accumulation and inhibited expression of adipogenic markers. Molecular studies showed that activated transforming growth factor-β (TGF-β) and suppressed signal transducer and activator of transcription 3 (STAT3) signaling pathways were mediated by butein.

Analysis of the temporal expression profiles suggests that TGF-β signaling precedes the STAT3 in the butein-mediated anti-adipogenic cascade. Small interfering RNA-mediated silencing of STAT3 or SMAD2/3 blunted the inhibitory effects of butein on adipogenesis, indicating that an interaction between two signaling pathways is required for the action of butein. Upon butein treatments, stimulation of TGF-β signaling was still preserved in STAT3 silenced cells, whereas regulation of STAT3 signaling by butein was significantly impaired in SMAD2/3 silenced cells, further showing that TGF-β acts upstream of STAT3 in the butein-mediated anti-adipogenesis. Taken together, the present study shows that butein, a novel anti-adipogenic compound from RVS, inhibits adipocyte differentiation through the TGF-β pathway followed by STAT3 and peroxisome proliferator-activated receptor γ signaling, further implicating potential roles of butein in TGF-β- and STAT3-dysregulated diseases.

Thermal modification of vegetable oils

Doll, K.M., and H.-S. Hwang, *Lipid Technol.* 25:83–85, 2013.

This article reviews old and recent literature concerning the hypothesis that the Diels-Alder reaction is the dominant reaction in the thermal polymerization of vegetable oil. Both triacylglycerol oils and methyl esters are used to show that this mechanism is unlikely to be a significant contributor en route to the reaction products. The products formed under a range of different reaction conditions are reviewed, including dimer acid, where Diels-Alder chemistry is not claimed, to the polymerization of mono-unsaturated methyl oleate in the presence of oxygen. In these, and even in the system where Diels-Alder chemistry is claimed, the polymerization of conjugated methyl linoleate, six-membered ring structures are not found in levels detectable by ^{13}C nuclear magnetic resonance. Since such structures are formed by a Diels-Alder reaction, it is unlikely that any more than 5% of the reaction could be formed by that method. Other factors against the Diels-Alder contribution to this process, such as conformation and electron-withdrawing ability of the substrates, are also discussed.

Minor components in oils and their effects on frying performance

Aladedunye, F.A., and R. Przybylski, *Lipid Technol.* 25:87–90, 2013.

Minor components are the non-triacylglycerol constituents of oil and constitute up to 5% of the total lipid composition. Though minor in composition, they can exert major influence on the performance of oil during frying. The effect of the minor components on frying performance depends on their chemical nature, composition, and amount in the oil. Among these minor components, tocopherols, phytosterols, phospholipids, γ-oryzanol, lignans, phenolics, and carotenoids are the most important. Here, their effect on the frying performance of edible oils is discussed.

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Mintec

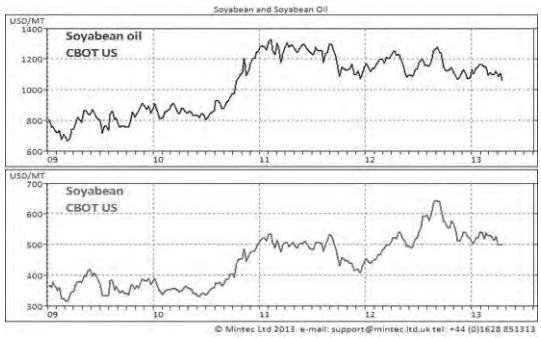
STATISTICAL ANALYSIS FROM MINTEC

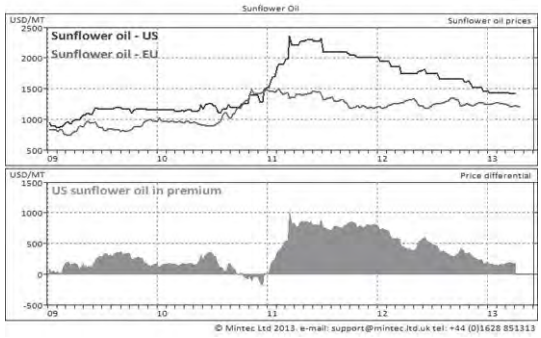
Jade Savage at Mintec

World soybean production is expected to be up 12% year-on-year to 268 million metric tons (MMT) in 2012/13 as South American production is expected to recover following last season's drought. World production of soybean oil is forecast to rise only 2% to 43.2 MMT, however, as Brazil and Argentina will limit crushing to rebuild their depleted soybean stocks.

World production of sunflower seed is estimated to be 36.2 MMT in 2012/13, down 10% from the previous season's excellent crop as dry conditions affected production in Ukraine, Russia and the European Union, which together account for 60% of world production and 70% of sunflower oil exports. Total exports of sunflower oil from those regions are expected to fall by 9% to 13.7 MMT as a result.

US production of sunflower oil typically satisfies domestic demand. In 2011/12, however, demand exceeded production by 40%, as drought limited the sunflower seed crop. In 2012/13, US sunflower seed production is expected to recover, rising an anticipated 37% year-on-year to 1.3 MMT. Sunflower oil production is forecast to rise 34% to 200,000 metric tons. This has helped US sunflower oil prices to fall from the highs of last season.





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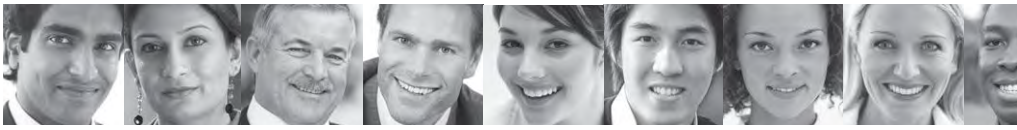

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AOCS CORPORATE MEMBER

Why we care about scientific misconduct: a view from an editor-in-chief

Eric J. Murphy

Many may not fully appreciate why the scientific community cares so much about protecting the integrity of the scientific record and what the career-altering implications are for those who commit it. The first is a relatively simple concept: that what we do as scientists is uniquely pure amongst professions. As scientists, we make measurements of one sort or another, interpret the results based on the current state of knowledge, and report these results in the scientific literature to our colleagues. We do not make up data to fit our grand hypothesis, we don't misuse statistics to make the data work, we don't alter data to help our cause, and we certainly do not use others' work without attribution.

- **Scientific misconduct is defined as acts that involve plagiarism, fabrication of, and falsification of data.**
- **Because scientific misconduct is often found in peer-reviewed journals, editors-in-chief can play an important role in detecting, preventing, and mitigating it.**
- **There is a slippery slope of inappropriate behaviors practiced by authors that can potentially escalate into more serious offenses.**

COMMON PUNISHMENTS FOR SCIENTIFIC MISCONDUCT

If a scientist is caught committing an act of misconduct, the ramifications for that individual's career and, in fact, his or her life are indeed great. The Office of Research Integrity (ORI), part of the US Department of Health and Human Services (HHS), is responsible for investigating acts of misconduct by investigators with Public Health Service (PHS) funding. A confirmed finding of the commission of scientific misconduct can be career ending or at the least have a dramatic impact on career progression. A common punishment is a three-five year debarment from any federal funding and participation on grant review panels. Lesser punishment, often used for postdoctoral fellows, is conducting research under the supervision of an individual's institutional compliance office to ensure the integrity of the research process. In severe cases, permanent debarment from federal funding can occur, the equivalent of a death sentence for one's career in the United States and in countries with similar penalties.

FABRICATION, FALSIFICATION, AND PLAGIARISM (FFP): JUDGMENT AND FORENSICS SOFTWARE

Defining fabrication, falsification, and plagiarism (FFP) is simple, but detecting these acts is much more difficult. Forensics software can now compare homology between a submitted manuscript and the published literature. However, how good are the results? I have found that internet sites such as *Déjà vu*, while perhaps well intentioned by the creators, can easily be misused by possibly equally well-intentioned but ill-informed individuals. For instance, some abstracts from papers published in *Lipids* had >85% homology, yet upon closer examination, the abstracts are very similar in the use of words but are reporting different results from two vastly different organisms! So a rash, uneducated decision would have resulted in an inappropriate accusation of misconduct, when in reality there was no misconduct at all. At the end of the day, it is difficult to write a manuscript regarding analytical analysis of two different organisms without using a tremendous number of the same words.

Hence, the results from forensics software or from databases such as *Déjà vu* are not the end of an investigation, but the beginning. Commonly, the same words are used in technical

writing, so the ability to write succinctly and to be vastly different from other papers from one's lab can be difficult. This is an important lesson: Highly significant homology identified using forensics software or on sites such as *Déjà vu* needs to be closely examined and read by individuals who will work diligently to determine the extent of redundancy, not in words but in meaning.

Recently an individual using a pseudonym of "Clare Francis" recently accused an author of a review paper in *Lipids* of having published a similar paper in another journal. (Clare Francis is an unidentified whistleblower who uses software to detect plagiarism and sends the findings to journal editors.) After careful examination, it quickly became apparent that there were similarities but also dramatic and glaring differences between the papers. However, I did not proceed to issue a retraction nor did the other editor-in-chief involved. Why? Because both of us used good judgment based on our experience and careful examination of the involved literature. These papers were an overview of a laboratory's work and included little new data, so undoubtedly there will be some degree of overlap, including some sentences that are very similar. Do these limited similarities really indicate an intentionally duplicate publication?

No, it does not, and this is truly where judgment comes into play. As an editor-in-chief, determining plagiarism that is white and black is easy. There is no judgment required when an author liberally borrows two or three paragraphs verbatim from another author. However, when looking at situations such as a two review papers from different symposia, editors-in-chief must exercise restraint from rushing to make a rash decision and must use good judgment when making their decision.

EDITOR-IN-CHIEF: ENFORCER OR REFEREE?

Is an editor-in-chief more like a police officer enforcing the law in a rigid manner? Or are we more like a sports official whose judgment is constantly used to enforce the rules? Unlike a police officer that has a judge and jury to sort everything out, an editor-in-chief doesn't have that option. Our position is one in which we have to make a decision based on our own judgment. This authority comes with a great responsibility to act appropriately and without malice. However, it also means we have the responsibility to examine each potential case of misconduct and to provide the institutional compliance officers with the evidence as needed.

While plagiarism is a bit easier at times to detect, fabrication and falsification of data may go undetected, despite our efforts during peer review to detect such misconduct. However, with the increasing publication of results from Western blot analysis and photographs containing immunohistochemistry in *Lipids*, requires a diligent effort to examine manuscripts for potential fabrication and falsification of data. All in all, these acts are neither simple nor easy to detect.

HANDLING CASES OF SCIENTIFIC MISCONDUCT

It is absolutely critical during the examination process of putative scientific misconduct to protect all parties. Individuals' reputations and careers are at stake. I contact the corresponding author via telephone and avoid email while the case is under examination. Why? Because it is too easy for someone to overhear a message left on a phone and misinterpret what may have been said and emails can be intentionally or unintentionally read by others. Either situation puts a potentially innocent person's reputation in jeopardy for no reason other than that of convenience. In short, it is my responsibility to protect all involved parties until a decision is made regarding the potential outcome of the misconduct case.

Having dealt with about five to seven cases per year, I approach each case as being unique. For traditional FFP, my approach includes a careful examination of all involved materials, notification and discussion of the core issues by phone with the involved parties, and, following careful consideration of all the evidence, rendering of a decision and notification of the decision to the senior author. Where appropriate, the evidence is presented to

CONTINUED ON NEXT PAGE

INFORMATION

- Errami, M., and H. Garner, A tale of two citations, *Nature 451*:397–399 (2008).
- Martinson, B.C., M.S. Anderson, and R. de Vries, Scientists behaving badly, *Nature 435*:737–738 (2005).
- The article was adapted from my editorial "Scientific Misconduct and Lipids: A View from an Editor-in-Chief," *Lipids 48*: 1–2 (2013).

institutional compliance officials. After presentation of evidence to the appropriate parties, my role in the process is done until additional requests from institutional compliance officials occur.

BEYOND FFP: INAPPROPRIATE BEHAVIORS IN PUBLISHING

But while FFP is the misconduct of interest to the ORI and other federal compliance offices, many other forms of misconduct exist that do not meet the definition of FFP. Are these acts of misconduct an entry act to FFP? Several years ago, a commentary published in *Nature* detailed the frequency of what I refer to as entry acts of misconduct (Martinson *et al.*, 2005). The authors of this commentary conclude that "our findings suggest that US scientists engage in a wide range of behaviors extending far beyond falsification, fabrication, and plagiarism." These acts include, but are not limited to, those involving authorship, incorrect use of statistical analysis, improper elimination of "errant" results, improper use of animals or humans in research, failure to cite the literature properly, misleading titles that do not convey the major thrust of the results, and inappropriate or limited interpretation of results.

While these acts are indeed a bit more of a gray area, detecting and dealing with these acts is of equal importance. Why? Because ignoring these acts does not form an effective deterrent to commission of similar acts in the future. In addition, lack of author education with regard to these more minor offenses and acceptance of these issues as permissible may lead to an ever-escalating level of offenses in the future by the authors. In the end, an editor-in-chief has a crucial role in detecting and dealing with all levels of scientific misconduct and must be prepared to do so with a high level of rigor and integrity. We serve a role in which author education regarding these "entry acts" of misconduct is a critical and important responsibility. As such, I spend a lot of time educating authors on these issues and forcing them to take corrective actions. From trimming the list of authors on a manuscript to only those individuals who made a true intellectual contribution or using proper statistical analysis or having authors cite the relevant literature or aiding authors in writing a proper title, these are all essential processes in educating authors about responsible publishing.

IF ONCE IS GOOD, TWICE IS BETTER: DUPLICATE PUBLICATIONS

We have increasingly faced the dreaded problem of duplicate publication. Interestingly, roughly 4–6% of authors admit to committing this behavior, one in which mid-career scientists participate at a significantly higher rate than early-career scientists (Martinson *et al.*, 2005). Duplicate publication was the subject of another commentary in *Nature* in which the authors suggest a rise in the occurrence of duplicate publications (Errami and Glover, 2008). These authors conclude that the single most important driving factor for individuals to author duplicate publications is the ease of committing these acts.

SUMMARY

As the editor-in-chief of *Lipids*, I take each and every act of misconduct seriously. Whether it is something as simple as a misleading title to as complex as fabrication of data, appropriate steps are taken to ensure the highest integrity of the journal. Author education is an absolutely critical approach taken to curb the incidence of bad behaviors or entry acts of misconduct. While it takes time to educate authors on what may be gray areas, in the end this produces a better, higher-quality paper for publication in *Lipids*. It is my responsibility to educate authors about misconduct and to detect misconduct, both FFP and entry acts of misconduct, and deal with these acts using good judgment. This is important as we serve as the last bastion between what is often an easily correctable situation and one that requires significant effort to correct, results in damage to someone's career, and tarnishes the community of science in the eyes of the public who funds our work.

Eric J. Murphy is a tenured associate professor in the Department of Pharmacology, Physiology, and Therapeutics at the University of North Dakota, Grand Forks, USA. He has served as editor-in-chief of Lipids *since 2006 and as an associate editor with the* Journal of Neurochemistry *since 2004. He can be contacted at murphy@med.und.edu.*

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Six receive AOCS' highest honors

Ragnar Ohlson, an AOCS member since 1964 and AOCS Fellow since 2009, received the AOCS Award of Merit on Monday, April 29, at the Business Luncheon during the AOCS 104th Annual Meeting & Expo (AM&E) in Montréal, Québec, Canada.


Ohlson

The award recognizes leadership in technical, administrative, or special committees and AOCS activities, as well as outstanding service that has advanced the Society's prestige, standing, or interests.

Among his many accomplishments, Ohlson was the general secretary of the International Society for Fat Research (ISF) for over 10 years and was instrumental in AOCS being named the ISF Secretariat in 1992. In addition, he was involved in the formation of the AOCS European Section.

Ohlson also served on the AOCS Governing Board (1994–1996), was co-chairman of the AOCS World Congress on Oil Technology (1995), and is a member of the *JAOCS* Editorial Advisory Board (1998–present). Further, Ohlson has assisted AOCS by representing the Society at many European meetings and conferences.

He is a member of the Royal Swedish Academy of Agriculture and Forestry (1983) and of the Royal Swedish Academy for Engineering Sciences (1975).

2013 FELLOWS INDUCTED

Five new AOCS Fellows were inducted at the AM&E: Erich E. Dumelin, Steven (Steve) A. Howell, Magdi M. Mossoba, Frank T. Orthoefer, and Bernard (Bernie) F. Szuhaj.

The distinction of Fellow is given to "veteran AOCS members whose achievement 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 members for a minimum of 15 years. For more information, see http://tinyurl.com/AOCSFellows.

Erich E. Dumelin, who is a native of Switzerland, retired from Unilever as vice president, supply chain strategy and technology foods. He is recognized internationally as an authority on the sustainability of raw materials and renewable energy resources.


Dumelin

As an AOCS member for 25 years, he has been active in technical committees, the education and meetings steering committee, the financial steering committee, the AOCS European Section, and AOCS-sponsored world conferences. Dumelin served on the AOCS Governing Board (2006–2013), including a stint as AOCS vice president (2010) and AOCS president (2011). Among other distinctions, Dumelin received the International Lecture Award from the Society of Chemical Industries in 2009.

Steven (Steve) A. Howell is president of Marc-IV Consulting Inc. and technical director of the National Biodiesel Board (NBB; Jefferson City, Missouri, USA). Howell has served as technical director since shortly after NBB's inception in 1992, and is credited with helping to navigate the nascent biodiesel industry through an obstacle course of technical challenges. Those include completing health effects testing, establishing ASTM standards, and securing Original Equipment Manufacturer approval, to name just a few.


Howell

Howell has been an AOCS member since 1994 and has been active within the Industrial Oils Products Division, serving as member-at-large (1998), membership development coordinator (1999–2006), and as NBB's representative to the Division (2006–2010).

Magdi M. Mossoba, a research chemist with the US Food and Drug Administration, is known for his development of Fourier Transform Infrared (FT-IR) spectroscopy methodology. His work has generated a number of official methods and has furthered the use of FT-IR within the FDA and demonstrated its widespread applicability.


Mossoba

Mossoba has been an AOCS member since 1992 and has served on a number of committees within AOCS, including serving as chairperson of the Books and Special

CONTINUED ON NEXT PAGE

Publications Committee (1996–present), the Uniform Methods Committee, and the Analytical Division (2000–2002).

He is a recipient of the Herbert J. Dutton Award (AOCS, 2008) and the Associate Referee of the Year Award (AOAC International, 2000).

Orthoefer

Frank T. Orthoefer, a consultant based in Lenoir, Tennessee, USA, is a distinguished scientist with over 35 years of industrial experience in lipid and grains research and development. This includes 150 publications on a wide range of topics, including grains, proteins, phospholipids, and edible oils, and 17 United States patents. Currently, he is concentrating on the development of *trans*-free, trait-modified oils, including low-linolenic, high-oleic, and high-saturate oils.

Orthoefer has been an AOCS member since 1979, was one of the founding members and first chairperson of the Edible Applications Technology Division. He has organized and chaired many symposia and technical sessions, as well as serving as an associate editor of the *Journal of the American Oil Chemists' Society* and technical program chair for the AOCS Annual Meeting & Expo.

Szuhaj

Bernard (Bernie) F. Szuhaj, a consultant based in Fort Wayne, Indiana, USA, led a lecithin and protein research group focused on the value and application of phospholipids and soy protein while director and vice president at Central Soya. He is a named inventor on eight United States patents and contributed two chapters for the fifth revision of *Bailey's Industrial Oil and Fat Products.*

Szuhaj has been an AOCS member since 1969, is a founding member and first chairperson of the Phospholipid Division, and served on the AOCS Governing Board as a member-at-large (1989). He was also instrumental in developing the 15+-year partnership between the AOCS Phospholipid Division and the International Lecithin and Phospholipid Society. ■

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Researchers put olive oil "fridge test" to the test

Nancy Flagg

On a recent episode of the Emmy Award-winning US television program, "The Dr. Oz Show," which airs in 118 countries, Oz warned his audience that more than two-thirds of extra virgin olive oil (EVOO) sold is not pure EVOO. He recommended that viewers paying premium prices for EVOO should conduct a home test to find out if their purchase is pure EVOO quality. Oz advised buyers to put their bottles of EVOO into the refrigerator to see if the oil solidifies. If it does solidify, they can be "pretty sure it's pure," said Oz; though he also cautioned that the test is "not 100% foolproof."

Some experts debunk the so-called fridge test, including expert Australian taster Richard Gawel, who called the test a "myth," and the North American Olive Oil Association (NAOOA), which described it as "completely false and misleading."

The University of California Davis (UCD) Olive Center (USA) recently put the fridge test to the test. Olive Center Director Dan Flynn, who was a guest on Oz's show, said that there were many calls and emails to his office, to supermarkets, and to olive oil producers after the program aired. Viewers who had tried the test and found their oil failed had concerns and questions. Flynn said Olive Center Research Director Selina Wang had the idea for the team to conduct its own research experiment to "help clear up the confusion."

Flynn told *Olive Oil Times* that the results of the experiment, which were released in March 2013, showed that the fridge test is an unreliable indicator of olive oil quality.

Seven oil samples, including EVOO, lesser-grade olive oils, olive oil blends, and non-olive oils were placed in a refrigerator and checked at intervals up to 180 hours. Although no samples fully solidified, a sample of EVOO mixed with up to 50% lesser-grade olive oil congealed in the bottle, meaning it could be interpreted as passing the refrigerator test even though it was not pure EVOO. The study concluded that the fridge test is not reliable for determining oil purity or quality. (See "Refrigeration is not reliable in detecting olive oil adulteration" at http://tinyurl.com/Fridge-Test (pdf).)

If the fridge test cannot be relied on, what can consumers do? Flynn advises consumers to buy darker bottles that protect the oil from light, purchase oil within 15 months of the harvest date (which should be printed on the label), and look for certification seals.

Flynn recommends certifications that include both a chemical profile test and a sensory evaluation, such as the Australian and Californian certifications. The NAOOA, which represents American olive oil importers, also conducts a quality seal program that includes analyses by a certified taste panel.

Chemical tests alone are "not enough to tell if an oil tastes good," said Flynn.

Nancy Flagg is a freelance writer based in Sacramento, California, USA, who writes about olive oil, agriculture, and business. She can be reached at nfbugg1@gmail.com.

This article first appeared in Olive Oil Times *and is reprinted with permission.*

Fat fight (cont. from page 352)

in oleochemical raw materials supplies for those processors that rely heavily on tallow feedstock.

"In the medium term, we believe that stearin will greatly increase its presence in the EU fatty acid sector, whether directly as an input, or indirectly via larger imports of fatty acids from Southeast Asia as European tallow supplies become more constrained," noted UK-based consulting firm LMC International on its 2012 Oleochemicals summary report.

LMC said it expects tallow prices to remain at historically high levels for a sustained period. Tallow and palm stearin, the main nonlauric raw materials for fatty acid production, are typically cheaper than crude palm oil. LMC noted that throughout 2011 and 2012, tallow prices were higher than they used to be even in relation to other oils and fats.

In the United States, tallow and grease prices saw record highs in 2011, according to the NRA. The average price for inedible tallow was $1,097 per metric ton, up over 34% from 2010 as reported by the US Department of Agriculture's Agricultural Marketing Service (AMS).

Yellow grease averaged $957 per metric ton, up 38% from 2010. In 2011, the price of tallow was higher than that of palm oil for most of the year, while the spread between soybean oil and tallow narrowed very considerably.

In 2012, palm oil prices declined over 28% between January and December, noted Kent Swisher, vice president, international programs at NRA.

"These lower prices also pulled tallow and grease down toward the latter half of the year. It must be noted, however, that the demand in the US domestic market did create a lag in the response to the downward pressure created by palm oil prices," he said.

The US export market for tallow and grease also fell because of the struggling global economy and oversupply of cheap palm oil. Total exports of tallow and grease decreased by 32% from 1.3 million metric tons to 895,000 metric tons between 2011 and 2012, according to the NRA.

The NRA expects prices to recover in 2013 as palm oil prices are expected to have bottomed out.

"The average palm/soy spread over the last 10 years has been around $77 per metric ton but this more than doubled in 2012," said Swisher. "Toward the end of the year, the spread was as high as $277 per metric ton. This spread is not sustainable and as stockpiles decline, prices for palm oil should rebound."

STABLE DOMESTIC DEMAND

Although tallow and grease use in the US biodiesel industry fell in 2012 by 6% compared to 2011, consumption in the feed, food, pet food, and oleochemical sector increased by 16% last year over 2011, according to the NRA.

Currently the NRA lumps all domestic usage of animal fats by taking production and subtracting exports and use in biodiesel. The US Census Bureau stopped reporting consumption data on tallow and grease in July 2012.

In 2012, ethanol producers aggressively adopted new technologies that allowed them to extract corn oil from dry distillers' grains with solubles (DDGS). This new corn oil production replaced some tallow and grease in the biodiesel industry, said Swisher.

"Approximately 714,000 metric tons of tallow and grease went into the domestic biodiesel industry in 2012 which is down about 6% over 2011. This decline is mainly due to increased corn oil use in the biodiesel sector," Swisher added.

"At the same time, DDGS going into the feed sector did not contain the energy that they once did, creating more demand for tallow and grease in feed rations," he said.

For 2013, the NRA expects demand for animal fats to remain steady because of the increased RFS mandate, reinstated tax credits for biodiesel, continuous strong demand from the oleochemical industry, and added demand in the feed sector because of projected increases in domestic swine production and continued energy decreases in DDGS.

"Of course, as palm oil prices correct in early 2013 there could be added export demand," Swisher noted. ■

"The use of animal fats for oleochemical production has historically allowed the domestic industry to compete in the global market by providing a cost-competitive raw material. That competitive raw material edge is now being profoundly eroded."

Biofuels+ (cont. from page 358)

The use of palm oil in Malaysia for biodiesel was introduced in 2008, according to the *Business Times*, but implementation has lagged until now.

Insights into jatropha

INOCAS and The Platform for Sustainable Aviation Fuels at Leuphana University, Lüneburg, Germany, recently released a 72-page report entitled "Insights into Jatropha Projects Worldwide: Key Facts & Figures from a Global Survey." The document is available for download at http://tinyurl.com/INOCAS-jatropha.

Data presented in the document were collected in a global survey conducted May–September 2011 of 154 producers of jatropha, castor, neem tree, moringa, pongamia, and croton. Of the 260 projects identified, there were 154 preliminary responses, and 139 were dedicated to jatropha oil. One hundred eleven of this 139 provided further information by both telephone interview and computer-assisted self-interviewing. Of these, 42 projects were in Africa, 35 in Asia, and 34 in Latin America and the Caribbean. Looking at individual countries, the project collected data on nine projects in India, seven in China, and six in Brazil

According to results developed from the 111 projects surveyed, a total of 1,191,625 hectares had been planted with jatropha trees as of 2011. More than 860,000 hectares of that total were in India. More than 70% of the operational projects surveyed in the study started planting jatropha between 2007 and 2009. Establishment of cultivation sites peaked in 2008.

The researchers indicate that yield levels among the 111 projects, taken together, are not yet sufficient to ensure the necessary cash flows and financial profitability for jatropha. Average yield as of 2011 was 2.1 metric tons of dry seeds per hectare per year. Most of the projects (84%) send their oilseeds into biofuel production. Seventy-one percent use jatropha press cake as fertilizer. Sixteen percent mention aviation fuels as a current or future market.

As part of its summary, the report indicates, "According to experts and project representatives, finding lucrative markets for by-products will be decisive for making a successful business case for jatropha (p. 58)."

News of castor oil

Polyamides. France-based specialty chemical firm Arkema and castor oil and derivatives producer Jayant Agro Organics Ltd. of Mumbai, India, signed a joint venture (JV) agreement in April 2013. As part of the terms, Arkema will acquire a 25% stake in Ihsedu Agrochem, a subsidiary of Jayant Agro, which specializes in the production of castor oil. Arkema entered the agreement to gain long-term secure access to castor oil, which it uses in making biosourced polyamides. The latter are used as innovative materials for lighter vehicles and for oil and gas extraction (http://www.arkema.com/en/media/news/news-details/Arkema-partners-with-Jayant-Agro-in-India/?back=true)

According to the Indian publication MoneyControl.com, in this JV, Ihsedu will focus on manufacturing and sales of all grades of castor oil. For its part Jayant Agro will concentrate on manufacturing and sales of value-added castor oil products. (http://tinyurl.com/Arkema-castor).

Solar panels. BioSolar Inc. announced its first commercial sale of bio-based backsheets, or covers, for specialty photovoltaic (PV) solar modules in March 2013. However, the company, based in Santa Clarita, California, USA, did not name the purchaser (http://tinyurl.com/BioSolar-sales).

A special feature of the BioSolar backsheets is that they are made with castor oil, which is an ingredient in forming a polyamide resin similar to nylon. In the manufacturing process, the resin is reinforced with cotton that has been recycled from rags to form a protective covering. The company indicates that the castor oil/cotton sheet affords the durability and environmental characteristics of conventional petroleum-based plastics, such as electromagnetic properties, mechanical strength, dimensional stability, and weatherability required by PV solar applications.

The company also claims production costs for these Bio-Backsheets are less than for petroleum-based backsheets. That latter are typically made with polyester film, partly because the base materials are cheaper than petroleum and partly because they consists of a single composite layer rather than laminated layers (http://tinyurl.com/BioSolar-castor). ■

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Enzymes answer the Chinese detergent challenge

Cynthia Bryant

The number of washing machines in China is growing rapidly; 89% of households will have them by 2020. Although washing machines are gaining ground, many Chinese people still prefer the traditional method of hand washing. In fact, Novozymes Inc. recently funded a study in China showing that a little more than half of the 500 surveyed customers who have a washing machine still do 25–50% of their laundry by hand.

Not only is traditional hand washing time consuming, but obtaining satisfactory results without a great deal of scrubbing and physical effort is difficult with the traditional detergents that are used.

THE SUSTAINABILITY CHALLENGE

Apart from being time consuming and mechanically difficult, hand washing with traditional detergents burdens the already scarce water supply in China because it requires more water than machine washing. Also, chemicals in traditional detergents are discharged with the wastewater. Hand washing with traditional detergents is also not energy friendly since it requires high water temperatures.

DR. SINNER'S CIRCLE

A great deal of innovation is happening with washing machines. New cycles with different mechanics are being developed so that wash cycles can be shortened and temperatures lowered. Meanwhile, detergent ingredients that improve performance and enable new patterns of use are being developed.

Despite technological progress in machine washing, chemistry is largely responsible for the

CONTINUED ON PAGE 390

- **Although the number of washing machines in China is rapidly growing, many Chinese consumers continue to wash by hand.**
- **Detergents that use enzymes can deliver optimal results for laundry done by machine or by hand. Also, in both hand and machine washing, such enzyme-enhanced detergents reduce washing times, require less mechanical action, and wash at lower temperatures—all of which save time and money.**
- **Replacing surfactants and detergent builders with enzymes decreases CO_2 emissions and increases wastewater quality.**

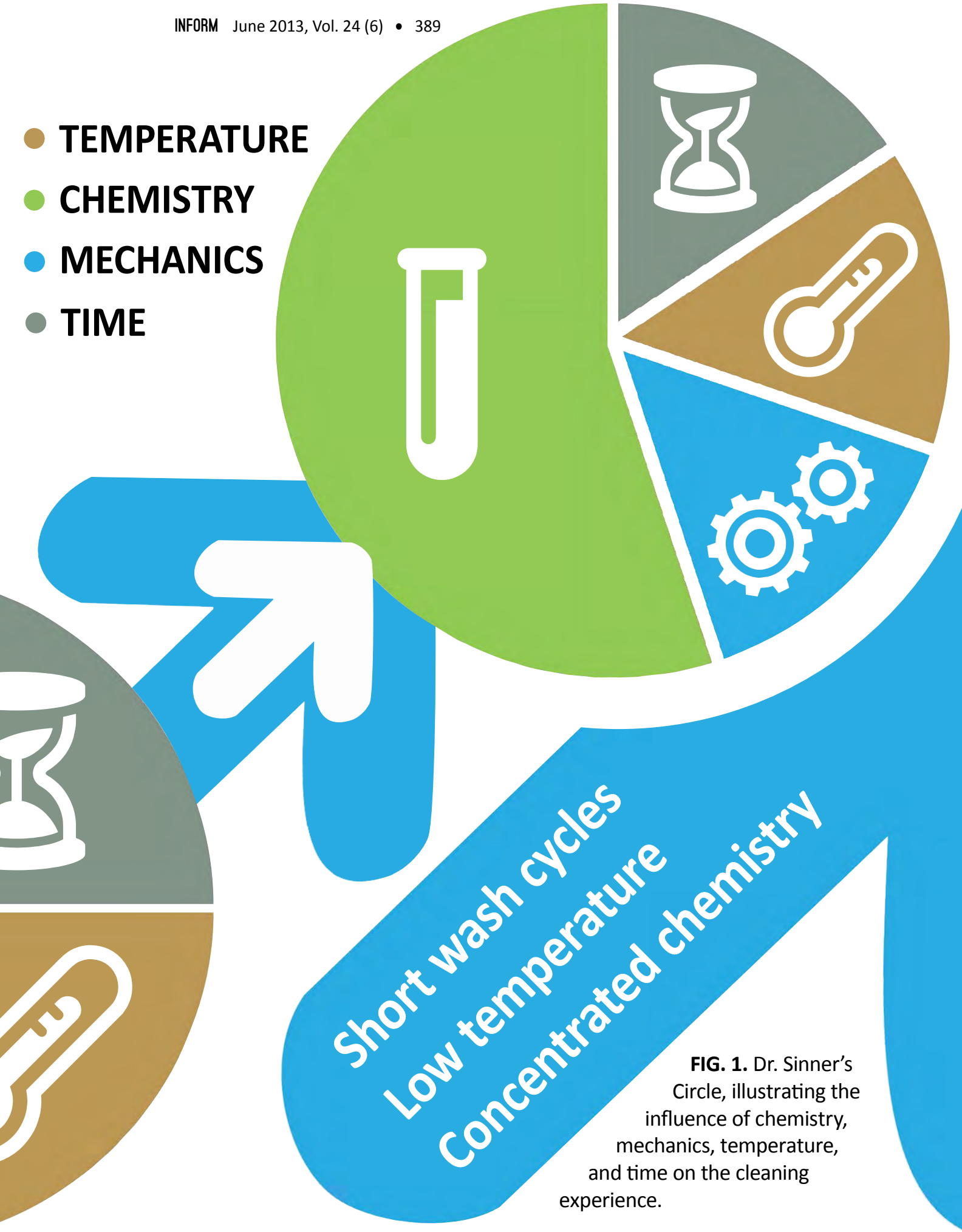

FIG. 1. Dr. Sinner's Circle, illustrating the influence of chemistry, mechanics, temperature, and time on the cleaning experience.

"If all 3 million tons of detergents used in China every year were optimized with enzymes, the CO_2 savings would be 83,000 metric tons of CO_2, equivalent to taking 35,000 cars off the roads . . ."

cleaning that takes place in a wash cycle. Enzyme technology can play a key role in delivering the desired performance that other factors once delivered.

According to Dr. Sinner's Circle, the four key drivers that determine performance in cleaning clothes and removing stains are: temperature, time, chemistry, and mechanics. (This circle was first presented in 1959 by Herbert Sinner, a chemical engineer with Henkel from 1932 to 1965; http://tinyurl.com/Sinner-circle.) If one driver is increased, other drivers can be reduced to achieve the same performance and vice versa (Fig. 1, page 389).

Increasing the temperature not only is costly for the consumer but also has a negative impact on the environment, as much energy is used. Increasing time or effort spent on washing is not desirable either; the last option is chemistry or ingredients. This is where enzymes come into play; replacing detergent ingredients with the right composition of enzymes enables high-performance cleaning that satisfies consumer needs and meets environmental challenges.

THE ENZYMATIC SOLUTION

In 2012, Novozymes developed a multi-enzymatic solution that addresses the unique challenges of both hand and machine washing in China.

"Novozymes has developed a range of enzymes optimized for detergents and used them to provide Chinese consumers with optimal results for laundry done by machine or by hand," Per Falholt, Novozyme's chief science officer, explained. "These multi-enzyme solutions consist of up to eight different enzymes and can deliver the performance that consumers want in shorter time with less mechanical action and at lower temperatures. In addition, replacing surfactants and builders with enzymes has a positive impact on CO_2 emissions and water quality," he added.

Most of these enzymes are hydrolases. With this multi-enzyme solution, it is possible to replace high volume surfactants with low volume enzymes and achieve the same or better performance—without increasing the cost. Adding enzymes also means that the performance of the detergent can be increased in terms of stain removal, total cleaning, and fabric and color care.

Enzymes can reduce or replace the amounts of pollutant chemicals actually used in a detergent formulation. Each enzyme performs a specific role, and each is added to target specific kinds of dirt and stains. Also, with enzymes, it is possible to avoid releasing vast amounts of chemicals the environment, thus contributing to a more sustainable laundry.

ENZYMES TO TARGET STAINS

Enzymes are substrate specific so they target and dissolve the substrate they were designed for very effectively.

However, undegraded soils that are dissolved from the stains, such as proteins, fat, starch, mannan, and β-glucan, can be redeposited on the fabric as a thin, sticky film of invisible dirt. This film acts as a glue and traps particulate soils in washing and wearing, giving the garment a gray, dull appearance. Again, different enzymes are able to remove different types of glues so that redeposition of soils is avoided.

While enzymes degrade stains, they are gentler on fabrics and colors. General wash and wear damages cotton fibers and creates bristly microfibrils that attract and trap the dirt floating in the wash water. To give an example, cellulases cleave these microfibrils, preventing the dirt from being trapped in the cotton; and the results are better whiteness and color and fabrics that appear smoother.

In summary, the new enzymatic solution enables faster hand washing with less mechanical scrubbing; saves water, energy and time; and maintains the desired level of performance.

THE ENVIRONMENTAL BENEFITS IN CHINA

"If all 3 million tons of detergents used in China every year were optimized with enzymes, the CO_2 savings would be 83,000 metric tons of CO_2, equivalent to taking 35,000 cars off the roads. Wastewater quality would also improve as enzymes are used in much smaller quantities, so the water quality of 2.8 million m^3 of water would be improved," Per Falholt concluded.

Heating wash water to achieve the performance that Chinese consumers want can have significant environmental implications. However, with the use of enzymes, this scenario can be avoided, as enzymes can deliver the desired performance at the current low temperatures, thus saving 5 million metric tons of CO_2. This would be equivalent to taking 2.1 million cars off the road—or almost half the cars in Beijing.

The use of enzymes in detergents also complements China's 12th Five-Year-Plan. The Chinese government is focusing on resource efficiency and lowering CO_2 emissions, and the plan encourages use of compact liquid detergents. Incorporating enzymes in detergents will help China achieve these goals while at the same time providing the potential for increased detergent cleaning performance for consumers.

Cynthia Bryant is marketing director for House Hold Care in Novozymes. She can be contacted at cwby@novozymes.com.

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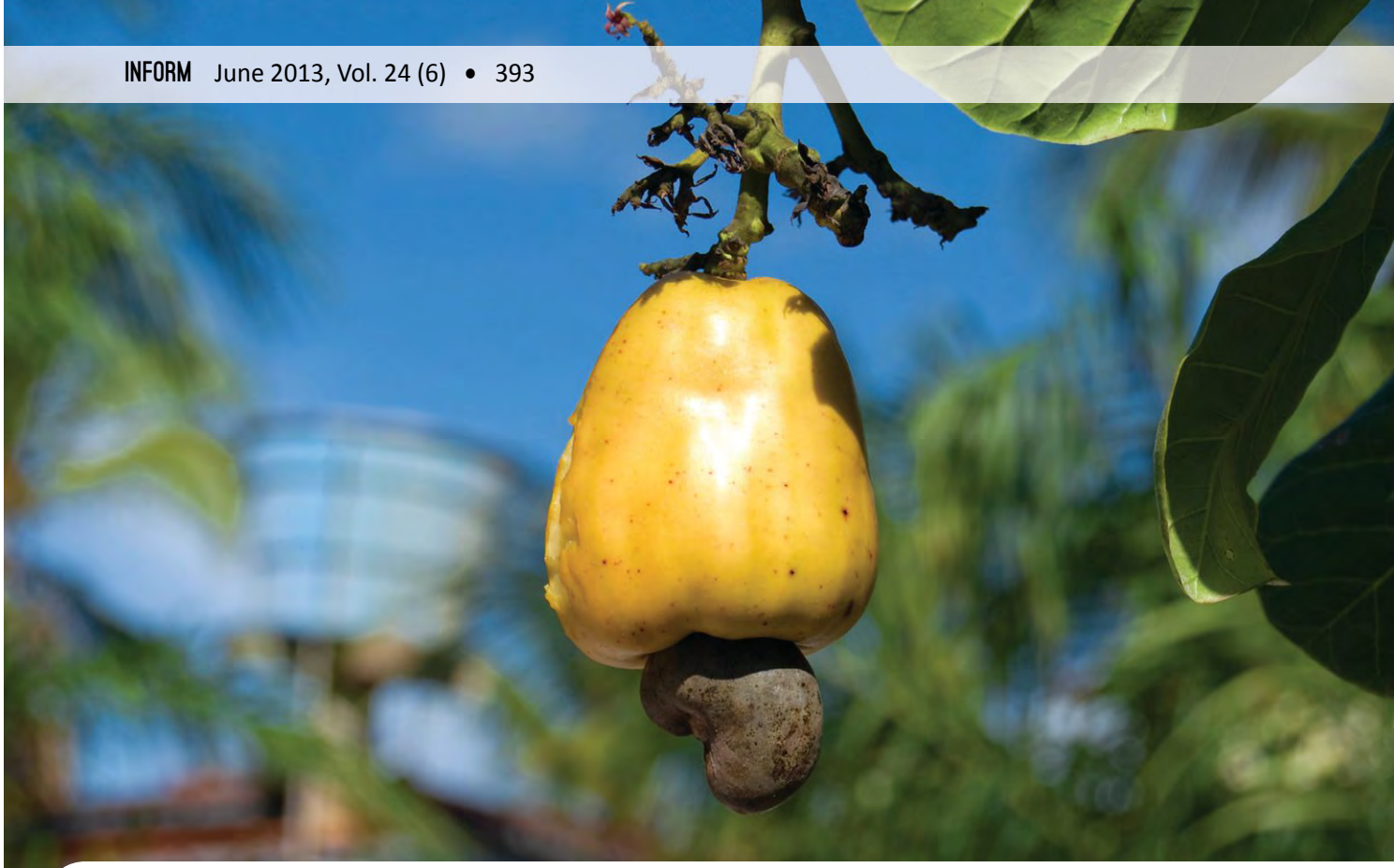

The cashew fruit, or cashew apple, which is five times richer in vitamin C than oranges, is used in soft drinks, jam, and wine. Gray-colored cashew nuts grow at the bottom of each fruit. However, only the kernels inside the nuts are edible. Consequently, what most people think of as a "cashew nut" is actually the kernel, not the whole nut.

From cashew nut shell liquid (CNSL) to polyols for polyurethanes

Mihail Ionescu and Zoran S. Petrović

When you eat a cashew nut, you are only eating the edible kernel inside the nut. The nonedible parts just might hold the key to making safer and more sustainable polyurethanes (PU).

The cashew tree (*Anacardium occidentale*) is originally from Brazil. Its fruit, or apple, is five times richer in vitamin C than oranges and is traditionally used to prepare soft drinks, jams, and wine. The nut, which is outside of the fruit, has a unique structure that consists of an edible nut kernel within an inner and outer shell, and a brown cashew nut shell liquid (CNSL) that floats in a honeycomb structure between the shells (Fig. 1, page 394).

CONTINUED ON NEXT PAGE

- **Cashew nut shell liquid (CNSL) is a by-product of the cashew nut fruit industry. It is used as a raw material for a variety of industrial products and is an attractive base material for developing polyols and polyurethanes (PU).**
- **Polyols made from CNSL are suitable for all applications in rigid PU foams for packaging; thermal insulation of freezers, buildings, pipes, and storage tanks; or as a decorative wood substitute.**
- **CNSL is a nonestrogenic, nontoxic, biodegradable, inexpensive, and natural substitute for nonylphenol, which is currently used to prepare Mannich polyols and ethoxylated nonionic surfactants. Replacing nonylphenol is desirable, as it is considered to be an endocrine disruptor and its use is restricted in Europe.**

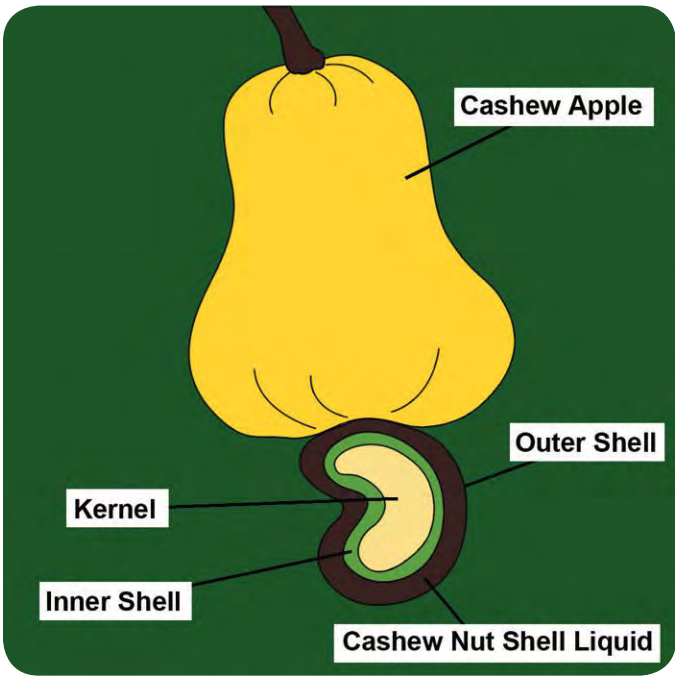

FIG. 1. Cross-section of cashew nut fruit. Found between the inner shell and outer shell, in a honeycomb-like structure, is the cashew nut shell liquid (CNSL).

The leading producers of cashew fruits are Vietnam (30.3% of the total world production), Nigeria (19.4%), India (16%), Côte d'Ivoire (10.8%), and Brazil (5.5%) (faostat.fao.org, accessed April 2013), and CNSL is a by-product of the cashew fruit industry.

The CNSL content in raw cashew nuts varies between 20–25%. Its main components are anacardic acid (90%) and cardol (10%). During high-temperature distillation of CNSL, anacardic acid is decarboxylated to form 3-n-pentadecadienyl phenol, also known as cardanol. Cardanol (Fig. 2) has a phenolic ring with a 15-carbon unsaturated hydrocarbon chain in the meta position, having one, two or three double bonds.

Cardanol is imported to the United States mainly from Brazil and India.

CNSL is a versatile and important raw material for preparation of phenolic resins used as friction materials for the automotive industry (brake linings and clutch discs). CNSL is used for preparation of acid-resistant paints, varnishes, enamels, lacquers, epoxy resins, and diluents for epoxy resins. Because of its dark color, CNSL is used in the manufacture of dark-colored paints and enamels. CNSL has antimicrobial and antibacterial properties and is used as an insecticide and fungicide. In traditional Asiatic medicine, it has been used for treating leprosy, elephantiasis, and psoriasis.

CSNL is an attractive base material for polyols for polyurethanes. Polyols for PU foams should have high functionality, typically 3–8 hydroxyl groups/mol e, and relatively low molecular weight in order to obtain highly cross-linked products with isocyanates. In its initial form, cardanol cannot be used for this purpose since it has one phenolic hydroxyl group, which either does not react or reacts slowly with isocyanates. Hydroxyl groups can be introduced at the phenolic ring and at the double bonds of C15 chains to obtain highly functional polyols. These hybrid aromatic-aliphatic structures are suitable for the preparation of high-quality rigid PU foams.

We have developed Mannich polyols using oxazolidine chemistry (1). Oxazolidines are heterocyclic compounds formed by reaction of aldehydes or ketones with aminoalcohols. Reaction of paraformaldehyde with diethanolamine at 50–60°C with the removal of reaction water results in *N*-hydroxyethyl 1,3-oxazolidine. Simple mixing of oxazolidine with cardanol produces Mannich bases. Propoxylation of Mannich bases from

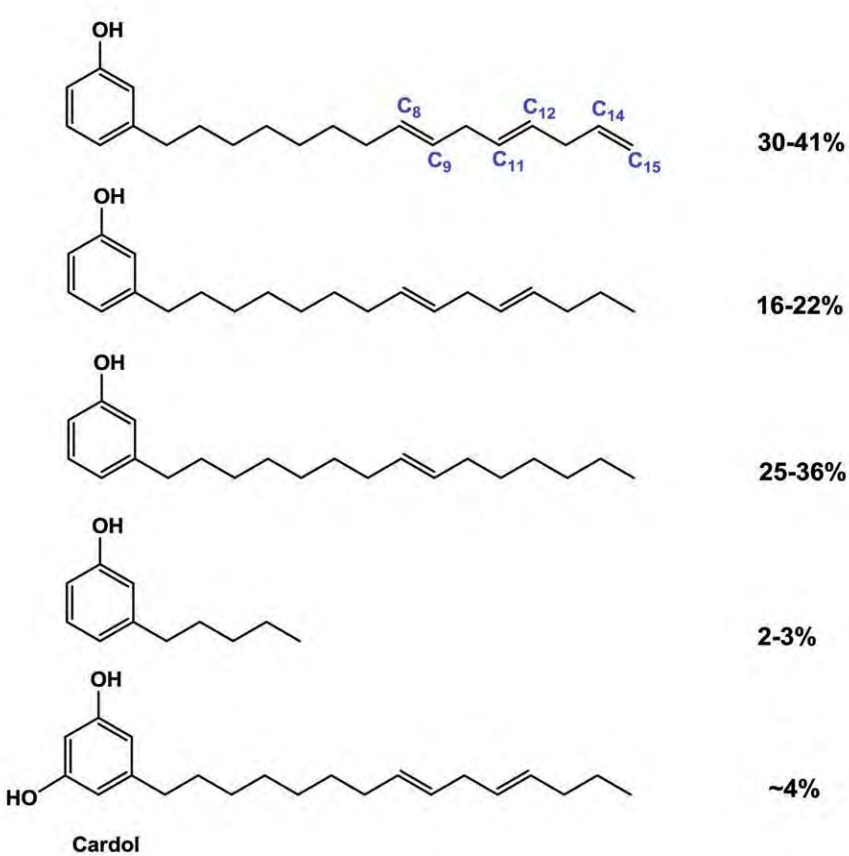

FIG. 2. Composition of cardanol.

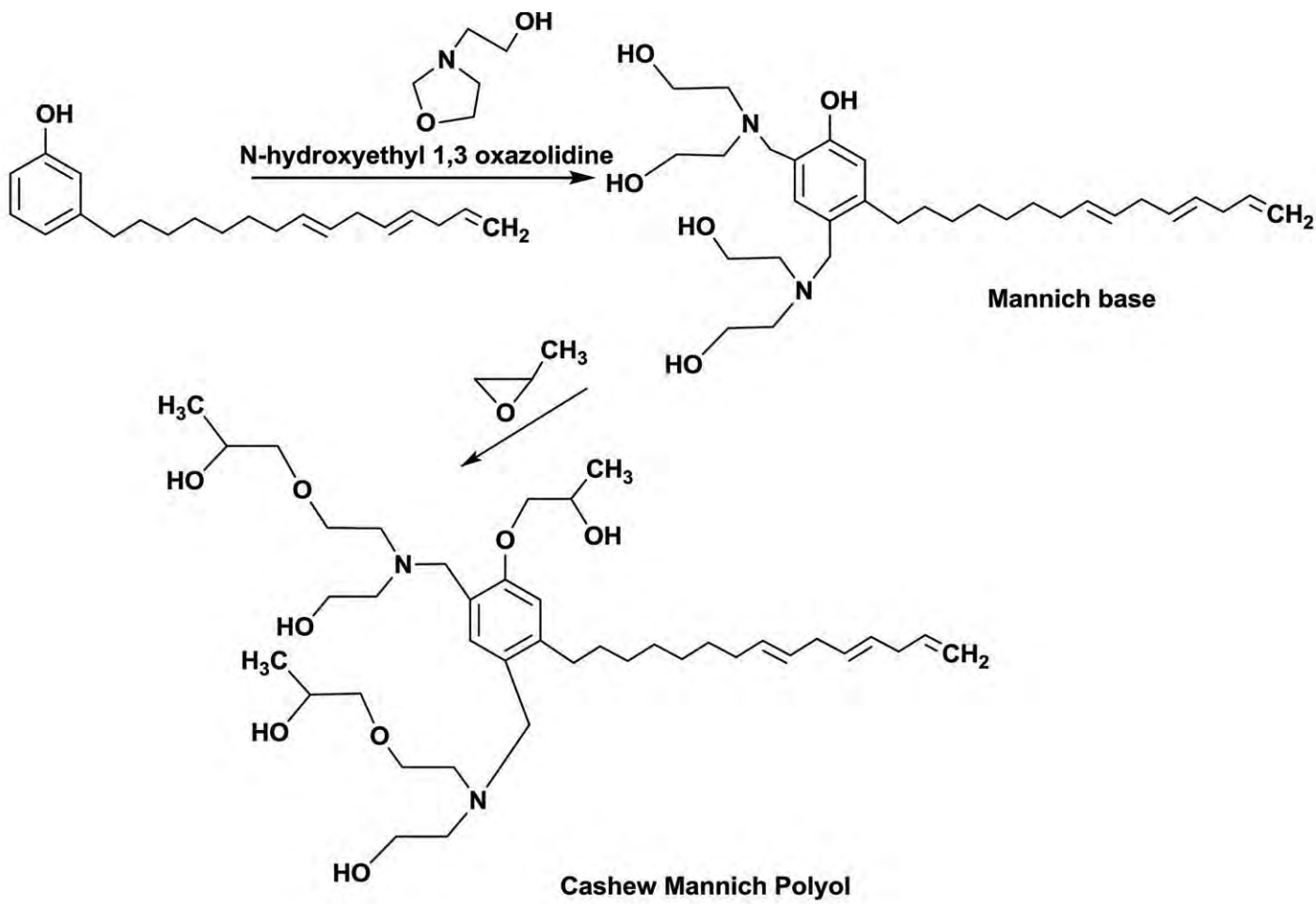

FIG. 3. Synthesis and structure of Mannich polyols from cardanol.

cardanol gives Mannich polyols, having hydroxyl number of 340–450 mg KOH/g, low viscosity of 3–5 Pa·s at 25°C, a tertiary nitrogen content of 1.6–3 mequiv/g, and 3–5 hydroxyl groups/mole, depending on oxazolidine/cardanol molar ratio. The chemistry is illustrated in Figure 3.

Mannich polyols, sometimes called autocatalytic polyols, are very reactive due to the presence of tertiary amine. Rigid PU foams based on these polyols have excellent fire resistance and mechanical properties as a consequence of the high aromatic content.

Novolac polyols are prepared by condensation of cardanol with formaldehyde in the presence of acid catalysts (oxalic acid). The phenolic hydroxyls are transformed to reactive hydroxyalkyl groups in the reaction with propylene oxide or ethylene oxide in the presence of a tertiary amine (Fig. 4, page 396).

Reactions at the phenolic ring and at the double bonds of the C15 chains of cardanol were used to increase functionality of polyols and improve the distribution of hydroxyl groups. Before functionalization of double bonds from C15 chains, the phenolic groups of cardanol were propoxylated to avoid side reactions at the phenolic aromatic ring. The introduction of OH groups to C15 chains (Fig. 4, page 396) was carried out by hydroformylatian, thiol-ene chemistry, and epoxidation with subsequent ring-opening with methanol. Hydroformylation in the presence of rhodium catalyst followed by hydrogenation produces polyols with very high viscosity (100 Pa·s) which was reduced by ethoxylation to 5–10 Pa·s at 25°C. Hydroxyl numbers were 300–320 mg KOH/g and acid values, below 1 mg KOH/g.

Epoxidation of propoxylated cardanol with peroxyacetic acid or peroxyformic acid in the presence of acid catalysts produced epoxidized propoxylated cardanol which can itself be a useful product. Polyols with hydroxyl groups on the aromatic ring and aliphatic C15 chain were obtained by ring-opening with methanol. The relatively high polyol viscosity (28 Pa·s at 25°C) was reduced by ethoxylation with 10–15% ethylene

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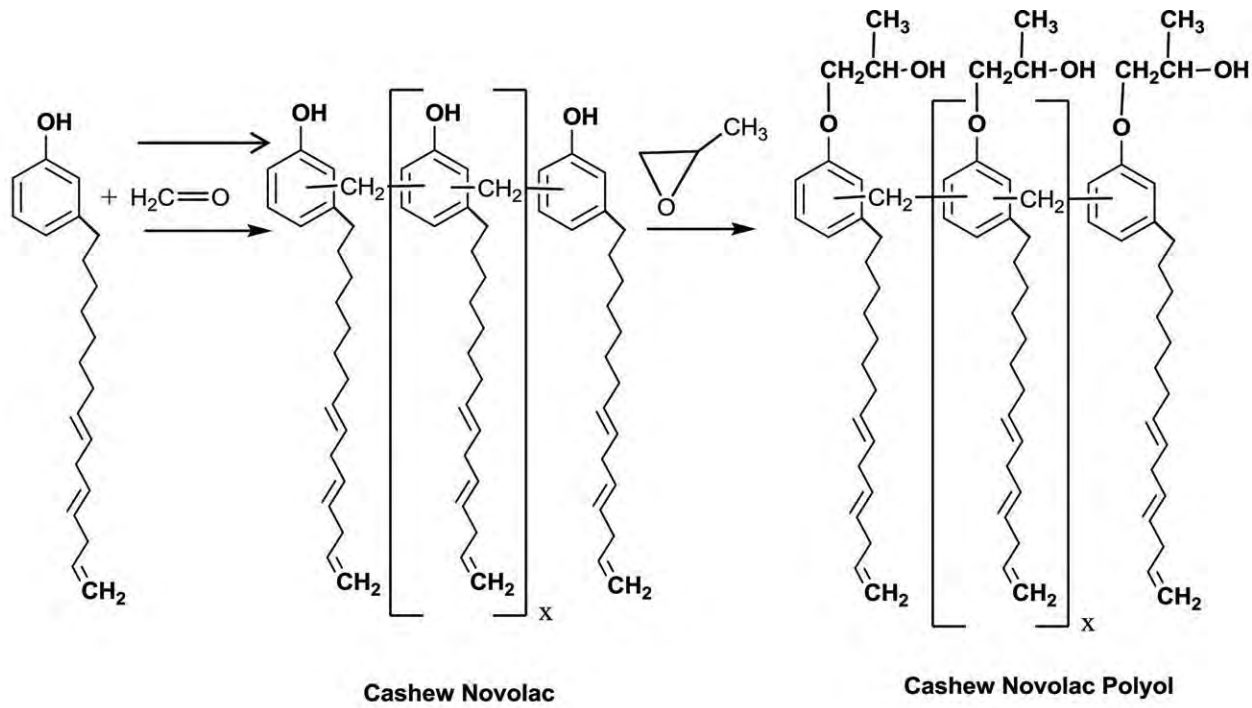

FIG. 4. Synthesis and structure of cashew novolac polyols.

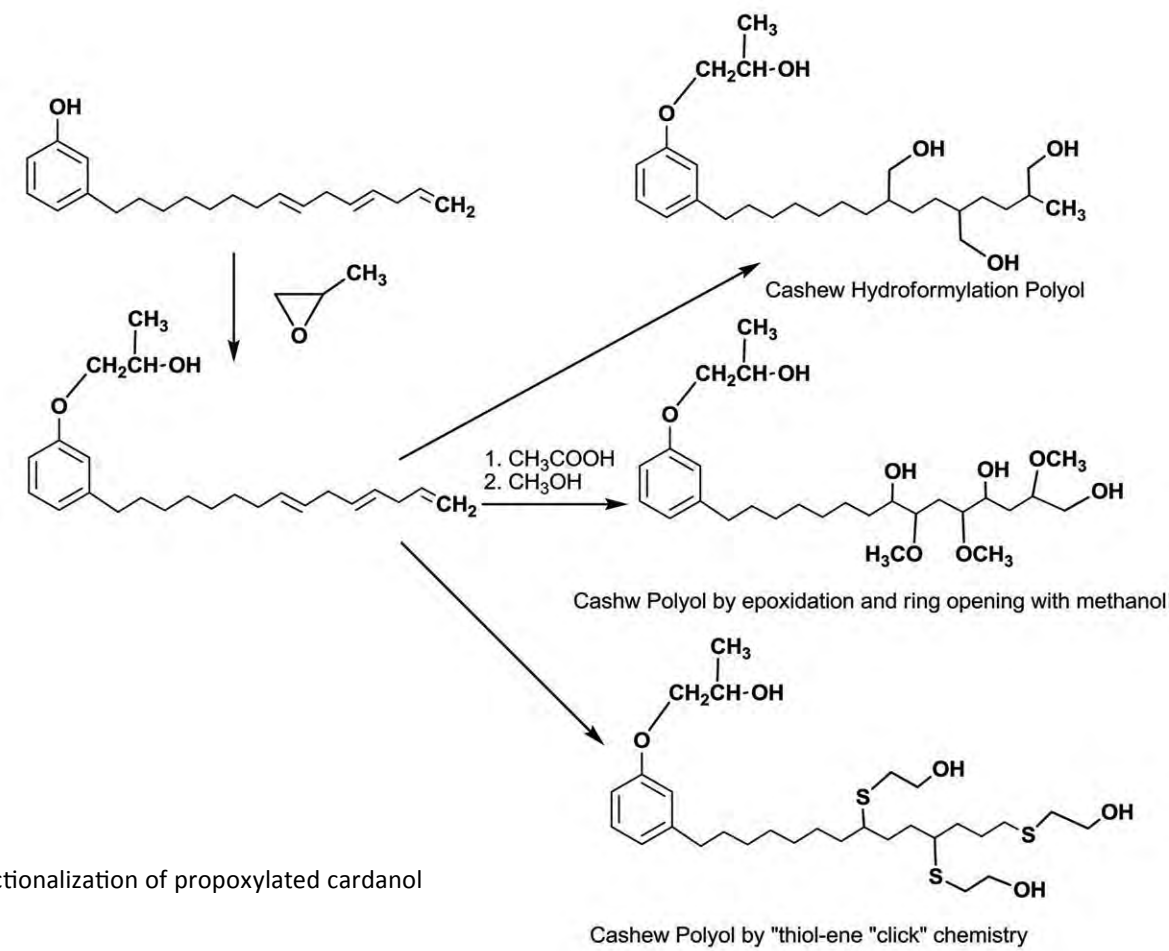

FIG. 5. Functionalization of propoxylated cardanol to polyols.

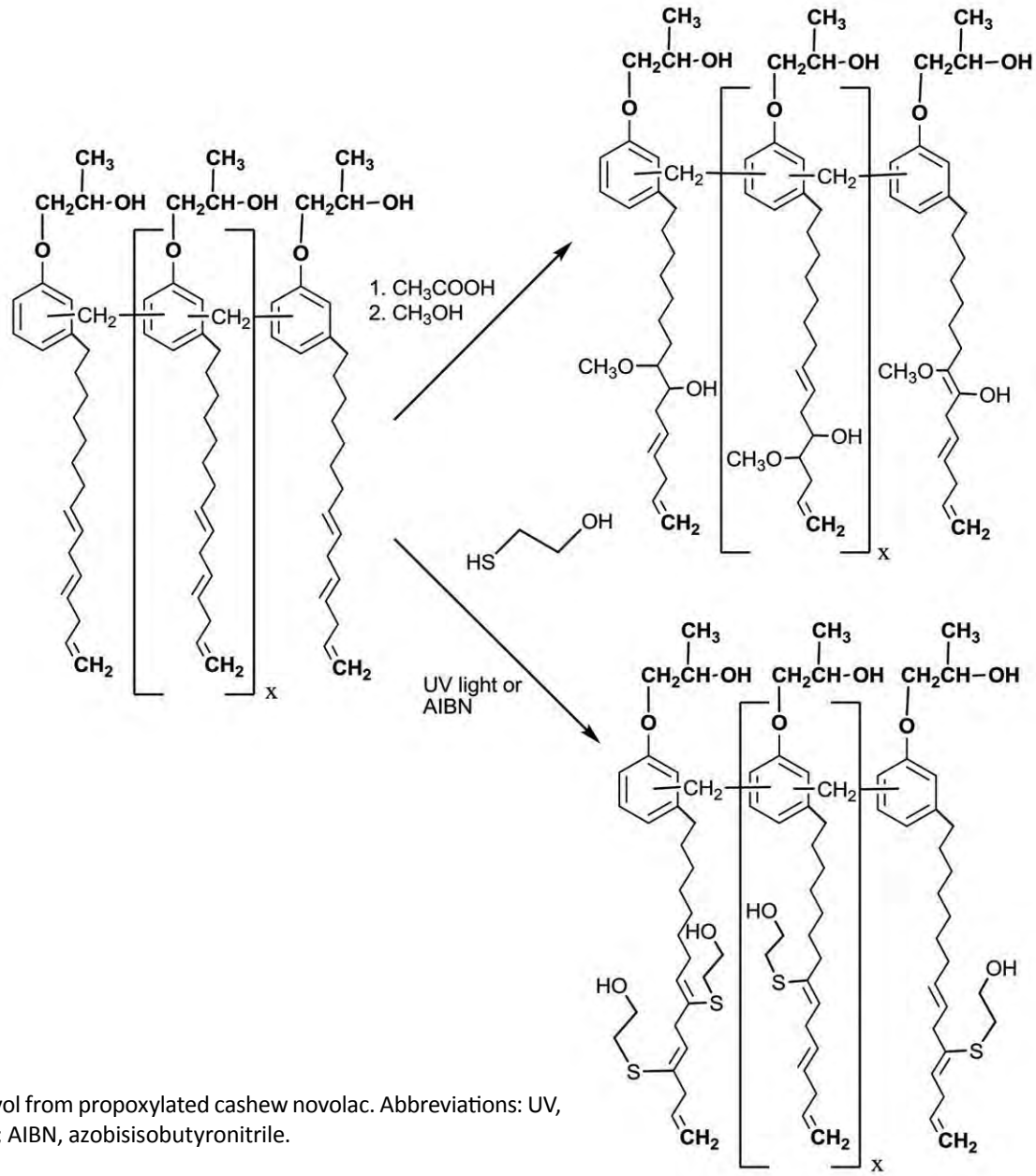

FIG. 6. Polyol from propoxylated cashew novolac. Abbreviations: UV, ultraviolet; AIBN, azobisisobutyronitrile.

oxide to 4–6 Pa·s at 25°C. Hydroxyl numbers were approximately 300 mg KOH/g.

Polyols with hydroxyl groups at aromatic side and at C15 aliphatic chains (Fig. 5) were prepared by thiol-ene click chemistry. Propoxylated cardanol reacted with 2-mercaptoethanol in the presence of ultraviolet light or in the presence of radical initiators, resulting in polyols with viscosity of 10–20 Pa·s at 25°C and hydroxyl numbers of 300–310 mg KOH/g.

A series of polyols was prepared from cardanol novolac resins by epoxidation and thiol-ene reactions (Fig. 6). Epoxidation of cardanol novolac resins followed by ring-opening with methanol led to solid polyols. By ethoxylation, they were converted to liquids with hydroxyl numbers of 390–400 mg KOH/g. Unfortunately, they also had a very high viscosity of 147 Pa·s at 25°C. Thermal thiol-ene reactions (initiated by azobisisobutyronitrile, or AIBN) of cardanol novolacs with 2-mercaptoethanol led to polyols of high functionality and hydroxyl numbers of 240–250 mg KOH/g with a desirable viscosity of 15–20 Pa·s at 25°C. (Photographs of the rigid PU foams and scanning electron micrographs of their cell structure are available in the supplement to the digital edition of *Inform*, which can be accessed by logging in at: aocs.org/login.)

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- www.cardolite.com

CNSL is a natural substitute for nonylphenol, currently used for preparation of Mannich polyols and of ethoxylated nonionic surfactants. Nonylphenol is listed as an endocrine disruptor (similar to bisphenol A). As a consequence, search is ongoing to substitute nonylphenol with nonestrogenic phenols. CNSL was proved to be a nonestrogenic, nontoxic, biodegradable, and inexpensive substitute. CNSL price range is $450–600/metric ton compared to $2,000–2,500/metric ton for nonylphenol.

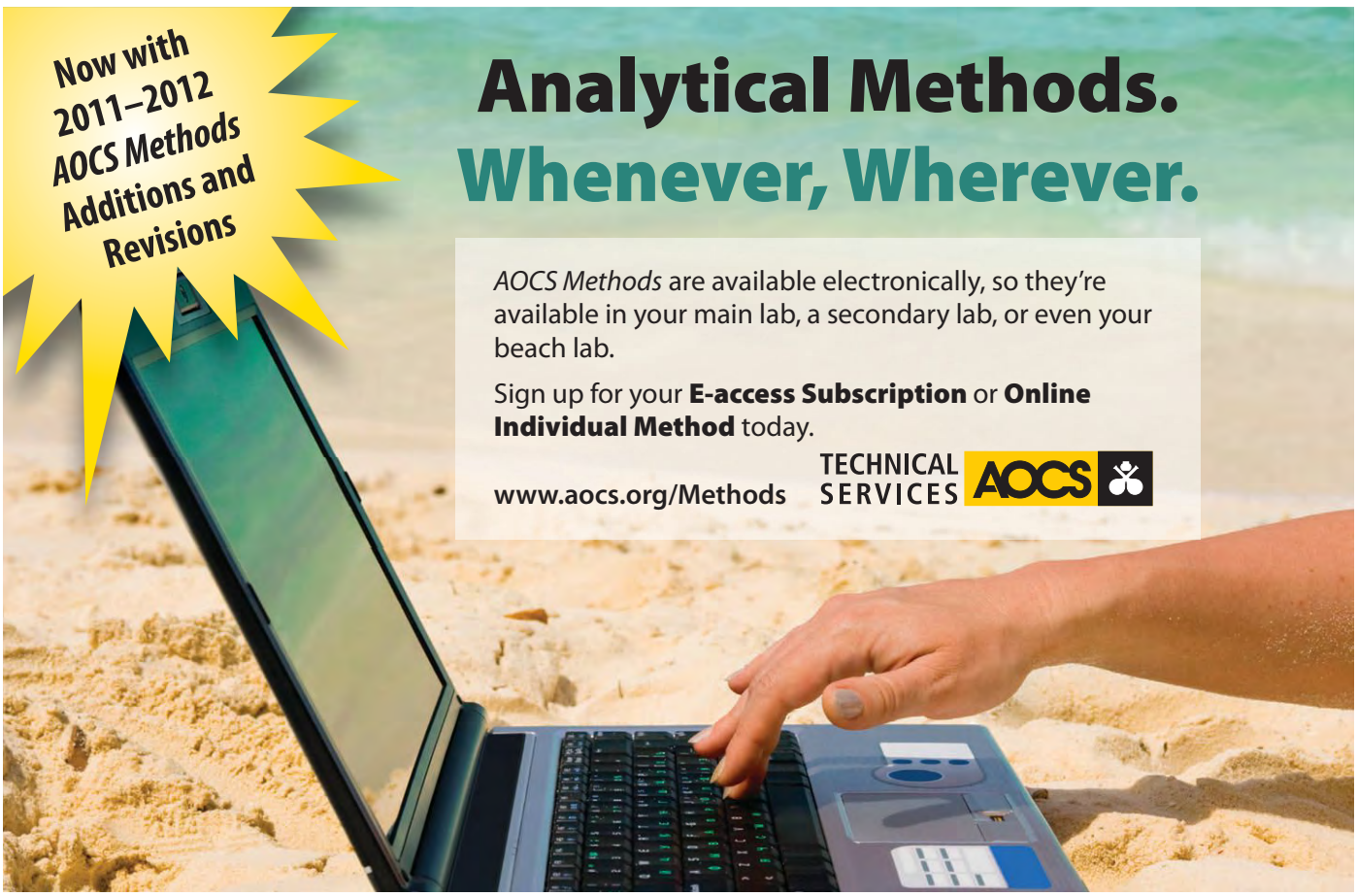
Polyols based on CNSL are suitable for all applications in rigid PU foams for packaging, thermal insulation of freezers, buildings, pipes and storage tanks, or as a decorative wood substitute.

Mannich polyols, cashew nut novolacs, cashew novolac polyols, and epoxy resins based on cashew novolacs are commercially produced in the USA (2). Some CNSL-derived polyols were synthesized by an Indian group (3). CNSL and epoxy resins, reactive diluents, and amine curing agents for epoxy resins derived from CNSL are commercialized in the USA (4).

CNSL polyols and polyurethanes are high value-added products from a cheap waste product of the cashew nut fruit industry.

Mihail Ionescu is world expert in polyols and polyurethanes. He is currently senior research associate at Kansas Polymer Research Center, Pittsburg State University, Kansas, USA. He can be contacted at mionescu@pittstate.edu.

Zoran S. Petrović is senior research advisor and the founder of the Kansas Polymer Research Center at Pittsburg State University. He can be contacted at zpetrovic@pittstate.edu.



Extracts & Distillates

(cont. from page 375)

Interesterification of soybean oil and lard blends catalyzed by SBA-15-pr-NR3OH as a heterogeneous base catalyst

Xie, W., and Q. Cong, *J. Agric. Food Chem. 61*:3373–3381, 2013.

A novel heterogeneous SBA-15-pr-NR_3OH catalyst has been prepared by reactions of dimethyloctadecyl[3-(trimethoxysilyl) propyl]ammonium chloride with mesoporous SBA-15 materials. The solid base catalysts were characterized by using Fourier-transform infrared spectra, thermogravimetric analysis, nitrogen adsorption–desorption, and elemental analysis techniques. By using the solid catalyst, an environmentally benign process for the interesterification of soybean oil and lard blends in a heterogeneous manner was developed. The interesterification was investigated regarding the slip melting point (SMP), iodine value (IV), triacylglycerols (TAG) profile, fatty acid composition at the *sn*-2 position in TAG, and differential scanning calorimetry (DSC). The obtained results revealed that the solid base catalyst was capable of catalyzing TAG interesterification. It was shown that interesterification significantly modified the physicochemical properties of the oil and fat blends. The interesterified products had lower SMP than their corresponding physical blends. These changes in melting behaviors were mostly due to the alterations in TAG compositions. The DSC cooling and melting thermograms showed an obvious change in thermal properties after the interesterification reaction.

Deep eutectic solvents: synthesis, application, and focus on lipase-catalyzed reactions

Durand, E., *et al.*, *Eur. J. Lipid Sci. Technol. 115*:379–385, 2013.

In recent years, a novel medium with similar properties to ionic liquids but with additional advantages regarding cost, environmental impact, and synthesis has been developed: deep eutectic solvents (DES). These solvents result from the association between an organic salt (ammonium or phosphonium) with a hydrogen-bond donor such as alcohols, acids, or amides. To date, the availability of green, inexpensive, and easy-to-handle solvents is almost nonexistent. Therefore, DES currently arouse growing interest in many research fields. This review deals with the major applications of this new family of solvents with a particular focus on lipase-catalyzed reactions such as hydrolysis, aminolysis, or alcoholysis.

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Patents (cont. from page 371)

hydrotreated natural fat and oil, transesterified natural fat and oil and hydrotreated transesterified natural fat and oil. The lubricating oil composition contains a component (A) that is an alkaline earth metal-based detergent. The component (A) is contained by a content of more than 0.35 mass% and 2 mass% or less of the total amount of the composition in terms of alkaline earth metal.

Triglyceride compositions useful for preparing composite panels and applications thereof

Wantling, S.J., *et al.*, Momentive Specialty Chemicals Inc., US8343634, January 1, 2013

Composite panels may be prepared using a moisture resistance additive having a formulation that includes a triglyceride having a saponification value of at least 150 and an iodine value of at least 35. The additive may be used in the form of a water emulsion. The water emulsion may be prepared by dispersing the components of the additive formulation under conditions sufficient to at least partially saponify the triglyceride. The moisture resistance additive can impart resistance to moisture absorption and thickness swelling to composite panels prepared therewith.

Multi-element screening of trace elements

Maeder, K., *et al.*, Hoffman-La Roche Inc., US8343543, January 1, 2013

Pharmaceutical compositions that contain a lipase inhibitor having a melting point ≥37°C, a sucrose fatty acid ester wherein the sucrose fatty acid ester is a mono-, di-, tri-, or tetra-ester, and optionally one or more pharmaceutically acceptable excipients, are useful for treatment of obesity.

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.

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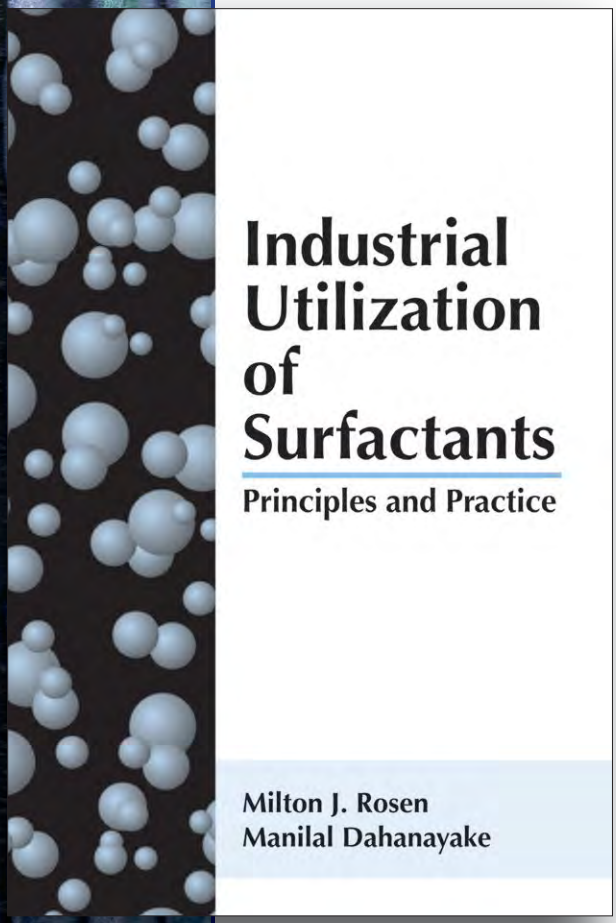

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Principles and Practice

Editors: Milton J. Rosen and Manilal Dahanayake
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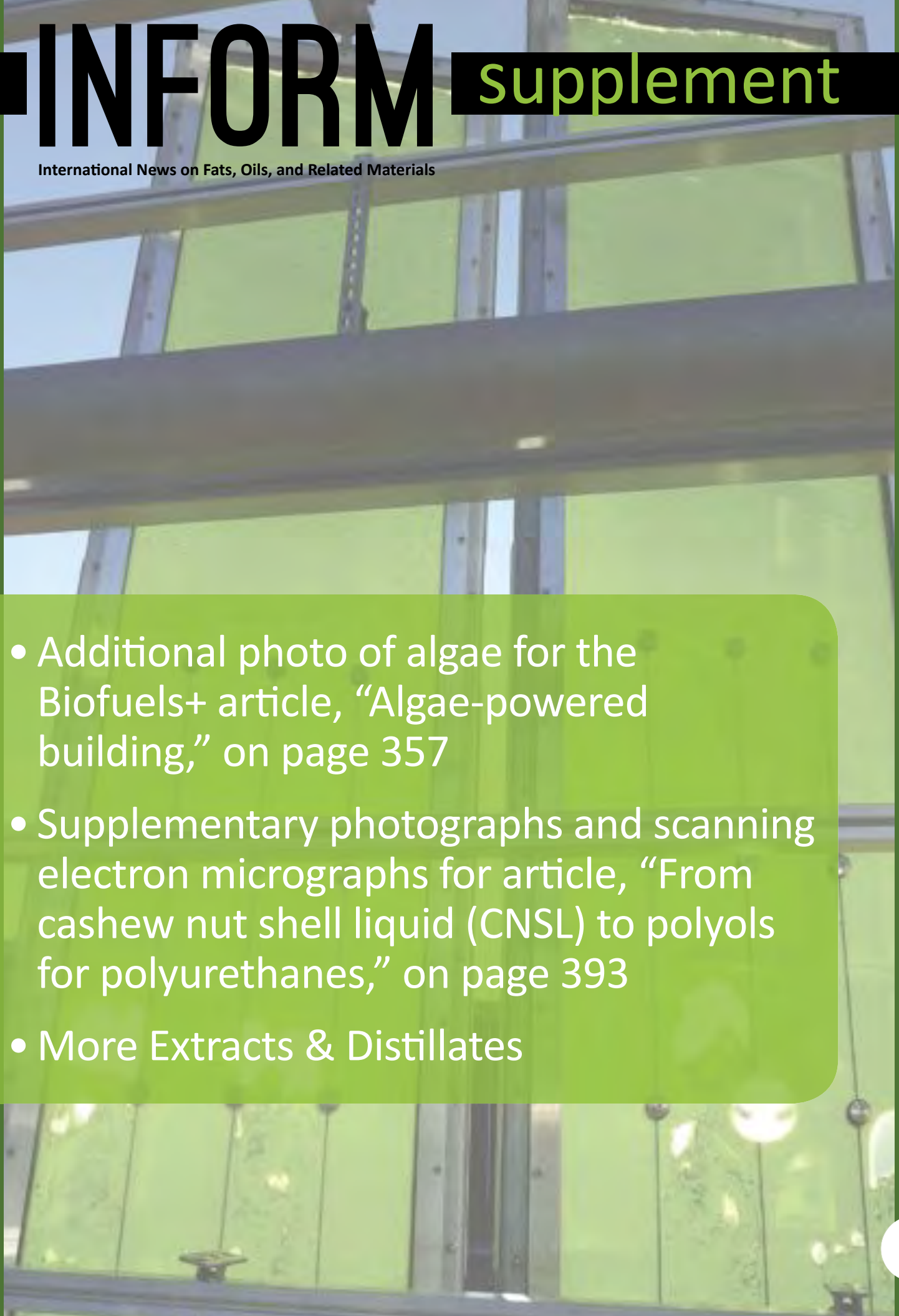


- Additional photo of algae for the Biofuels+ article, "Algae-powered building," on page 357
- Supplementary photographs and scanning electron micrographs for article, "From cashew nut shell liquid (CNSL) to polyols for polyurethanes," on page 393
- More Extracts & Distillates

June 2013

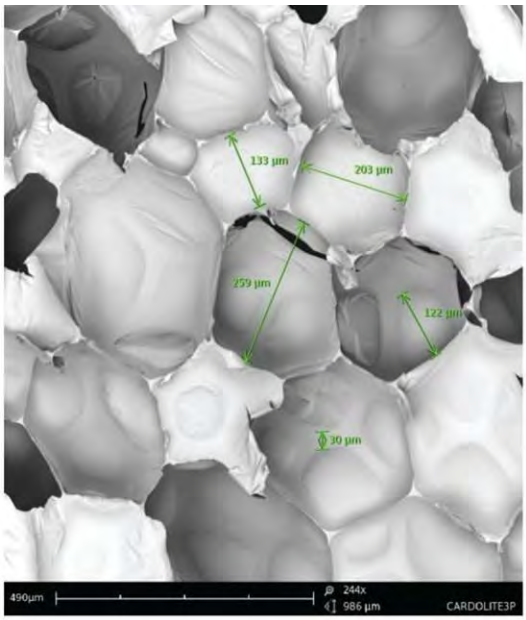
Algae-powered building

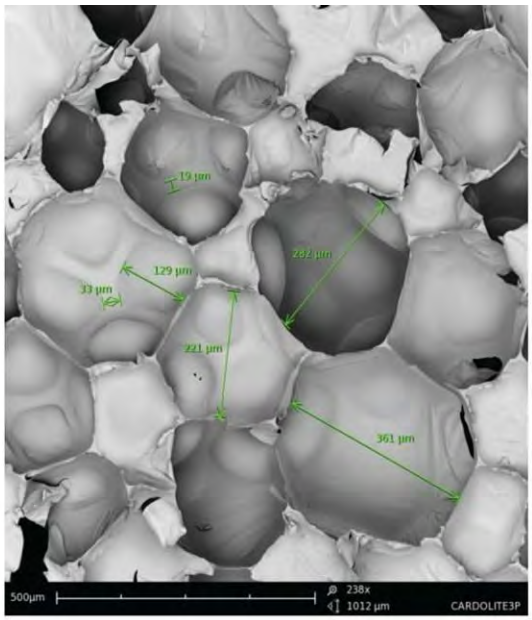
This movable flat-panel glass louver, filled with microalgae, is one of 129 in a system that covers about 200 square meters of Algae-powered BIQ [Bio Intelligent Quotient] House, a four-storey apartment building and pilot project for sustainable energy production in urban areas. © Colt International, Arup Deutschland, SSC GmbH. (See article on page 357).

From cashew nut shell liquid (CNSL) to polyols for polyurethanes

These figures supplement the article, From cashew nut shell liquid (CNSL) to polyols for polyurethanes, on page 393.

Images of rigid PU foams from cashew Mannich polyols.





Scanning electron micrographs of cell structure of rigid PU foams from cashew Mannich polyols

EXTRACTS & DISTILLATES

Evaluation of FT-NIR and ATR-FTIR spectroscopy techniques for determination of minor odd- and branched-chain saturated and *trans* unsaturated milk fatty acids

Stefanov, I., *et al.*, *J. Agric. Food Chem. 61*:3403–3413, 2013.

Determination of nutritionally important *trans* monounsaturated fatty acids (MUFA), conjugated linoleic acid (CLA), and odd-branched chain milk fatty acids (OBCFA) (often present in amounts lower than 1.0 g/100 g of total fat) using fast and nondestructive analytical methods would enhance their use as diagnostic tools in dairy herd and human health management. Here, partial least squares (PLS) regression using attenuated total reflectance/Fourier-transform infrared (ATR/FTIR) spectra indicated potential for determination of *trans*-11 C18:1 and *trans*-12 C18:1 ($R_{cv}^2 \geq 0.80$), and *trans*-9 C18:1 in very minor concentration ($R_{cv}^2 > 0.82$), as well as *anteiso* C15:0 ($R_{cv}^2 = 0.57$) and *iso* C17:0 ($R_{cv}^2 = 0.61$). Furthermore, the main *cis*-9,*trans*-11 CLA isomer was predicted well despite the high *trans* MUFA concentration. Differentiation between the CLA and the *trans* MUFA signals was evident (based on specific *cis*/*trans* bands), and branched-chain saturated fatty acid methyl esters revealed specific *iso* and *anteiso* ATR/FTIR absorbance bands. None of the minor fatty acid PLS results with FT-near infrared showed interesting potential, except satisfactory predictions for *trans*-9 C18:1 and *cis*-9,*trans*-11 CLA. Overall, ATR/FTIR resulted in better calibrations and provided more specific information for determination of minor milk fatty acids.

Feasibility of ionic liquids as extractants for selective separation of vitamin D_3 and tachysterol$_3$ by solvent extraction

Liang , R., *et al.*, *J. Agric. Food Chem. 61*:3479–3487, 2013.

A selective separation of vitamin D_3 and tachysterol$_3$ by solvent extraction with 7 organic solvents and 11 ionic liquids (IL) has been reported. Among organic solvents sulfolane showed optimal extraction performance, giving only a selectivity of 1.44 for tachysterol$_3$ over vitamin D_3. IL with unsaturated bonds demonstrated high selectivity probably due to their different π–π interactions with the two compounds. A pyrrolidinium-based ionic liquid, for example, [BMPr][NTf_2], provided the highest selectivity up to 1.77. Acceptable selectivity and distribution coefficients were observed by a combination of organic solvents and IL as extracting agents. In this work, the effects of concentrations, anions, cations, and substituent of IL were investigated, which may provide a rational strategy for the design of novel IL for extractive separation of structural analogs. The purification and recovery of vitamin D_3 via continuous multistage extractions were simulated, indicating that IL-based liquid–liquid extraction might be superior to traditional organic solvents in practical production.

The galactolipase activity of some microbial lipases and pancreatic enzymes

Amara1, S., *et al.*, *Eur. J. Lipid Sci. Technol. 115*:442–451, 2013.

Several well-known microbial lipases were screened for their ability to hydrolyze synthetic medium-chain monogalactosyldiacylglycerol (MGDG) and digalactosyldiacylglycerol (DGDG). *Fusarium solani* cutinase and *Thermomyces lanuginosus* lipase (TLL) were found to hydrolyze MGDG at high rates (984 ± 62 and 450 ± 41 U/mg, respectively). These activities remained, however, lower than those measured with pancreatic lipase-related protein 2 (PLRP2) on the same substrate. As previously observed with PLRP2, galactolipid–bile salt mixed micelles were found to be the best substrate form for microbial enzymes. The galactolipid to bile salt molar ratios for measuring maximum galactolipase activities were found to be similar to those previously established with PLRP2, suggesting that bile salts have mainly an effect on the substrate and not on the enzyme itself. The galactolipase activity of cutinase and TLL, as well as human and guinea pig PLRP2, were also measured using galactolipid monomolecular films. Enzymes having a lid (TLL and human PLRP2) were found to act at higher surface pressures than those with no lid (cutinase and guinea pig PLRP2). *In silico* docking of medium-chain MGDG and DGDG in the active site of guinea pig PLRP2 and TLL reveals some structural analogies between these enzymes.

Multivariate data analysis for finding the relevant fatty acids contributing to the melting fractions of cream

Buldo, P., *et al.*, *J. Sci. Food Agric. 93*:1620–1625, 2013.

The melting behavior and fatty acid composition of cream from a total of 33 cows from four farms were analyzed. Multivariate data analysis was used to identify the fatty acids that contributed most to the melting points and to differentiate between creams from different practical feeding regimes. It was demonstrated that the melting point of the medium-melting fraction of milk fat was positively correlated with palmitic acid (C16:0), whereas it was negatively correlated with oleic acid (C18:1 *cis*9), conjugated linoleic acid (CLA *cis*9,*trans*11), vaccenic acid

(C18:1 *trans*11), elaidic acid (C18:1 *trans*9), and myristoleic acid (C14:1). The melting points of the high-melting fractions could not be related to the fatty acid composition. Addition of palmitic acid-based fat supplement to the feeding ration in combination with a lower forage intake increased the amount of C16:0 and palmitoleic acid (C16:1) in milk fat, whereas it decreased the amount of stearic acid (C18:0) and C18:1 *trans* fatty acid. Average data on the melting behavior of cream separated the farms into two groups where the main differences in feeding were the amounts of maize silage and rapeseed cake used. Multivariate analysis of data from individual cows identified the most relevant fatty acids contributing to the melting point of the medium-melting fraction of cream. The fatty acid composition of milk fat could differentiate cream from different feeding strategies; however, owing to individual cow variation, it was not possible to extract clear correlations between feeding regime and melting behavior of cream.

Chemical characterisation of kernels, kernel meals, and oils from *Jatropha cordata* and *Jatropha cardiophylla* seeds

Gámez-Meza1, N., *et al.*, *J. Sci. Food Agric.* *93*:1706–1710, 2013.

Jatropha cordata and *Jatropha cardiophylla* are native to northwestern Mexico and are adapted to arid and semi-arid conditions (<500 mm of precipitation per year and temperatures from 8 to 45°C). The aim of this study was to evaluate the chemical composition of *J. cordata* and *J. cardiophylla* kernels and oils as well as antinutrients in the defatted kernel meals of these species. Kernels of *J. cordata* and *J. cardiophylla* seeds analyzed in this study were rich in crude protein (283 and 289 g kg^{-1}, respectively) and lipid (517 and 537 g kg^{-1}, respectively). The main fatty acids in *J. cordata* and *J. cardiophylla* oils were linoleic and oleic acids. High levels of trypsin inhibitor and phytates and low levels of saponins were present in the meals. The phorbol ester contents in *J. cordata* and *J. cardiophylla* kernel meals were 2.73 and 1.46 mg g^{-1}, respectively. For both *J. cordata* and J. *cardiophylla* it could be inferred that (i) the oil and kernel meal were toxic and the kernel meal could be used as livestock feed only after detoxification, (ii) the oil could be used for non-alimentary purposes, that is, biodiesel production, and (iii) the seed or oil could be used for isolating various bioactive compounds for pharmaceutical and agricultural applications.

A simple method for the determination of bioactive antioxidants in virgin olive oils

Garcia, B, *et al.*, *J. Sci. Food Agric.* *93*:1727–1732, 2013.

The importance of olive polyphenols as bioactive compounds has grown in recent years as a result of intensive research on their anticancer, antiatherosclerotic, and antihypertensive activities. However, there is currently no official method for determining the content of polyphenols in olive oils because of the technical difficulties in their determination. Here a simple method for the analysis of extra virgin olive oil *o*-diphenols by visible spectrometry is proposed and compared with the traditional method of solid-phase extraction followed by colorimetric determination using sodium molybdate or Folin–Ciocalteu reagent or by high-performance liquid chromatography (HPLC) analysis using ultraviolet detection. This new approach to determining total *o*-diphenolic compounds exploits the oxidation of *o*-diphenols to quinones in a basic medium. Preliminary results showed a better correlation between the total *o*-diphenol determination by HPLC and by the proposed method (R^2 = 0.9229) than between the total *o*-diphenol determination by HPLC and by the molybdate colorimetric method (R^2 = 0.8689). A good correlation was also observed between the total phenolic content determined by HPLC and by the proposed method (R^2 = 0.8196), but this correlation was a little lower than the one obtained between the HPLC method and the Folin–Ciocalteu method (R^2 = 0.8752). The proposed method involves very little sample manipulation, requires inexpensive reagents, and can be performed in less than 40 min for several samples at the same time, using olive oil samples of only 1–2 g.

Optimization of an oil leaching process to reduce the level of dioxins and dioxin-like PCBs in fishmeal

Oterhals, A., and B. Kvamme, *J. Sci. Food Agric.* *93*:1649–1659, 2013.

Fishmeal produced from fish caught in polluted fishing areas might contain dioxins and dioxin-like polychlorinated biphenyls (PCBs) above maximum permitted levels (MPL) for use in feed. Decontamination of the fishmeal can be achieved by hexane extraction. The principal objective of this study was to optimize a more environmentally friendly alternative based on oil leaching of the moist presscake intermediate product during fishmeal manufacturing. A central composite design and response surface methodology was used to study the influence of the process variables temperature (T), presscake moisture content (MC), and leaching time (LT) on the decontamination process. A significant squared MC effect was observed, resulting in an optimum leaching rate at 27% MC. This corresponds to 5% improved dibenzo-*p*-dioxin/dibenzo furan (PCDD/F)–PCB toxic equivalent (TEQ) reduction compared to normal presscake (55% MC). The initial leaching rate was fast, with a TEQ reduction of 69% after only 2 min at 87°C and 55% MC. Under the best experimental conditions (87°C, 38% MC, 12 min LT) a TEQ reduction of 82% was achieved. Excess oil in the presscake after the leaching operation could be removed by use of a water washing step. No reduction in protein quality measured by mink digestibility could be observed. The results confirm that the oil leaching process is robust and offers easily achievable TEQ levels well below present maximum permissible levels based on process conditions normally used by the

CONTINUED ON NEXT PAGE

industry. Comparative effects on non-dioxin-like PCBs are expected.

Detection and identification of extra virgin olive oil adulteration by GC-MS combined with chemometrics

Yang , Y., *et al.*, *J. Agric. Food Chem*. *61*:3693–3702, 2013.

In this study, an analytical method for the detection and identification of extra virgin olive oil adulteration with four types of oils (corn, peanut, rapeseed, and sunflower oils) was proposed. The variables under evaluation included 22 fatty acids and 6 other significant parameters [the ratio of linoleic/linolenic acid, oleic/linoleic acid, total saturated fatty acids (SFA), polyunsaturated fatty acids (PUFA), monounsaturated fatty acids (MUFA), MUFA/PUFA]. Univariate analyses followed by multivariate analyses were applied to the adulteration investigation. As a result, the univariate analyses demonstrated that higher contents of eicosanoic acid, docosanoic acid, tetracosanoic acid, and SFA were the peculiarities of peanut adulteration, and higher levels of linolenic acid, 11-eicosenoic acid, erucic acid, and nervonic acid the characteristics of rapeseed adulteration. Then, partial least squares–linear discriminant analysis made the detection of adulteration effective with a 1% detection limit and 90% prediction ability; a Monte Carlo tree identified the type of adulteration with 85% prediction ability.

Lysophosphatidylethanolamine effects on horticultural commodities: A review

Amaro, A.L., and D.P.F. Almeida, *Postharvest Biol. Technol*. *78*:92–102, 2013.

Lysophosphatidylethanolamine (LPE) is a naturally occurring lipid with regulatory effects in senescence and ripening. When applied exogenously to horticultural crops, LPE affects growth, development, and postharvest longevity. The effects of exogenously applied LPE have been studied in a range of plant organs in more than a dozen horticultural species. The claimed horticultural benefits include delayed leaf senescence, stimulation of ripening in table grape, acceleration of color development and extension of shelf life in cranberry and tomato, and increased vase life of cut flowers. Responses to LPE application are found to vary dramatically within horticultural commodity, developmental stage, and organ type. Effects on ethylene responses are contradictory. LPE inhibits phospholipase D and is reported to affect the activity of enzymes relevant for produce quality, such as phenylalanine ammonia lyase and acid invertase. The biochemical mode of action of LPE is poorly understood. In particular, a mechanism by which a plant growth regulator might delay senescence of plant organs and accelerate ripening-related changes is not obvious. The horticultural, physiological, and biochemical effects of LPE are reviewed in an attempt to highlight the knowledge gaps regarding the putative regulatory role of exogenously applied LPE.

Lipid needs of preterm infants: updated recommendations

Lapillonne, A., *et al.*, *J. Pediatr*. *162*:S37–S47, 2013.

Long-chain polyunsaturated fatty acids (LCPUFA) are of nutritional interest because they are crucial for normal development of the central nervous system and have potential long-lasting effects that extend beyond the period of dietary insufficiency. Here we review the recent literature and current recommendations regarding LCPUFA as they pertain to preterm infant nutrition. In particular, findings that relate to fetal accretion, LCPUFA absorption and metabolism, effects on development, and current practices and recommendations have been used to update recommendations for health care providers. The amounts of long-chain LCPUFA used in early studies were chosen to produce the same concentrations as in term breast milk. This might not be a wise approach for preterm infants, however, particularly for very and extremely preterm infants, whose requirements for LCPUFA and other nutrients exceed what is normally provided in the small volumes that they are able to tolerate. Recent studies have reported outcome data in preterm infants fed milk with a docosahexaenoic acid (DHA) content two to three times higher than the current concentration in infant formulas. Overall, these studies show that providing larger amounts of DHA supplements, especially to the smallest infants, is associated with better neurologic outcomes in early life. We emphasize that current nutritional management might not provide sufficient amounts of preformed DHA during the parenteral and enteral nutrition periods and in very preterm/very low birth weight infants until their due date, and that greater amounts than used routinely likely will be needed to compensate for intestinal malabsorption, DHA oxidation, and early deficit. Research should continue to address the gaps in knowledge and further refine adequate intake for each group of preterm infants. ■