

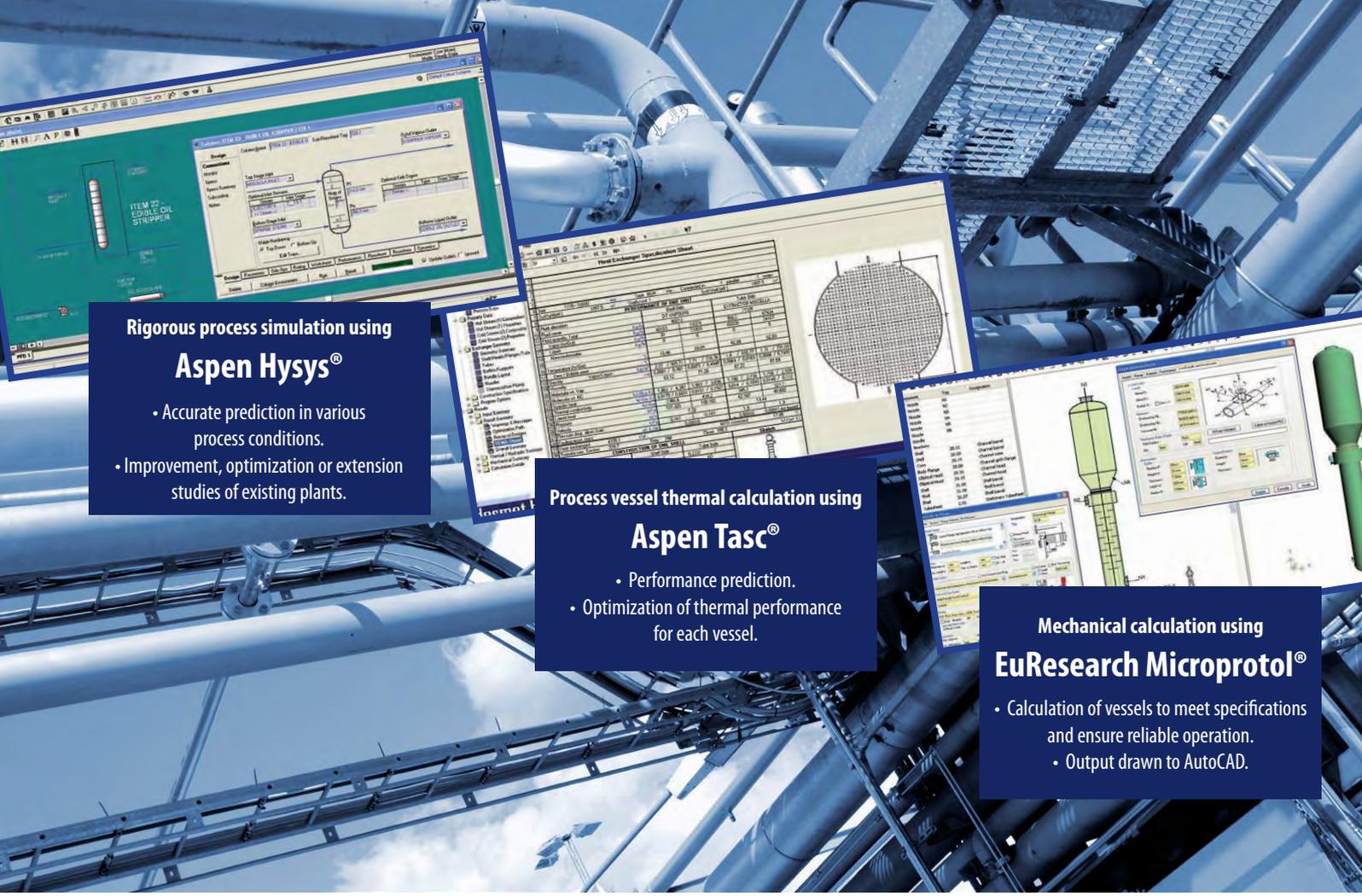
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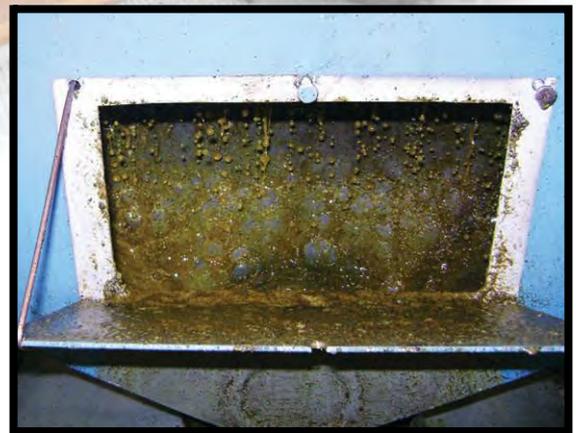
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Departments and Information

196 Index to Advertisers

196 Calendar

Marketplace:

219 News & Noteworthy

223 Biofuels News

228 Health & Nutrition News

232 Biotechnology News

236 Surfactants, Detergents & Personal Care News

241 People News/Inside AOCs

242 In Memoriam

Publications:

244 Book review

246 Extracts & Distillates

251 Patents

247 Classified Advertising

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April 2012 Volume 23 (4) 193-272

201

Letter from the president

Outgoing AOCs President Erich Dumelin reviews progress in 2011 and looks forward to the organization's increasing efforts to address global challenges via a global interactive collaborative network that will link AOCs with more than 600 organizations worldwide.

203

President's profile: Deland J. Meyers

Incoming AOCs President Deland J. Myers expands on his 22-year relationship with AOCs, his career, and his family life.

206

Oil in biomass: a step-change for bioenergy production?

Can crops be reprogrammed to accumulate higher amounts of energy-dense lipids in their leaves and other nonseed tissues? Researchers describe how plant genetics and metabolism can be manipulated to meet the increasing demand for biofuels.

212

the power of mass spectrometry in the detection of fraud

The makers of fraudulent products are extremely inventive and cost legitimate businesses billions of dollars a year. Fortunately, novel technologies in mass spectrometry can keep us one step ahead of the bad guys by enabling the detection of all kinds of fakes—from perfume to infant formula.

216

Making lemonade: how a resilient US sunflower industry continues to beat the odds

The recently retired head of the National Sunflower Association reflects on the past and future of the US sunflower industry, noting the important role adversity has played in developing its united front.

255

AOCs 2012 award recipients announced

262

Singapore 2012: Don't miss the chance

Preview the highlights of the world's premier conference on fabric and home care.

265

Phytosterol oxidation in foods and food products

Plant sterols help lower cholesterol, but they are also vulnerable to oxidation. A food scientist reviews what is currently known about such oxidation mechanisms, the levels of oxyphytosterols in enriched foods, and their health implications.

269

A CEO's guide to innovation in China

There's no magic formula for innovation, but there are some critical variables that will influence which companies lead China's innovation revolution and how far it goes.

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April 29–May 2, 2012. 103rd AOCS Annual Meeting & Expo, Long Beach Convention Center, Long Beach, California, USA. Information: phone: +1 217-693-4821; fax: +1 217-693-4865; email: meetings@aocs.org; annualmeeting.aocs.org.May 16–19, 2012. 2nd International Symposium on Microbial Lipids, Bern, Switzerland. Information: eurofedlipid.org/meetings/bern2012.May 17–19, 2012. Euro Fed Lipid 2nd International Symposium on Microbial Lipids, Bern, Switzerland. Information: eurofedlipid.org/meetings/bern2012/index.htm.

May

May 6–10, 2012. Society of Tribologists and Lubrication Engineers Annual Meeting & Exhibition, St. Louis, Missouri, USA. Information: Merle Hedland at +1 630-428-2133 or mhedland@stle.org; stle.org.May 21–22, 2012. The Science of Science Communication, Washington, DC, USA. Information: tinyurl.com/ScienceComm.May 7–8, 2012. LIPID MAPS Annual Meeting, La Jolla, California, USA. Information: lipid-maps.org/meetings.May 22–24, 2012. Vitafoods Europe, Geneva, Switzerland. Information: tinyurl.com/vitafoods.May 13–16, 2012. 10th International Symposium on Supercritical Fluids, San Francisco, California, USA. Information: issf2012.com.May 23–24, 2012 Home and Personal Care Ingredients Exhibition and Conference, Istanbul, Turkey. Information: hpci-congress.com.May 14–16, 2012. United Nations Conference on Sustainable Development (Earth Summit 2012/Rio+20), Rio de Janeiro, Brazil. Information: earthsummit2012.org.May 23–24, 2012. Round Table on Responsible Soy Association, RT7, London, UK. Information: annualconference.responsiblesoy.org.May 14–18, 2012. 11th International Hydrocolloids Conference, Whistler Center for Carbohydrate Research, Stewart Center, Purdue University, West Lafayette, Indiana, USA. Information: international-hydrocolloids-conference.com.May 25–26, 2012. Global JojobaWorld 2012, Jaipur, India. Information: tinyurl.com/Jojoba2012.May 26–30, 2012. 10th Congress of the International Society for the Study of Fatty Acids and Lipids (ISSFAL), Westin Bayshore Hotel, Vancouver, British Columbia, Canada. Information: issfal.org/conferences/vancouver-2012.

Index to advertisers

*Anderson International Corp.	194, 243	Desmet Ballestra Group NV.	C2, 211	McCutcheon's Publications.	238
Armstrong Engineering Assoc.	210	*French Oil Mill Machinery Co.	218	Mectech Process Engineers	239
Avanti Polar Lipids, Inc.	248	GEA Westfalia Separator Group.	199	Myers Vacuum Distillation Division	251
BASF Corporation	C4	J. M. Pedroni Y Asociados SA	233	*Novozymes A/S	C3
Blackmer/A Dover Company.	198	John Wiley & Sons	260	Ohmi Aktiengesellschaft	227
Bruker Optics	221, 245	Koerting Hannover AG	249	*Oil-Dri Corporation of America	204
Buhler, Inc.	222	Lipotech Project Engineering.	200	Sharplex Filters (India) PVT. LTD.	215
*Crown Iron Works Company.	225	*Lovibond N A dba Orbeco-Hellige.	226	Verenium Corp.	202
*Danisco USA	193	Mahle Industrial Filtration	217		

AOCS Meeting Watch

April 29–May 2, 2012. 103rd AOCS Annual Meeting & Expo, Long Beach Convention Center, Long Beach, California, USA. Information: phone: +1 217-693-4821; fax: +1 217-693-4865; email: meetings@aocs.org; annual-meeting.aocs.org.

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

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

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

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May 29–31, 2012. Metabolism, Diet and Disease 2012, Washington, DC, USA. Information: amiando.com/metabolism-diet-and-disease.html.

May 30–31, 2012. Cosmetic Science: The Good, the Bad and the Beautiful, Trinity College, Dublin, Ireland. Information: scs.org.uk/symposium-2012.

June

June 4–5, 2012. 9th European Workshop on the Biotechnology of Microalgae, Nut-hetal, Germany. Information: microalgal-biotechnology.com.

June 10–13, 2012. The 2nd International Conference on Algal Biomass, Biofuels and Bioproducts, San Diego, California, USA. Information: algalbbb.com.

June 10–14, 2012. 3rd International Conference on the Olive Oil Revolution—Quality, Culinary and Health, Tel Aviv, Israel. Information: terraolivo.org/con_index.htm.

June 10–15, 2012. FASEB Conference: Retinoids, Snowmass Village, Colorado, USA. Information: <https://secure.faseb.org/faseb/meetings/Summrconf/Programs/11621.pdf>.

June 11–13, 2012. Sensory Properties of Canola Oil and Olive Oil, Würzburg,

Germany. Information: dgfett.de/meetings/aktuell/index.htm.

June 11–15, 2012. Advances in Emulsion Polymerization and Latex Technology, Bethlehem, Pennsylvania, USA. Information: fp2.cc.lehigh.edu/inemuls/epi/Lehigh_sc.htm.

June 11–14, 2012. World Food and Agribusiness Forum, Symposium and Case Conference, Shanghai, China. Information: tinyurl.com/IFOMA2012.

June 13–14, 2012. European Biodiesel 2012, Kraków, Poland. Information: tinyurl.com/EUBiodiesel.

June 14–15, 2012. CosmeticBusiness 2012, Munich, Germany. Information: cosmetic-business.com/en/tradefair.

June 17–22, 2012. Gordon Research Conference on Lipoprotein Metabolism, Waterville Valley, New Hampshire, USA. Information: grc.org/programs.aspx?year=2012&program=lipoprot.

June 18–20, 2012. 16th Annual Green Chemistry & Engineering, Washington, DC, USA. Information: acswebcontent.acs.org/gcande.

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CONTINUED ON NEXT PAGE

June 18–21, 2012. BIO (Biotechnology Industry Organization) International Convention, Boston, Massachusetts, USA. Information: convention.bio.org.

June 18–22, 2012. 20th European Biomass Conference and Exhibition, Milan, Italy. Information: conference-biomass.com.

June 18–22, 2012. ACHEMA, Frankfurt am Main, Germany. Information: achema.de/index.php?selectedArea=1&selectedItem=1&spkz=E.

June 19–22, 2012. 15th Workshop on Vitamin D, Houston, Texas, USA. Information: vitaminD.UCR.edu.

June 21–22, 2012. Science and Technology of Food Emulsions, London, UK. Information: soci.org/General-Pages/Display-Event?EventCode=OF114.

June 25–29, 2012. Institute of Food Technologists' Annual Meeting and Expo, Las Vegas, Nevada, USA. Information: ift.org.

June 27–28, 2012. Separation Science 2012, Kuala Lumpur, Malaysia. Information: tinyurl.com/SepScience.

June 27–29, 2012. Heart UK 26th Annual Conference 2012: Metabolic Syndrome, Obesity and Pre-Diabetes, Newcastle upon Tyne, UK. Information: heartuk.org.uk/index.php?events/heart_uk_26th_annual_conference_2012.

June 28–29, 2012. 1st European Conference on the Replacement, Reduction and Refinement of Animal Experiments in Ecotoxicology, Dübendorf, Switzerland. Information: euroecotox.eu.

July

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

July 9–12, 2012. 8th Asia-Pacific Conference on Algal Biotechnology, Adelaide, Australia.

Information: sapmea.asn.au/conventions/apcab2012/index.html.

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

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

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

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

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

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

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

September

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

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

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

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

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

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

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

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

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Letter from the president



In my opening address at last year's Annual Meeting & Expo (AM&E) in Cincinnati, I challenged AOCs to adapt to the changing world around it by creating something new for the good of the community we serve. I am happy to report that we have made significant progress in spite of continuing global and economic uncertainties.

During 2011–2012, we introduced a more flexible governance model that will allow AOCs to act more strategically, decisively, and quickly as key issues and new opportunities emerge. Specifically, within the Governing Board, we formed four smaller working groups that will be charged with focusing on targeted issues from a strategic perspective. The redesigned AOCs Governing Board and committee structure includes

four Strategic Working Groups (Strategic Planning, Board Operations, Constituent Relations, and Finance Tracking) that will explore select issues and opportunities at a higher level and provide reports to the full Board that will inform decision making.

These smaller working groups have already been assembled and are currently investigating issues and opportunities that are critical to our future. Members of the Constituent Relations Strategic Working Group, for example, are investigating the feasibility of expanding AOCs' presence in China. They are also considering ways to increase our focus on biobased materials. Meanwhile, members of the Board Operations Strategic Working Group will review the effectiveness of our new governing structure over time by evaluating the Board and Committees and identifying candidates and volunteers on a continual basis. Members of this self-monitoring working group recently recommended a change in the AOCs bylaws that will provide additional opportunities for members to become meaningfully engaged in the organization via a revised volunteer committee structure that centers on AOCs' core competencies: content, networking, and technical services. This new core value committee structure will allow AOCs to benefit from the knowledge and expertise of more members by encouraging volunteers to contribute their knowledge via *ad hoc* committees. This knowledge will serve as the foundation that drives AOCs' offerings with respect to networking, technical services, and the content we produce via our journals, *inform*, the website, meeting programming, books, social networking, and the like.

We similarly reorganized our AM&E program so that participants who have specific requirements or who are pressed for time can more easily attend those portions of the meeting that are of most value to them. The reformulated program, which will be launched in Long Beach this spring, begins with general management and business sessions before moving into the technical portions of the program. We hope that such efforts to improve customer service will make it easier for more people to attend our meetings and ultimately help us grow.

Last year also entailed a successful search for a new chief executive officer (CEO) who will set the tone and provide the vision and energy to move these initiatives and drive AOCs forward. It involved a

five-person search committee, a four-person contracts committee, and an executive search firm. The AM&E in Long Beach will be the first opportunity many of you will have to meet our new CEO, Patrick Donnelly, who joined us on January 30, 2012. Patrick brings 20 years of senior-level experience in leading private and nonprofit organizations and initiatives to AOCs, as well as a doctoral degree in reproductive physiology and a passion for science. I would personally like to thank the AOCs staff and members of those two committees for the many hours they spent in helping us recruit the right person.

We made a lot of progress in just a year's time, but as we look to the future, I would like to emphasize that while our constituent industries have an excellent record when it comes to meeting typical technical challenges, the more recent and pressing challenges we are now facing—preserving our environment, climate change, raw material availability, and sustainability in a wider sense—are of a very different dimension and nature than those we have faced before. These tests will stay with us for a long time and must be addressed globally. Our community could be impacted dramatically in the long term if we do not take the initiative and act accordingly—particularly as it does not look as if politicians will come to any conclusions or agree on constructive actions in time.

The global nature of these issues calls for joint and aligned activities on a multidisciplinary level. Coordinating these activities will require a neutral, global platform, and AOCs is in the best possible position to provide it. Working with regional and local partners, we laid some of the groundwork for that this year by co-organizing events in Turkey, Colombia, and India. We also established new relationships that enabled us to reach out to regions of the world in unprecedented ways. For example, the AOCs European Section was inducted as the 13th member organization of Euro Fed Lipid, a highly respected society that serves European fats and oils interests. We also collaborated with regional organizations in India to produce *C3 Science*, a publication geared toward home and personal care professionals in India that debuted in the third quarter of 2012. And, we laid plans to reach into the Pan-Pacific region with the first Singapore 2012 World Conference on Fabric and Home Care. Next year, we will build on those connections by creating a global interactive collaboration network that will link us with more than 600 organizations worldwide. To support that bold endeavor, we reviewed and approved a new fundraising campaign that will provide us with the financial resources we need to grow.

As my term as president draws to a close, I am optimistic that AOCs will continue to build on these efforts. It has been both a pleasure and honor to work with such an enthusiastic board and dedicated group of staff professionals in Urbana, and I am confident that the organization is in good hands with incoming president Deland Myers.

Erich E. Dumelin
AOCs President 2011–2012

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President's profile: Deland J. Myers

Deland J. Myers takes office as AOCS president at the AOCS Meeting & Expo (April 29–May 2, 2012) in Long Beach, California, USA. Although inform previously published a brief biography of Myers as a candidate for the AOCS Governing Board, we asked him to expand on his background and relationship with AOCS for this profile.

To be named president of AOCS is one of the greatest honors I have received in my professional career. Looking back, I never would have dreamed that I would have the opportunity to be in this position or even in the field of food science.

As a young man growing up in Kansas City, Missouri, USA, my goal was to be a medical doctor. After graduating from high school, I enrolled at the University of Missouri-Kansas City as a premedical student majoring in biology. During my junior year, my interests changed. I no longer wanted to pursue a medical degree and was looking for a field that would allow me to continue to my goal of having a career that would benefit people while remaining involved in science. My adviser, Daniel Stern, suggested that I consider the field of food science and technology. My response, which I still hear from prospective students today, was that I did not like cooking. He then explained to me that food science and technology is not about culinary arts but about applying basic science in the development and safety of foods.

Taking his advice, I applied for and was accepted into the graduate program in food technology at Iowa State University in Ames, Iowa. I had indeed found my niche, as I thoroughly enjoyed my studies of the microbial safety of foods under the direction of Homer Walker. While in graduate school I also discovered another interest: teaching. To earn extra money, I began tutoring students in a variety of subjects including chemistry, biology, and statistics. I enjoyed it so much that sometimes I would forget to submit my pay time sheets.

Through my tutoring job I met the love of my life, Eveadean (Evie) Morrison



Deland Myers and his wife Eveadean (Evie) met at Iowa State University, where he tutored her in chemistry.

Myers, who for the last 30 years has been a co-laborer in both my personal and professional life. We met innocently enough with a phone call. Evie was an elementary education student at the time and was having difficulty in chemistry. She had very little background in science and math and needed assistance in order to complete the class and obtain her degree. Although her science and math background was not very strong, she was an excellent student, and after several weeks of study, passed her final exams, obtained her bachelor's degree, and was accepted to law school at the University of Iowa. We continued our friendship after she graduated and 18 months later we were married.

After earning our respective law and doctoral degrees in 1984, Evie and I moved to the Twin Cities of Minneapolis and St. Paul, Minnesota, to work for the Pillsbury Co. As a product development scientist there, I was involved in the development of numerous consumer food products including Totino's Pizza, Jeni's Pizza Rolls, Toaster Strudel, and microwave popcorn and pancakes. Evie was a

litigator in the legal department. During that time, we adopted our older son, Corey, and our daughter, Latisha, was born.

After five years in product development, my love for teaching drew me back to Iowa State University, where I joined the faculty of the Food Science and Human Nutrition Department as an assistant professor. Evie was also employed at Iowa State in the Office of Affirmative Action, and our son, Deland J. Myers II (DJ), was born. At Iowa State, I met Larry Johnson, AOCS president in 2004–2005, who would have a profound impact on my career. He introduced me to the potential of agricultural materials in nonfood applications such as adhesives, textile fibers, and plastics—a field that became the focus of my academic career for the next 18 years, resulting in patents, book chapters, and refereed presentations and publications on this subject.

Larry also acquainted me with an organization that he believed could assist me in the development of my professional career.

CONTINUED ON NEXT PAGE

That organization was AOCS. The first AOCS meeting I attended was in Baltimore, Maryland, in 1990. Larry introduced me to some of the world's experts in fats and oils as well as key members of AOCS staff. As I attended that first meeting, I observed two characteristics about AOCS. The first was the warm reception and invitation to participate I received from the staff and members. The second was the strong communication and interaction that existed among professionals from industry, academia, and government. I believe both of these to be major strengths of AOCS and ones that I want to maintain and enhance during my tenure as president.

I first became active in AOCS, as do many members, at the division level. As a member of the Protein and Co-Products Division, I initially assisted in the development of the division's annual meeting symposia and later served as division vice president and president. As a member of the Protein and Co-Products Division, I was also an associate editor for *inform* magazine from 1998 to 2000. I was later given the opportunity to serve as the technical chair for the Annual Meeting & Expo (AM&E) in Orlando in 1999, and as the chair for the AM&E held in Kansas City in 2003.

My participation continued to grow after being nominated and elected to the Governing Board and later as chair of the Education and Meetings Steering Committee in 2005. Working with AOCS staff, we implemented a number of changes to enhance the annual meeting that are still part of the program today including the dedicated poster and hot topics sessions (now the Forum on Emerging Technologies).

Through my association with AOCS, I have received numerous opportunities to present and publish my research both nationally and internationally (including in Hungary and twice in Brazil) and to learn leadership skills that assisted me in my promotion from assistant professor to associate professor and then to professor. For this, I will be eternally grateful to the staff and members of this great organization.

Evie and I are now living in Fargo, North Dakota, where we have both worked for North Dakota State University (NDSU) since 2007. I currently serve as the director of the School of Food Systems, where I lead the food science, cereal science, and food safety programs; Evie currently serves as the vice president for equity, diversity, and global outreach. I also serve as the National Collegiate Athletic

Association faculty athletic representative for the university's athletic programs.

As incoming president of AOCS, I plan to continue the mission of AOCS to be the primary source of information for fats, oils, soaps, detergents, and related materials. This mission comes with tremendous responsibility, as the fats- and oils-related industries face major global challenges such as survival in a global economy, environmental protection and sustainability, diet and health, product quality, and the identification of new chemical feedstocks. As industry, academia, and government grapple with these issues, AOCS will continue to provide the scientifically based knowledge and expertise needed to resolve these problems. In fact, I believe that AOCS is uniquely positioned to continue its role as the primary information resource. However, we are now challenged to find new ways to provide this information in a relevant, time-sensitive, and efficient manner.

I look forward to working with all of you, along with AOCS staff and our new chief executive officer, Pat Donnelly, to meet this challenge. By working together, we will fulfill our mission and be the scientific organization that our members need for networking and professional growth. ■

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OIL IN BIOMASS: a step-change for bioenergy production?

**John Dyer,
Robert Mullen, and
Kent Chapman**

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To help meet the rapidly growing demand for biofuels, scientists and policy makers envision that a variety of agricultural, municipal, and forest-derived feedstocks will be used to produce “second-generation” biofuels, whereby carbon-rich materials are either fermented to produce ethanol or combusted under oxygen-limiting conditions to produce “syngas” (which can be used to produce a variety of biofuels or chemicals). Alternatively, these same carbon-rich materials can be fractionated to recover energy-dense molecules such as oils from a variety of nonfood sources, including algae (Table 1).

Biotechnology will certainly play an important role in the further development of biofuels because it offers creative approaches to solving some of the most vexing problems associated with biofuels. For example, some of the main challenges for production and use of biofuels are that current agricultural practices simply cannot deliver sufficient amounts at low-enough prices to meet the massive demand. These problems could be addressed, in part, by engineering crops to yield significantly greater carbon and energy content.

Biotechnology offers multiple opportunities to achieve that goal. For instance, plants might be engineered for enhanced cellulose production (and reduced lignin content) for ethanol production. Alternatively, or in addition, crops might be developed to accumulate higher amounts of energy-dense lipids, including vacuole-imported secondary metabolites, cuticular waxes on aerial surfaces, or oils (triacylglycerols) in leaves (see

inform 22:631–634, 2011) and other vegetative parts of plants. This latter scenario is particularly attractive because the biomass of (nonseed) aerial parts of plants (e.g., leaves and stems) is generally far greater than the amount accounted for by seeds. As such, a rapidly growing perennial grass, such as *Panicum* (commonly referred to as switchgrass) or *Miscanthus*, might be developed with the capacity to accumulate oil in leaves (Fig. 1). The harvested biomass could then be used for the recovery of both the oil for biodiesel and the cellulosic residues for ethanol production. Alternatively, this energy-rich biomass (oil has twice the energy content of carbohydrate on a mass basis) could be combusted to produce syngas or electricity.

In the next section, we highlight new and emerging research that suggests we are in fact moving closer to realizing the potential of increasing the amounts of recoverable, renewable energy from bioengineered crop plants.



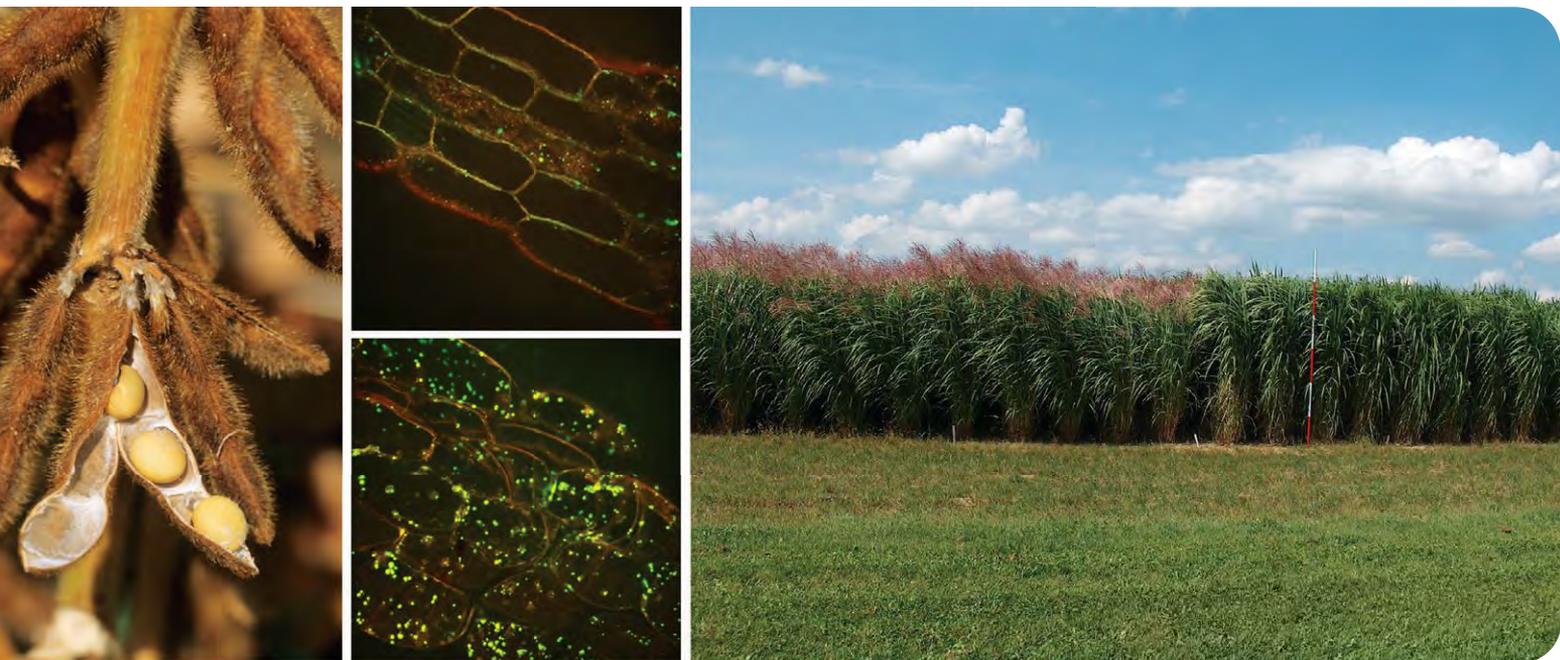


FIG. 1. Production of oil in plant leaves. Shown on the left is an image of mature soybean seeds, a major source of biodiesel in the United States, and on the right, the high-yielding perennial grass *Miscanthus*. The micrographs in the middle show images of wild-type *Arabidopsis* leaves (top panel), and leaves that have been engineered to contain a mutation in the *cgi58* gene (bottom panel), which results in the hyper-accumulation of lipid droplets (seen here as green-stained punctae). Middle panels reprinted with permission from the Proceedings of the National Academy of Sciences (*Disruption of the Arabidopsis CGI-58 homologue produces Chanarin-Dorfman-like lipid droplet accumulation in plants*, James, et al., PNAS 107:17833-17838, 2010). Left and right panel images provided by the USDA-ARS Image Gallery and Bill Deen (University of Guelph, Canada), respectively.

Biotechnology for producing oils in nonseed plant biomass

Although seeds are the primary site of oil synthesis and storage in plants, there is increasing appreciation that other plant parts can also synthesize and accumulate significant amounts of oil. For instance, the single greatest source of vegetable oil in the world is the oil palm tree, which produces ~35% of the world's vegetable oil. Palm oil is obtained from both the seed (palm kernel) and the fleshy fruit tissue (mesocarp) that surrounds the seed and that contains up to 90% oil by weight. Olive oil is similarly derived from the oil-rich mesocarp tissues surrounding the seed. Other pertinent examples of nonseed sources of oils include the “oil firewood” plant *Tetraena mongolica* Maxim, which contains up to 5% oil in stem tissues (dry weight), and the yellow nutsedge plant (*Cyperus esculentus*), which contains about 24% (dry weight) oil in underground storage organs known as tubers.

Whereas all of these examples provide precedents for production of oil in nonseed parts of the plant, they also involve

t ABLE 1. Current and potential feedstocks for biofuel production

Source	Fuel type
Corn	Ethanol
Sugarcane	Ethanol
Soybean	Biodiesel
Rapeseed	Biodiesel
Perennial plants on degraded lands	Ethanol/syngas/electricity
Crop residues (e.g., corn stover)	Ethanol/syngas/electricity
Sustainably harvested forest materials	Ethanol/syngas/electricity
Double crops/mixed cropping systems	Ethanol/biodiesel/syngas/electricity
Municipal and industrial wastes	Ethanol/biodiesel/syngas/electricity
Recovery of oils from food industry	Biodiesel
Algae	Biodiesel

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10 Projects That Could Transform Plant-Based Oil Production

In October 2011, the US Department of Energy's Advanced Research Projects Agency-Energy announced plans to put \$36 million into 10 biofuels-related projects that could transform plant-based oil production.

These Plants Engineered to Replace Oil (PETRO) projects push the limits of the amount of fuel that can be produced per acre or hectare of planted land by improving the efficiency with which plants use carbon and light, causing plants that currently produce sugar to produce oil instead, and maximizing oil storage in perennial grasses and woody biomass (see tinyurl.com/ARPA-E-PETRO).

University of Massachusetts, Amherst, is developing an improved oilseed crop that uses carbon more efficiently than traditional crops. The plant will incorporate features that significantly improve photosynthesis and also allow the plant to produce useful, high-energy fuel molecules directly within leaves and stems, in addition to seeds. This will allow a substantial increase in production of fuel per acre of planted land.

University of California, Los Angeles, is streamlining the process by which green plants convert carbon dioxide into sugar or biofuels. This technology could be applied broadly to improve yields of grain and biomass in crop plants.

Donald Danforth Plant Science Center's Center for Enhanced Camelina Oil, St. Louis, Missouri, is engineering camelina with several genes that allow the plant to use light more efficiently, increase its carbon uptake, and divert more energy to the production of oil, which is stored in seeds and is convertible to fuels. The goal is to combine all of these genes into one engineered variety of camelina, and to prepare it for field trials.

Texas Agrilife Research at Texas A&M University, College Station, is trying to make photosynthesis more efficient by redirecting otherwise wasted energy in plants into energy-dense fuel molecules. The fuel will be readily separated from the plant biomass through distillation.

Lawrence Berkeley National Lab, Berkeley, California, is developing tobacco plants with leaves that contain fuel molecules via engineered traits that confer hydrocarbon biosynthesis, enhanced carbon uptake, and optimized light utilization. The tobacco will be grown using advanced cultivation techniques to maximize biomass production.

Arcadia Biosciences, Inc., Davis, California, is modifying a number of genes involved in oil biosynthesis to induce grasses to produce vegetable oil. Arcadia's technology will yield biomass comprising 20% oil by weight and can be transferred into highly productive energy crops such as sorghum and switchgrass.

University of Illinois at Urbana-Champaign is engineering sugarcane and sorghum to produce and store oil instead of sugar. The team will optimize the intensity of the leaf color to more efficiently capture and use sunlight, improving energy yields by up to 50% compared to conventional crops. The resulting plants will be crossbred with the energy grass *Miscanthus* to increase their geographic range of cultivation.

North Carolina State University, Raleigh, is engineering the oilseed crop camelina with traits that increase the yield per acre of biodiesel. The project incorporates both an alternative way to capture carbon from air and features that allow the plant to accumulate larger quantities of vegetable oil and other fuel molecules in oilseeds. When combined, the fuel molecules plus vegetable oil isolated from the plant can be converted into a fuel mixture that is comparable to diesel or jet fuel.

Chromatin, Inc., Chicago, Illinois, is engineering sweet sorghum, a plant that produces large quantities of sugar and requires less water than most crops, so that it can accumulate the fuel molecule farnesene. Genes from microbes and other plants will be incorporated into sorghum to allow the plant to produce up to 20% of its biomass as farnesene, which can be readily converted into a type of diesel fuel. Farnesene will accumulate in the sorghum plants similar to the way in which sugar accumulates in sugarcane.

University of Florida, Gainesville, is increasing the production of turpentine, a natural liquid biofuel isolated from pine trees. The pine tree developed for this project is designed both to increase the turpentine storage capacity of the wood and to increase turpentine production from 3% to 20%. The fuel produced from these trees would become a sustainable domestic biofuel source. Production of 100 million gallons of fuel per year from less than 25,000 acres of forestland is predicted.

specialized organs for oil synthesis and storage. Thus, it would be difficult to engineer this type of oil accumulation process into a biomass crop such as *Miscanthus*. On the other hand, all plant cell types, including those in leaves and stems, have the capacity to synthesize some oil, specifically triacylglycerols (TAG), and scientists are now trying to exploit this observation to significantly ramp up the amounts of TAG in nonseed plant parts through various engineering techniques. TAG are conveniently packaged into lipid droplets for storage in the cytosol of cells.

Two general approaches have been explored thus far. The first involves more "global" efforts to reprogram leaves for oil synthesis by modifying the normal actions of DNA transcription factors. Transcription factors are proteins that bind to DNA in order to induce the expression of a gene or suite of genes whose encoded product(s) (e.g., a protein) serve a particular purpose within the cell. Several years ago transcription factors called LEC1, LEC2, and WRI-1 were shown to control the expression of genes involved in oil synthesis in developing plant seeds. Remarkably, the ectopic expression of these

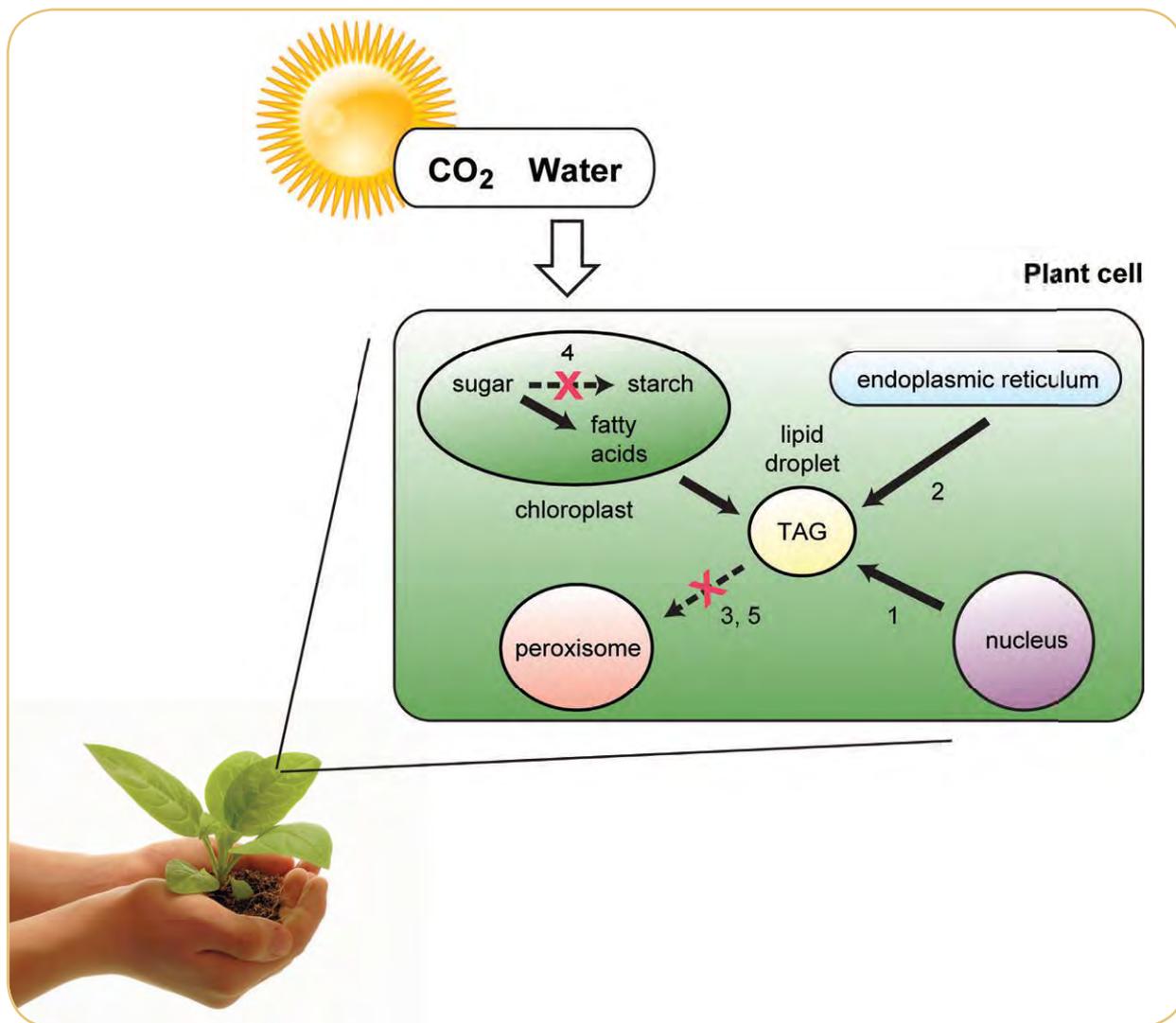


FIG. 2. Strategies for increasing oil content in the leaves of plants. The numbers 1–5 correspond to strategies described in the text.

transcription factors in leaves reprogrammed them for the synthesis of oil, such that not only did TAG oil content increase, but fatty acids normally found exclusively in seed oils were also present in leaf tissues (Fig. 2, strategy 1). Using transcription factors in this manner, however, is not without its shortcomings, since reprogramming a leaf to become more seed-like can have negative effects on normal leaf structure, development, and function.

A second approach to increase oil content in nonseed tissues is to alter fatty acid metabolism in leaves in favor of oil production. For instance, the final step of TAG synthesis is catalyzed by an enzyme called diacylglycerol acyltransferase (DGAT), and multiple studies have demonstrated that overexpression of this often rate-limiting enzyme in developing seeds can boost their oil content by up to 25% (wt/wt). Scientists also have overexpressed DGAT in leaves, resulting in a notable increase in oil content (Fig. 2, strategy 2). In another approach, scientists blocked the ability of plants to break down fatty acids altogether, and this also caused an increase in oil content of leaves under certain growth conditions (Fig. 2, strategy 3). Similarly, inhibition of a key step in starch biosynthesis

in plant leaves, to reduce the flow of carbon into starch, also led to an accumulation of TAG (Fig. 2, strategy 4). Lastly, mutating a gene in *Arabidopsis* (considered to be a model system for studies of plant biology) that regulates multiple aspects of fatty acid metabolism in plant cells, particularly the breakdown and turnover of TAG by peroxisomes (Fig. 2, strategy 5), produced a significant increase in oil content in plant leaves.

Although all of these approaches increase oil content in leaves, greater increases will likely come from combinations of approaches. One study recently reported a 5.8-fold increase in TAG accumulation, with a 9.5-fold increase in energy content in leaves by combining oil-specific transcription factors with a targeted reduction of starch biosynthesis.

Challenges for producing oil in biomass

Significant challenges remain for the use of biofuels as sustainable alternatives to fossil oil-derived fuels, such as the relatively high cost of biofuel production, competition with food-related practices (e.g., arable land and water usage), and the sheer

differences in market size between agriculture and energy sectors.

Many technical challenges also remain, including those for producing oil in biomass. Our knowledge of oil synthesis in plant leaves and its regulation is still rudimentary. A significant amount of research is required to understand these processes better, especially in the context of bioenergy production. One example is that the normally low amounts of TAG present in leaf cells are thought to be a transient depot for fatty acids that can either be transferred in and out of cellular membranes or metabolized for energy, depending on the immediate needs of the cell or organism. How then does one “stabilize” the TAG pool so that it will accumulate as a “sink” in leaves, similar to how it accumulates in developing seeds? This might be accomplished by expressing structural proteins from plant seeds called oleosins that normally bind to and stabilize the TAG in specialized lipid droplets. It might also be important to modify the fatty acid composition of leaf-derived oil, which is in polyunsaturated fatty acids and thus might not be ideal for biodiesel production (but should not matter for either syngas production or direct combustion of the plant material to produce electricity).

Clearly, as we begin to understand more about how oils are produced and degraded in plant cells, there will be increasing opportunities to further enhance the energy content in the nonseed tissues of plants. ■

information

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Bert Poepping

Fraudulent products cost industry billions of dollars each year. Perfumes are a good example. Figure 1 shows two look-alike products.

The original product on the right, was purchased from Douglas, a high-street retailer in Prague, Czechoslovakia. The look-alike copy on the left was purchased from a Vietnamese merchant in the same city. The price for the 90-mL look-alike was equivalent to \$7.70, whereas the 30-mL original J'Adore perfume made by Christian Dior and purchased from Douglas cost \$72.80—an almost 30-fold price difference. To the untrained nose, the scents were very similar, showing the expert knowledge the producers of fraudulent products have acquired in composing products with very similar fragrances and appearances.

The two perfumes were subjected to a very fast mass spectrometric analysis using direct analysis in real time (DART) technology (Popping *et al.*, 2008). Not entirely unexpectedly, the DART profiles were also very similar for the major components.

However, several reproducible peaks were identified that allowed us to clearly distinguish between the fraudulent product and the high-street product.

In the textile and fragrances industries, look-alike products are usually a straightforward copy—good or poor—of the original (jeans, T-shirts, handbags, etc.), but the



FIG. 1. This copy (left) cost about one-thirtieth of the original perfume (right) from Douglas.

palette of fraud options in the food industry is much wider. Straightforward replacement with lower-quality products or faked labels is just one option. There is also the often-favored option of blending, which is more difficult to detect.

The fraud industry is extremely inventive: If the makers of fraudulent products know what analysts look for to detect a fraud, they can specifically add an identical or seemingly identical component but leave the remaining, lower-quality components portion unchanged. One blunt and

lethal attempt at fraud was the addition of melamine to infant formula to mimic a high protein content (see who.int/csr/don/2008_09_22/en/index.html). A very simple and commonly used method for determining protein content is a Kjeldahl analysis, in which the total reduced nitrogen content is determined. Since the fraudsters knew this, they added melamine, a small molecule with very high nitrogen content, to the formula. In Kjeldahl analysis of the formula, the trace

CONTINUED ON PAGE 214

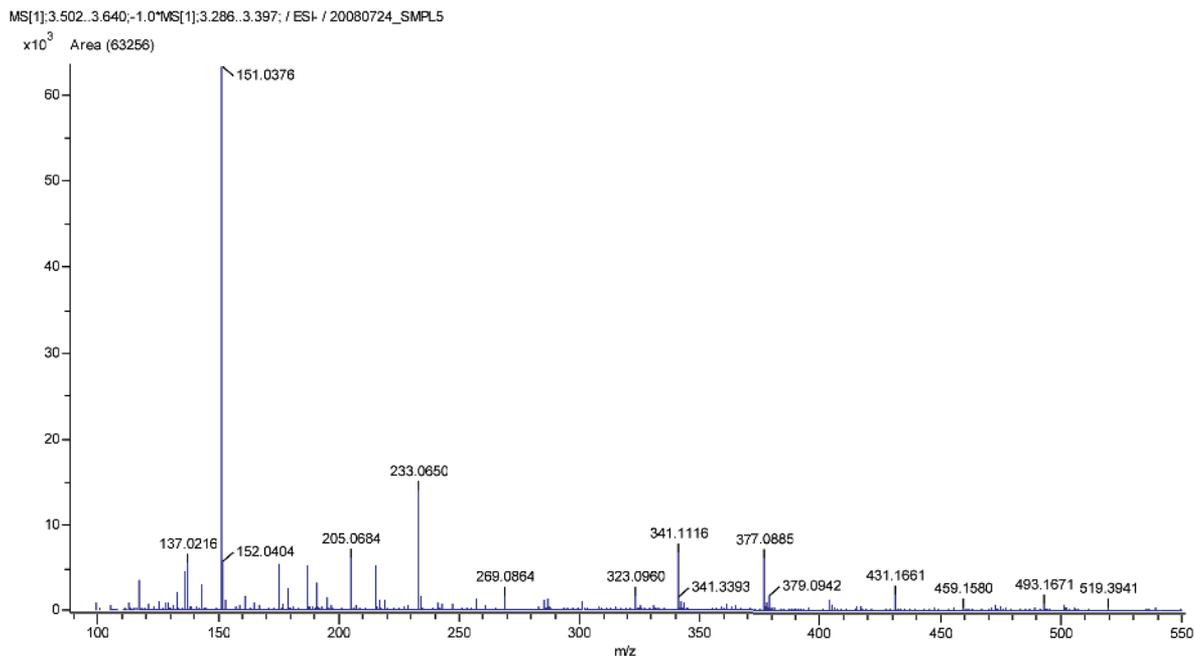


FIG. 2. The direct analysis in real time technology profile of the original perfume purchased from Douglas.

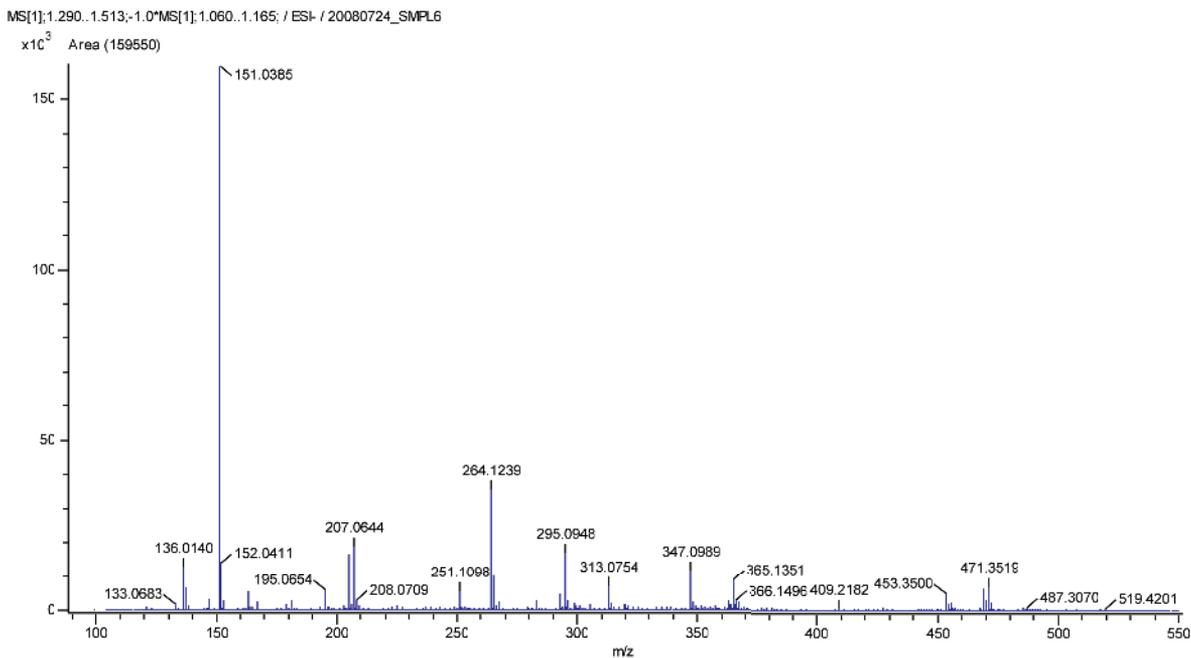


FIG. 3. The direct analysis in real time technology profile of the fraudulent copy.

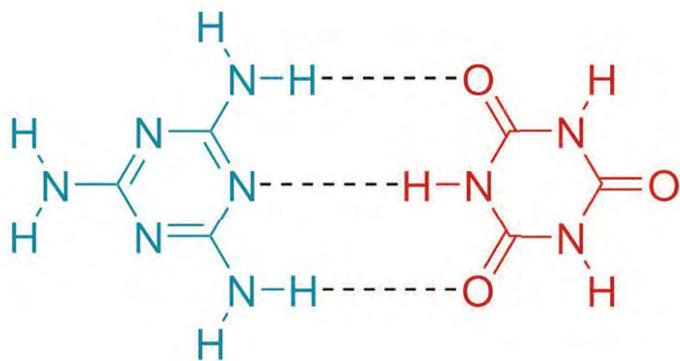


FIG. 4. Melamine-cyanuric acid complex (source: Wikipedia).

levels of melamine led analysts to believe that the products had a very high protein content, and therefore a high nutritional value. Unfortunately, the melamine was contaminated with cyanuric acid, which forms a complex (Fig. 4) and precipitates as lethal crystalline spicules in the kidney, killing some animals and humans. Unlike in the textile industry, where the use of products does not tend to have a negative health impact, fraud in the food industry can cost lives.

In this case, novel technologies help to identify and prevent fraud. Tandem mass spectrometry (MS/MS) is one of the common modern detection systems used for the analysis of melamine and cyanuric acid. MS/MS looks at not only the individual composition of a molecule but also its total mass and charge, thereby helping to identify the actual substance. The use of (forbidden) pesticides or veterinary drugs can also easily be detected if reference materials are available, as it is the case for most of them.

Another area of application of this technology is in premium products that, as in the textile industry, are often copied or blended with lower-quality materials. One example is single malt whisky. Here, some producers of the water of life (from the Gaelic *uisge beatha* or *iskie bae*, commonly known as whisky/whiskey) tend to use sugar profiles to characterize the brand and quality of the whisky. These

can either be naturally occurring profiles in the grains used for distilling or intentionally added as markers. By using these profiles, an MS analysis can identify not only a replacement product but also a blending of lower-quality whisky with the original product. This is possible because the MS analysis also has the option to quantify the analytical target, in this case the sugar molecules. For this, standards of known concentration—typically isotopic versions of the target molecule that cause a slight shift in mass but have otherwise identical properties—are added that allow the quantity of the analyte in the unknown sample to be determined. An alternative method for quantification is standard addition, which requires measuring the same sample twice: once without the added standard, and once with it. The amount of target can be determined by calculating the difference between the two.

In the category of premium oils, if it is suspected that extra virgin olive oil has been adulterated with hazelnut oil, principal component analysis (PCA) can be used to identify blends of olive and hazelnut oil. With gas chromatography–MS, for example, principal components of hazelnut oil and of olive oils are identified and compared with the unknown sample. The PCA approach tends to be more reliable than just looking at one or two individual components, as some individual components can change with weather, storage, and processing conditions. However, when using the PCA approach, it is important that all possible aspects be covered by analyzing samples from different harvesting periods, storage, and processing conditions against a reference in order to include the variability aspect in the profile.

MS analysis does not stop at small molecules. More recently, food protein analysis has become a new playground for mass spectrometrists. To give just one example of where MS can be used for protein analysis, some ethnic groups reject eating either pork or beef products. And while in many cases polymerase chain reaction (PCR) is a good tool for identifying the species from which the meat originated, it fails in others. One example is in hydrolyzed protein from pigs or cattle, which is sometimes injected into chicken breasts to increase their weight through the retention of water. Here, DNA is often completely destroyed. The proteins are degraded and may no longer be detected by enzyme-linked immunosorbent assay (ELISA), while large quantities of smaller peptides are still present. The latter can still

TABLE 1. Detection of egg using enzyme-linked immunosorbent assay (ELISA), and a comparison of ELISA and mass spectrometric (MS) analysis.

Allergenic Food	ELISA test kit	ELISA results				MS results		
		0 µg/g flour	0 µg/g bread	1,000 µg/g flour (x 10 ² µg/g)	1,000 µg/g bread (x 10 ² µg/g)	Peak area (PA) flour (x 10 ⁴ cps)	Peak area (PA) bread (x 10 ⁴ cps)	PA _{bread} /PA _{flour}
Egg	C	< 0.5	< 0.5	4 ± 0.5	< 0.005	6 ± 0.05	1 ± 0.4	17
	D	< 1	< 1	8 ± 0.8	< 1			
	E	< 0.5	< 0.5	8 ± 0.8	< .005			

ELISA: negative at 1,000 mg/kg; MS: positive at 1,000 mg/kg. Source: Heick et al., 2011.

SNIFFING OUT FAKE PERFUME

Counterfeit perfumes are big business. During 2011, US Customs and Border Protection (CBP) officials seized a total of \$51 million worth of them. The most frequently intercepted fake was counterfeit Sex in the City perfume related to the highly popular HBO movie and television series.

CBP had targeted 138 commercial shipments of perfumes for possible trademark infringement, and 52 shipments were seized for infringing a trademark, including the one for Sex in the City. The domestic value of the seized shipments, which con-

tained more than one million pieces, was nearly \$8 million. If the trademark had been genuine, the manufacturer's suggested retail price of the perfume would have been more than \$45 million.

In the past year, the CPB uncovered more than 30 entities involved in the importation of counterfeit perfume. During that same time, 24,792 seizures of counterfeit and pirated goods with a total domestic value of \$178.9 million and a manufacturer's suggested retail price of \$1.1 billion were intercepted before entering the United States. ■

be detected by MS, making it possible to differentiate products based on what is suitable for a specific ethnic group. A similar situation exists for allergens in processed products, where PCR is unable to detect egg and even ELISA fails to detect large quantities of the proteins present, whereas MS easily detects the target peptides (Table 1).

MS is an excellent technology for identifying fraud when the fraudulent action relates to a change of composition of the product, that is, a replacement, blend, or addition. Other technologies may aid this, such as Site-specific Natural Isotope Fractionation (SNIF), a technology that allows the geographic origin of a product to be determined. However, as fraud gets more sophisticated, methods must be developed further. Initial approaches are underway to give MS the ability to detect unknown compounds: the so-called nontarget analysis. This, however, requires that the original product with all of

its (biological) variability be available—an immense challenge with respect to computer power and storage, since each analysis generates tens to hundreds of gigabytes of data that need to be compared and evaluated. The current rate of storage capacity and computing power will not be a significant bottleneck for the future, making MS one of the most powerful technologies for the detection of fraud.

Bert Poepping is director of scientific development at Eurofins and on the editorial board of several peer reviewed publications including the Journal of AOAC International, the Journal of Food and Agricultural Contaminants, and the Journal of Food Analytical Methods and Quality Assurance of Foods and Crops. He also serves on the board of the international MoniQA Association as vice chair and is member of numerous national and international committees.

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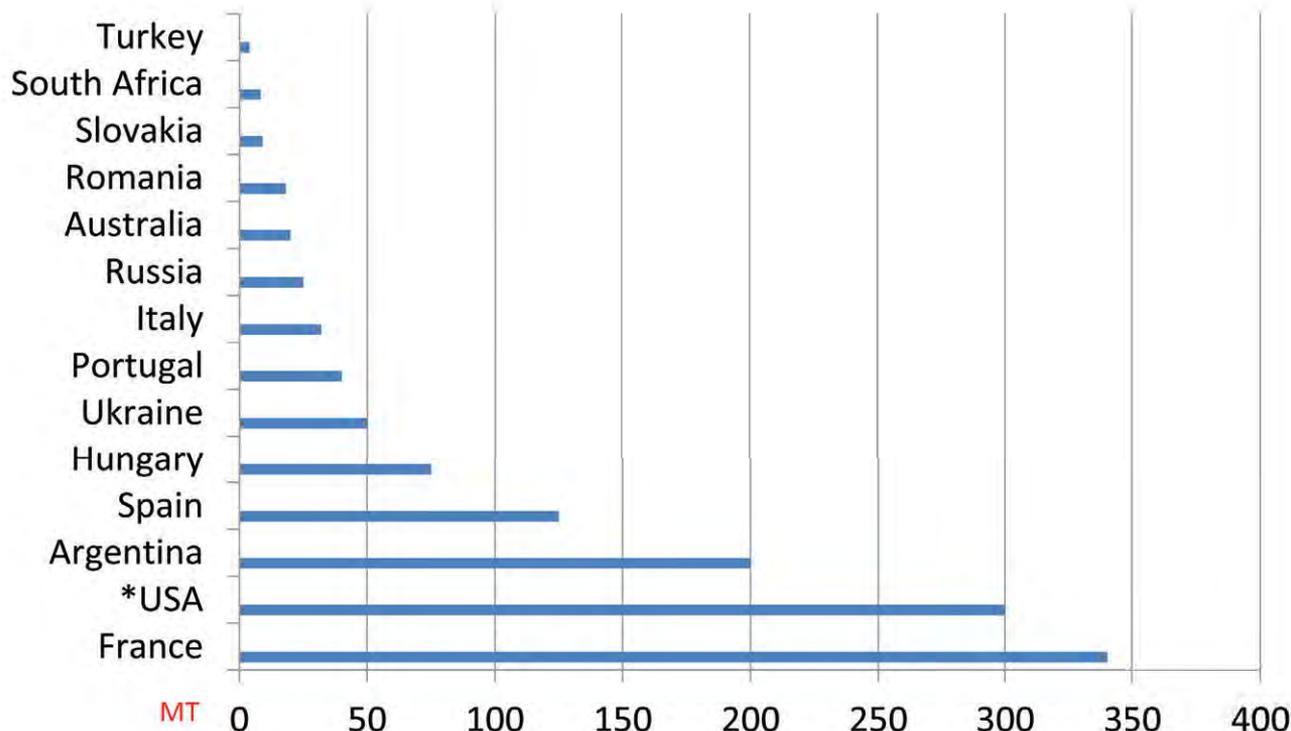


FIG. 1. Estimated high-oleic sunflower oil (HOSO) production in 2010. Estimates based on conversation with industry. *Combined NuSun and HOSO. MT: metric tons. HOSO: high-oleic sunflower oil.

Making lemonade:

How a resilient US sunflower industry continues to beat the odds

Larry Kleingartner

The old adage of making lemonade when life presents you with lemons might well summarize the US sunflower industry over its 35-year history. The fledgling industry began with huge exports of sunflower seed to Europe and Mexico. When those markets changed, export subsidies were used to move sunflower oil into North Africa and Turkey. It was generally assumed that sunflower oil could not make a dent in a US market dominated by inexpensive soybean oil—that is, until leaders in the sunflower industry decided to change sunflower oil's fatty acid composition, which was dominated by polyunsaturated fatty acids, to a composition that favored monounsaturated fatty acids.

The US sunflower industry's decision to switch to monounsaturates was based on two factors. One, the subsidized export of US

sunflower was not sustainable, and new countries were lining up to compete in some of the same overseas markets. Two, the issue of fats containing *trans* fatty acids was gaining importance based on several national studies indicating their negative effects on heart health. Although the decision to switch to monounsaturates was made in 1995—well before the US Food and Drug Administration (FDA) issued any announcements on *trans* fats—sunflower industry leaders had literally “bet the farm” that *trans* would become a significant issue based on food industry advice.

Fortunately for their industry, they were right. Not long afterward, the FDA determined that *trans* fats were harmful to heart health and required special labeling. Domestic food manufacturers finally gave sunflower oil a serious look, because it offered them what the industry badly needed . . . an oil that provided excellent functionality without hydrogenation.

Switching the entire industry to a new type of sunflower oil was a monumental task. Fortunately for public and private sunflower seed breeders, high-oleic acid sunflower was already available in the gene pool. However, a patent on high-oleic seed and oil eliminated high-oleic for the foreseeable future. Thus, the idea of mid-oleic sunflower was born. Mid-oleic sunflower oil gave the industry a way to

TABLE 1. Fatty acid composition (%) of five types of sunflower oil

Fatty acid	16:0	18:0	18:1	18:2	18:3	Misc ^a
Traditional	7.0	4.5	18.7	67.5	0.8	1.5
Mid-oleic	4.6	4.2	63	26	0.6	1.6
High-oleic	3.5	5.2	82	9.0		0.3
High-stearic/ high-oleic	4	18	70	4		4.0
Low saturate	1.9	0.7	94	2	0.2	1.2

^aMisc: may contain less than 0.5% of a combination of other

circumvent a patent that would not expire for another five years. Seed companies were instructed to develop hybrids with fatty acid compositions of oleic acid under 70% with a minimum of 55%.

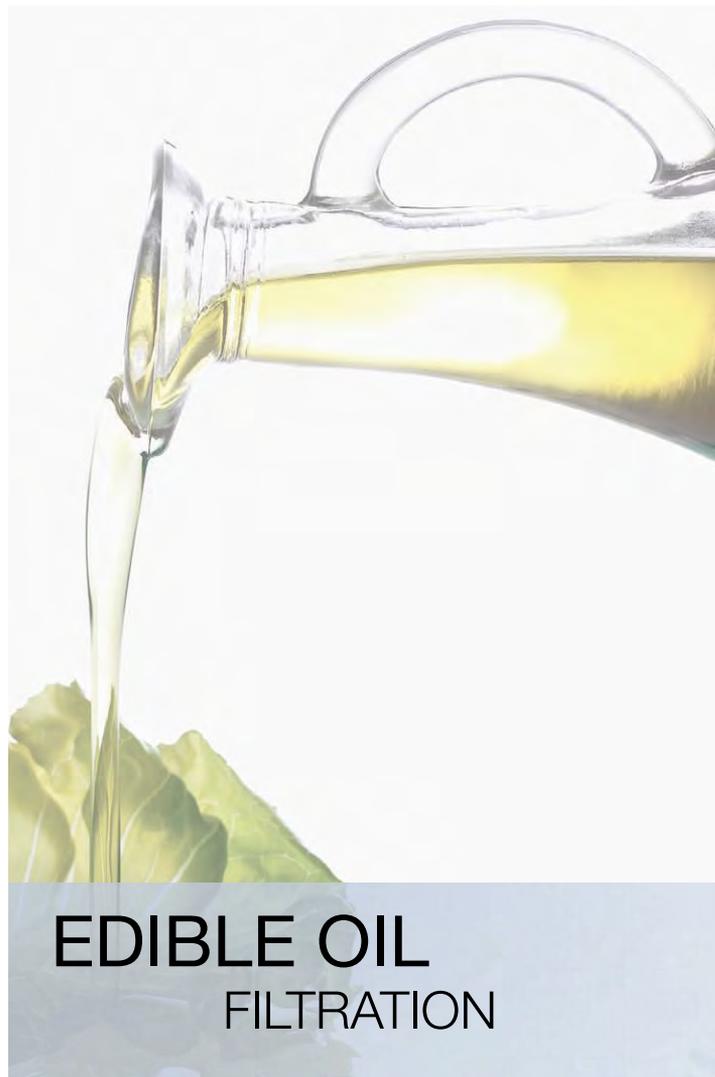
There are many links in a commodity chain, and each link had to make adjustments during the transition. The hybrid seed companies had the most significant challenge of all: developing new planting seeds with the desired fatty acid composition while maintaining superior agronomic traits. Although the majority of sunflower hybrid seed companies are international, the development of mid-oleic sunflower seeds was purely a US effort and remains so today.

Other sectors had to make expensive adjustments as well. Crushing plants built additional storage tanks to segregate the two types of seeds and the resultant oils. Then, to entice producers to switch to the new seeds, they developed a two-price system with a premium for the new seed. First handlers similarly required separate storage to differentiate seed quickly and inexpensively, and farmers found it uncomfortable switching from their favorite hybrid to planting seeds that were not yet totally proven. The name NuSun®, trademarked by the National Sunflower Association, was created for this mid-oleic oil to aid in segregating seeds from the farm to the end user. This proved to be successful, yet it still took more than 10 years before the transition was complete.

On an international level, traditional high-linoleic acid sunflower oil has ruled supreme since the introduction of sunflower oil. Major producers of sunflower now include Russia, Ukraine, Argentina, and France (Fig. 1). Most of these production centers are limited in their ability to segregate production, and most of their markets—both domestic and international—have no fatty acid preference. An exception is France, where a significant portion of production is high-oleic sunflower. The vast majority of this production is used within France. The oil is produced and marketed to food companies that have committed to purchasing the oil before planting takes place.

Most hybrid seed companies today have an excellent lineup of high-oleic hybrids for all production locations around the world. However, a transition to more high-oleic sunflower production in some of the major producing counties such as Russia and Ukraine is not likely to occur quickly. Government labeling requirements or consumer demand for lower *trans* and/or saturates will need to occur in these countries and their major importing markets.

Now that the US high-oleic sunflower patent has expired, it is very likely that US production will shift from NuSun to high-oleic. This will provide efficiency in producing planting seeds since



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MAHLE
Industry

high-oleic breeding is already well established. It will also make it more efficient to minimize segregation requirements within the marketplace. To add to the complexity of segregation, two new fatty acid composition sunflower seeds are being introduced: high-oleic/high-stearic and high-oleic/low-saturate. Both have unique potential markets (Table 1 on page 217).

The concern is that sunflower will soon have too many types of fatty acid choices for the total size of the available acreage. Thus, eliminating NuSun reduces one of the alternatives. Traditional high-linoleic acid sunflower oil is no longer produced in the United States. However, a transition from NuSun will be driven by the market and not an edict from one entity such as the National Sunflower Association. It is important to point out that the US sunflower industry also produces confection in-shell and hulling types for the seed market.

GM technology and research

While the US sunflower industry was spending its time and resources on fatty acid changes, biotechnology companies were investing in transgenic methodologies, which have been used to produce genetically modified (GM) corn, soybeans, cotton, and canola. The technology created a firestorm among some governments and consumers. However, US farmers and some others loved the technology and quickly adopted it. After all, GM crops offered farmers higher yields and greater production efficiency. Yet, while tech companies were initially interested in producing GM sunflower, the growing controversy over GM organisms in Europe and Japan and ever-increasing

registration costs associated with GM seeds throughout the world temporarily prevented sunflower and other additional crops from benefiting from this new technology. This delay has proven to be a significant disadvantage for sunflower and other crops that missed the first round of technology development.

Developing herbicide resistance, disease resistance, or fatty acid changes through traditional breeding is comparatively cumbersome. As a result, the acreage of GM crops in the United States and South America has ballooned at the expense of traditionally bred crops such as sunflower. The production of ethanol from corn has similarly become a disadvantage to other crops competing for acreage. These two developments have significantly limited sunflower acreage in both of these regions.

Despite the lack of new transgenic technology, the US sunflower industry has created two new herbicide-resistant sunflower types that mimic Roundup Ready™ corn or soybeans. Although neither has the broad-spectrum weed control, as does the herbicide Roundup™, it is a race for yield that wins the farmer's heart. From that standpoint most crops are at a disadvantage to corn, which enjoys several unique genomic tools. Plus, the private sector is making major investments in corn that cannot be matched in any other crop.

Here again, the US sunflower industry has come together—this time in a research partnership known as the National Sunflower Association SNP Consortium. SNP stands for single nucleotide polymorphism, a fairly new gene marker tool that is independent

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Briefs

Mecpro Heavy Engineering Ltd. (New Delhi, India) announced in February 2012 its inclusion in a 7th Framework Programme of the European Commission known as APROPOS. The focus of the program is to develop novel eco-friendly biomechanical processing solutions to enrich intermediate fractions from industrial high-protein and oil-containing process residues originating from agriculture and fisheries. The consortium consists of seven academic partners and 10 small and medium enterprises from eight countries. For more information, see tinyurl.com/APROPOSmecpro



A Norwegian company has applied to the UK's Food Standards Agency for approval to market the oil from a miniature shrimp (*Calanus finmarchicus*) as a novel food ingredient for use in food supplements. (See tinyurl.com/calanus.) The shrimp is one of the most common species of zooplankton found in the North Atlantic Ocean and is able to produce large lipid stores (primarily in the form of wax esters or triglycerides). The company—Calanus AS—intends that the oil will be marketed in the form of food supplements, and it is one of an increasing number of oils rich in the polyunsaturated fatty acids docosahexaenoic acid and eicosapentaenoic acid. The comment period on the application closed on March 1, 2012.



Castor production is expected to rise in India for the marketing year 2011/12, according to the Solvent Extractors' Association of India. Based on preliminary crop surveys conducted by AC Nielsen, the total area under castor is projected to be 1.2 million hectares (ha), up 34% compared with the previous year. Estimated total production of castor seeds for 2011/12 is 1.6 million metric tons, which is an increase of 30% over the previous year. The average yield for 2011/12 is projected at 1,417 kilograms/ha, which is a decrease of 3% compared with the previous year. ■

News & Noteworthy



Is the US *trans* regulation working?

Serum levels of four *trans* fatty acids (TFA) decreased by 58% in white Americans from 2000 to 2009, according to a research letter in the *Journal of the American Medical Association* (JAMA: doi: 10.1001/jama.2012.112, 2012).

Has there also been a decrease in the risk and/or incidence of heart disease? Opinion is mixed on that question, in part because no hard data exist. According to Robert Anderson, chief of the Mortality Statistics Branch of the Centers for Disease Control and Prevention (CDC), the adjusted death rate for all causes in the United States has decreased from 257.6/100,000 population in 2000 to 182.8/100,000 population in 2009. Reasons for the drop undoubtedly are manifold and almost certainly include less cigarette smoking and more effective interventions in addition—presumably—to the decrease of TFA in the food supply.

The JAMA data suggesting a drop in serum TFA levels come from the National Health and Nutrition Examination Survey (NHANES), an annual program of studies designed to assess the health and nutritional status of adults and children in the United States. Researchers wanted to see if the changes in *trans*-fat labeling requirements

instituted by the Food and Drug Administration (FDA) in 2003 have had an impact on public health.

The FDA regulation was implemented in 2006 and requires manufacturers of food and dietary supplements to list reportable amounts of TFA (0.5 gram or more per serving) on the Nutrition Facts panel of product labels. Also during this period, some local and state health departments have required restaurants to limit their use of TFA. As a result, a large amount of TFA has been removed from the US food supply.

In 2008, AOCS member David Dzisiak of Dow AgroSciences (DAS; Indianapolis, Indiana, USA) estimated the amount of partially hydrogenated oils used annually in foods in North America decreased by about 50% from about 3.6 million metric tons (MMT) to 1.8 MMT immediately before *trans* fat labeling became mandatory on January 1, 2006. A recent DAS study estimates that about 500,000 metric tons of partially hydrogenated oils are still being used annually in North American food production.

STUDY RESULTS

NHANES is an annual cross-sectional survey of the non-institutionalized civilian population of the United States, weighted to be nationally representative. The preliminary

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Sustainability watch

From 2012 onward, Düsseldorf-based Henkel will purchase certificates for sustainable palm kernel oil for its entire range of laundry and home care products. “This ensures that for the quantity of palm kernel oil used in the production of surfactants for Henkel’s detergents and cleaning products, a corresponding quantity of sustainable palm kernel oil will be produced and enter the supply chain,” the company said in a statement.



Humankind’s water footprint is the subject of a new study analyzing the quantity and distribution of global water use from 1996 to 2005.

The study, conducted by researchers at the University of Twente in Enschede, Netherlands, is the third major effort to quantify global water consumption patterns. The three usage types quantified by the scientists are the amount of rainwater consumed, the volume of ground and surface water depleted, and the volume of water polluted.

Agriculture accounts for 92% of all freshwater use globally, with the production of cereal grains such as wheat, rice, and corn accounting for 27% of the world’s water footprint. Meat production (particularly grain-fed beef) accounts for 22% and dairy for 7%, the research suggests.

The United States is the third-largest consumer of freshwater, the study indicates, even though it has only 5% of the world’s population. (China and India are the first- and second-largest consumers.)

Approximately one-fifth of the water consumed worldwide is what the researchers call “virtual water.” This is water that moves between countries when, for instance, soybeans grown in Argentina are exported to China. The largest net virtual water exporters, the scientists say, are North and South America, South Asia, and Australia. The biggest net virtual water importers are North Africa, the Middle East, Mexico, Europe, Japan, and South Korea.

The study appears in the *Proceedings of the National Academy of Sciences USA* (tinyurl.com/WaterFootprint). ■

survey reported in *JAMA* looked at a subset of non-Hispanic white adults participating in NHANES. Half of the white persons aged 20 years or older who had a morning fasting blood sample in 2000 (229 subjects) and 2009 (292 subjects) were randomly selected. Four TFA were measured: elaidic acid (C18:1n-9t), vaccenic acid (C18:1n-7t), linoelaidic acid (C18:2n-6t,9t), and palmitelaidic acid (C16:1n-7t). Levels of these four TFA decreased by 63%, 56%, 49%, and 49%, respectively.

The researchers, led by Hubert Vesper of the CDC, suggested that “these are the four major TFA and provide a reasonable representation of TFA in blood.” They cautioned that these data “cannot be used to distinguish food intake from natural versus industrial sources.”

The survey also found a decrease in serum low-density lipoprotein (LDL) and triglycerides, as well as an increase in serum high-density lipoprotein (HDL) when comparing data from 2000 and 2009. Additional studies are underway to examine TFA levels in other races, children, and adolescents, the researchers said.

“The TFA decline definitely supports the cardiovascular disease hypothesis in terms of the LDL/HDL ratio shift, which decreased 17% due to a striking rise in HDL, as one would expect,” commented K.C. Hayes, a professor of biology (nutrition) at Brandeis University in Waltham, Massachusetts, USA. “It also suggests strongly that the FDA should draw a deeper line in the sand and ban all modified fats with *trans* from being used in the food supply.”

“It is more complex than just looking at the amount of serum *trans* fat,” adds Fred Kummerow, a veterinary biosciences professor emeritus at the University of Illinois at Urbana. Kummerow has conducted research on the health effects of dietary *trans* fats since 1957 and advocated for their removal from the food supply ever since. He filed a citizen’s petition on August 7, 2009, requesting the FDA to ban *trans* fats completely rather than only requiring amounts over 0.5 g/serving be listed on nutrition labels.

“When the amount of *trans* fat in the food supply goes up as in the 1960s and 1970s, you have more heart disease. That is well documented. But lowering the amount of serum *trans*, even 58%, is not enough. I believe that the *trans* fats should be banned outright.”

Kummerow’s petition (FDA-2009-P-0382-0008) is still open, having received six brief comments. An FDA spokesperson said the agency “continues to evaluate the petition Dr. Kummerow submitted, taking into account the additional information submitted to FDA by interested parties.” Kummerow’s petition, supporting materials, and comments on the petition are available at tinyurl.com/Kummerow.

Arsenic found in soy-based infant formula

Researchers at Dartmouth College in Hanover, New Hampshire, USA, have concluded there is an “urgent need for regulatory limits on arsenic in food.” The team, led by Brian Jackson, found that the levels of arsenic in soy-based infant formula and other products made with organic brown rice syrup were as much as six times higher than US Environmental Protection Agency limits for safe drinking water.

The Dartmouth group previously found that brown rice itself contains significant levels of arsenic, most likely because of natural processes. Arsenic in the soil accumulates in the plant, with inorganic arsenic—the more problematic variety—accumulating in the hull, which is removed when the rice is polished.

The researchers used mass spectrometry to determine the arsenic content of organic brown rice syrups and a range of products made with



and without syrup, including energy bars, cereal, and energy drinks. Analysis of three commercially available brown rice syrups found total arsenic concentrations ranging from 80 to 400 nanograms per gram (ng/g).

The team also analyzed 17 infant formulas, 15 without organic brown rice syrup and two that did contain it—a dairy- and a soy-based product. Products without the syrup had total arsenic concentrations of between 2 and 12 ng/g. In the other two with syrup, concentrations were more than 20 times higher, Jackson and colleagues found.

The proportion of inorganic arsenic varied both between products and between lots of the soy-based product, the researchers reported, but when they were reconstituted, the concentration was at or above the US regulatory limit for safe drinking water: 10 micrograms/liter ($\mu\text{g/L}$). One lot of the reconstituted soy-based product had total arsenic concentrations of more than 60 $\mu\text{g/L}$.

The number of children using formula with high levels of arsenic “is presumably a very low percentage,” the scientists reported, because a web-based search found only those two products containing brown rice syrup on the market.

All 29 energy bars tested contained detectable levels of arsenic, within a range of 8–128 ng/g. The study appeared in *Environmental Health Perspectives* (doi:10.1289/ehp.1104619, 2012).

Proposition 65 case against omega-3 products settled

A case in California (USA) Superior Court against five makers of fish-oil supplements found to contain polychlorinated biphenyl (PCB) products was settled on February 1, 2012, on behalf of 30 manufacturers of omega-3 products.

The 30 companies are members of GOED, the Global Organization for EPA and DHA Omega-3s, a trade group based in Salt Lake City, Utah, USA. GOED, on behalf of the firms, entered into an agreement with the Mateel Environmental Justice Foundation, which filed a suit in March 2010 against five manufacturers as well as two drugstore chains and Omega Protein Inc., of Houston, Texas, USA, which is the self-described largest producer of omega-3 fish oil in the world.

According to Nutraingredients-USA.com, the settlement gives the companies “operating certainty around Proposition 65 limits for dioxins, furans, PCBs, and dioxin-like PCBs in products with EPA and DHA omega-3s.”

Proposition 65 was introduced in 1986. It requires manufacturers selling products in California to provide warnings on products that expose consumers to any detectable amount of more than 800 chemicals suspected of causing cancer or reproductive harm.

The limits agreed to by GOED are not official statewide limits, the Nutraingredients report notes, but are effective immediately for the 30 companies involved in the settlement. GOED will update its voluntary monograph on quality to reflect the changes. In the meantime, the companies can sell products that meet the standards without warning labels and without fear of future lawsuits “that take advantage of the fact that California has not set firm limits on these contaminants but still identifies them as toxicants.”

The GOED member companies that are parties to the settlement with the Mateel Foundation are Aker Biomarine, Aurora Algae, Austral Group, Azantis, Barlean's Organic Oils, BASF, Biodroga, Bioriginal Food & Science, Bizen Chemical, Copeinca, Croda Chemical, Denomega,

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19 arrested in Spain for olive oil fraud

Spanish police arrested 19 people in mid-February 2012 for allegedly engaging in a multi-million euro olive oil swindle, including money laundering and tax evasion.

The arrests came after a year-long investigation by an economic crime unit based in Madrid, according to the *Diario Jaén* newspaper. Details released by Spanish police and reported by the *Olive Oil Times* (OOT) suggested that the ring passed off palm, avocado, sunflower, and other cheaper oils as extra virgin olive oil. OOT said the oils were “blended in an industrial biodiesel plant and adulterated in a way to hide markers that would have revealed their true nature.”

According to both reports, most of those arrested were owners or managers of olive oil mills in various parts of the province of Jaén. Fifteen of those arrested are Spanish, OOT said, two are Ecuadorian, one is Colombian, and another Italian.

The alleged fraud, the police report said, “involved a complex network of 30 companies and ‘straw men’ from Spain, Italy, and Portugal, and an estimated 3 million euro (\$4 million) or more Spanish VAT fraud.” The police, OOT said, believe two main avenues were used to pass on the adulterated oil: bulk sales to unsuspecting third-party businesses and sales of mislabeled bottled oil.

Third soy-protein/cholesterol claim rejected

The European Food Safety Authority (EFSA) rejected a third soy-cholesterol lowering health claim in February 2012. EFSA rejected two similar claims in 2009 and 2010.

The opinion from EFSA’s Panel on Dietetic Products, Nutrition and Allergies (NDA) rejected 10 of 11 submitted meta-analyses because they “were not designed to assess the effects of ISP [isolated soy protein] but rather of isoflavones or of soy protein from different sources, including soy foods, on blood cholesterol concentrations.”

A further six randomized clinical trials (RCT) were discounted because they used whole foods. Another 19 trials were rejected because they were subject to a “high risk of bias owing to methodological limitations.” The panel concluded: “In weighing the evidence, the Panel took into account that under similar conditions four RCT reported an effect of ISP on blood LDL/non-HDL cholesterol concentrations, whereas 14 RCT did not report such an effect, and another RCT showed no consistent effects.” (LDL refers to low-density lipoprotein and HDL to high-density lipoprotein.) The panel also took into account that most of these RCT were at high risk of bias, that differences in the results obtained between trials appear unrelated to the dose of ISP used, to sample size, or to study duration, and that the evidence provided in support of a possible mechanism was not convincing.”

Health claims linking consumption of soy protein to lowered LDL-cholesterol have been approved in Japan, the United States, the United Kingdom, South Africa, the Philippines, Brazil, Indonesia, South Korea, Malaysia, and Turkey. ■

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Briefs

The Algal Biomass Organization (Minneapolis, Minnesota, USA) has initiated a new website, AllAboutAlgae.com, to showcase the potential of algae-based products to provide sustainable and scalable sources of food, energy, and fuel. The website has been developed in cooperation with the National Biodiesel Board (Jefferson City, Missouri, USA) and with support from the US Department of Energy. Users can navigate between basic and more complex aspects of algae and answer questions about what algae are and their unique characteristics as feedstock for biodiesel, aviation fuel, biochemicals, animal feed, and nutritional supplements.



Low-cost imports are threatening the biodiesel industry in the European Union (EU). Meanwhile, input costs are high, and political support for biodiesel is becoming uncertain owing to doubts about its environmental credentials. Many plants were idled in 2011, after a decade of rapid expansion, and further consolidation in the industry is anticipated in 2012. F.O. Licht analyst Claus Keller indicated that input costs are high owing to a tight global vegetable oil market (tinyurl.com/Reuters-Europe-Biodiesel). Susan Hansen, an analyst for Rabobank, cited overcapacity and cheap imports from Argentina and Indonesia as being among the key threats to the EU industry in 2012, according to Reuters.



UPM—The Biofore Co. is planning to start construction in the third quarter of 2012 of a biorefinery in Lappeenranta, Finland. It is being scaled to produce about 100,000 metric tons annually of advanced second-generation biodiesel from crude tall oil. UPM predicts the biorefinery's annual production will account for about a quarter of Finland's biofuel target.

Tall oil is a residue of chemical pulp production, mainly generated in the production of sulfate cellulose from softwood. Fatty acids and rosin can also be refined from tall oil. UPM is consider-

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Biofuels News

CREDIT: NORFOLK SOUTHERN CORP.



Major US railroad adopts renewable diesel

Dynamic Fuels, LLC (Geismar, Louisiana) and Mansfield Oil Co. (Gainesville, Georgia) signed an agreement in mid-February 2012 to supply renewable diesel to the Norfolk Southern Corp., one of the largest rail transporters of coal and industrial products in the United States. Norfolk Southern has primarily been using a 100%-pure Dynamic Fuels renewable diesel at its Meridian, Mississippi, rail yard since early January, according to the company.

Tyson Foods, Inc. (Springdale, Arkansas) and Syntroleum Corp. (Tulsa, Oklahoma) each own 50% of Dynamic Fuels, which recently signed the commercial off-take and strategic alliance agreement with Mansfield to market renewable diesel to fleet customers. Dynamic Fuels' plant in Geismar

produces renewable and synthetic fuels from animal fats and greases. About half of Dynamic Fuels' monthly production of 3 million to 4 million gallons (11–15 million liters) of renewable diesel will go Mansfield Oil under the agreements.

In a company statement, Gerhard Thelen, vice president of operations planning and support for the railroad, said, "Norfolk Southern is pleased to be the first fleet user of renewable diesel in the United States." He added, "Our locomotive engines are completely compatible with the pure renewable diesel provided by Dynamic Fuels and Mansfield" (<http://tinyurl.com/NS-RR-biodiesel>).

Norfolk Southern operates about 20,000 route miles (32,000 kilometers) in 22 states and the District of Columbia and serves every major container port in the eastern United States.

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ing construction of another biorefinery, either in Finland or France, that will use wood stumps and bark as raw material.



The Oklahoma USA House of Representatives passed Bill 2189 in mid-February 2012, making it unlawful to plant, nurture, or otherwise commercially produce castor beans in the state. Violation of the law would be a misdemeanor, incurring a fine of up to \$500. The bill has now passed to the state senate for consideration. The law arose out of concern for the spread of ricin, a toxin found in oil-rich castor beans, into fields, planting and harvesting equipment storage bins, and trucks and railroad cars used to transport grain. Nurseries can still raise castor as an ornamental flowering plant.



The first certification against the Roundtable on Sustainable Biofuels (RSB) was announced in February. The Manildra Group, headquartered in Auburn, New South Wales, Australia, received the certification. Through its subsidiary Shoalhaven Starches Pty. Ltd., the group is producing bioethanol from starchy wastewater generated by its wheat-processing facility.

The RSB Certification System (see energycenter.epfl.ch) allows farmers, feedstock processors, and biofuel producers to demonstrate that their operations comply with safeguards that protect natural or rare ecosystems and food security; respect human rights to land, water, and decent work conditions; and positively affect the management of water resources. The RSB Certification System is approved by the European Commission, as proof of compliance with the Renewable Energy Directive (2009/29/EC). ■

What's new with you?

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

Energy projects suspended

In mid-February 2012 the US Department of Energy (DOE) suspended six clean-energy projects for missing performance milestones. The six had been funded for \$10.4 million. The unspent cash, about \$3.7 million, will be returned to the US Treasury.

Among those returning money is Iowa State University (Ames, USA), which had spent about 56% of \$4.4 million to create biofuel feedstock from aquatic microalgae. Nalco Holding Co. (Naperville, Illinois) is returning about \$500,000 and United Technologies Research Center (Hartford, Connecticut) about \$404,000. Both had been working on projects to capture carbon from coal-fired power plants.

These projects have been under the purview of the DOE's Advanced Research Projects Agency-Energy (ARPA-E). Damien LaVera, a spokesman for ARPA-E, said in an email to Bloomberg (see tinyurl.com/Bloomberg-ARPA-E), "By their very nature, these aggressive research milestones will often not 'pan out' despite the best efforts of recipients."

When will aviation biofuel be competitive?

Bloomberg New Energy Finance published research to its clients in February forecasting when costs of biofuels for aviation will approach those of conventional jet fuel. The research considered four feedstocks: (i) nonfood vegetable oils, (ii) edible vegetable oils, (iii) woody materials, and (iv) algae (bnef.com/PressReleases/view/188).

If production efficiency continues to improve, the company predicts that by 2018 the cost of biofuels based on nonfood

vegetable oils such as jatropha or camelina could be close to that of conventional jet fuel (Table 1), which was about \$0.85 per liter in early 2012.

With respect to edible vegetable oils, Bloomberg predicts that biofuel made from oils such as soybean, rapeseed, and palm may never become fully competitive. As for fuels produced via the gasification of wood and the Fischer-Tropsch process, these are unlikely to be competitive as aviation fuels until well into the 2020s, according to Bloomberg. And jet fuel derived from algae will not achieve cost parity with petroleum-based fuel this decade.

If governments mandate that airlines burn a significant proportion of nonfossil fuels before 2020, they will have to subsidize these fuels, according to Bloomberg, or else introduce mandates requiring carriers to use a certain percentage of sustainable biofuels in their mix—and then deal with complaints of rapidly rising ticket prices.

Algae production at ethanol plant in Iowa

BioProcess Algae LLC and Green Plains Renewable Energy, Inc. have started construction of BioProcess Algae's 5-acre (2-hectare) production facility at Green Plains' ethanol plant in Shenandoah, Iowa, USA. The project comprises at-scale Grower Harvester™ bio-reactors and a plant to further dewater and process the algae into finished products. The horizontal reactors have been running successfully since the latter part of 2011.

The companies are planning to commercialize algae for use in animal feed, fuel, omega-3 fatty acid products, and high-value nutraceuticals.

"After a successful rollout of the horizontal reactors at full commercial scale, we are eager to move forward with this project

TABLE 1. Bloomberg predictions of aviation biofuel costs by 2018^a

Feedstock	Processing technique	Cost/liter (2012 dollars)
Non-food vegetable oils	Hydrotreatment	0.86
	Pyrolysis	0.90
Edible vegetable oils		1.20
Woody materials	Gasification + Fischer-Tropsch	2.60
Algae		Not yet viable

^aAdapted from: bnef.com/PressReleases/view/188

producing meaningful quantities of dried wholesale algae for use in products now,” said Todd Becker, president and chief executive officer of Green Plains, in a company statement. “This new phase will mark the successful transition to a larger footprint located adjacent to our Shenandoah, Iowa, ethanol plant, which will provide the basic inputs the bioreactors need: carbon dioxide, warm water, and heat.”

BioProcess Algae Grower Harvester bioreactors at the Shenandoah, Iowa, site have been continually running since their Phase I launch in October 2009.

Phosphorus proposed as limit on algae

Chris Rhodes, an independent consultant in Reading, UK, is involved in projects concerning energy and the environment, including alternative fuels. In mid-February, he discussed on his blog (ergobalance.blogspot.com) what he calls “The Achilles’ Heel of Algal Biofuels—Peak Phosphate.”

Rhodes argues that depletion of the world’s rock phosphate reserves—for use in fertilizers—will restrict the amount of food that can be grown. He contends that the situation can be compounded by the production of biofuels, including large-scale generation of biodiesel from algae. A peak in worldwide phosphorus production from rock is anticipated in the next 30 years (phosphorus-futures.net/peak-phosphorus), which could have a profound effect on how much food the world can grow for the 9 billion world population anticipated by 2050 (sciencemag.org/content/333/6042/540).

Calculations presented in this blog show that producing enough oil from algae to replace annual petroleum production would require about 2.5 times the amount of rock phosphate currently produced in a year.

This calculation does not indicate that production of algae for biofuel is infeasible, but it does point out that phosphorus will need to come from someplace other than mineral rock phosphate. Suggested alternatives include phosphorus from productive areas of the sea, recycling from manure and

other kinds of plant and animal waste, or even the residual phosphorus remaining in the algal waste left after the oil extraction process.

The key would be to create—or recreate—a cycle of nutrients (energybulletin.net/node/33164).

Ionic liquids proposed for extracting algae

Fuel production from algae is not yet economically viable because of limitations on growing the organisms and on feedstock extraction. In particular, extraction strategies require prohibitive energy inputs to break through the cell wall and separate lipids. Current methods of extraction, which depend on mechanical disruption, account for 30–50% of the overall biodiesel production cost, making such fuels six to 10 times more costly than petroleum-sourced diesel (Teixeira, R., Energy-efficient extraction of fuel and chemical feedstocks from algae, *Green Chem.* 14:419–427, 2012).

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At the same time, polysaccharide- and protein-rich “leftovers” from algal extraction are underused. Teixeira points out that focusing on development of strains of algae producing high quantities of lipids consistently has destabilized cultivars and reduced cell productivity, thus nullifying gains in lipid yield per cell.

Teixeira describes a simple reaction between undried algae and ionic liquid that may serve as an energy-efficient process for converting algal biomass into a cell-free mixture that can be separated into constituent fractions. He conducted experiments with several algae species, including *Neochloris pseudostigmata*, *Chlorella pyrenoidosa*, *Scenedesmus quadricauda*, and *Selenastrum capricornutum*, and showed they were quickly solubilized and hydrolyzed in hydrophilic ionic liquids at 100–140°C and atmospheric pressure in a one-step conversion.

Furthermore, he found that the process is species insensitive, which would enable the effective processing of mixtures of algae species along with other microorganisms, even those that are regarded as invasive. Cultivation of algae in cheap open ponds would be possible by choosing species and culture conditions optimized to the local environment and available resources.

Results from the algae experiments were modeled, resulting in an estimate of a need for process energy that is an order of magnitude lower than current extraction methods.

Sunho Biodiesel patents process for pure monoglycerides

Sunho Biodiesel Corp. (SBC) announced in Taipei, Taiwan, in February 2012 that it had developed a new enzymatic process for the production of pure monoglycerides. The product can be a mixture of different types of monoglycerides or a neat product consisting of only one type of monoglyceride (patent applied for under the Patent Cooperation Treaty).

SBC's new lipid-based technology uses enzymatic transesterification, esterification, and glycerolysis to produce up to 100% yield.

According to a company statement, current monoglyceride manufacturing often leads to low yield or to a mixture with diglycerides and triglycerides. Crude products are then purified by molecular distillation, which is expensive. Uncontrolled polymerization of unsaturated components at high reaction temperatures is a further hindrance to the process.

The company's present technologies include oil extraction, oil degumming, and transesterification. The newly developed MG Process technology can produce monoglycerides in high yield and high purity at room temperature, which also allows for the production of unsaturated monoglycerides. The process is not feedstock specific.

The company is seeking partners to set up a demonstration facility (see sunhobiodiesel.com).

Algae + waste feedstocks = fuel for \$2.28/gallon?

Algae can be made into transportation fuels for as little as \$2.28/gallon (\$0.60/liter), according to an analysis announced by OriginOil (Los Angeles, California, USA) on February 24, 2012. A blend of algae and waste feedstocks provides the starting materials for the fuels.

The company's model analyzes the entire algae production process at scale, integrating the latest advances in growth, harvesting, and fuel conversion. The lowest-cost scenario incorporates algae harvested using the company's Algae Appliance™ (a low-energy, chemical-free, continuous flow wet harvest system that efficiently dewateres, compromises cell walls, and concentrates dilute microalgae in suspension) that are then blended with waste feedstocks. The blend is converted onsite to gasoline or biodiesel.

The cost approximately doubles (to \$5.44/gallon) if pure algae serve as feedstock.

Piedmont produces enzyme-based biodiesel

Piedmont Biofuels announced in February 2012 that the company is now producing zero-waste biodiesel on a commercial scale by using enzyme catalysis. Lyle Estill, president of Piedmont (Pittsboro, North Carolina, USA), said in a company statement, “With the enzyme process, we eliminate the caustic chemicals, which allows biodiesel producers to decrease waste and increase yield, with all types of feedstocks.

Piedmont has collaborated with the enzyme producer Novozymes to develop this process and has received financial support from a US Department of Energy Small Business Innovation and Research grant. ■

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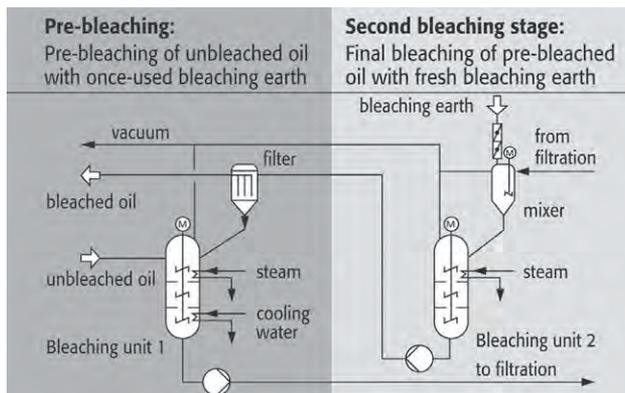


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Health & Nutrition News

A study in the *American Journal of Clinical Nutrition* (doi:10.3945/ajcn.111.023408, 2012) examined the effects of a butter naturally rich in rTFA (ruminant *trans* fatty acids) on plasma lipid concentrations in women. The study involved 72 healthy women aged 19–70 who were fed two isoenergetic diets lasting four weeks each. The diets were identical in terms of menus, calories, and macronutrient composition, with the exception of rTFA. The butter enriched with rTFA was obtained by altering the cows' diet. The absolute amount of vaccenic acid, the predominant TFA in the TFA-enriched butter, was 3.7 times that in the control butter. The study showed that an increase in the dietary intake of rTFA in healthy women corresponding to 1.2% of daily energy had no significant effect on plasma low-density lipoprotein-cholesterol concentrations but had a small high-density lipoprotein-lowering effect, particularly in overweight women. The long-term effect of these changes on the risk of cardiovascular disease risk is unknown.



Researchers at the University of Zurich have begun recruiting subjects from five countries for a study (that they say is “the largest of its kind in Europe”) to prove that three affordable interventions can significantly reduce the burden of chronic diseases in the elderly. The three interventions are supplementation with vitamin D3 and omega-3 fatty acids along with a simple exercise program. The evidence suggesting these strategies has come from epidemiological and mechanistic studies; the researchers hope this clinical trial with 2,000 healthy-at-start subjects will provide the evidence that can drive public health recommendations. The three main industry partners for the study are DSM, Nestlé, and Roche Diagnostics.



A recent study by US confectionary company Mars, Inc. and partners underscores the importance of metabolism in understanding the health benefits of cocoa flavanols. It also calls into question the reliability of *in vitro* studies using unmetabolized materials. As a result of what the researchers call “improved analytical methods,” this study demonstrated the extensive



Food fried in olive or sunflower oil is not linked to heart disease

Eating food fried in olive or sunflower oil is not associated with heart disease or premature death, according to Spanish researchers publishing in the *British Medical Journal* (doi:10.1136/bmj.e363, 2012).

The authors stress, however, that because their study took place in Spain, a Mediterranean country where olive or sunflower oil is used for frying, their results would probably not be replicable in a country where solid and recycled oils were used for frying.

The researchers, led by Pilar Guallar-Castillón of Autonomous University of Madrid, surveyed the cooking methods of 40,757 adults aged 29–69 over an 11-year period. None of the participants had heart disease when the study began. During the follow-up period there were 606 events linked to heart disease and 1,134 deaths.

Trained interviewers asked participants about their diet and cooking methods. Fried food was defined as food for which frying was the only cooking method used. Questions

were also asked about whether food was fried, battered, crumbed, or sautéed.

The authors conclude: “In a Mediterranean country where olive and sunflower oils are the most commonly used fats for frying, and where large amounts of fried foods are consumed both at and away from home, no association was observed between fried food consumption and the risk of coronary heart disease or death.”

In an accompanying editorial, Michael Leitzmann of the University of Regensburg in Germany says the study discredits the myth that “frying food is generally bad for the heart” but stresses that this “does not mean that frequent meals of fish and chips will have no health consequences.” He adds that specific aspects of frying food are relevant, such as the type of oil used.

Nutritional labeling failing?

A significant number of consumers around the world have difficulty understanding nutritional labels on food packaging, according to market research firm Nielsen Holdings NV.

A recent Nielsen study shows that 59% of consumers around the world have difficulty understanding nutritional facts on food packaging, with 52% understanding the labels “in part.” Forty-one percent of global respondents “mostly” understand nutritional labels, down from 44% in a 2008 Nielsen report. Seven percent say they do not understand nutritional labels at all.

Consumers in North America show the most confidence in understanding nutritional labels, with 57% indicating they mostly understand the information. Fifty-eight percent of US respondents report mostly understanding the information, compared with 49% of Canadians. In contrast, consumers in Asia Pacific show the lowest level of nutritional label understanding, with less than one-third (31%) mostly understanding nutritional information. Nielsen’s survey results show that food label confusion is highest in the Chinese-speaking world and other Southeast Asian markets, with greater levels of understanding in India, Australia, and New Zealand.

European consumers are split, with 45% reporting a strong understanding of nutritional labels. Sixty percent of Portuguese respondents largely understand nutritional labels, the highest reported country in the study. French consumers are the least likely to understand nutritional information, with 31% indicating full comprehension.

The Nielsen study shows that global respondents are skeptical about the accuracy and believability of health claims found on food packaging, such as “low fat” and “all natural.” Across 10 nutritional content categories studied, more than two-thirds of global respondents indicate they believe the nutritional claims are either never or only sometimes trustworthy.

Calorie count claims are the most trusted, with 33% of respondents believing calorie count claims are always accurate, and 58% finding them sometimes accurate. Vitamin and fat content are the second and third most-trusted claims, respectively.

On average, 15% of global respondents rate less-defined claims such as “freshness” and “heart-healthy” as “always accurate.” Nearly 80% of consumers surveyed indicate either never or only sometimes considering these assertions as believable.

Overall, Latin American consumers indicate the most trust in packaging health claims across the nutritional and content categories in the survey, according to an average reported number of consumers who believe the claims as always accurate. By this measure, an average

of 22% of Latin American respondents found the claims always accurate or truthful compared to a global average of 19%. Consumers from the Middle East/Africa and Asia Pacific were the second most likely to trust the labels, followed by consumers in Europe and North America.

The Nielsen Global Survey of Food Labeling Trends was conducted in March–April 2011 and in August–September 2011 and polled more than 25,000 consumers in 56 countries throughout Asia Pacific, Europe, Latin America, the Middle East, Africa, and North America. The sample has quotas based on age and sex for each country based on their Internet users and is weighted to be representative of Internet consumers, with a maximum margin of error of $\pm 0.6\%$.

The report can be accessed online (requires free registration) at tinyurl.com/LabelReport.

Diet linked to cognitive ability, brain shrinkage

If you are what you eat, does eating healthfully help protect the aging brain?

Scientists at the Oregon Health and Science University in Portland (USA) and the Linus Pauling Institute at Oregon State University answer “yes” to that question. Their study is among the first of its type, they say, to measure a wide range of blood nutrient levels instead of basing findings on less precise data from food questionnaires.

In brief, their research found that elderly people with higher serum levels of several vitamins and omega-3 fatty acids had better performance on mental acuity tests and less of the brain shrinkage typical of Alzheimer’s disease—whereas “junk food” diets produced the opposite result.

“This approach clearly shows the biological and neurological activity that’s associated with actual nutrient levels, both good and bad,” said AOCs member Maret Traber, a principal investigator with the Linus Pauling Institute and co-author on the study.

“The vitamins and nutrients you get from eating a wide range of fruits, vegetables, and fish can be measured in blood biomarkers,” Traber said. “I’m a firm believer these nutrients have strong potential to protect your brain and make it work better.”

The study was done with 104 people, at an average age of 87, with no special risk factors for memory or mental acuity. It tested 30 different nutrient biomarkers in their

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metabolism of (–)-epicatechin following consumption of a flavanol-containing cocoa drink. As *in vitro* studies using unmetabolized cocoa flavanols do not consider this metabolism, they are not able to reflect accurately what is happening in the body, the researchers say. For example, early findings looking at flavanols in a test tube suggested that they exerted their benefits through an antioxidant mechanism. However, this latest research adds to a growing body of evidence challenging this notion and indicating that—when examined in the body—flavanols’ cardiovascular benefits are in fact independent of any antioxidant properties. The work appears in *Free Radical Biology and Medicine* and is available free of charge at tinyurl.com/flavanol.



Achieving an appropriate level of docosahexaenoic acid (DHA) in the neonatal brain is an important goal of neonatal nutrition. A team of French investigators evaluated how α -linolenic acid (ALA) provided by different dietary fat matrices improved DHA content in the brains of both young male and female rats. Young rats born from dams fed during gestation and lactation with a low ALA diet (0.4% of fatty acids) were subjected for six weeks after weaning to an anhydrous dairy fat blend-based diet that provided 1.5% ALA or to a palm oil blend-based diet that provided the same ALA level: either 1.5% ALA alone or 1.5% ALA plus 0.12% DHA with 0.4% arachidonic acid (ARA). With each diet, the n-6/n-3 ratio was similar to values generally recommended for infant formula. Fatty acid analysis in the whole brain showed that the 1.5% ALA dairy fat blend was superior to both 1.5% ALA palm-oil blends, supplemented or not with dietary DHA, for increasing brain DHA. Females compared to males had significantly higher brain DHA with the 1.5% ALA palm-blend diet, but the dietary supplementation with DHA smoothed the differences via an increase of the males’ brain DHA. The team concluded that a dairy fat blend enriched with ALA appears to be an interesting strategy for achieving optimal DHA levels in the brain of post-weaning rats. Inclusion of dairy fat in infant formulas should be reconsidered, they say. The work appeared in *Oléagineux, Corps Gras, Lipides* (doi:10.1684/ocl.2011.0420, 2012) and was led by Bernadette Delplanque of the Université Paris-Sud. ■

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*As of February 16, 2012. For the most up-to-date list, go to www.aocs.org/2012expo.

blood, and 42 participants had MRI scans to measure their brain volume.

“These findings are based on average people eating average [Western] diets,” Traber said. “If anyone right now is considering a . . . resolution to improve their diet, this would certainly give them another reason to eat more fruits and vegetables.”

Among the findings and observations:

- The most favorable cognitive outcomes and brain-size measurements were associated with two dietary patterns—high levels of marine fatty acids and high levels of vitamins B, C, D, and E.

- Consistently worse cognitive performance was associated with a higher intake of the type of *trans*-fats found in baked and fried foods, margarine, fast food, and other less-healthy dietary choices.

- The range of demographic and lifestyle habits examined included age, gender, education, smoking, drinking, blood pressure, and body mass index.

- The use of blood analysis helped to eliminate issues such as people’s flawed recollection of what they ate, and personal variability in nutrients absorbed.

- Much of the variation in mental performance depended on factors such as age or education, but nutrient status accounted for 17% of thinking and memory scores and 37% of the variation in brain size.

- Cognitive changes related to different diets may be due to impacts on both brain size and cardiovascular function.

The epidemiology of Alzheimer’s disease has suggested a role for nutrition, the researchers note in their study, but previous research using conventional analysis, and looking in isolation at single nutrients or small groups, has been disappointing. The study of 30 different blood nutrient levels done in this research reflects a wider range of nutrients and adds specificity to the findings.

The study needs to be confirmed with further research and testing of other variables, the scientists said. Their work was supported by the National Institutes of Health and appeared in *Neurology* (78:241–249, 2012). The full article is available free of charge at tinyurl.com/NeurologyAging.

Lorenzo’s Oil may soon be unavailable in the United States

The preventive protocol known as Lorenzo’s Oil (for the real-life Lorenzo Odone, whose story was told in the 1992 movie of that name starring Nick Nolte and Susan Sarandon) may soon be unavailable in the United States—a victim of funding cuts. The oil is a mix of oleic and erucic acids that was invented by Lorenzo’s parents with help from several AOCS members. Its administration, in conjunction with a low-fat diet, can prevent the onset of symptoms for most boys diagnosed with X-linked adrenoleukodystrophy (X-ALD). The genetic mutation that causes the disorder results in a breakdown of the neurological system leading to an accumulation of very long-chain fatty acids that damage the myelin sheath covering nerve cells. Untreated, the disease can result in gradual brain damage and early death.

More than 70 boys nationwide receive Lorenzo’s oil through the Kennedy-Krieger Institute in Baltimore, Maryland; the US Food and Drug Administration will only allow the oil to be dispensed as part of a study. The Institute is losing its funding and the one continuing study likely will be shut down. For more on this story, see *inform* 14:38–39, 2003, and tinyurl.com/LorenzoOil. ■

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Biotechnology News

France still seeks to suspend authorization to plant Monsanto's genetically modified (GM) MON810 corn despite losing court rulings allowing its cultivation. In 2008 France banned MON810, the only GM crop approved for planting in the European Union, citing environmental risks. In September 2011, the European Court of Justice ruled against a ban on MON810, and the highest court in France also ruled against a ban. On February 20, 2012, the environment ministry of France asked the European Union executive to ban the GM crop based on "significant risks for the environment" shown in recent scientific studies.



According to *The Guardian* newspaper, UK Secretary of State for Environment, Food and Rural Affairs Caroline Spelman said drought may be the new reality for Britain. Large parts of south and southeast England are officially in drought. "Drastic measures" including cultivation of genetically modified crops may be part of the solution. In a speech to the National Union of Farmers on February 21, she asked, "What if this is what climate change means?" Spelman pointed out an Australian project to develop drought-resistant GM rice and emphasized that this technology should be considered for crops grown in the UK (tinyurl.com/Guardian-UKdrought).

Peter Kendall, president of the National Union of Farmers, said it was "desperately worrying" that GM crops were not being developed in Europe at the same rate as in the United States, China, and elsewhere.



Under forthcoming US Department of Agriculture rule changes, seed companies will get speedier regulatory reviews of their genetically modified crops. The goal is to reduce the current average time to approval of three years by half. Changes were to be published in the *Federal Register* in March. One of the changes will invite submission of public comments as soon as seed developers file a complete petition for deregulation of a biotech crop, rather than waiting until the end of the review.

CONTINUED ON NEXT PAGE



Rice RNA found in blood and organs of people

Researchers from Nanjing University (China) and associated institutions have reported finding microRNA from rice in the sera and various tissues of laboratory mice and people. Furthermore, they suggested this microRNA could decrease the removal of LDL (low-density lipoprotein) from mouse plasma (Zhang, L., *et al.*, Exogenous plant MIR168a specifically targets mammalian LDLRAP1: evidence of cross-kingdom regulation by microRNA, *Cell Res.* 22:107–126, 2012). The source of this microRNA, says the report, is food intake, specifically the rice consumed by the people who served as subjects for the study.

MIR168a, one of the two plant microRNAs with the highest levels in the Chinese subjects in this study, is abundant in rice. Zhang and co-workers found through functional studies *in vitro* and *in vivo* that "MIR168a could bind to the human/mouse low-density lipoprotein receptor adapter protein 1 (LDLRAP1) mRNA, inhibit LDLRAP1 expression in liver, and consequently decrease LDL removal from mouse plasma." In addition, "exogenous plant microRNAs in food can regulate the expression of target genes in mammals."

As pointed out by web blogger Chris Hinyub (tinyurl.com/rice-Hinyub), Zhang and co-workers did not address whether assimilation of plant RNA into human systems from genetically modified (GM) crops could have negative implications. If so, this characteristic might need to be taken into consideration going forward.

Consumer groups petition FDA to ban GE salmon

Consumer groups Consumers Union, Food & Water Watch, and the Center for Food Safety petitioned the US Food and Drug Administration (FDA) on February 7, 2012, to classify AquaAdvantage genetically engineered (GE) salmon (produced by AquaBounty of Waltham, Massachusetts, USA; see *inform* 22:506, 2011) and all its components as a food additive. The groups contend that the present proposal to treat GE salmon as a new animal drug is insufficient to protect public health; instead, the fish should be reviewed under a more rigorous category of "novel substance added to food."

Food & Water Watch Executive Director Wenonah Hauter stated, "AquaBounty's own study showed that GE salmon may contain

increased levels of IGF-1 [insulin-like growth factor-1], a hormone that helps accelerate the growth of the transgenic fish and is linked to . . . cancer" (tinyurl.com/salmon-AquaBounty).

To create the transgenic fish, AquaBounty genetically engineered an Atlantic salmon (*Salmo salar*) by inserting a Chinook salmon (*Onchorhynchus tshawytscha*) growth-hormone gene, as well as a gene sequence from an ocean pout (*Zoarces americanus*). The resultant animal has a higher growth rate than the unaltered fish and reaches market size in half the normal time.

GM crops affect markets in the Indian subcontinent

A February 2012 article in India's *The Economic Times* by Nidhi Nath Srinivas reviews the effects that introduction of genetically modified (GM) crops in the Indian subcontinent are having or will shortly have on agriculture and markets there (tinyurl.com/GM-crops-India).

Following the introduction of *Bt* brinjal [eggplant genetically modified to contain insect-fighting genes from *Bacillus thuringiensis*] in Bangladesh within the next year or so, farmers in the east Indian states of West Bengal and Bihar will see this economically important crop thriving—while Indian farmers fight to keep their plants healthy and productive by using more than a dozen

pesticide sprays. And Bangladeshi farmers will earn greater profits from their *Bt* brinjal. Srinivas points out: "What are the chances that some *Bt* brinjal seed will not be 'borrowed' and sown in India? Nil. Such 'borrowing' is commonplace in farming. Farmers routinely exchange seeds with each other." Sharing of such seeds can have measurable impacts on markets and local agriculture.

As another example, Super basmati rice has been grown in Pakistan near the northwestern Indian state of Punjab for several years now. Farmers in India liked the variety so much that they started planting it too, even though it was not a government-authorized variety. The Indian government found it could not persuade the farmers to relinquish Super basmati, so they changed the rules: Super basmati can be legally exported from India as basmati, but the Ministry of Agriculture does not recognize it as a basmati within the country.

Bt cotton is another case. Although it became available in India in 2002, initially no varieties were approved for use in the northern states. Farmers in Punjab planted the GM cotton anyway, and by 2005 the Indian government had released 60 varieties just for Punjab. So many Pakistani farmers eyed the cotton produced by their Indian counterparts and adopted the seed that the Pakistani government was forced to officially approve it in 2010.

The Economic Times predicts that Indian agriculture can only benefit from serious consideration of the adoption of biotech corn, rice, brinjal, and sugarcane. ■

Annabel Soutar's play *Seeds* opened for a short run in February 2012 in Toronto, Canada, at the Young Centre's Michael Young Theater. Eric Peterson stars as Percy Schmeiser, the Saskatchewan farmer who took on Monsanto in the 1990s after the company accused him of illegally growing its genetically modified canola. During his four-year court battle, Schmeiser became an international spokesman for farmers' rights and a little-guy hero to opponents of genetic engineering.

Soutar began following the case in 2003 after reading about it in a newspaper. She drove from her home in Montreal to Ottawa to sit in the courtroom and listen to the testimony. After the case concluded, she conducted interviews with Schmeiser, his lawyers, scientists, academics, and advocacy groups.

As well as dealing with the factual material established in the court records, *Seeds* "spins out into larger questions about scientific theory, the role of the corporate Goliath in society, and even what constitutes life," according to the review in *The Globe and Mail* (tinyurl.com/GlobeandMail-Seeds). The review concludes, "[Soutar's] play gives us plenty to think about, but leaves us to make up our own minds."

The play closed in March after its scheduled three-week run. A French version will be presented in Montreal in the third quarter of 2012. ■



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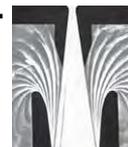
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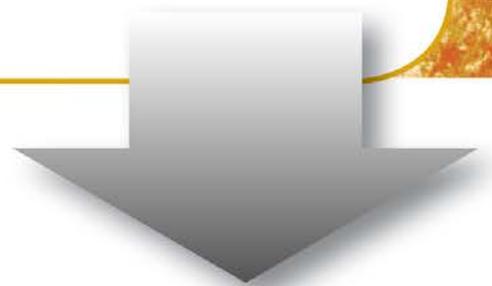
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Briefs

Several years ago, antibacterial mouthwash was found to inhibit certain bacteria on the tongue. Normally, bacteria in the mouth convert nitrate obtained from green leafy vegetables into nitrite. When the nitrite is swallowed, it is converted into nitric oxide in the stomach; nitric oxide is an important cellular signalling molecule and vasodilator.

In a study led by Catherine Bon-donno and colleagues at the University of Western Australia (Perth) and Shaanxi Normal University (Xi'an, China), the team examined the effects of increasing nitrate intake. They found that increasing nitrate intake resulted in a dose-related increase in nitric oxide status and nitrate reduction in the mouth. This increase was not inhibited by antibacterial toothpaste. Their study appeared in *Food & Function* (doi:10.1039/c2fo10206d, 2012).



A team of researchers at the Institute for Chemical and Bioengineering in Zurich, Switzerland, took inspiration from Camembert cheese in developing a self-cleaning fabric. The scientists created a living fabric composed of a bottom layer of impermeable polymer and a nanoporous surface film surrounding a layer of agar inoculated with the mold *Penicillium roqueforti*. The cleaning action is not fast, however: It took 11 days for the mold to consume a glucose "stain." Their work appeared in the *Proceedings of the National Academy of Sciences* (doi:10.1073/pnas.1115381109, 2012). Visit tinyurl.com/PNASCloth for the abstract.



Dow Corning (Midland, Michigan, USA) has introduced HY-3200 Emulsifying Soy Wax, which the company says "emulsifies and thickens at low-use levels, supports consumer beauty trends for anti-aging and sustainable products, and reduces the number of ingredients required, which presents a potential cost advantage."

At lower use levels in formulations, Dow Corning said the soy wax can form a stable emulsion across a broad range of oils. To produce the wax, soybean oil

Surfactants, Detergents & Personal Care News



No groundwater contamination from fracking?

Hydraulic fracturing (fracking) of shale formations to extract natural gas is a process much maligned by environmental groups. The process uses surfactants to reduce surface tension and aid in fluid recovery and hydrocolloids (primarily guar gum and derivatives) as gelling agents to minimize formation damage.

At the top of the list of presumed ill effects from fracking is groundwater contamination. Now, a draft report from the Energy Institute at The University of Texas at Austin (USA) shows no evidence of groundwater contamination from fracking.

The draft study results were released at the annual meeting of the American Association for the Advancement of Science in Vancouver, British Columbia, Canada, in February 2012. The researchers, led by Charles Groat, found that many incidences of contamination could be traced to above-ground spills or other mishandling of wastewater from fracking.

Critics pointed to a lack of citations in the report and its draft status, and questioned the impartiality of the researchers. (One comment at epaonline.com summed up the latter: "A study [from] Hershey, Pennsylvania, just annou[n]ced that chocolate isn't fattening.") The report also runs counter to a draft report released in December 2011 from the US Environmental Protection Agency (EPA), which said its examination of a hydraulic fracturing site in Pavillion,

Wyoming, found hydraulic fracturing fluids and chemicals associated with natural gas production in deep water wells. (See tinyurl.com/PavillionReport.)

An Energy Institute spokesperson noted that the Environmental Defense Fund helped to develop the scope of work and methodology for the study. He also said that the study will be submitted for peer review.

For its part, the EPA released its final plan for a multiyear study of hydraulic fracturing at the end of 2011. The study will focus on five key areas and questions covering the full life cycle of the fracking process: (i) water acquisition—"what are the potential impacts of large volume water withdrawals from ground and surface waters on drinking water resources?"; (ii) chemical mixing—"what are the possible impacts of surface spills on or near well pads of hydraulic fracturing fluids on drinking water resources?"; (iii) well injection—"what are the possible impacts of the injection and fracturing process on drinking water resources?"; (iv) flowback and produced water—"what are the possible impacts of surface spills on or near well pads of flowback and produced water on drinking water resources?"; and (v) wastewater treatment and disposal—"what are the possible impacts of inadequate treatment of hydraulic fracturing wastewaters on drinking water resources?"

See tinyurl.com/EPAFracking for more information.

World's first magnetic soap

Scientists from UK's Bristol University have developed a soap composed of iron-rich salts dissolved in water that responds to a magnetic field when placed in solution.

The soap's magnetic properties apparently result from tiny iron-rich clumps that sit within the watery solution. The generation of this magnetic property in a fully functional soap could calm concerns over the use of soaps in oil-spill cleanups and revolutionize industrial cleaning products, the researchers suggest.

Scientists have long been searching for a way to increase the ability of surfactants to dissolve oils in water and then remove them from a system. The team at Bristol University has previously worked on soaps sensitive to light, carbon dioxide, or changes in pH, temperature, or pressure.

Ionic liquid surfactants, composed mostly of water with some transition metal complexes (heavy metals such as iron bound to halides such as bromine or chlorine), have been suggested as potentially controllable by magnets for some time, but it had always been assumed that their metallic centers were too isolated within the solution, preventing the long-range interactions required to be magnetically active.

The team at Bristol, led by Julian Eastoe, produced their magnetic soap by dissolving iron in a range of inert surfactant materials composed of chloride and bromide ions, very similar to those found in everyday mouthwash or fabric conditioner. The addition of the iron creates metallic centers within the soap particles.

To test its properties, the team introduced a magnet to a test tube containing their new soap lying beneath a less-dense organic solution. When the magnet was introduced, the iron-rich soap overcame both gravity and surface tension between the water and oil to levitate through the organic solvent and reach the source of the magnetic energy, proving its magnetic properties.

Once the surfactant was developed and shown to be magnetic, Eastoe's team took it to the Institut Laue-Langevin (ILL) in Grenoble, France. Scientists at ILL used small-angle neutron scattering to confirm that the surfactant's magnetic properties were caused by the micelles formed by the iron-rich surfactant.

The potential applications of magnetic surfactants are vast. Their responsiveness to external stimuli allows a range of properties—such as their electrical conductivity, melting point, the size and shape of aggregates, and how readily they dissolve in water—to be altered by a simple magnetic on-and-off switch. Traditionally, these factors—which are key to the effective application of soaps in a variety of industrial settings—could only be controlled by adding an electric charge or changing the pH, temperature, or pressure of the system—all changes that irreversibly alter the system's composition and cost money to remediate.

The surfactant's magnetic properties also make it easier to round it up and remove it from a system once it has been added, suggesting further applications in environmental cleanups and water treatment. Scientific experiments that require precise control of liquid droplets could also be made easier by

is metathesized, hydrogenated, and then modified by the addition of polar groups. The result is an emulsifying wax with thickening benefits in combination with a wide range of cosmetic oils that can create emulsions that are pH- and electrolyte-tolerant, the company said.

■ ■ ■

Clorox has introduced a smartphone application (app) so consumers can look up the ingredients of the company's household and commercial products. The introduction extends the company's Ingredients Inside effort, which began in February 2010 when Clorox published ingredients lists online for hundreds of its products. With the app installed, customers can scan a UPC code to get information about a product's ingredients. The app currently is available to iPhone users; it will be made available for other mobile devices soon, Clorox said.

■ ■ ■

Global demand for household cleaning agents will exceed \$83 billion (€62 billion) by 2015, according to *The Household Cleaners: A Global Outlook*, a report by Global Industry Analysts. The report identifies demand from consumers in Asia-Pacific countries as an important factor in the expected growth. Social factors such as concern over the spread of infectious diseases and food hygiene will also play a central role in driving demand, according to a company statement.

■ ■ ■

Air Products & Chemicals has acquired Rovi Cosmetics International, according to *Chemical & Engineering News* magazine. Rovi is a German manufacturer of cosmetic active ingredients and delivery systems for the European market. The acquisition will add "critical mass" to Air Products' personal care business, the company said. ■

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the addition of this surfactant and a magnetic field.

Peter Dowding, an industrial chemist not involved in the research, said: "Any systems [that] act only when responding to an outside stimulus that has no effect on its composition [are] a major breakthrough as you can create products [that] only work when they are needed to. Also, the ability to remove the surfactant after it has been added widens the potential applications to environmentally sensitive areas [such as] oil spill cleanups where in the past concerns have been raised."

The work appeared in *Angewandte Chemie* (doi:10.1002/anie.201108010, 2012).

New product-use sampling method developed

US and Korean scientists have developed a passive method of determining what

household and personal care products people have in their homes and quantifying the amount used over a one-week period.

In the past, such information has been collected through questionnaires, which takes time, is difficult for participants, and is prone to recall bias. As part of the SUPERB Project (Study of Use of Products and Exposure-Related Behaviors) at the University of California, Davis (UC-Davis), the researchers developed a novel platform using bar codes to inventory in-home products and usage.

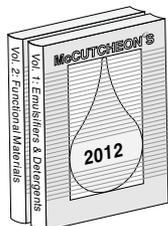
The proof-of-concept research was a longitudinal field study that included 47 California households, 30 with young children and 17 with an older adult. "Acceptability was defined by refusal rates; feasibility was evaluated in terms of readable bar codes, useful product information in our database for all readable barcodes, and ability to find containers at both the start and end of the week," the authors write.

The team found that 63% of personal care products and 87% of the household care products had readable barcodes, with

47% of personal care products and 41% of household care products having sufficient data for product identification. Further, the amount used could be determined "most of the time."

In conclusion, "our method appears to be appropriate, acceptable, and useful for gathering information related to potential exposures stemming from the use of personal and household care products," they write. "A very low drop-out rate suggests that this methodology can be useful in longitudinal studies of exposure to household and personal care products."

Their work appears in the *Journal of Exposure Science and Environmental Epidemiology* (22:148–160, 2012). Deborah H. Bennetta of the UC-Davis Department of Public Health Sciences led the team, which included researchers at the Seoul National University (Department of Environmental Health, Graduate School of Public Health), Seoul, South Korea.



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China releases draft proposal on licensing cosmetics

The comment period on China's recent organization of "special use cosmetics" into eight different categories by the State Food and Drug Administration (SFDA) closed on January 12, 2012. Further information about when the proposal will be made final had not yet been posted as *inform* went to press (see tinyurl.com/SDACosmetics).

Previously, a manufacturer or importer of cosmetics in China could apply for a record-keeping certificate from SFDA for an ordinary cosmetic or a hygienic license for a special-use cosmetic. In late December 2011, the SFDA published eight draft categories for hygienic licenses including: liquid, half-solid, solid, cream or lotion, aerosol, organic solvent, ceryl-based, and "other."

According to *Cosmetics & Toiletries (C&T)* magazine, ordinary cosmetics have been defined as hair care, nail care, skin care, perfumes, and makeup. Special-use cosmetic categories have been defined as hair growth, hair dye, hair permanent, hair removal, breast-shaping, fitness, deodorizing, spot removal, and sunscreen.

The eight new categories, *C&T* says, are based on the production process and product type. "Liquid cosmetics are any liquid cosmetic other than creams, whereas half-solid cosmetics are gel products other than creams. Solid cosmetics are solid products other than creamy powder. Cream or lotion cosmetics are those made by emulsification. Aerosol cosmetics are self-explanatory.... Organic solvent cosmetics are liquid products that contain a large amount of volatile organic solvents (perfume, nail polish, and the like). Ceryl-based cosmetics use waxes as basic ingredients."

Foreign companies must appoint a Chinese responsible agent to deal with registration and obtain the necessary license or certificate, *C&T* notes. All formulae must meet the Hygienic Standard for Cosmetics published by the Ministry of Health in 2007. "This standard banned more than 1,200 chemicals in cosmetics and restricted the use of 73 chemicals, 56 preservatives, 156 colorants, 28 sunscreen agents, and 93 dyes in cosmetics," the *C&T* report says. "A new ingredient that is not currently listed on the Inventory of Existing Cosmetic Ingredients in China (IECIC) also requires registration with SFDA. In addition, new cosmetic ingredients might be subject to the requirements of new chemical notification in China." ■

US SUNFLOWER INDUSTRY (CONTINUED FROM PAGE 218)

of foreign genes. Eight seed companies, the United States Department of Agriculture—Agricultural Research Service, and a private genetic diagnostics laboratory have joined forces to use marker technology as efficiently as possible. Good progress has been made in a very short time with the mapping of a rust gene known to provide resistance to all known races of rust. Other defensive traits are on the drawing table for gene mapping, which will provide a great deal of efficiency in individual breeding programs. The ultimate goal of the SNP Consortium is to provide the latest technology at reasonable costs through volume use to enhance yields at the farm level. Experts believe that the gene-rich sunflower genome is a goldmine for future genetic enhancements.

The US sunflower industry has had its share of lemons. Making lemonade has been a full-time job for industry leaders in the past and will likely occupy a significant

portion of their time in the future. Concerns revolve around farm policy and the timely availability of crop protection products. Farm policy is always a worry for commodity leaders, who want to ensure that Washington policy does not favor one crop over another. Getting new crop protection labels is of special urgency to crops of only several million acres, compared to the three "big" of corn, soybean, and wheat, which each range in US acreage from 50 million to nearly 100 million acres (20–50 million hectares). But the die is cast. The US sunflower industry has become quite efficient at making lemonade.

Larry Kleingartner recently retired from the National Sunflower Association (NSA) after 33 years at the helm of that organization. He continues to work on special projects with the NSA. He can be reached at larry.kleingartner@me.com.



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People News/Inside AOCS



Rodney Mailer receiving award as an International Fellow of the Royal Swedish Academy of Agriculture and Forestry from Sara von Arnold, president of the Academy.

Mailer recognized for work on canola

The Royal Swedish Agricultural Society awarded **Rodney Mailer**, research fellow with Australian Oils Research, Wagga Wagga, as one of five International Fellows of the KSLA (Kungl. Skogs- och Lantbruksakademien, or the Royal Swedish Academy of Agriculture and Forestry) in 2012. The award was presented to him by the president of the KSLA in the presence of the King of Sweden Carl XVI Gustaf in a ceremony in Stockholm on January 28.

He was recognized for his work relating to canola research and breeding programs in Australia and internationally over the last 30 years. The citation also pointed to his role with the International Society of Fat Research (ISF) and the ISF conference that Australia hosted—and that Mailer chaired—in Sydney in September 2009.

The presentation of the award occurred in conjunction with a dinner for academy members and guests. The main course was “grilled moose steak, served with a light jus with a note of truffle and a rich terrine of root vegetables.” Afterward, Mailer and his wife—along with 20 others—had coffee with King Carl Gustaf. In the audience during the

presentation was **Lawrence Johnson**, past president of AOCS. Johnson has been a KSLA International Fellow since 1999. He and Mailer presented talks on their research at three different venues in Sweden over several days following the ceremony. Mailer’s talks were on oilseeds in Australia and on the Australian biodiesel industry. Johnson lectured on the bioeconomy.

Mailer continues as the Australian representative on the ISF committee and conducts research on canola through the New South Wales Department of Primary Industries.

Ghosh joins University of Saskatchewan

Supratim Ghosh joined the Food and Bioproduct Sciences Department of the University of Saskatchewan, Saskatoon, Canada, as an assistant professor in November 2011. He is conducting research in the areas of lipids, emulsions, and food nanotechnology.

Ghosh earned a Ph.D. in Food Science from Pennsylvania State University (State College, USA) and carried out a post-doctoral appointment under D errick Rousseau at Ryerson University, Toronto, Canada, before moving to Saskatchewan.

He served on the AOCS Membership Development Committee in 2009–2010.

Promotions at the American Cleaning Institute (ACI)

In February, the American Cleaning Institute announced the following promotions:

■ **Richard Sedlak** became executive vice president for technical and international affairs. He has been with the ACI (formerly, the Soaps and Detergents Association) since 1977.

■ **Nancy Bock** became senior vice president for meetings and education. She has been with the ACI since 2001.

■ **Helen Benz** is now chief financial officer. She started with ACI in 2006.

New officers elected by NOPA

The National Oilseed Processors Association (NOPA) elected new officers at its 2012 Annual Meeting, held February 12–16 in Palm Beach, Florida, USA:

■ **Mark Stonacek**, chairman; he is president and business unit leader, grain and oilseeds supply chain North America, of Cargill, Inc. (Minnetonka, Minnesota, USA).

■ **Chris Nikkel**, chairman-elect; he is vice president of risk management—oilseeds for Bunge North America, Inc., St. Louis, Missouri, USA.

■ **John Campbell**, secretary-treasurer; he is senior vice president for renewable fuels and government relations, Ag Processing Inc., Omaha, Nebraska, USA and Mankato, Minnesota.

■ **Tom Malecha**, immediate past chairman; he is vice president for food and food ingredients, CHS Inc., Mankato, Minnesota.

Becherer named leader

John Becherer, chief executive officer of the United Soybean Board and the national soy checkoff, was named 2012 Agribusiness Leader of the Year by the National Agri-Marketing Association. The award will be presented at the opening general session of the 2012 Agri-Marketing Conference to be held in Kansas City, Missouri, on April 19. ■

IN MEMORIAM

Graham Barker

Emulsions and cosmetics chemist Graham Barker died on October 6, 2011, in Fair Lawn, New Jersey, USA. He was 90 years old.

Barker was well known in the field of cosmetics chemistry and was a member of both AOCS and the Society of Cosmetic Chemists (SCC). He served as president (1981), director, and chairman of the board of the SCC.

He spent most of his career with Witco Chemical Corp., serving in such roles as manager of the special products division. His name appears as inventor on a dozen US patents as well as international patents. These patents involved emulsions, synthetic detergents, waterproof makeup, fabric conditioners, and shampoos.

Barker shared his knowledge through teaching short courses and, more formally, through teaching occasional college courses; through writing for trade publications; and through contributing expert chapters (e.g., *Surfactants in Cosmetics*, 1st edn., CRC Press, 1987). Ken Klein, a chemist working in some of the same areas as Barker, said, "He taught that unless you really understood the chemistry of the materials, you could never be a good cosmetic chemist" (tinyurl.com/Barker-obit).

He received his B.S. in chemistry from the City College of New York in 1942. For the next four years, he was in the US Army, serving in the Pacific theater of operations during World War II. He later received his master's degree in chemistry from Brooklyn College in 1954.

After a long career in the cosmetics industry, Barker established himself as a consultant through his own company, Granum, Inc., in Fair Lawn, New Jersey.

Barker is survived by his wife Muriel, a daughter and a son, and four grandchildren.

Stanley Bader

Stanley Earle Bader died February 13, 2012, in Winnipeg, Manitoba, Canada, at the age of 86. He was an emeritus member of AOCS, having joined in November 1962.

Bader had a lifelong association with Winnipeg, where he was born, attended school, and graduated with a B.Sc. in chemistry from the University of Manitoba in 1946.

His first job out of undergraduate school was as an oil chemist in the Edible Oils Division of Canada Packers Ltd. He stayed on until he retired in 1988. After retirement, he stayed active by doing consulting in his field. He and his wife continued to faithfully attend AOCS annual meetings for many years after he retired.

Bader's first wife Collette predeceased him in 1982. He is survived by his second wife, Irene, six children, eight grandchildren, and his sister.

Frank Holden

Born January 28, 1932, Frank Franzell Holden died in Carlsbad, California, USA, at the age of 79 on September 19, 2011. He joined AOCS in 1997.

Holden grew up in the state of Pennsylvania and earned his bachelor's degree in chemical engineering from Bucknell University (Lewisburg, Pennsylvania, USA) in 1954. He went on to receive his master's degree from Rutgers University (New Brunswick, New Jersey, USA) in 1959.

At the time he joined AOCS, Holden was vice president of Gillco East, Inc., Rumson, New Jersey, USA. The company, later known as Animal Essentials, Inc., was located in Carlsbad, California, USA. It manufactures and distributes holistic supplements for pets.

AOCS Corporate Member profile

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1885 by Joseph Lovibond, a prominent brewery owner who developed the colorimeter as a means of ensuring the quality of his beer. By 1893, he had perfected his research and introduced the first commercial instruments.

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ranging from chemical, petrochemical, pharmaceutical, and medical, to those producing everyday foodstuffs and beverages.

As a committed member of AOCS, Lovibond Tintometer takes an active part in the definition and development of color standards. The company's knowledge of color science ensures its products are capable of reading multiple scales including, but not limited to, those from AOCS, ASTM, CIE, and ISO. A full list of supported scales, color values, and spectral data and their reference platforms can be viewed at lovibondcolour.com.

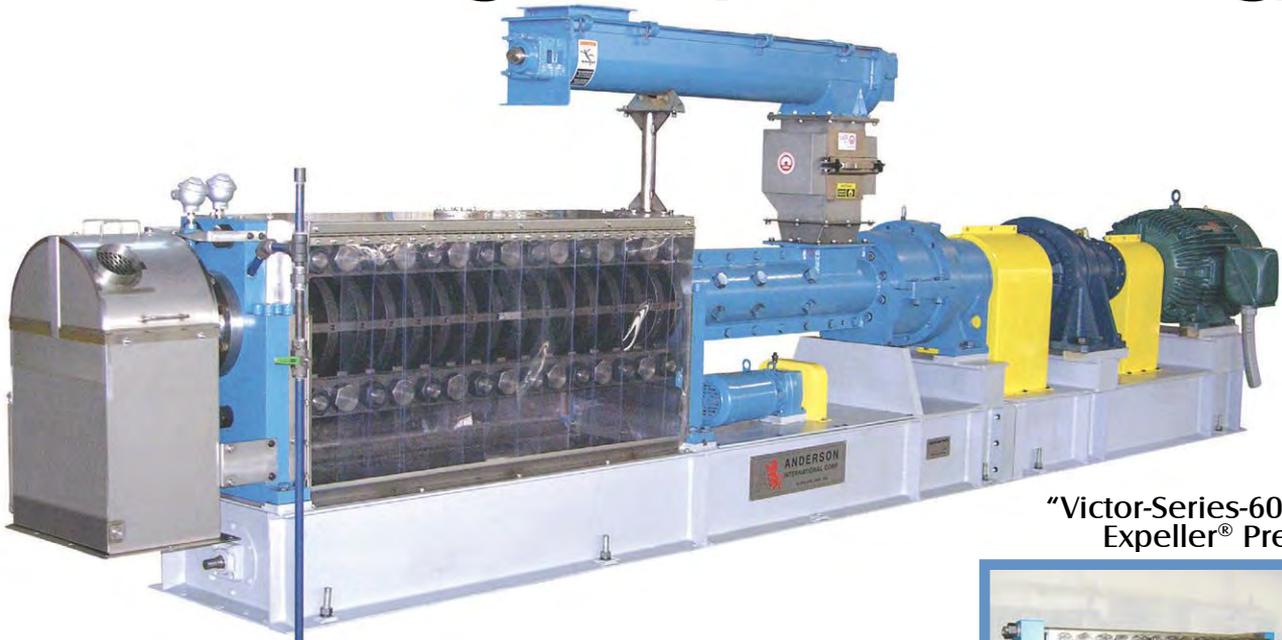
*As a benefit of corporate membership in AOCS, companies are entitled to provide a 250-word profile for inclusion on a space-available basis in *inform* magazine. For more information, contact Nicole Philyaw at nicolep@aocs.org.*

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Book Review

Oxidation in Foods and Beverages and Antioxidant Applications, Vol. 2:

Management in Different Industry Sectors

E.A. Decker, R.J. Elias, and D.J. McClements (eds.),
Woodhead Publishing Ltd., 2010,
528 pages, \$255, ISBN 978-1-84569-983-3

William E. Artz

This second of two excellent volumes focuses on the application side. The first volume is theoretical and mechanistic in its subject matter and approach (see *inform* 22:95, 2011). As with Vol. 1, the editors have selected an excellent international group of authors, primarily from Europe.

The first volume is in two parts: (i) oxidation in foods and beverages and (ii) antioxidants (AO) in foods and beverages. This second book focuses in three parts on specific commodities and industrial product groups. The first part is on animal products and covers meat, poultry/eggs, dairy, and fish. The second section covers plant products, including edible oils, nuts, confectionery products, cereals, fruit, vegetables, beer, and wine, plus a couple of chapters on specific products and processes—emulsions and frying. The third part on AO delivery has two chapters, covering encapsulation and packaging. The text is a well-written and informative resource for those interested in food lipid oxidation, particularly those interested in how AO can best be applied to prevent or reduce oxidation in specific products and product situations.

At the end of each chapter, a relatively unusual resource has been provided—sources of additional information, including university faculty; particularly noteworthy books and review articles; online resources; commercial labs and consultants; testing and processing equipment manufacturers; plus various organizations with special expertise and interests regarding the topics covered.

The first chapter, on red meats, covers oxidation and substrate components, pro-oxidants, animal diet, processing, and various aspects of meat protein oxidation. AO, endogenous and added, are presented. Some of the specialized processing aspects discussed include the effects of added nitrates, CO, and high-pressure and irradiation processing. This chapter, as are most chapters, is well referenced (~270 references). A typical chapter has 100 to 150 references, although a couple (Chapter 10 on confectionery products and the last two on AO delivery) have ~50 references, which are sufficient for the topics covered in those three chapters.

Chapter 2 overlaps slightly with the first, since it covers poultry (meat) and eggs, but it is a good addition to the text. In addition to color, texture, as affected by oxidation, is discussed. Options to reduce oxidation (AO added during processing, via the animal diet, smoking, nitrates/nitrites, and packaging options [modified atmosphere]) are considered.

There are two chapters (3 and 5) on fish oils and fish-based products. These are challenging products, since they contain pro-oxidants, similar to red meats, with an array of moderately to highly unsaturated fatty acids. Oxidation is thoroughly discussed in chapter 3, whereas in chapter 5, techniques and problems associated with overcoming the addition of fish oils to various products (mayonnaise, salad dressings, margarine, milk, yogurt, bakery products, and assorted meat products [beef, surimi, ground turkey, pork sausage]) are discussed.

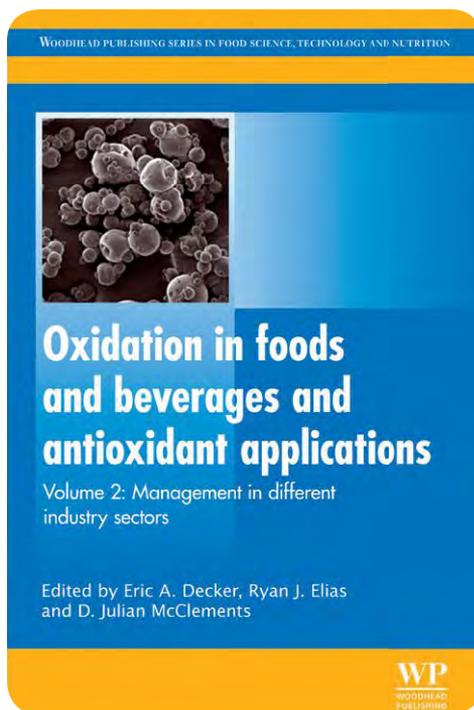
Chapter 4 covers topics such as photosensitizers and AO in milk, photo-oxidation in milk, oxidation of butter, cheese, dried milk, and ice cream, to name a few.

The second section comprises nine chapters and ~300 pages of excellent information on oxidation in plant-based foods and beverages including edible oils, nuts, confectionery products, baked goods, snacks, fruits, vegetables, and two of my favorites—beer and wine. The plant-based section would be a valuable textbook all by itself.

The first two chapters in this section are on edible oils and the extremely challenging conditions related to oil oxidation during frying. The first chapter introduces the chemistry and measurement (including a good discussion on sensory aspects) of food-oil oxidation, followed by processing procedures that can be used and concerns that must be addressed to make high-quality products, including careful consideration of raw material product quality, refining, packaging, and the like. Both restaurants and production facilities are concerned with fried food quality, although the problems posed are different for the two. Restaurants take the oil to (and often beyond) its useful endpoint, whereas they have few concerns regarding long-term storage of the fried food product. Numerous compositional, procedural, and testing concerns regarding frying oils are discussed in the chapter.

The primary nuts (and their corresponding nut oils) are presented in chapter 8, including factors affecting oxidation (composition, processing, roasting), plus sensory aspects, the presence of AO present (natural and added), and packaging. Emulsions have their own inherent oxidation problems, and chapter 9 provides an interesting and well-written synopsis of this product category. The chapter is more research-oriented than most chapters (which I liked), but it does address all the important factors that need to be considered when designing and producing emulsions.

Chapter 10 covers two narrow but important categories, confectionery products and biscuits (the author is from the UK, and the UK biscuit refers to “any of various hard or crisp dry baked products,” similar to the American English terms cracker or cookie). After an extensive introduction to the oxidative problems associated with



the products, the various processing, packaging, and AO options to control oxidation are discussed.

Chapter 11 covers the primary cereals (barley, corn, oats, wheat, and rice) and the products made from them. There is good compositional information, as well as information on the most effective additives to use when designing cereal-based snack foods. Chapter 12 considers the stability of the AO found in fruits and vegetables as well as factors affecting shelf life and treatments that would be effective in extending product shelf life (such as AO addition, special packaging, modified atmosphere storage, and the use of specialized edible coatings).

Chapter 13 discusses flavor changes that can occur in the staling of beer, particularly those that result from oxidation, such as the oxidation of unsaturated fatty acids and the photo-induced degradation of hops components. Barley and hops, which are beer constituents, contain a variety of plant phenolics having antioxidant activity. Processing affects final product flavor, from raw material handling to brew house procedures to the yeast selected to procedures used to reduce the oxygen content in the water used.

Wine (chapter 14), particularly red wine, is an excellent and well known source of plant-based AO. As with beer, oxygen concentration is important in the early stages of wine fermentation to achieve the large increase in yeast cell numbers necessary for an active and successful fermentation. Soon thereafter, the level of oxygen is important in the switch to an anaerobic fermentation to maximize ethanol production. A variety of plant phenolics are present in wine (phenolic alcohols, phenyl propanoid acids, flavanols, etc.). The extent of oxidation must be carefully controlled to maintain product quality and desirable flavor. Barrel aging increases the extent of oxidation, while reducing the fruit flavor intensity. But, if done correctly, it will add a group of flavor compounds that increase the complexity of the beverage (e.g., vanillin, eugenol, syringaldehyde, cinnamon, and oak lactones) without reducing the fruitiness of the wine excessively.

The final, two-chapter section is titled "Antioxidant Delivery in Foods and Beverages." The first chapter covers encapsulation, including system design, processing, and preparation of the encapsulated oils, and discusses the oxidation that occurs after encapsulation and applications of lipid-encapsulated systems in processed food products. The second chapter in this section is on AO-active food packaging, including AO edible films. The approaches used include oxygen absorbents and scavengers, AO addition to the packaging materials, and AO in coatings and films. Examples of particular packaging systems, as well as application to specific products (meat), are included.

This is a well-written, well-researched, and excellent source on AO. For those in the food industry or those doing applied research on oxidation, I highly recommend the text.

William E. Artz is a faculty member at the University of Illinois at Urbana with 30+ years of experience in plant phenolics and fat/oil chemistry and analysis.

The AOCS member magazine, *inform*, is looking for book reviewers. We provide a general review guideline, you have three to four months to prepare the review, and—best of all—the book remains in your library. Interested? Please email William Artz, the book review editor, at wartz@illinois.edu and indicate your subject areas of interest. You do not need to be a member to participate.



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Lowering the boiling point curve of biodiesel by cross-metathesis

Montenegro, R.E., and M.A.R. Meier, *Eur. J. Lipid Sci. Technol.* 114:55–62, 2012.

One of the challenges of today's biodiesel (fatty acid methyl esters, or FAME) is its unsuitable boiling curve behavior. A more or less continuously increasing curve is beneficial because it provides good fuel ignition and combustion in the cylinder of the engine. Here, we present the results of our investigation on the chemical modification of biodiesel with the use of a well-known catalytic reaction, olefin metathesis. Self- and cross-metathesis of biodiesel and 1-hexene were carried out. Ten different ruthenium-based metathesis catalysts were initially subjected to a screening. After selection of the most active catalyst, a series of reactions were prepared wherein the concentration of the biodiesel was held constant, while the amount of 1-hexene was varied. The samples were then analyzed by simulated distillation to determine their boiling curve range. Results revealed that as the hexene amount was increased, a more favorable distillation curve was observed since it generated a fairly good distribution of low to high molecular weight compounds, which in turn exhibited an almost steadily increasing distillation curve, more similar to that of a conventional diesel fuel.

Rapid characterization of lipids by MALDI MS. Part 1: Bacterial taxonomy and analysis of food oils

Lay, J.O., et al., *Lipid Technol.* 24:11–14, 2012.

Several new methods have been developed recently that allow the direct detection of lipids without resorting to derivatization or chromatographic separation. The simplest of these is direct MALDI MS (matrix-assisted laser desorption/ionization mass spectrometry). This approach is most useful for mixtures that contain minimal amounts of ion-suppressing interfering components. However, even when such components are present, their effects can often be minimized by using

CONTINUED ON PAGE 248

AOCS Journals



Journal of the American Oil Chemists' Society (March)

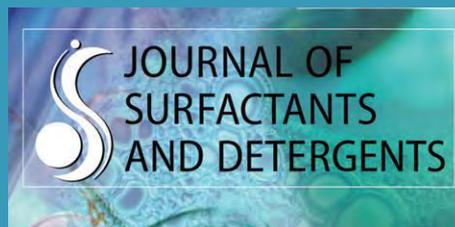
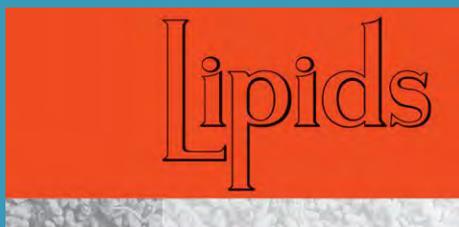
- Improved estimation of oil, linoleic and oleic acid and seed hull fractions in safflower by NIRS, Rudolph, S., H.C. Becker, A. Schierholt, and S. von Witzke-Ehbrecht
- The influence of growing region on fatty acids and sterol composition of Iranian olive oils by unsupervised clustering methods, Piravi-Vanak, Z., J.B. Ghasemi, M. Ghavami, H. Ezzatpanah, and E. Zolfonoun
- The interactions between rapeseed lipoxygenase and native polyphenolic compounds in a model system, Dwiecki, K., A. Siger, J. Czubiński, M. Nogala-Kałucka, and E. Lampart-Szczapa
- PAHs, PCBs, PBDEs and pesticides in cold-pressed vegetable oils, Roszko, M., A. Szterk, K. Szymczyk, and B. Waszkiewicz-Robak
- Effects of geographical origin on the conjugated linolenic acid of *Trichosanthes kirilowii* Maxim seed oil, Yang, J., C. Zhou, G. Yuan, and D. Li
- Improving acid number testing of biodiesel feedstock and product, Kovács, A., I. Czinkota, and J. Tóth
- Application of a novel, heated, nine-reflection ATR crystal and a portable FTIR spectrometer to the rapid determination of total *trans* fat, Mossoba, M.M., J.K.G. Kramer, H. Azizian, J. Kraft, P. Delmonte, et al.
- Identification of high oleic castor seeds by near infrared reflectance spectroscopy, Fernández-Cuesta, Á., J.M. Fernández-Martínez, and L. Velasco
- The effect of limonene on the crystallization of cocoa butter, Ray, J., W. MacNaughtan, P.S. Chong, J. Vieira, and B. Wolf
- Effect of alcohol in starch-thickened fillings on the storage stability of dark choc-

olate pralines, Böhme, B., R. Kretzschmar, Y. Schneider, P. Fiala, and H. Rohm

- Lipase-catalyzed synthesis of saccharide-fatty acid esters utilizing solvent-free suspensions: effect of acyl donors and acceptors, and enzyme activity retention, Ye, R., and D.G. Hayes
- Metabolic engineering and oil supplementation of *Physcomitrella patens* for activation of C₂₂ polyunsaturated fatty acid production, Chodok, P., D.J. Cove, R.S. Quatrano, A. Kanjana-Opas, and S. Kaewsuwan
- Effects of amino acids and peptide on lipid oxidation in emulsion systems, Park, E.Y., Y. Nakamura, K. Sato, and Y. Matsumura
- Employment of differential scanning calorimetry in detecting lard adulteration in virgin coconut oil, Mansor, T.S.T., Y.B. Che Man, and M. Shuhaimi
- Optimization of biodiesel production using a magnetically stabilized fluidized bed reactor, Guo, P., F. Huang, Q. Huang, and C. Zheng
- Synthesis of animal fats ethylolamides, ethylolamide phosphates and their petroleum-collecting and dispersing properties, Asadov, Z.H., R.A. Rahimov, and N.V. Salamova
- Lubricity-enhancing low-temperature diesel fuel additives, Wang, S., J. Shen, and M.J.T. Reaney
- Bactericidal and antioxidant activity of essential oils from *Myristica fragrans* Houtt and *Salvia microphylla* H.B.K., Lima, R.K., M. das Graças Cardoso, M.A. Andrade, P.L. Guimarães, L.R. Batista, et al.
- Odorous compounds in bioplastics derived from bloodmeal, Verbeek, C.J.R., T. Hicks, and A. Langdon
- Properties of canola protein-based plastics and protein isolates modified using SDS and SDBS, Manamperi, W.A.R., and S.W. Pryor

Lipids (March)

- The front-end desaturase: structure, function, evolution and biotechnological use, Meesapyodsuk, D., and X. Qiu
- 7-Ketocholesterol is not cytotoxic to U937 cells when incorporated into acety-



lated low density lipoprotein, Rutherford, L.D., and S.P. Gieseg

- Involvement of liver X receptor alpha in histone modifications across the target fatty acid synthase gene, Yu, H., J. Wu, M. Yang, J. Guo, L. Zheng, *et al.*
- Paraoxonase 1 activity in chylomicrons and VLDL: the effect of type 2 diabetes and meals rich in saturated fat and oleic acid, Manning, P.J., S.A. de Jong, A.R. Ryalls, and W.H.F. Sutherland
- An egg-enriched diet attenuates plasma lipids and mediates cholesterol metabolism of high-cholesterol fed rats, Yang, F., M. Ma, J. Xu, X. Yu, and N. Qiu
- A low-protein, high-carbohydrate diet increases fatty acid uptake and reduces norepinephrine-induced lipolysis in rat retroperitoneal white adipose tissue, dos Santos, M.P., S.A. de França, J.T.F. dos Santos, S.L. Buzelle, G.L. Bertolini, *et al.*
- Interaction between marginal zinc and high fat supply on lipid metabolism and growth of weanling rats, Weigand, E., and C. Boesch-Saadatmandi
- Characterization of secretory phospholipase A₂ with phospholipase A₁ activity in tobacco, *Nicotiana tabacum* (L.), Fujikawa, Y., R. Fujikawa, N. Iijima, and M. Esaka
- The production of conjugated α -linolenic, γ -linolenic and stearidonic acids by strains of bifidobacteria and propionibacteria, Hennessy, A.A., E. Barrett, P.R. Ross, G.F. Fitzgerald, R. Devery, *et al.*
- Comparison of separations of fatty acids from fish products using a 30-m Supelcowax-10 and a 100-m SP-2560 column, Santercole, V., P. Delmonte, and J.K.G. Kramer

Journal of Surfactants and Detergents (Issue 2)

- Carbohydrate-modified silicone surfactants, Han, F., Y. Deng, Y. Zhou, and B. Xu

- Cleanability improvement of cotton fabrics through their topographical changes due to the conditioning with cellulase enzyme, Calvimontes, A., N.J. Lant, and V. Dutschk
- Water-in-diesel fuel nanoemulsions prepared by high energy: emulsion drop size and stability, and emission characteristics, Al-Sabagh, A.M., M.M. Emara, M.R. Noor El-Din, and W.R. Aly
- The composition of mixed micelles formed by dodecyl trimethyl ammonium bromide and benzethonium chloride in water, Rodríguez, J.L., R.M. Minardi, E.P. Schulz, O. Pieroni, and P.C. Schulz
- On the characteristic curvature of alkyl-polypropylene oxide sulfate extended surfactants, Hammond, C.E., and E.J. Acosta
- Classification of fragrances and fragrance mixtures based on interfacial solubilization, Tchakalova, V., and W. Fieber
- Fatty acids in heterocyclic synthesis Part XII: synthesis of surfactants from pyrazole, isoxazole, pyrimidine and triazine, incorporating the 1,3,4-thiadiazole moiety having dyeing and antimicrobial activities, Amine, M.S., A.A. Mahmoud, S.K. Badr, and A.S. Gouda

ties, Amine, M.S., A.A. Mahmoud, S.K. Badr, and A.S. Gouda

- Synthesis and surface properties of succinic acid end-capped alkyl-polyxyloides, Renault, B., C. Portella, S. Marinkovic, and B. Estrine
- Investigation of the stability of quaternary ammonium methyl carbonates, Weisshaar, D.E., G.W. Earl, M.W. Amolins, K.L. Mickalowski, J.G. Norberg, *et al.*
- Synthesis and micellization properties of new anionic reactive surfactants based on hydrogenated cardanol, Kattimuttathu I, S., G. Foerst, R. Schubert, and E. Bartsch
- The surface activity of borate surfmers with different hydrophobic chain length and their mixing effect with hexadecyl trimethyl ammonium bromide, Liang, Z., L. Ma, C. Lü, and Y. Zhai
- Synthesis and biocidal activity of some naphthalene-based cationic surfactants, Aiad, I.A., A.M. Badawi, M.M. El-Sukkary, A.A. El-Sawy, and A.I. Adawy
- Study of the S_N2 substitution reactions between methyl naphthalene-2-sulfonate and methyl 4-nitrobenzene sulfonate and bromide ions in dodecyl dibromide dimeric micellar solutions in the absence and presence of alcohols, del Mar Graciani, M., A. Rodríguez, V.I. Martín, and M.L. Moyá
- Microwave-assisted synthesis and properties of sodium glycol bis-(isooctyl)sulfosuccinate, Chen, H., and S. Tang

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such as solid-phase extraction (SPE) or thin-layer chromatography (TLC). For example, direct MALDI has been used for rapid screening of lipids and for taxonomic identification of the source organisms with no sample pretreatment. Fractions collected from SPE cartridges have also been used to avoid the most extreme effects of ion suppression from more complex lipid mixtures. More recently, direct MALDI has been applied to the analysis of TLC plates allowing the detection of TLC-separated lipids from the complex lipidome. Herein, we briefly describe the application of rapid MALDI MS to some typical research problems involving the characterization of lipids. In Part 1 these include bacterial taxonomy by direct analysis of intact lipids in simple extracts rather than by conversion to fatty acid methyl esters. Food oils such as triacylglycerols can be characterized simply and easily by direct MALDI MS without resort to any sort of separation. Part 2 (in the next issue of *Lipid Technology*) will cover the spontaneous fragmentation of protonated lipids, ion suppression, and the use of SPE and TLC with MALDI MS to characterize complex biological samples.

Impact of high-fat and high-carbohydrate diets on liver metabolism studied in a rat model with a systems biology approach

Bertram, H.C., *et al.*, *J. Agric. Food Chem.* 60:676–684, 2012.

The aim of the present study was to investigate the use of an integrated metabolomics and proteomics approach in the elucidation of diet-induced effects on hepatic metabolism in a rat model. Nuclear magnetic resonance (NMR)-based metabolomics of liver extracts revealed a pronounced effect of a high-fat diet on the hepatic betaine content, whereas a carbohydrate-rich diet induced increases in hepatic glucose. In addition, the metabolomic investigations revealed that the high-fat diet was associated with increased hepatic lipid levels, which was not evident with the carbohydrate-rich diet. The proteomic investigations revealed strong high-fat diet effects on the expression of 186 proteins in the liver including malate dehydrogenase. Comparison of malate dehydrogenase

expression determined by proteomics and NMR metabolite profiles revealed correlations between malate dehydrogenase and lactate, glucose, and glutamine/glutamate signals, thereby demonstrating a diet-induced regulation that was evident at both proteomic and metabolomic levels.

Peroxidation of lipoproteins in multiple sclerosis

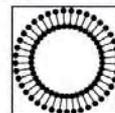
Ferretti, G., and T. Bacchetti, *J. Neurol. Sci.* 311:92–97, 2011.

Human plasma low density lipoproteins (LDL) and high density lipoproteins (HDL) are involved in the transport of lipids, modulate membrane lipid composition, and regulate signal transduction. HDL-like lipoproteins have been shown also in human cerebrospinal fluid, and it has been hypothesized that they could have a role in lipid transport in central nervous system. After synthesis, lipoproteins are susceptible to lipid peroxidation triggered by reactive oxygen species (reactive oxygen species—ROS—and reactive nitrogen species—RNS) produced by peripheral and brain

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cells. Aim of the paper has been to review the scientific literature on the role of lipid peroxidation of LDL and HDL in the molecular mechanisms of multiple sclerosis (MS). Several studies have demonstrated a significant increase in lipid peroxidation products in brain, plasma, and cerebrospinal fluid of MS patients. The increase of antibodies against ox-LDL in plasma and the presence of ox-LDL in demyelinating plaques in MS brain suggest that the disease is associated with oxidative damage of lipoproteins. The impairment of antioxidant systems or an increase in the production of ROS and RNS could contribute to lipoprotein peroxidation in MS. Oxidized lipoproteins show several alterations of their functions; they are neurotoxic and have pro-inflammatory properties. Therefore, lipoprotein lipid peroxidation products could be involved in demyelination and axonal injury in MS.

Regulation of inflammation in cancer by eicosanoids

Greene, E.R., *et al.*, *Prostaglandins Other Lipid Mediat.* 96:27–36, 2011.

Inflammation in the tumor microenvironment is now recognized as one of the hallmarks of cancer. Endogenously produced lipid autacoids, locally acting small molecule lipid mediators, play a central role in inflammation and tissue homeostasis, and have recently been implicated in cancer. A well-studied group of autacoid mediators that are the products of arachidonic acid metabolism includes: the prostaglandins, leukotrienes, lipoxins, and cytochrome P450 (CYP) derived bioactive products. These lipid mediators are collectively referred to as eicosanoids and are generated by distinct enzymatic systems initiated by cyclooxygenases (COX 1 and 2), lipoxygenases (5-LOX, 12-LOX, 15-LOXa, 15-LOXb), and cytochrome P450s, respectively. These pathways are the target of approved drugs for the treatment of inflammation, pain, asthma, allergies, and cardiovascular disorders. Beyond their potent anti-inflammatory and anti-cancer effects, non-steroidal anti-inflammatory drugs (NSAIDs) and COX-2 specific inhibitors have been evaluated in both pre-clinical tumor models and clinical trials. Eicosanoid biosynthesis and actions can also be directly influenced by nutrients in

the diet, as evidenced by the emerging role of omega-3 fatty acids in cancer prevention and treatment. Most research dedicated to using eicosanoids to inhibit tumor-associated inflammation has focused on the COX and LOX pathways. Novel experimental approaches that demonstrate the anti-tumor effects of inhibiting cancer-associated inflammation currently include: eicosanoid receptor antagonism, overexpression of eicosanoid-metabolizing enzymes, and the use of endogenous anti-inflammatory lipid mediators. Here we review the actions of eicosanoids on inflammation in the context of tumorigenesis. Eicosanoids may represent a missing link between inflammation and cancer and thus could serve as therapeutic target(s) for inhibiting tumor growth.

Lipid biosynthesis and metabolic regulation in microalgae

Zhu, S.N., *et al.*, *Prog. Chem.* 23:2169–2176, 2011.

With the increasingly severe energy and environmental problems, biodiesel from microalgae has become a hot topic. Compared with traditional oil crops, microalgae have advantages of rapid growth, high lipid content, non-occupation of arable land, etc., which have been considered as a highly potential feedstock of biofuels. Although neutral lipids, especially triacylglycerols (TAG), which are the main feedstock of biodiesel production, can be accumulated in many algal cells under stress conditions, little is known about microalgal lipid synthesis and metabolic regulation so far. To better understand and manipulate microalgal lipid metabolism for improvement of lipid production, we present an overview of advances of lipid biosynthesis and metabolic regulation in microalgae, including TAG biosynthesis pathway, biochemical regulation, and genetic engineering strategies. Effects of nutrition on lipid production are represented. Five genetic engineering strategies are summarized including enhancement of fatty acids synthesis pathway, enhancement of Kennedy pathway, regulation of alternative pathway of TAG, inhibition of competing pathway of lipid biosynthesis, and lipid catabolism. The prospects of research on microalgal lipid metabolism are also discussed. ■

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Patents

Published Patents

Process for the preparation of carboxylic acids and/or derivatives thereof

Law, D.J., BP Chemicals Ltd., US8053600, November 8, 2011

Process for preparing an aliphatic carboxylic acid having $(n+1)$ carbon atoms where n is an integer up to 6, and/or an ester or anhydride thereof by contacting an aliphatic alcohol having n carbon atoms and/or a reactive derivative thereof with carbon monoxide under hydrous conditions in the presence of a ferrierite catalyst.

Process for producing propylene glycol

Kouso, H., *et al.*, Mitsui Chemicals, Inc., US8053608, November 8, 2011

It is an object of the present invention to provide a process for producing propylene glycol from glycerol as a raw material without the necessity for a step of gasifying glycerol. The process for producing propylene glycol of the present invention comprises a step of subjecting glycerol to catalytic hydrogenation in the presence of a catalyst A containing zinc oxide, silica, and at least one of copper and copper oxide.

Enhanced biodiesel fuel having improved low-temperature properties and methods of making same

Zhou, G., *et al.*, Chevron USA Inc., US8057558, November 15, 2011

The present invention is generally directed to novel biodiesel fuel compositions having enhanced low-temperature properties. The present invention is additionally directed to methods (i.e., processes) for making such enhanced biodiesel fuels by improving the low-temperature properties of ester-based biodiesel fuels via *in situ* enhancement and/or additive enhancement.

Hydrogen generator and hydrogenation apparatus

Ichikawa, M., *et al.*, Hrein Energy, Inc., US8057559, November 15, 2011

The efficiency of dehydrogenation and that of hydrogenation are improved. A hydrogen generator for generating hydrogen by dehydrogenation of organic hydrides in the presence of a catalyst is characterized by comprising a multi-tubular reactor vessel having a region for supplying fuel to generate heat for dehydrogenation. The region contains a combustion catalyst for combusting fuel, and a region containing a dehydrogenation catalyst necessary for dehydrogenation. The regions are arranged radially side by side with a wall separating them. A hydrogenation apparatus which synthesizes organic hydrides by way of hydrogenation of unsaturated hydrocarbons in the presence of a catalyst is characterized by comprising a multi-tubular reactor vessel having a region for removing the heat generated by hydrogenation and a region containing a hydrogenation catalyst necessary for hydrogenation, the regions being arranged radially side by side with a wall separating them.

Automatic or machine dishwashing compositions of sulfonated estolides and other derivatives of fatty acids and uses thereof

Bernhardt, R.J., *et al.*, Stepan Co., US8058223, November 15, 2011

Sulfo-estolides and methods of making them are described. Useful methods include acid side bleaching, partial hydrogenation of the fatty acid, pretreatment of the fatty acid to provide color inhibition, acid side hydrolysis of the sulfo-estolides, or conversion of SHP ("sultone hydrolyzed product") to an essentially fully hydrolyzed product (HSHP) or a partially hydrolyzed product (PHSHP). Formulations and concentrated formulations of automatic dishwasher detergent or machine wash detergent compositions containing sulfo-estolides, among others, are also included.

Flexible glycerol conversion process

Abhari, R., Syntroleum Corp., US8058484, November 15, 2011

The present invention relates to a process for converting by-products of the manufacture of biodiesel into industrially useful oxygenated products of greater commercial value. The process includes a trickle bed reactor in which a glycerol-rich feedstock is reacted with hydrogen in the presence of a nickel-tungsten catalyst under typical refining condition of high temperature and pressure, yielding propane synfuel or propanediols.

CONTINUED ON NEXT PAGE

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Nitrated extreme pressure additives and blends

Ngyen, D.N., Dover Chemical Corp., US8058317, November 15, 2011

This invention relates to products and processes for making extreme-pressure (EP) additives (water-dispersible and oil-based). The process includes nitrating fatty raw material sources such as animal fats, vegetable oils, the fatty acids and synthetic esters derived therefrom, terminal or internal olefins, polyalkenes or their linear copolymers, and alkylated phenols, using 70% nitric acid or nitrogen dioxide gas. The additives are used as soluble oils or as lubricating blends by the inclusion of emulsifiers. The nitrated unsaturated fatty acids such as tallow fatty acid, oleic acid, tall oil fatty acid, tall oil-derived dimer acids, castor oil fatty acid, alkyl succinic acids, are modified by post-reaction to form alkanolamine (monoethanolamine triethanolamine) salts or alkanolamides in order to obtain the derived water-dispersible nitro-EP additives. The same nitration method is used to make ethoxylated fatty esters by reaction with water-soluble polyglycols in order to obtain water-dispersible nitro-EP additives.

Microwave popcorn with viscous liquid fat and method of preparation

Plank, D.W., et al., General Mills, Inc., US8057837, November 15, 2015

Microwave popcorn articles including a thickened liquid (at room temperature) oil and their methods of preparation are disclosed. The microwave popcorn articles comprise any conventional microwave popcorn bag or container and a food charge disposed therein comprising kernel popcorn and/or puffed pellets; 1% to 45% liquid (at

room temperature) oil; and 0% to 4% salt. The oil ingredient has a melting point of $\leq 25^{\circ}\text{C}$. The oil ingredient includes an oil thickening ingredient, especially a starch-based oil thickening ingredient such as a cyclodextrin, in amounts sufficient to dimensionally stabilize the oil. By avoiding hydrogenation to solidify the oil into a solid fat at room temperatures, finished popcorn products can be provided that are desirably low in *trans* fatty acid content. The methods of preparation include preparing a heated oil thickened with cyclodextrin complexed with the oil and adding the thickened oil to the microwave container.

Method for purifying biodiesel fuel

Takanashi, H., Kagoshima University, US8062391, November 22, 2011

Provided is a method for purifying a biodiesel fuel while completely preventing or greatly reducing generation of wastewater. The present invention relates to a method for purifying a biodiesel fuel characterized by applying an electric field to or heating a crude biodiesel fuel and a method for purifying a biodiesel fuel characterized by adding water (preferably containing a demulsifier such as an inorganic calcium salt or a magnesium salt) to a crude biodiesel fuel to form a W/O [water-in-oil] emulsion and breaking the emulsion by application of an electric field or heating etc.

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.



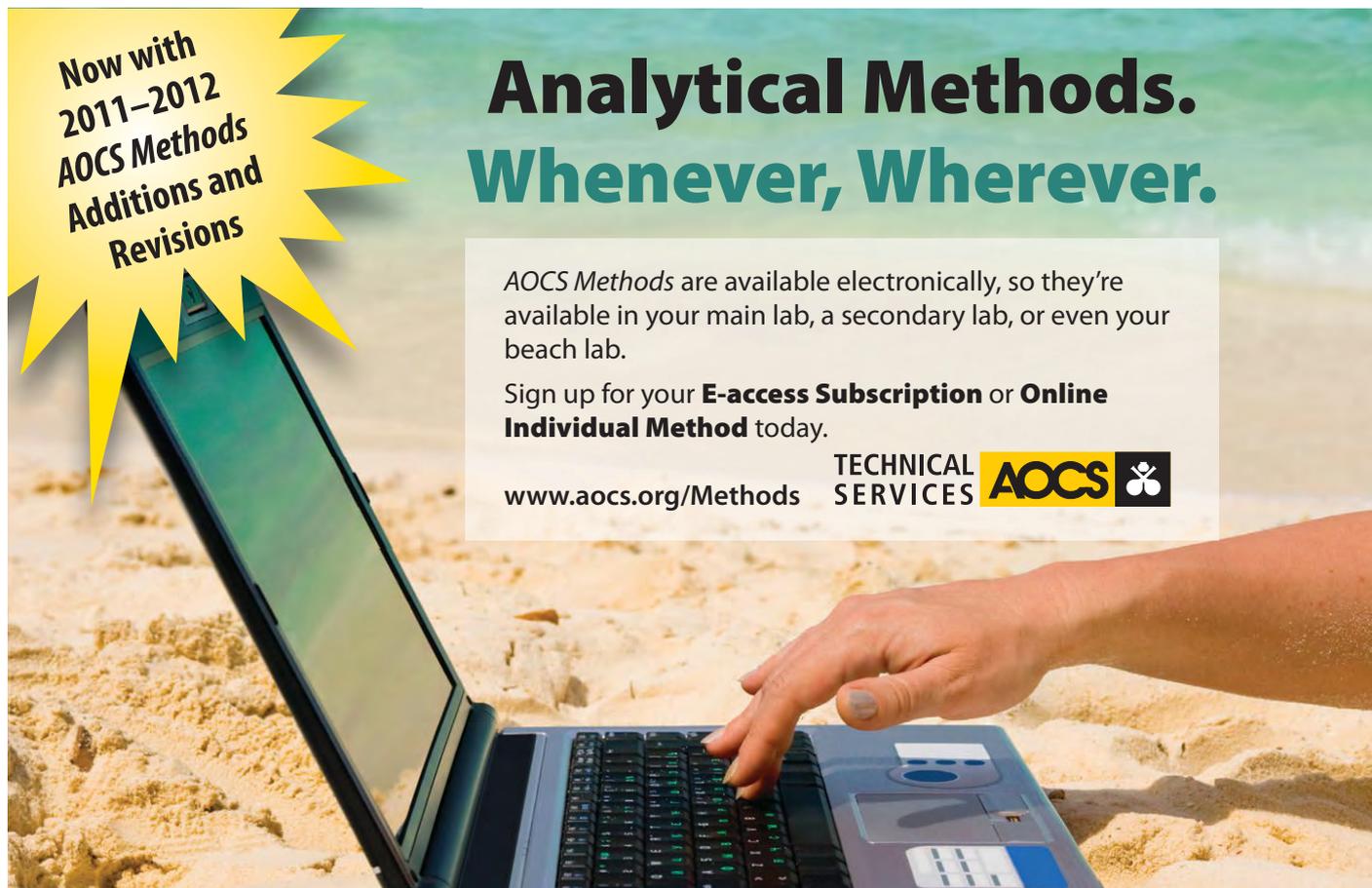
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AOCS Press Book of the Month



Edible Oleogels Structure and Health Implications

Alejandro Marangoni and Nissim Garti, Editors
2011. Hardbound. 346 pages.
ISBN 978-0-9830791-1-8. Product code 258

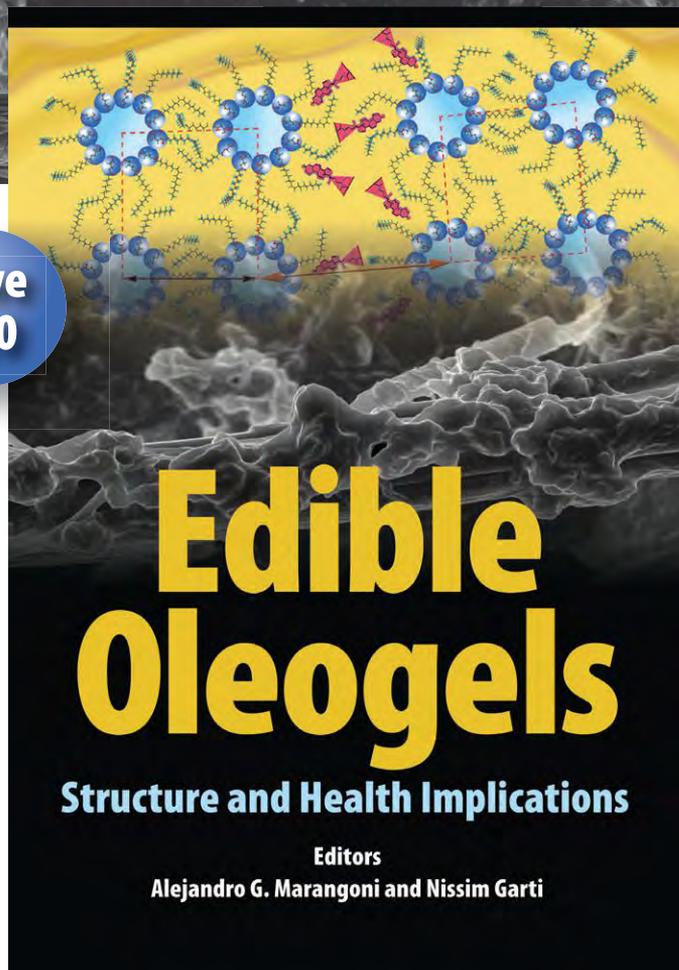
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In an effort to provide alternatives to *trans* and saturated fats, scientists have been busy modifying the physical properties of oils to resemble those of fats. Many food products requiring a specific texture and rheology can be made with these oleogels without causing significant changes to product quality. The major approach to form these materials is to incorporate specific molecules (polymers, amphiphiles, waxes) into the oil components that will alter the physical properties of the oil so that its fluidity will decrease and the rheological properties will be similar to those of fats. This emerging technology is the focus of many scientific investigations geared toward helping decrease the incidence of obesity and cardiovascular disease.

Contents

- An Overview of the Past, Present, and Future of Organogels
- Novel Strategies for Nanostructuring Liquid Oils into Functional Fats
- Edible Oil Organogels Based on Self-assembled β -sitosterol + γ -oryzanol Tubules
- Vegetable Oil-Based Ricinelaic Acid Organogels—Phase Behavior, Microstructure, and Rheology
- Hydroxystearic Acid Oleogels
- Candelilla Wax as an Organogelator for Vegetable Oils—An Alternative to Develop *Trans*-free Products for the Food Industry
- Physical Properties of Organogels Made of Rice Bran Wax and Vegetable Oils
- Monoglycerides in Oils
- Physical Properties of β -fat Gel Made of Fully-hydrogenated Rapeseed Oil and Vegetable Oils
- Ceramide Oleogels
- Oleogels Based on Non-lamellar Lyotropic Liquid Crystalline Structures for Food Applications
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AOCs 2012 award recipients announced

AOCs awards have a rich history of honoring those individuals and teams who have taken the industry to the next level, who have advanced the quality and depth of the profession, and who have leveraged their knowledge for the benefit of the Society.

These individuals from around the world will be recognized during the 103rd AOCs Annual Meeting & Expo to be held April 29–May 2, 2012, in Long Beach, California, USA. The following list includes awards for whom recipients had been named by the deadline for this issue of *inform*.

SOCIETY AWARDS

A. Richard Baldwin Distinguished Service Award

MICHAEL J. HAAS, US Department of Agriculture, USA

\$2,000 honorarium, travel allowance, and a plaque

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Haas



Erhan



Hartel



Hill

AOCs Fellows

SEVIM Z. ERHAN, US Department of Agriculture, USA

RICHARD W. HARTEL, University of Wisconsin-Madison, USA

STEVEN E. HILL, Kraft Foods Inc., USA

JERRY W. KING, University of Arkansas, USA



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LUIS SPITZ, consultant, USA

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SCIENTIFIC AWARDS

Supelco/Nicholas Pelick–AOCs Research Award

CASIMIR C. AKOH, The University of Georgia, USA

\$10,000 honorarium, \$1,500 travel stipend, and a plaque

The Supelco/Nicholas Pelick–AOCs Research Award is for accomplishment of outstanding original research in fats, oils, lipid chemistry, or biochemistry, the results of which have been presented through publication of technical papers. The award is funded by Supelco Inc., a subsidiary of Sigma-Aldrich, and Nicholas Pelick, an AOCs past president.



Akoh

Stephen S. Chang Award

GARY R. LIST, consultant, retired US Department of Agriculture, USA

\$4,000 honorarium and a jade horse

The Stephen S. Chang Award recognizes a scientist, technologist, or engineer who has made decisive accomplishments in basic research for the improvement or development of products related to lipids. The award was established by former AOCs President Stephen S. Chang and his wife, Lucy, for individuals who have made significant contributions through a single breakthrough or through an accumulation of publications.



List

George Schroepfer Medal

MICHAEL R. WATERMAN, Vanderbilt University, USA

\$5,000 honorarium and a bronze medal

The George Schroepfer Medal recognizes significant and distinguished accomplishments in the steroid field, which is defined to encom-



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pass sterols and other natural and synthetic compounds incorporating the tetracyclic gonane ring system. The award is presented every two years, and was established to honor the memory of George J. Schroepfer Jr., a leader in the sterol and lipid field for more than 40 years.

AOCS Young Scientist Research Award

RICHARD P. BAZINET, University of Toronto, Canada

\$1,000 honorarium, \$1,500 travel stipend, and a plaque

The AOCS Young Scientist Research Award recognizes a young scientist who has made a significant and substantial research contribution in one of the disciplines represented by AOCS Divisions. Vijay K.S. Shukla and the International Food Science Centre A/S of Denmark sponsor the award.



Bazinet

DIVISION/SECTION AWARDS

Analytical Division: Herbert J. Dutton Award

WM. CRAIG BYRDWELL, US Department of Agriculture, USA

\$1,000 honorarium and a plaque

The award is presented for significant contribution to the analysis of fats and oils or to improvement in the understanding of the processes used in the fats and oils industries. The award is named for Dutton, a long-time research leader at the US Department of Agriculture facility in Peoria, Illinois, USA.



Byrdwell



Zhou



Agiomyrgianaki

Student Awards

LISA ZHOU, The Pennsylvania State University, USA

ALEXIA AGIOMYRGIANAKI, University of Crete, Greece

\$250 honorarium, \$500 travel stipend, and a certificate

Edible Applications and Technology Division: Timothy L. Mounts Award

ROMAN PRZYBYLSKI, University of Lethbridge, Canada

\$500 honorarium and a plaque

The award is for either basic or applied research accomplishments relating to the science, technology, or application of edible oils in food products. It memorializes the former AOCS president, who was a distinguished research scientist with the US Department of Agriculture. The award is sponsored by Bunge North America.



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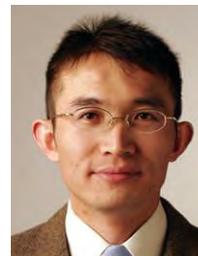


Shufan

Student Award

YA'EL SHUFAN, Hebrew University of Jerusalem, Israel

\$500 travel stipend and a certificate



Zhou

Health and Nutrition Division: Student Award

ALBERT ZHOU, Utah State University, USA

\$500 honorarium and a certificate

Industrial Oil Products Division: ACI/ NBB Glycerine Innovation Award

ADI WOLFSON and DORITH TAVOR, Sami Shamoon College of Engineering, Israel

\$5,000 honorarium and a plaque

The ACI/NBB Glycerine Innovation Award, sponsored by the American Cleaning Institute and the National Biodiesel Board, recognizes achievements in research relating to new applications for glycerine, particularly those with commercial viability.



Wolfson



Tavor

Biotechnology Division: Student Awards

1st place—**XUE PAN**, University of Alberta, Canada

\$300 honorarium and a certificate

2nd place—**LESLIE KLEINER**, The University of Georgia, USA

\$200 honorarium and a certificate

3rd place—**MARYA AZIZ**, McGill University, Canada

\$100 honorarium and a certificate

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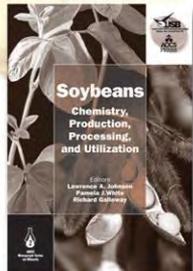
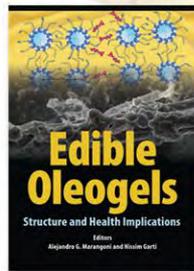
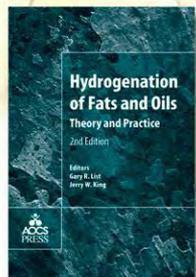
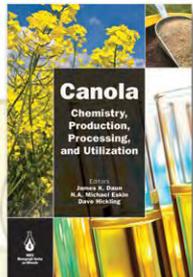
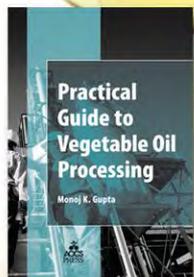
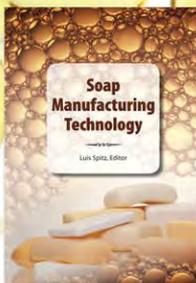
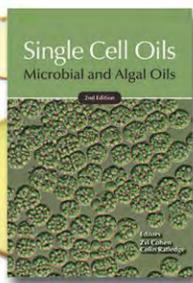
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Student Award

RONGPENG WANG, Missouri University of Science and Technology, USA

\$500 travel stipend and a certificate



Wang

Lipid Oxidation and Quality Division: Edwin Frankel Best Paper Award

The Efficacy of Compounds with Different Polarities as Antioxidants in Emulsions with Omega-3 Lipids (*Journal of the American Oil Chemists' Society* 88:489–502)

A.-D. M. SØRENSEN¹, N.S. NIELSEN¹, E.A. DECKER², M.B. LET³, X. XU³, and C. JACOBSEN¹, ¹Technical University of Denmark, Denmark; ²University of Massachusetts, USA; and ³Aarhus University, Denmark

Plaque and certificates for all authors.

The award recognizes the best paper relating to lipid oxidation or lipid quality published during the previous year by AOCs Press. Kalsec Inc. sponsors the award.

Phospholipid Division: Best Paper Award

Gut Flora Metabolism of Phosphatidylcholine Promotes Cardiovascular Disease (*Nature* 472:57–63)

Z. WANG¹, E. KLIPFELL¹, B.J. BENNETT², R. KOETH¹, B.S. LEVISON¹, B. DUGAR¹, A.E. FELDSTEIN¹, E.B. BRITT¹, X. FU¹, Y.-M. CHUNG¹, Y. WU³, P. SCHAUER¹, J.D. SMITH¹, H. ALLAYEE¹, W.H. WILSON TANG¹, J.A. DIDONATO¹, A.J. LUSIS², and S.L. HANZEN¹

¹Cleveland Clinic, USA; ²University of California, Los Angeles, USA; and ³Cleveland State University, USA

Plaque and certificates for all authors

The award recognizes an outstanding paper related to phospholipids published during the previous year. The International Lecithin & Phospholipid Society sponsors the award.

Processing Division Student Awards

EHSAN JENAB, University of Alberta, Canada

\$1,000 honorarium and a certificate



Jenab

Surfactants and Detergents Division: Samuel Rosen Memorial Award

ROBERT REIERSON, Rhodia Inc, USA

\$2,000 honorarium and a plaque

The award recognizes a significant advance in, or application of, the principles of surfactant chemistry by a chemist working in the industry. The award is sponsored by Milton Rosen in honor of his father, Samuel, who worked as an industrial chemist on the formulation of printing inks for more than four decades.



Reiersen

American Cleaning Institute (ACI) Distinguished Paper

Comparison of a Cationic Gemini Surfactant and the Corresponding Monomeric Surfactant for Corrosion Protection of Mild Steel in Hydrochloric Acid (*Journal of Surfactants and Detergents* 14: 605–613)

M. MAHDAVIAN¹, A.R. TEHRANI-BAGHA¹, and K. HOLMBERG²

¹Institute for Color Science and Technology, Iran; and ²Chalmers University of Technology, Sweden

Glass plaques for all authors

The award is presented annually to the authors of the best technical paper published during the preceding year in the *Journal of Surfactants and Detergents*. The award is sponsored by the American Cleaning Institute.

Student Award

PAUL TONGWA, Missouri University of Science and Technology, USA

\$500 travel stipend and a certificate



Tongwa

USA Section:

Alton E. Bailey Award

MARCEL LIE KEN JIE, University of Hong Kong, China

\$750 honorarium and a plaque

The award recognizes outstanding research and exceptional service in the field of lipids and associated products. The medal commemorates Alton E. Bailey's great contributions to the field of fats and oils as a researcher, as an author of several standard books in the field, and as a leader in the work of the Society. Archer Daniels Midland Co. and Kraft Foods Inc. sponsor the award.



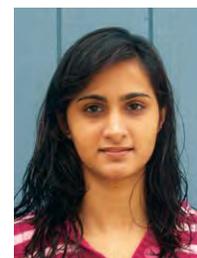
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Hans Kaunitz Award

TANUSHREE TOKLE, University of Massachusetts-Amherst, USA

\$1,000 honorarium, \$500 travel allowance, and a certificate

The award recognizes the outstanding performance and merit of a graduate student within the geographical boundaries of the USA Section.



Tokle

CONTINUED ON NEXT PAGE

STUDENT RECOGNITION**Thomas H. Smouse
Memorial Fellowship Award****BINGCAN CHEN**, University of Massachusetts-
Amherst, USA**\$10,000 scholarship, \$5,000 research
funding, and bookends**

The Archer Daniels Midland Foundation, AOCS, the AOCS Foundation, and the family and friends of Dr. Smouse have established and assisted in funding a fellowship program designed to encourage and support outstanding graduate research in a field of study consistent with the areas of interest to the AOCS.

*Chen**Ahn**Chua**Horn***AOCS Foundation Honored
Student Awards**

The award recognizes graduate students at any institution of higher learning who are conducting research in any area of science dealing with fats and lipids and who are interested in the areas of science and technology. Supported by contributions from members as well as companies in the industry.

Travel stipend and a certificate**Manuchehr (Manny) Eijadi Award**

The Eijadi Award recognizes outstanding merit and performance by an AOCS Honored Student. The award, established by Eijadi, is intended to help the recipient finance his or her studies.

\$1,000 scholarship and a certificate**Peter and Clare Kalustian Award**

The Kalustian Award recognizes outstanding merit and performance by an AOCS Honored Student. The award is supported by the Kalustian estate.

\$1,000 scholarship and a certificate**KOLLBE AHN**, Kansas State University, USA—Honored Student
and Manuchehr Eijadi Award**SEONG-CHEA CHUA**, Aarhus University, Denmark—Honored
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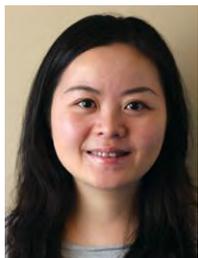
Panya

ATIKORN PANYA, University of Massachusetts-Amherst, USA—Honored Student

JIAJIA RAO, University of Massachusetts-Amherst, USA—Honored Student

UTKARSH SHAH, University of Arkansas, USA—Honored Student

ALBERT ZHOU, Utah State University, USA—Honored Student and Kalustian Award



Rao



Shah



Zhou

Ralph H. Potts Memorial Fellowship Award

CHODCHANOK ATTAPHONG, University of Oklahoma, USA

\$2,000 scholarship, travel stipend, and a plaque

The Ralph H. Potts Award is presented annually to a graduate student working in the chemistry of fats and oils and their derivatives. The award is sponsored by AkzoNobel to memorialize Ralph Potts, a pioneer in research on industrial uses of fatty acids. ■



Attaphong

ANNA FRISENFELDT HORN, Technical University of Denmark, Denmark—Honored Student

EHSAN JENAB, University of Alberta, Canada—Honored Student

BEHNOUSH MAHERANI, Institut National Polytechnique de Lorraine-Nancy, France—Honored Student



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Singapore 2012: Don't miss the chance

Emily Wickstrom

Be seen in Singapore!



The fabric and home care industry will gather this September for Singapore 2012: The World Conference on Fabric and Home Care. This conference features a dynamic program and several extraordinary networking opportunities in which you can meet global leaders of the fabric and home care industry, including CEOs, presidents, and senior managers.

Be seen ... at the world's premier conference on fabric and home care

Singapore 2012 attendees will experience a top-tier, forward-thinking program, with presentations by 17 innovators in the fabric and home care industry. Highlights will include keynote addresses by CEOs from three leading companies: Paul Polman of Unilever, Bob McDonald of The Procter & Gamble Co., and Motoki Ozaki of Kao Corp. The

opportunity to hear from top industry executives is part of what makes Singapore 2012 unique.

Be seen ... and shape the industry's future

The overall theme of Singapore 2012 is "Driving Performance through Sustainable Innovation." Four sessions over the two-day program will focus on the future of the fabric and home care industry, ensuring that the information presented is innovative and relevant:

- Balancing the Shifting Market Dynamics with Economic Realities: What is Ahead?
- Resource Management, Product Performance, and Environmental Responsibility: What is the Winning Formula?
- Innovative Supply Systems and Manufacturing Paradigms: What are the Solutions?
- Revolutionary Products and Breakthrough Technologies: What is Driving the Future?

Be seen ... and help carry on the tradition

Singapore 2012 was created to carry on the success of the Montreux World Conferences on Detergents, a premier industry event held every

four years in Montreux, Switzerland. The most recent conference, in October 2010, was particularly successful, with nearly 900 attendees from 57 countries. Based on delegate feedback, organizers determined that the technology in the fabric and home care industry was changing too quickly to meet only every four years. Singapore was chosen as the destination for the next World Conference on Fabric and Home Care because it is centrally located for executives in countries such as India, China, Japan, and Indonesia.

Be seen ... at the top exposition in the fabric and home care industry

The exhibition at Singapore 2012 will showcase over 50 leading companies and organizations that provide the detergent industry with everything from raw materials to equipment and production facilities. Visiting the expo hall is a great way to learn about the latest products, services, and technology while making key business connections.

Be seen ... and strengthen your connections

Valuable networking and social events are scheduled throughout the conference, ensuring that attendees will have ample opportunities to make new contacts and strengthen previous connections. High-energy evening receptions, along with luncheons and session breaks will facilitate debates and discourse. Singapore 2012 will close Tuesday evening with a reception and dinner on Siloso Beach, giving you one last chance to network before returning home.



Consistently ranked as one of the top luxury hotels in Asia and the world, the Shangri-La Hotel is located within 15 acres of lush botanical gardens and just a short stroll from top entertainment and shopping.

Be seen ... and experience a one-of-a-kind destination

While not in sessions or at networking events, Singapore 2012 attendees should take some time to enjoy the one-of-a-kind destination. Although geographically small, Singapore features a rich history while serving as a showcase for modern innovation and design. There are endless opportunities for entertainment and dining, as well as museums and galleries, local music venues, shopping boutiques, amusement parks, and architectural attractions.

Emily Wickstrom is a marketing and public relations specialist at AOCS. She can be contacted at emilyw@aocs.org.

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Phytosterol oxidation in foods and food products

Paresh Dutta

The cholesterol-lowering effect of phytosterols/plant sterols (PS) has been known since the 1950s—initially from studies using very high doses of PS. Later, human trials demonstrated that a PS dose of 2 g/day consistently lowered plasma cholesterol levels. Dietary intakes of PS range from 150 to 400 mg/day, and the absorption of PS is below 10%. On the other hand, the PS intake of vegetarians is up to 40% higher than the average in the non-vegetarian general population. Such increased consumption of PS and phytosterols has been reported to increase the cholesterol-lowering effect by up to 15%.

The PS have a backbone structure similar to that of cholesterol, but with an additional methyl or ethyl group and/or a double bond in the side chain. If the molecule is saturated in the ring structure, the compound is referred to as a phytostanol. Phytosterols are also present in some cereal lipids, but they are not as ubiquitous as sitosterol (Fig. 1).

The cholesterol-lowering effect is attributed to both free PS and their esterified forms, but free PS are difficult to solubilize at the required concentration in foods and food products. This hurdle was overcome during the 1990s by esterification of PS and phytosterols with fatty acids. The first commercial product containing esters of phytosterols was a table margarine called Benecol, which was initially marketed in Finland during the mid-1990s (Miettinen *et al.*, 1995). Since then, many food products—such as margarine, milk, mayonnaise, cheese, pasta, yogurt, meat products, snack bars, cooking oil, beverages—enriched with PS and phytosterols have been marketed (Moreau, 2004), and more products are expected to be introduced.

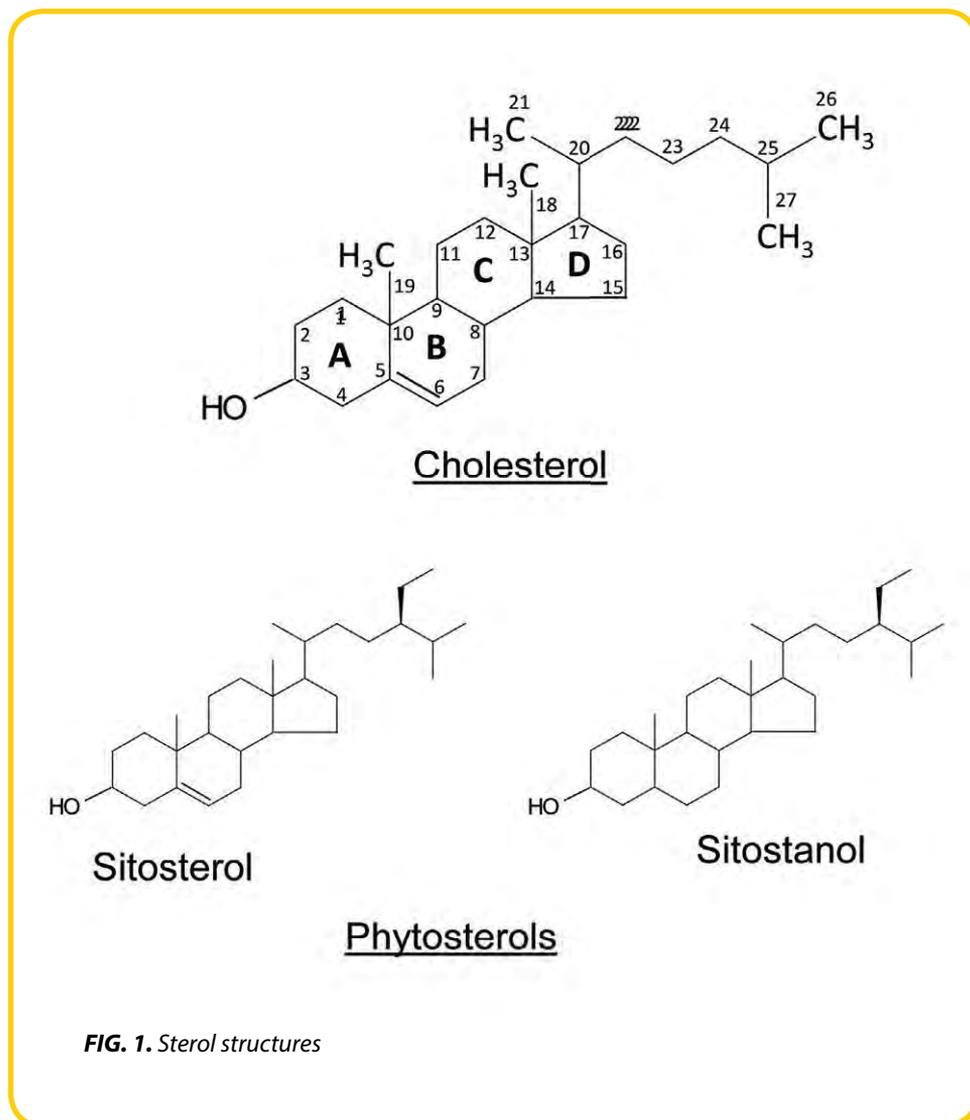


FIG. 1. Sterol structures

Oxidation of phytosterols in foods and raw materials

PS are extracted from the by-product distillate produced by vegetable oil refineries, and phytosterols are generally derived by hydrogenation of PS from tall oil (see *inform* 11:580–588, 2000). The esters of PS and phytosterols are produced on an industrial scale by esterification with naturally occurring fatty acids.

During the refining of crude oils and fats, some PS are oxidized during heating,

degumming, neutralization, bleaching, deodorization, storage, and handling. Much of what is known about the oxidation mechanisms for PS is based on cholesterol studies. PS oxidation can be initiated and facilitated by many factors such as heat, light, air, water, and transition metals, as well as by many different reactive oxygen species present in the foods and raw materials. Some common oxyphytosterols/oxyphytosterols (POP) in foods and animal tissues include 7-hydroperoxides,

CONTINUED ON NEXT PAGE

TABLE 1. Oxyphytosterols (POP) in human serum/plasma

Subjects	Total POP (ng/mL)	Reference
Control ^a	nd ^b	Plat <i>et al.</i> (2001)
Patient ^c	4,670	Plat <i>et al.</i> (2001)
Healthy volunteers ^d	113	Grandgirard <i>et al.</i> (2004)

^aPooled serum sample from 15 human subjects not suffering from any sterol-related disease.

^bNot detected.

^cA phytosterolemia human patient with high level of serum phytosterols (44 mg/dL) compared with control group (1.3 mg/dL). Approximate composition: 7 β -hydroxysitosterol (19%), 7-ketositosterol (20%), 5 α ,6 α -epoxysitosterol (50%), and sitostanetriol (12%).

^dMean value of POP in the plasma of 13 healthy human subjects. The composition of the POP: 7-ketositosterol (5%), 5 α ,6 α -epoxysitosterol (5%), 5 β ,6 β -epoxysitosterol (51%), sitostanetriol (35%), and campestanetriol (4%).

7 α -hydroxysterols, 7 β -hydroxysterols, 7-ketosterols, epimers of epoxy derivatives, and triols. Moreover, 24- and 25-hydroxy derivatives of PS are also reported (Ryan *et al.*, 2009).

Stanolols do not contain a double bond at the $\Delta 5$ position and are therefore considered more stable than their counterparts that contain an olefinic unsaturation (Fig. 1). Clearly, based on its structure, sitostanol is expected to be less susceptible to oxidation than PS. However, in a study by Soupas

et al. (2007), levels of POP were found to be rather similar in ingredients based on PS esters and phytostanyl esters. This might indicate that the POP had been generated in the ingredients during extraction and subsequent esterification of PS and phytostanolols with fatty acids. Recently, levels of POP in the PS- and PS-ester-based ingredients extracted from different vegetable oils and tall oil from pine trees were found to range from 29 to 110 $\mu\text{g}/100\text{ g}$ (González-Larena *et al.*, 2011).

POP in vegetable oils and in enriched foods

Owing to the lack of harmonized analytical methods, published data on the levels of POP in different vegetable oils are difficult to compare even in similar types of material. For example, levels of POP in rapeseeds and different rapeseed oil samples range from zero to more than 100 ppm. Several food products enriched with PS and stanol esters are available, which might be sources of higher intake of POP. Three independent studies have shown rather comparable levels (44 to 68 $\mu\text{g}/\text{g}$ sample) of POP in a commercial margarine product containing PS esters (for details see, Ryan *et al.*, 2009).

Are oxyphytosterols (POP) of health concern?

Unoxidized PS has been investigated extensively because it is a component in many enriched food products. More vegetable oils are being used for cooking than 20 years ago, and many food products enriched with PS and phytostanolols are available to consumers. Extensive studies have been conducted on oxysterols (COP) for their potentially adverse health effects such as atherogenicity,

information

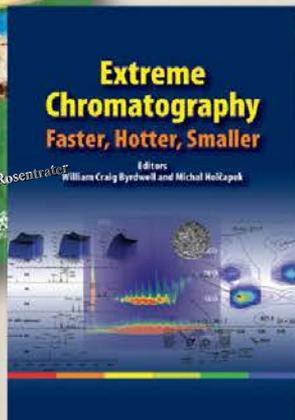
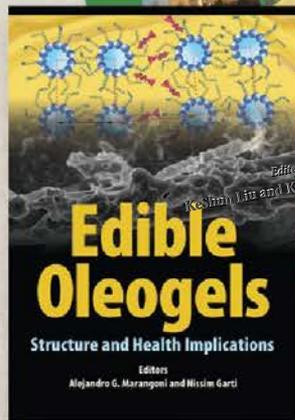
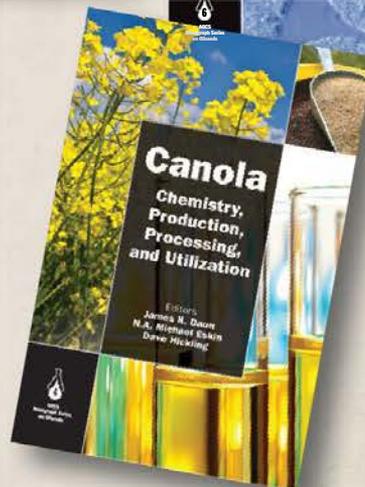
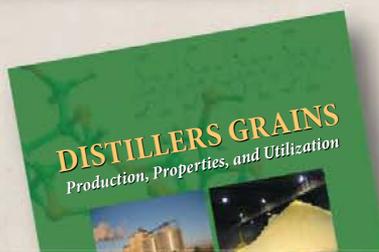
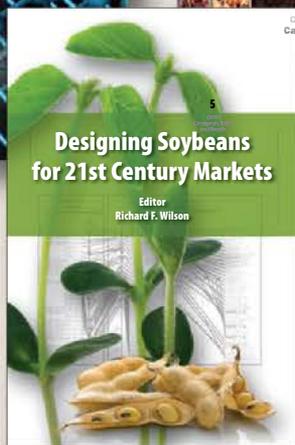
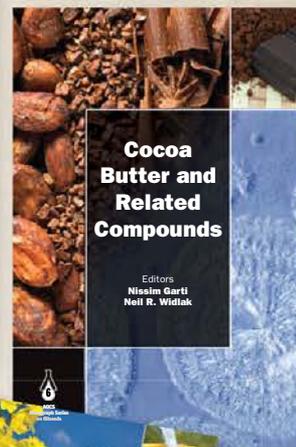
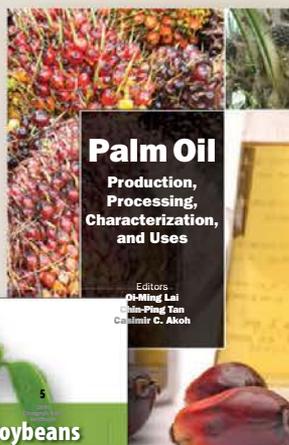
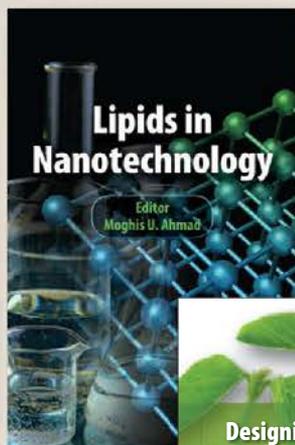
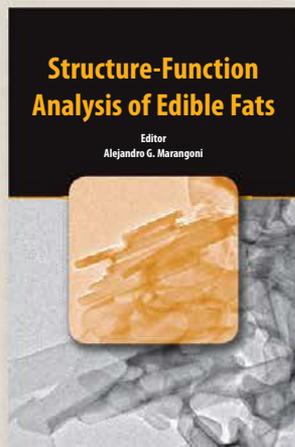
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A CEO's guide to innovation in China

Dynamic domestic players and focused multinationals are helping China churn out a growing number of innovative products and services. Intensifying competition lies ahead; here's a road map for navigating it.

Gordon Orr and Erik Roth Source

China is innovating. Some of its achievements are visible: a doubling of the global percentage of patents granted to Chinese inventors since 2005, for example, and the growing role of Chinese companies in the wind- and solar-power industries. Other developments—such as advances by local companies in domestically oriented consumer electronics, instant messaging, and online gaming—may well be escaping the notice of executives who aren't on the ground in China.

As innovation gains steam there, the stakes are rising for domestic and multinational companies alike. Prowess in innovation will not only become an increasingly important differentiator inside China but should also yield ideas and products that become serious competitors on the international stage.

Chinese companies and multinationals bring different strengths and weaknesses to this competition. The Chinese have traditionally had a bias toward innovation through commercialization—they are more comfortable than many Western companies are with putting a new product or service into the market quickly and improving its performance through subsequent generations. It is common for products to launch in a fraction of the time that it would take in more developed markets. While the quality of these early versions may be variable, subsequent ones improve rapidly.

Chinese companies also benefit from their government's emphasis on indigenous innovation, underlined in the latest five-year plan. Chinese authorities view innovation as critical both to the domestic economy's long-term health and to the global competitiveness of Chinese companies. China has already created



the seeds of 22 Silicon Valley-like innovation hubs within the life sciences and biotech industries. In semiconductors, the government has been consolidating innovation clusters to create centers of manufacturing excellence.

But progress isn't uniform across industries, and innovation capabilities vary significantly: several basic skills are at best nascent within a typical Chinese enterprise. Pain points include an absence of advanced techniques for understanding—analytically, not just intuitively—what customers really want, corporate cultures that don't support risk taking, and a scarcity of the sort of internal collaboration that's essential for developing new ideas.

Multinationals are far stronger in these areas but face other challenges, such as high attrition among talented Chinese nationals that can slow efforts to create local innovation centers. Indeed, the contrasting capabilities of domestic and multinational players, along with the still-unsettled state of intellectual-property protection (see sidebar, "Improving the patent process"), create the potential

for topsy-turvy competition, creative partnerships, and rapid change. This article seeks to lay out the current landscape for would-be innovators and to describe some of the priorities for domestic and multinational companies that hope to thrive in it.

China's innovation landscape

Considerable innovation is occurring in China in both the business-to-consumer and business-to-business sectors. Although breakthroughs in either space generally go unrecognized by the broader global public, many multinational B2B competitors are acutely aware of the innovative strides the Chinese are making in sectors such as communications equipment and alternative energy. Interestingly, even as multinationals struggle to cope with Chinese innovation in some areas, they seem to be holding their own in others.

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The business-to-consumer visibility gap

When European and US consumers think about what China makes, they reflexively turn to basic items such as textiles and toys, not necessarily the most innovative products and rarely associated with brand names.

In fact, though, much product innovation in China stays there. A visit to a shop of the Suning Appliance chain, the large Chinese consumer electronics retailer, is telling. There, you might find an Android-enabled television complete with an integrated Internet-browsing capability and preloaded apps that take users straight to some of the most popular Chinese Web sites and digital movie-streaming services. Even the picture quality and industrial design are comparable to those of high-end televisions from South Korean competitors.

China's solar- and wind-power industries are also taking center stage. The country will become the world's largest market for renewable-energy technology, and it already has some of the sector's biggest companies, providing critical components for the industry globally. Chinese companies not only enjoy scale advantages but also, in the case of solar, use new manufacturing techniques to improve the efficiency of solar panels.

Success in B2B innovation has benefited greatly from friendly government policies, such as establishing market access barriers; influencing the nature of cross-border collaborations by setting intellectual-property requirements in electric vehicles, high-speed trains, and other segments; and creating domestic-purchasing policies that favor Chinese-made goods and services. Many view these policies as loading

THE STRENGTH OF THE COUNTRY'S SCIENTIFIC AND TECHNICAL TALENT IS GROWING, AND LOCAL COMPANIES INCREASINGLY BRING REAL CAPABILITIES TO THE TABLE.

We observe the same home-grown innovation in business models. Look, for example, at the online sector, especially Tencent's QQ instant-messaging service and the Sina Corporation's microblog, Weibo. These models, unique to China, are generating revenue and growing in ways that have not been duplicated anywhere in the world. QQ's low, flat-rate pricing and active marketplace for online games generate tremendous value from hundreds of millions of Chinese users.

What's keeping innovative products and business models confined to China? In general, its market is so large that domestic companies have little incentive to adapt successful products for sale abroad. In many cases, the skills and capabilities of these companies are oriented toward the domestic market, so even if they want to expand globally, they face high hurdles. Many senior executives, for example, are uncomfortable doing business outside their own geography and language. Furthermore, the success of many Chinese models depends on local resources—for example, lower-cost labor, inexpensive land, and access to capital or intellectual property—that are difficult to replicate elsewhere. Take the case of mobile handsets: most Chinese manufacturers would be subject to significant intellectual property-driven licensing fees if they sold their products outside China.

Successes in business to business

Several Chinese B2B sectors are establishing a track record of innovation domestically and globally. The Chinese communications equipment industry, for instance, is a peer of developed-world companies in quality. Market acceptance has expanded well beyond the historical presence in emerging markets to include Europe's most demanding customers, such as France Télécom and Vodafone.

Pharmaceuticals are another area where China has made big strides. In the 1980s and 1990s, the country was a bit player in the discovery of new chemical entities. By the next decade, however, China's sophistication had grown dramatically. More than 20 chemical compounds discovered and developed in China are currently undergoing clinical trials.

the dice in favor of Chinese companies, but multinationals should be prepared for their continued enforcement.

Despite recent setbacks, an interesting example of how the Chinese government has moved to build an industry comes from high-speed rail. Before 2004, China's efforts to develop it had limited success. Since then, a mix of two policies—encouraging technology transfer from multinationals (in return for market access) and a coordinated R&D-investment effort—has helped China Railways' high-speed trains to dominate the local industry. The multinationals' revenue in this sector has remained largely unchanged since the early 2000s.

But it is too simplistic to claim that government support is the only reason China has had some B2B success. The strength of the country's scientific and technical talent is growing, and local companies increasingly bring real capabilities to the table.

What's more, a number of government-supported innovation efforts have not been successful. Some notable examples include attempts to develop an indigenous 3G telecommunications protocol called TDS-CDMA and to replace the global Wi-Fi standard with a China-only Internet security protocol, WAPI.

Advantage, multinationals?

Simultaneously, multinationals have been shaping China's innovation landscape by leveraging global assets. Consider, for example, the joint venture between General Motors and the Shanghai Automotive Industry Corporation, which adapted a US minivan (Buick's GL8) for use in the Chinese market and more recently introduced a version developed in China, for China. The model has proved hugely popular among executives.

In fact, the market for vehicles powered by internal-combustion engines remains dominated by multinationals, despite significant incentives and encouragement from the Chinese government, which had hoped that some domestic automakers would emerge as leaders by now. The continued strength of multinationals indicates how hard it is to break through in industries with 40 or 50 years of intellectual

capital. Transferring the skills needed to design and manufacture complex engineering systems has proved a significant challenge requiring mentorship, the right culture, and time.

We are seeing the emergence of similar challenges in electric vehicles, where early indications suggest that the balance is swinging toward the multinationals because of superior product quality. By relying less on purely indigenous innovation, China is trying to make sure the electric-vehicle story has an ending different from that of its telecommunications protocol efforts. The government's stated aspiration of having more than five million plug-in hybrid and battery electric vehicles on the road by 2020 is heavily supported by a mix of extensive subsidies and tax incentives for local companies, combined with strict market access rules for foreign companies and the creation of new revenue pools through government and public fleet-purchase programs. But the subsidies and incentives may not be enough to overcome the technical challenges of learning to build these vehicles, particularly if multinationals decline to invest with local companies.

Four priorities for innovators in China

There's no magic formula for innovation—and that goes doubly for China, where the challenges and opportunities facing domestic and multinational players are so different. Some of the priorities we describe here, such as instilling a culture of risk taking and learning, are more pressing for Chinese companies. Others, such as retaining local talent, may be harder for multinationals. Collectively, these priorities include some of the critical variables that will influence which companies lead China's innovation revolution and how far it goes.

Deeply understanding Chinese customers

Alibaba's Web-based trading platform, Taobao, is a great example of a product that emerged from deep insights into how customers were underserved and their inability to connect with suppliers, as well as a sophisticated understanding of the Chinese banking system. This dominant marketplace enables thousands of Chinese manufacturers to find and transact with potential customers directly. What looks like a straightforward eBay-like trading platform actually embeds numerous significant innovations to support these transactions, such as an ability to facilitate electronic fund transfers and to account for idiosyncrasies in the national banking system. Taobao wouldn't have happened without Alibaba's deep, analytically driven understanding of customers.

Few Chinese companies have the systematic ability to develop a deep understanding of customers' problems. Domestic players have traditionally had a manufacturing-led focus on reapplying existing business models to deliver products for fast-growing markets. These "push" models will find it increasingly hard to unlock pockets of profitable growth. Shifting from delivery to creation requires more local research and development, as well as the nurturing of more market-driven organizations that can combine insights into detailed Chinese customer preferences with a clear sense of how the local business environment is evolving. Requirements include both research techniques relevant to China and people with the experience to draw out actionable customer insights.

Many multinationals have these capabilities, but unless they have been operating in China for some years, they may well lack the domestic-market knowledge or relationships needed to apply them effectively. The solution—building a true domestic Chinese presence rather than an outpost—sounds obvious, but it's difficult to carry out

without commitment from the top. Too many companies fail by using "fly over" management.

But some multinationals appear to be investing the necessary resources; for example, we recently met (separately) with top executives of two big industrial companies who were being transferred from the West to run global R&D organizations from Shanghai. The idea is to be closer to Chinese customers and the network of institutions and universities from which multinationals source talent.

Retaining local talent

China's universities graduate more than 10,000 science PhDs each year, and increasing numbers of Chinese scientists working overseas are returning home. Multinationals in particular are struggling to tap this inflow of researchers and managers. A recent survey by the executive-recruiting firm Heidrick & Struggles found that 77 percent of the senior executives from multinational companies responding say they have difficulty attracting managers in China, while 91 percent regard employee turnover as their top talent challenge.

Retention is more of an issue for multinationals than for domestic companies, but as big foreign players raise their game, so must local ones. Chinese companies, for example, excel at creating a community-like environment to build loyalty to the institution. That helps keep some employees in place when competing offers arise, but it may not always be enough.

CONTINUED ON NEXT PAGE

Looking for Leaders

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Talented Chinese employees increasingly recognize the benefits of being associated with a well-known foreign brand and like the mentorship and training that foreign companies can provide. So multinationals that commit themselves to developing meaningful career paths for Chinese employees should have a chance in the growing fight with their Chinese competitors for R&D talent. Initiatives might include in-house training courses or apprenticeship programs, perhaps with local universities. General Motors sponsors projects in which professors and engineering departments at leading universities research issues of interest to the automaker. That helps it to develop closer relations with the institutions from which it recruits and to train students before they graduate.

Some multinationals energize Chinese engineers by shifting their roles from serving as capacity in a support of existing global programs to contributing significantly to new innovation thrusts, often aimed at the local market. This approach, increasingly common in the pharma industry, may hold lessons for other kinds of multinationals that have established R&D or innovation centers in China in recent years (read about AstraZeneca's experience in "Three snapshots of Chinese innovation"). The keys to success include a clear objective—for instance, will activity support global programs or develop China-for-China innovations?—and a clear plan for attracting and retaining the talent needed to staff such centers. Too often, we visit impressive R&D facilities, stocked with the latest equipment, that are almost empty because staffing them has proved difficult.

Instilling a culture of risk taking

Failure is a required element of innovation, but it isn't the norm in China, where a culture of obedience and adherence to rules prevails in most companies. Breaking or even bending them is not expected and rarely tolerated. To combat these attitudes, companies must find ways to make initiative taking more acceptable and better rewarded.

One approach we found, in a leading solar company, was to transfer risk from individual innovators to teams. Shared accountability and community support made increased risk taking and experimentation safer. The company has used these "innovation work groups" to develop everything from more efficient battery technology to new manufacturing processes. Team-based approaches also have proved effective for some multinationals trying to stimulate initiative taking (read about General Motors' approach in "Three snapshots of Chinese innovation").

How fast a culture of innovation takes off varies by industry. We see a much more rapid evolution toward the approach of Western companies in the way Chinese high-tech enterprises learn from their

customers and how they apply that learning to create new products made for China (read a perspective on the evolution of its semiconductor sector in "Three snapshots of Chinese innovation"). That approach is much less common at state-owned enterprises, since they are held back by hierarchical, benchmark-driven cultures.

Promoting collaboration

One area where multinationals currently have an edge is promoting collaboration and the internal collision of ideas, which can yield surprising new insights and business opportunities. In many Chinese companies, traditional organizational and cultural barriers inhibit such exchanges.

Although a lot of these companies have become more professional and adept at delivering products in large volumes, their ability to scale up an organization that can work collaboratively has not kept pace. Their rigorous, linear processes for bringing new products to market ensure rapid commercialization but create too many hand-offs where insights are lost and trade-offs for efficiency are promoted.

One Chinese consumer electronics company has repeatedly tried to improve the way it innovates. Senior management has called for new ideas and sponsored efforts to create new best-in-class processes, while junior engineers have designed high-quality prototypes. Yet the end result continues to be largely undifferentiated, incremental improvements. The biggest reason appears to be a lack of cross-company collaboration and a reliance on processes designed to build and reinforce scale in manufacturing. In effect, the technical and commercial sides of the business don't cooperate in a way that would allow some potentially winning ideas to reach the market. As Chinese organizations mature, stories like this one may become rarer.

China hasn't yet experienced a true innovation revolution. It will need time to evolve from a country of incremental innovation based on technology transfers to one where breakthrough innovation is common. The government will play a powerful role in that process, but ultimately it will be the actions of domestic companies and multinationals that dictate the pace of change—and determine who leads it. ■

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IMPROVING THE PATENT PROCESS

In innovative sectors such as biotechnology, electric vehicles, pharmaceuticals, and solar energy, the number of patent applications from Chinese companies is rising. In fact, Huawei and ZTE ranked among the world's top five corporate patent registrants by volume in 2010. Intensifying patent activity reflects a growing recognition that intellectual property is essential to value. As this mentality takes hold, domestic innovators may pressure the government to create a more modern intellectual-property system.

Currently, China recognizes three categories of patents: invention (what most people elsewhere think of as worthy of a patent), utility (a new use for something that already exists), and design. Invention patents run for 20 years, the others only for 10. Patent reform—such as reducing the duration of design or

utility patents and raising the bar for what can be registered in those categories—would be a powerful way for the Chinese government to signal its seriousness about promoting indigenous innovation. If China decides to move ahead with patent reform, a desire for global consistency could well make it a high-priority multilateral issue.

Without patent reform, companies must rely on one of two strategies for protecting intellectual property. The first is to continue to outrun the competition by developing increasingly innovative solutions or building in protection through complex integration that is difficult to reverse-engineer. The second is to create easily identifiable technology "signatures" that would be hard to refute in legal proceedings.

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Asian plant lipid scientists meet in Hong Kong

Thomas J. Bach

The 4th Asian Symposium on Plant Lipids, held December 2-4, was organized by Mee-Len Chye (Hong Kong University) and supported by an international committee. About 95 people from Asia, Europe, the United States, and Canada, attended the conference, which featured 21 oral presentations and 32 posters.

The opening lecture, "Fatty acid desaturases, acyl transferases, and our challenge," was presented by **Norio Murata** (National Institute for Basic Biology, Okazaki, Japan), who described research that spanned several decades. Aspects like evolution and adaptation of lipid biosynthesis and composition in response to varying temperature were touched on, but the main emphasis was on the characterization of desaturases and the effect of unsaturated fatty acids on membrane fluidity and on vital processes like photosynthesis and respiration. Attempts to improve plant resistance to cold via genetic modifications were also described.

A special lecture was presented by **John L. Harwood** (Cardiff University, UK), who presented his ideas on the mechanisms that control lipid biosynthesis, the flux regulation of precursors and intermediates by limiting and non-limiting reactions, and the impact on the productivity of important oil crops. He revealed that such mechanisms seem to be specific to the plants species examined. How does one approach the problem? One way is to apply specific inhibitors, if available, by gradually down-regulating genes (for instance by RNAi) or by over-expressing them. This will help establish models of carbon flux to plant storage oils.

Hajime Wada (University of Tokyo) presented new data on the role of phosphatidylglycerol (PG) in Arabidopsis, such as its synthesis in subcellular compartments (i.e., ER, chloroplasts and mitochondria). When suitable mutants like *pgp1*, which is deficient in the functional phosphatidylglyceride (PG) phosphate synthase involved in the development of mitochondria and chloroplasts, were inserted, he could see no effect on mitochondria. This suggests that they are then provided by ER-derived

PG, needed for cardiolipin synthesis. Compromised growth of *pgp1* mutants was partially overcome by sucrose, but the development of chloroplasts remained affected. In *pgp2* mutants a weak effect on seed development was observed, but otherwise no special phenotype could be seen. However, in the generated *pgp1/pgp2* double mutant, embryo development was arrested at the early torpedo stage, indicative of the importance of PG synthesis. A mutant compromised in mitochondrial cardiolipin synthesis (*cls-2*) exhibits retarded root growth, abnormal, much bigger, and elongated mitochondria. Transformation with a dexamethazone-inducible *CLS-2* gene restored the wild-type phenotype.

Nina Sanina (Vladivostok) and collaborators presented studies on the influence of MGDG from marine macrophytes (*Ulva fenestra*) in conjunction with a triterpene glycosid cucumarioside A₂-2 from *Cucumaria japonica* on immunogenicity and conformation of antigens on the tubular immunostimulating (TI) complex. Such a type of new adjuvant seems to work more efficiently than the well-known Freund's. (A little side note: Members of this Siberian group used the pleasant "Spring" temperature at Hong Kong to go even swimming in the Sea!)

In a poster from the same group, with Natalia Vorobyeva as first author, the FA composition and phase transition properties of polar lipids from the marine macrophyte *Ulva* sp in different climatic zones was studied (means harvested in the Sea of Japan and in the Adriatic Sea in August, respectively). In the Adriatic Sea colorless *Ulva* was found, without containing glycolipids. Polar lipids contained a higher portion of unsaturated FA, but altogether, compensatory mechanisms seem not to be sufficient for protection of the photosynthetic apparatus against high temperature-induced damage.

Mi Chung Suh (Chonnam National University, Republic of Korea) presented new studies on the transcriptional regulation of cuticular wax biosynthesis under drought stress in Arabidopsis. Major focus was directed on the isolation of transcription factors whose transcript levels are significantly induced or repressed in response to drought stress and by abscisic acid (ABA). It revealed that MYB96 is induced by ABA plus drought and osmotic stress, and that MYB96 is apparently implied in the up-regulation of

genes coding for enzymes of cuticular wax biosynthesis and that the transcription factor (thereby?) partially regulates cuticular transpiration.

This observation was further detailed in a poster presented by **Saet Buyl Lee** as first author. The MYB96 protein apparently acts as a transcriptional activator of genes that code for VLCFA-condensing enzymes involved in wax biosynthesis. Another poster by **Hyojin Kim** et al. from the same group addressed the problem of hydrophobic lipid transfer to the plant cell surface passing the hydrophilic cell wall.

eties with naturally rich content in stearic acid and thus of fat that could be used in food industry without chemical manipulation such as hydrogenation, transesterification etc. Apparently, there is some difference in the physico-chemical properties to what should be expected, an effect of the affinity of acyl-CoA acyl-transferases, with the result of an asymmetric distribution of saturated FAs within the triacylglycerol (TAG) molecule.

Randall J. Weselake (University of Alberta, Edmonton, Canada) presented studies aiming at increasing seed oil accumulation by directed evolution of diacylglycerol

FINALLY THEY COULD IDENTIFY AN ABCA-TYPE TRANSPORTER, WHOSE OVER-EXPRESSION IN PLANTS LED TO SIGNIFICANTLY LARGER SEEDS AND AN UP TO 44% INCREASE IN TAG CONTENT AS COMPARED TO WT.

Glycosylphosphatidylinositol-anchored lipid transfer protein 1 (LTPG1) contributes to this export. Questions that still need answers are concerning the factors downstream in the ABA signaling chain. It should not escape the attention of readers that the generation of drought-resistant crops, i.e. through higher sensitivity to ABA, followed by stomata closure, but without compromising seed dormancy and germination and early development of seedlings is a rather hot field... A poster from the same group presented an analysis of an Arabidopsis mutant defective in marneral synthesis (*mnr1*), with a very dramatic phenotype that is mainly due to a problem with cell elongation, which is discussed as a membrane effect. The marneral synthase (MRN1) is localized to the ER. (Marneral and when reduced: marneral is an unusual triterpenoid with only one cycle in the structure. In *Iris* species marneral acts as precursor of iridoids, but what it does in Arabidopsis still remains somehow enigmatic.)

Chuang Yang (Chinese Academy of Sciences, Beijing, China) and coworkers studied the effect of thylakoid lipids on the function of minor light-harvesting Chl_{a/b} complexes in photosystem II. By following the effect of carotenoid and Chl_b excitation by 473 nm laser light and the use of proteoliposomes containing different components of PS-II supercomplexes, the interaction between LHCII and the PSII reaction centre were examined. Surprisingly, the presence of minor LHCII was not a prerequisite for Förster resonance energy transfer (FRET), albeit a dramatic reduction in the electron transport within the PSII core complexes was observed.

Enrique Martínez-Force and colleagues (Instituto de la Grasa, CSIC, Seville, Spain) are aiming at designing sunflower oils for "healthy foods", means generating vari-

acyltransferase (DGAT). Even an increase of seed oil by just one percent would already result in an additional \$90 million per year for the seed oil extraction and processing industry... DGAT catalyzes the acyl-CoA-dependent acylation of *sn*-1, 2-diacylglycerol to produce TAG, the main constituent of seed oil. A high-throughput screening method based on a yeast-recombinant system was established to identify DGAT with enhanced activity through a directed evolution approach. The best result so far was the identification of a DGAT variant with 7-fold increase in yeast TAG accumulation over the wild-type enzyme, only due to a single amino acid substitution.

Kent D. Chapman (University of North Texas, Denton, USA) and his numerous collaborators in the USA and in Germany astonished the audience with new techniques that allow the visualization of seed lipid composition. Such techniques, applied to cottonseed tissues involve miniaturized MALDI-MS imaging of cryosections of mature cotton embryos, which nicely showed a distinct, heterogeneous distribution of molecular species of TAGs and phosphatidylcholines (PCs). The analysis by using ¹H-NMR coincided with this pattern. Those high-resolution techniques have a strong potential even for the study of relatively minor lipids, for instance for those being involved in cellular signaling!

Kenzo Nakamura (Chubu University, Kasugai, Japan) talked about the repression of genes involved in seed oil accumulation after seed germination. This process concerns all genes that are actively expressed during accumulation of oil. Genes coding for seed-specific oleosins are eventually packaged into heterochromatin during seedling development. Chromatin immunoprecipitation with antibodies against transcription factors was used to

examine their role by real-time monitoring in repressing seed maturation genes. A luciferase reporter gene system was established for the large-scale screening of mutants being defective in the repression of seed maturation genes during germination.

The field of prenyl lipids was introduced by colleagues from the IBMP (CNRS and University of Strasbourg, France).

Thomas J. Bach focused his talk on the isoprenylation of proteins, using specially transformed tobacco BY-2 cells, expressing a GFP fusion protein carrying C-terminal motifs for either geranylgeranylation or farnesylation by corresponding protein prenyltransferases. Such cells were utilized to establish a visualization system for the biochemical process of isoprenylation, based on the subcellular localization. The system has been miniaturized for semi-automated confocal microscopy analysis, for identification of inhibitors and effectors that interfere with the plastidial methyl erythritol phosphate (MEP) pathway. Current attempts are directed towards the effect of precursor pools on the *in vivo* specificity of such protein prenyltransferases (apparently not identical with what can be measured *in vitro* with heterologously expressed enzymes). Furthermore, suitable Arabidopsis mutants are also under examination as to the tissue-specificity of protein isoprenylation.

The other colleague from the same institute at Strasbourg, **Hubert Schaller**, presented studies on reactions downstream of the sterol pathway, focusing for instance on cycloartenol synthase (CAS), converting 2,3-oxidosqualene into plant-specific cycloartenol, as the by far dominating first cyclization product over trace amounts of lanosterol that dominates in animals and fungi. He also reported on cyclopropyl sterol isomerase from Arabidopsis and tobacco, expressed in suitable yeast mutants and "*in planta*". Interesting to note that cycloartenol seems to play a very specific role in tobacco pollen tube development, but no end-of-chain sterol like sitosterol. Such studies were accompanied by analysis of the phosphoproteome in an Arabidopsis mutant being compromised in phytosterol synthesis due to a deficit in the HMG-CoA reductase (HMGR) 1 gene (*HMG1*) expression, apparently with a strong effect on proteins involved in general metabolism. (HMGR is regulating the mevalonic acid (MVA) pathway in plants and is thus controlling the substrate flux to sterols.)

Julia N. Valitova (Institute of Biochemistry & Biophysics, Kazan, Russia) and colleagues from St. Petersburg presented data on how membrane sterol depletion by the antifungal nystatin increases membrane permeability through complex formation, mainly with β -sitosterol, and how it modifies glycosphingolipid (GlcCer) composition and upregulates GlcCer concentration in wheat (*Triticum aestivum*) roots. The compound forms pores in the membrane through a "channel" with the hydroxyl groups being exposed to the inner side, which permits the passage of ions and thiol-containing compounds. The authors touched on the raft hypothesis, which means that there exist membrane sub-domains that are enriched in sterols and GlcCer, but also containing a special set of enzymes. Generally,

nystatin caused an increase in O_2 consumption, an accumulation of H_2O_2 , decreased cell viability and induced cell death *via* autophagy (demonstrated by using the Lyso Tracker Red stain). In contrast to nystatin, gramicidin forms non-specific channels. Interestingly, partial depletion of membrane sterols by treatment with methyl- β -cyclodextrin also resulted in an increase in GlcCer, some sort of functional compensation?

Dinesh A. Nagegowda (Central Institute of Medicinal and Aromatic Plants, Lucknow, India) has focused his attention on the biosynthesis of monoterpene indole alkaloids (MIA) in periwinkle (*Catharanthus roseus*), a quite hot field in view of the efficiency of vinblastine and vincristine as anti-cancer agents! The isoprenoid moiety of such molecules is derived from MEP-derived geraniol, thus the formation of geranyl diphosphate was studied at the gene and enzyme level, which resulted in the characterization of a geranyl-PP synthase and a bifunctional geranylgeranyl-PP synthase (CrGPPS and CrGGPPS). Co-expression in *E. coli* of CrGPPS and CrGGPPS with the catalytically inactive small subunit of *Antirrhinum* GPPS resulted in protein-protein interaction, which modified their chain length specificity. Moreover, transient over-expression of AmGGPS-SSU in *C. roseus* leaves resulted in a 45% increase in vindilines, an immediate monomeric precursor of vincristine and vinblastine, a quite promising observation.

Yuki Nakamura (Institute of Plant and Microbial Biology, Academia Sinica, Taipei, Taiwan) reported on the essential role of glycerolipids in plant reproductive processes. A KO mutant in monogalactosyl diglyceride (MGDG) synthesis showed bleaching and a distorted growth. Especially floral organs revealed a significant galactolipid synthesis, with an especially pronounced accumulation during pollen tube elongation. Arabidopsis inflorescences, containing flowers in different developmental stages were analyzed by "lipidomics", accompanied by transcriptomic analyses of relevant lipid biosynthetic genes. Further, it was demonstrated that TFL1 (a homolog of RAF kinase inhibitor protein - RKIB/PEBP - binds phosphatidyl choline (PC). One of the possible conclusions is that PC might modulate the inflorescence meristem. Some perspectives were presented on the application of such techniques to algal lipid engineering.

Ikuo Nishida (Saitama University, Japan) and his associates studied the effects of the *pect1-4* mutation in Arabidopsis. PECT1 (CTP:phosphoethanolamine cytidyltransferase) regulates PE biosynthesis. PE represents the major phospholipid in mitochondria and appears to play an important role in the respiration capacity in purified organelles (maximum: $250 \text{ nmol } O_2 \text{ min}^{-1} \text{ mg}^{-1}$). In the

mutant mainly the cytochrome pathway (CP) of electron transport was decreased. Cold treatment for 3 d (8°C) transiently decreased the CP and the alternative – plant-specific – pathway (AP) in both wild-type and *pect1-4* mitochondria, however a longer exposure to low temperature let the mitochondria resume the total respiration capacity; but in the mutant only CP capacity was increased, to the level of both CP and AP capacities together in wild-type mitochondria. Apparently, the *pect1-4* mutation affects CP capacity at ambient temperature and prevents the adjustment of AP capacity and of mitochondrial PE/PC ratios at 8°C.

The same group (**Yasuyo Yamaoka** et al.) had a poster on display, which demonstrated the important role played by phosphatidylserine (PS) synthase1 (PSS1) in root development of Arabidopsis. *Pss-1-1* and *pss1-2* homozygous mutants exhibit root growth inhibition, but with a significantly increased number of root hairs. The colleagues used a “biosensor” for PS, GFP-LactC2, apparently co-localizing to the endocytic red-fluorescence tracer FM4-64, the late endosomal marker ARA6-mRFP and the *trans*-Golgi network marker mRFP-SYP43. From this and further studies the authors concluded that PS could play an important role in late endosomal vesicle transport.

and the enzyme is localized to the ER, like FAH12. When expressed in Arabidopsis under the control of the *FAE1* promoter, PADT1-2 significantly enhanced accumulation of hydroxy FAs in TGA, at the expense of their presence in phospholipids in CL37 seeds, a promising observation in view of oilseed engineering. *FAD12* over-expression led also to up-regulation of genes involved in cutin biosynthesis in CL37 seeds.

Akinori Kiba (Kochi University, Nankoku, and colleagues from Nagoya University, Japan) elucidated the molecular mechanisms of lipid-mediated plant immune responses. They have isolated a gene from the *SEC14* gene superfamily (*NbSEC14*) that is induced in *Nicotiana benthamiana* leaves after inoculation with the systemic pathogen *Ralstonia solanacearum*. In *NbSEC14*-silenced (VIGS) plants the hypersensitive reaction was not affected, however expression of defense-related genes was compromised, leading to better growth of avirulent (RS8107) and virulent (RSOE1-1) bacteria. Interestingly, in yeast *SEC14* was isolated as gene coding for a transport protein. A temperature-sensitive *sec14* yeast mutant was complemented by *NbSEC14*, and recombinant NbSEC14 showed strong phosphatidylinositol and phosphatidylcholine transfer activities. *NbSEC14* silencing led also to a significant reduction

COMPARATIVE PROTEOME ANALYSIS REVEALED THAT PROTEINS INVOLVED IN GENE TRANSCRIPTION AND CELLULAR ORGANIZATION, CARBON METABOLISM AND ENERGY TRANSFER WERE DOWN-REGULATED, WHEREAS STRESS-RELATED PROTEINS WERE UP-REGULATED.

Hyun Uk Kim (National Academy of Agricultural Science, Suwon, and colleagues from the Chonnam Natl. University, Gwangju, Republic of Korea) focused their attention on the elucidation of TAG biosynthesis in castor bean (*Ricinus communis* L.). Castor oil contains ricinoleic acid (12-hydroxy-octadeca-9-enoic acid), which is useful in industrial materials. Ricinoleic acid (RA) is synthesized in phospholipids, indicative of an “editing enzyme”, which acts as a phospholipid:diacylglycerol acyltransferase (PDAT) with RA as substrate. When transgenic Arabidopsis plants were generated expressing a FA Δ^{12} -hydroxylase encoded by the castor bean *FAH12* gene, a limited amount of hydroxylated FA was produced in seeds, but it remained in membrane phospholipids. Two castor bean genes coding for PDAT: *PADT1-1* and *PADT2* are homologs of genes commonly found in plants, but *PADT1-2* seems to be a castor bean-specific gene. It is expressed in developing seeds

of phospholipase C and D activities and of lipid signaling molecules like diacylglycerol and phosphatidic acid.

Masahito Nakano and the colleagues from Kochi University, Ehime University, and the Iwate Biotechnology Research Center presented also a poster focusing on the functional characterization of *N. benthamiana* phosphatidic acid phosphatase (NbPAP). In *NbPAP*-silenced plants (VIGS) defense signaling pathways (JA and ROS-dependent) were activated, resulting in resistance to *R. solanacearum*, whereas over-expressing plants showed an increased susceptibility to those pathogenic bacteria. The authors propose PAP to act as a molecular switch in plant immunity by attenuating amounts of PA.

Hiroyuki Imai and colleagues (Konan University, Kobe, Japan) presented new data on the role of long-chain base-1-phosphate (LCBP), a lipid mediator, and on its synthesis and degradation in Arabidopsis. The structural

backbone of sphingolipids is generated from LCB and an amide-linked FA. Phosphorylation of LCB by LCB kinases is a reaction that is highly conserved in evolution. The *LCBK1* gene is highly expressed in flowers, and it seems to play an important role in sexual plant reproduction. Degradation of LCBP to LCBs is either catalyzed by LCBP phosphatases (SPP), or by LCBP lyase (DPL) to C₁₆-fatty aldehydes and phosphoethanolamine (PE) and thereby the PE pools might be affected. SPP1 is apparently involved in the ABA signaling chain. *Spp1* mutants displayed a higher sensitivity to ABA, *via* regulation of K⁺ channels in guard cells. For agronomy, a diminished stomata opening would for instance diminish transpiration and thus stomatal leaf conductance under drought conditions. *Dpl* mutants are for instance more sensitive to fumonisin B1 (a mycotoxin from *Fusarium moniliforme*).

instance, PLA2 is involved in (auxin-regulated) acid growth. Its inhibition by aristolochic acid or by manoalide blocks the auxin response. Only ER-localized PLA2 β is involved in the regulation of cell elongation. Sense expression promotes growth, increases leaf surface size through "longer cells", while anti-sense expression leads to retardation (stunted, "cubic" cells!) and shorter petioles. In a silenced line, a partial loss of gravitropism was observed. A model was presented in which auxin (and light) would act *via* PLA2 β by regulating

IT SHOULD NOT ESCAPE THE ATTENTION OF READERS THAT THE GENERATION OF DROUGHT-RESISTANT CROPS, I.E. THROUGH HIGHER SENSITIVITY TO ABA, FOLLOWED BY STOMATA CLOSURE, BUT WITHOUT COMPROMISING SEED DORMANCY AND GERMINATION AND EARLY DEVELOPMENT OF SEEDLINGS IS A RATHER HOT FIELD.

In form of a poster, the Konan group, with **Daiki Yanagawa** as first author went deeper into the role of LCBK1 in sexual plant reproduction. The *AtLCBK1* cDNA encodes a protein with 83.59 kDa, and when expressed in *E. coli* the enzyme specifically phosphorylated D-erythro-sphingosine (DHS). GUS expression under the control of a 1 kb genomic sequence upstream of the transcription initiation site was observed at some anthers. The loss-of-function strategy was apparently not yet crowned by success as no homozygous mutants could be obtained.

The same research team, with Kana Koizumi as first author had a poster on the characterization LCBP lyase (SPP1, Arabidopsis *Atg27980*), also known as dihydrosphingosine phosphate lyase (DPL1). A GFP-DPL1 fusion protein was found localized to the ER. The level of dihydrosphingosine 1-phosphate was increased in loss-of-function (*spp1*) mutants. In the meantime, *dpl1/spp1* double mutants have been generated.

Stephen Beungtae Ryu (Korea Research Institute of Bioscience & Biotechnology, Daejeon, South Korea) studied the cellular functions of phospholipase A2 in plants. Multiple PLA2 genes have been identified in plants, coding for isozymes with distinct regulatory and catalytic properties. For

an ATP-dependent H⁺ pump, followed by cell elongation. In contrast, PLA α would be involved in ABA signaling and induction of senescence. Lysophosphatidyl ethanolamine (LPE) retards senescence possibly by inhibition of PLA α .

Jun'ichi Mano (Yamaguchi University, Japan) reported on oxidative injury of plant cells, mediated by lipid peroxide-derived carbonyls. Plants that over-express enzymes capable of detoxifying such carbonyls show tolerance to various environmental stresses. In leaves that were illuminated with strong light, reactive carbonyls like acrolein and (*E*)-2-pentenal were increased more in WT plants than in transgenic lines over-expressing 2-alkenal reductase. The same transgenic tobacco plants showed an increased tolerance to Al³⁺, which can be explained by a lower content of 4-hydroxy-2-hexanal, 4-hydroxy-2-nonenal, malondialdehyde and formaldehyde as compared to the WT. Such compounds may accumulate in chloroplasts and originate from thylakoid membranes. It is known that α -linolenic acid can be degraded to acrolein, (*E*)-2-pentanal and propionaldehyde. Michael addition of acrolein might inactivate phosphoribulokinase, catalyzing an essential reaction in the Calvin cycle, *viz.*, the reconstitution of the CO₂ accepting molecule. Glutathione is a good protectant.

A poster from the Yamaguchi team (**Kanako Okamura** et al.) focused on examining the toxicity of 4-oxo-2-hexenal (OHE), a product from the peroxides of n-3 polyunsaturated FAs, which easily reacts with proteins. An antibody was generated against OHE-modified proteins that could distinguish OHE from other reactive carbonyls (4-hydroxy-2-hexenal and 4-oxo-2-nonenal). Not surprisingly, paraquat treatment (a herbicide accepting excited electrons from PSI and generating ROS) increased the content of OHE-modified proteins. OHE appears as toxic as acrolein, known to modify several enzymes in the Calvin-Bassham cycle.

infection by the common cutworm (*Spodoptera litura*) of intact tomato plants was examined. When exposed to volatiles such as (Z)-3-hexenol, the plants increased their resistance to herbivores.

Ivan R. Chechetkin and colleagues (Kazan Institute of Biochemistry & Biophysics, Russian Acad. Sci., Kazan, Russia) studied oxylipin biosynthesis in flax leaves. Oxylipin synthesis is controlled by lipoxygenases and by the CYP74 family of hydroperoxide-metabolizing enzymes like allene oxide synthases, also by hyperperoxide lyases and divinyl ether synthases. The transcriptome of flax leaves

COLLABORATORS IN THE UNITED STATES AND GERMANY ASTONISHED THE AUDIENCE WITH NEW TECHNIQUES THAT ALLOW THE VISUALIZATION OF SEED LIPID COMPOSITION.

Another poster from the same group (**Shota Akitake** et al.) demonstrated that tomato plants treated with MeJA showed higher resistance to pathogens like *Spodoptera litura* and *Botrytis cinerea*. The same resistance was observed in plants neighboring *S. litura*-attacked plants emitting volatile organic compounds (VOCs). Thus it could be concluded that JAs are at least partially involved in inducible defense elicited by perception of VOCs.

Kenji Matsui (Yamaguchi University) and **Junji Takabayashi** (Kyoto University, Japan) reported on green leaf volatiles (GLV) absorption and metabolism in Arabidopsis. The plant has an NADPH-dependent aldehyde reductase being capable of rapidly detoxifying such compounds like C₆ aldehydes (accompanied by alcohols and acetates) that are produced after disruption of plant tissue and that are functional in plant-insect and plant-plant interactions. For instance, an auxiliary insect (*Cotesia glomerata*) is chemo-attracted by such alcohols or their acetates, which are emitted after conversion of volatile aldehydes absorbed from atmosphere. ¹³C-labeled FAs (C16:3, C18:2, and C18:3) were prepared by incubation of *Chlorella vulgaris* with ¹³CO₂ and given to soybean seed lipoxygenase-1. Resulting hydroperoxides were reacted with recombinant pepper hydroperoxide lyase, which resulted in the formation of U-¹³C-labeled n-hexanal and (Z)-3-hexanal as the only volatiles. Arabidopsis leaves exposed to these aldehydes rapidly produced the corresponding alcohols. The authors tested also the effect of *Botrytis cinerea* as a pathogen. Questions that remain open concern the diffusion in and out of tissue and the further metabolism of alcohols, for instance by glucosylation. The glucoside of hexenol in the diet of herbivores inhibited their growth. Other reactions might imply the action of enzymes from the CYP74 family. In a poster from the same group the

was analyzed for the presence of new CYP74 genes by the use of degenerate primers, which led to identification of hitherto unknown member of the CYP74B subfamily. When expressed in *E. coli*, the enzyme preferably used the 13-hydroperoxide of α -linolenic acid, which was converted into divinyl ether (ω 5 (Z)-etherolenic acid), a constituent of the new family of complex oxylipins ("linolipins"), comprising at least seven members of molecular species of galactolipids, whose synthesis seems to be induced by pathogen (*Pectobacterium*) attack and wounding.

Jing Chen and colleagues (Tokyo Institute of Technology, Japan) presented data on the action of jasmonates (JAs) on hypocotyl elongation under red light and regulation by phytochrome B in Arabidopsis. Hypocotyl elongation was suppressed by exogenous MeJA treatment, requiring SCFC^{CO11}-mediated proteolysis. (For better understanding:

Binding of JA ligands promotes the binding of the SCFC^{CO11} ubiquitin ligase to and subsequent degradation of the JAZ1 repressor protein, which implicates the SCFC^{CO11}-JAZ1 protein complex as a site of perception of the biological active JA-isoleucine conjugate = (+)-7-iso-JA-L-Ile.) Interestingly, this latter amino acid conjugate showed a weaker effect than MeJA under dark and red light in this study now. Two mutants insensitive to MeJA on hypocotyl elongation (*jal1* and *jal36*) were isolated and shown mutated in the phytochrome B locus. When a *phyb9* mutant without MeJA inhibition of hypocotyl elongation was examined, it revealed that JA-responsive genes were differentially expressed. In WT plants, phytochrome B content was suppressed by MeJA. (+)-7-iso-JA-L-Ile was relatively efficient in suppressing root elongation.

In a corresponding poster from the same group the above-mentioned JAZ family proteins, repressors of MYC2,

a JA responsive transcription factor was outlined. The authors could identify a “constitutively hypersensitive to JA” Arabidopsis mutant (*chj*). The expression of a defense gene (*PDF1.2*) that is regulated by JA and ethylene was shown up-regulated in the *chj* mutant, which led to assume that CHJ negatively regulates the signal pathway after JA perception in the JA and ethylene cross-talk.

Markus R. Wenk (National University of Singapore) and his associates have focused their efforts on the development of analytical methods for identification of lipids and lipid biosynthetic pathways in oleaginous microalgae species, in conjunction with transcriptomics. They use electrospray ionization MS (ESI-MS) for high-resolution non-targeted lipid profiling and for quantitative analysis of neutral and polar lipids such as glycerolipids, glycerophospholipids and glycoglycerolipids by ESI-MS on triple quadrupole mass spectrometers. Nine algal species have already been profiled for lipids (for instance *Chlorella minutissima* put under nitrogen starvation), and others are about to follow. It has to be noted that Dr Wenk made a fascinating excursion to what else is ongoing work in his lab, covering for instance the analysis of TAG accumulation in dormant mycobacteria, not to forget the use of so-called click chemistry to generate suicide inhibitors. He also reported on the identification of tetrahydrolipstatin (Orlistat) analogues, inhibitors of fatty acid synthase (FAS), which are useful against human obesity.

Hong-Ye Li and colleagues from the Jinan University (Guangzhou, China) went deeper into studies as to nitrogen deprivation effects on the metabolism in the marine microalga *Pheodactylum tricorutum*, a species that contains up to 30% oil. Under photoheterotrophic conditions and under complete nitrogen starvation lipid content was increased by 2.6-fold, due to significantly elevated levels of short-chain FAs, partially at the expense of long- and medium-chain FAs, and total lipid unsaturation was decreased under such conditions. Comparative proteome analysis revealed that proteins involved in gene transcription and cellular organization, carbon metabolism and energy transfer were down-regulated, whereas stress-related proteins were up-regulated, also some being involved in signal transduction, gene transcription, and secondary metabolism. This study was completed with whole transcriptome shotgun RNA sequencing: 888 genes were found up-regulated and 4218 (!) down-regulated. Functionally it makes sense when under N-starvation gene coding for enzymes involved in N-fixation are up-regulated, whereas those making part in photosynthesis are down-regulated.

Yonghua Li-Beisson (CEA-CNRS-Aix-Marseille University, CEA Cadarache, France) and colleagues worked on lipid synthesis in the model microalga *Chlamydomonas reinhardtii*. In response to N-starvation the alga accumulates significant amounts of TAG in oil bodies, which is accompanied by an arrest in cell growth, loss of chlorophyll and a sharp decrease in plastidial lipids. Upon N feeding, such oil bodies are degraded and allow for further growth. They

can be considered as dynamic structures being involved in processes like membrane lipid recycling and homeostasis. This is supported by the fact that besides a major “lipid droplet protein” previously characterized, such oil bodies contain a large number of lipid metabolic enzymes. Among the 248 proteins (≥ 2 peptides) identified by LC-MS/MS, 33 were putatively involved in the metabolism of lipids. 19 new proteins of lipid metabolism were identified, spanning the key steps of the TAG synthesis pathway and including a glycerol-3-phosphate acyltransferase (GPAT), a lysophosphatidic acid acyltransferase (LPAT) and a putative phospholipid:diacylglycerol acyltransferase (PDAT). In addition, proteins putatively involved in de-acylation and/or re-acylation, sterol synthesis, lipid signaling and lipid trafficking could be identified. It is noteworthy to mention that the photosynthesis-dependent productivity of such algae is about ten times higher than in higher plants, which opens new perspectives in the production of biofuel...

Jaw-Kai Wang (President of the Shenzhen Jawkai Bio-engineering R&D Center, Shenzhen, China) more at the end of the meeting gave a very enthusiastic presentation of his company's work on the productivity and easiness of cultivation in open-air conditions of diatoms. Not only do they grow so rapidly that in a lake or tank no competing (invading!) organisms would have a chance, but they would be extremely helpful in cleaning up waste water, serving as “fertilizer”. The average diatom density of 0.14 g DW/L would translate into 120 tons per hectare and year, with a lipid yield of about 17% of DW, which is far beyond everything ever achieved with crop plants. But a major point for him to criticize “academic research” is the lack of profitability! However, for a company investments need to pay out on long hand. Here not only oil production should be considered, but also the generation of byproducts and capabilities, for instance in removing heavy metals from industry waste water, and even waste CO₂ and heat from oil refineries and power plants could be used in lipid and “bio-crude” production.

Another “biodiesel” production method was presented by **Donna Wren B. Libuano** (University of the Philippines Los Baños, Laguna, Philippines), based on the use of the pulp portion of Pili fruit (*Canarium ovatum* Engl.), which contains 30% of the total oil content, but is usually considered as waste material. The colleagues studied the KOH-catalyzed transesterification and optimized the conditions (temperature, MeOH to oil ratio, reaction time and so forth), leading to nearly 100% production of Pili pulp oil methyl esters, to about 26% containing palmitic acid and some 62% oleic acid. As this indigenous species to the Phil-

ippines is cultivated with more than 200,000 trees, it can be estimated that > 5 Mt of "waste" could be used with in average 33 kg pili fruits per tree and year. Such numbers were discussed in comparison for instance with *Jatropha* oil, which contains toxins.

In the context of the biodiesel work just mentioned above, the poster by **Sing Oun** and **Ning Li** (Hong Kong University of Science & Technology, Kowloon, China) presented data on EST sequencing and real-time qPCR to study gene expression in *Jatropha curcas* L. As a central outcome they could identify highly expressed genes that are involved in the regulation of lipid synthesis. A diglyceride acyltransferase (*DGAT1*) gene was expressed in yeast, leading to an increase in cellular lipids. Finally, this could be a candidate for genetic engineering of oil seed-bearing woody plants - given that suitable transformation protocols exist...

Masumi Otsuru and colleagues from Saitama University and the University of Tokyo examined the *pect1-4* Arabidopsis mutant. PECT1 (CTP:phosphorylethanolamine cytidyltransferase) regulates phosphatidylethanolamine (PE) synthesis, the major mitochondrial phospholipid. The mutant is severely growth-inhibited at 8°C, less pronounced at 23°C. The respiratory capacity was diminished through a decrease in the mitochondrial cytochrome pathway.

Ryo Tanoue and colleagues from the University of Tokyo investigated an Arabidopsis *pgp2* mutant deficient in phosphatidylglycerophosphate synthase. Apparently the enzyme PGP2 contributes only little to the biosynthesis of phosphatidylglycerol (PG), but when the *pgb2* mutant was crossed with *pgb1* it led to defects in embryo development.

Da-Huang Chen and colleagues from the National Chung-Hsing University, the National Don Hwa University

THE SIX GENES CODING FOR ACBPS IN RICE (*OSACBP1* TO *OSACBP6*) ARE UBIQUITOUSLY EXPRESSED, HIGHLY IN LEAVES, MODERATELY IN ROOTS, AND ONLY LITTLE IN STEMS.

Colleagues from the Shizuoka University (Japan) focused their attention on the function of MGDG and DGDG. **Koichiro Awai** presented data on the histochemical analysis of *MDG1* gene expression in Arabidopsis through GUS promoter analysis. (MGD1 is responsible for the bulk synthesis of MGDG.) **Eric Maida** had data on the replacement of DGDG in thylakoid membranes by other glycolipids. For this a gene encoding a bacterial glucosylgalactosyldiacylglycerol synthase (β -GLCT), catalyzing the attachment of glucose to MGDG with β linkage was introduced into *Synechococcus* sp. PCC 7942. The otherwise essential DGDG synthase gene (*dgdA*) could be knocked out, indicative of a functional replacement of DGDG by this unusual lipid.

Shinji Masuda and associates from the Tokyo Institute of Technology and the Kurume University, Japan) had a poster describing a novel MGDG synthase found in green sulfur (photosynthetic) bacteria such as *Chlorobacterium tepidum*, which contain so-called "chlorosomes", a light-harvesting complex. Its assembly requires an intact MGDG synthesis. In a further poster presented by Yuichi Yuzawa and colleagues the same group demonstrated the complementation of MGDG synthase in *Synechocystis* sp. PCC 6083 by Arabidopsis MGDG synthase 1 from Arabidopsis. For the assembly of MGDG cyanobacteria use monoglycosyldiacylglycerol (MGlCDG) from uridine diphosphate glucose and diacylglycerol (GAG), which is then epimerized to MGDG.

and of the Academia Sinica, Taiwan studied oil bodies in rice embryos and aleurone layers, containing oleosins H and L, coded for by the genes BAF12898.1 and BAF15387.1, respectively. In contrast, monocot-type caleosin was exclusively localized to the embryo. In an extension of this research direction, presented by Pei-Luen Jiang, a 29 kDa caleosin was identified in oil bodies of a *Chlorella* species, specifically accumulating under N-deficient conditions. Tryptic digestion led to isolation of a fragment that matched the (hypothetical) caleosin of sitka spruce (*Picea sitchensis*) and allowed for PCR cloning of the corresponding gene.

A group from Malaysia (Melaka Institute of Biotechnology, the AIMST University and the MMU), represented by **Amelia Kassim** focused on the *in silico* analysis of bean (*Phaseolus vulgaris* L.) ω -6 FA desaturase and characterized a PvO6FAD encoding cDNA from a library of some 6000 ESTs. The same group had another poster, with Edina Wang L.F. as first author, which reported on a cDNA clone with a 918 bp from the same EST library that was identified as coding for a β -carotene hydroxylase consisting of 305 amino acids.

The poster by **Tsutae Kawai** and colleagues from the Chubu University Aichi, the Nagoya University and the Japan Science and Technology Agency reported on the development of a large-scale screening of Arabidopsis seed oil mutants, in the search for factors needed for activation of genes involved in ER-localized TAG synthesis. A luciferase (LUC) reporter gene was placed under