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Processing Contaminants in Edible Oils

MCPD and Glycidyl Esters

Edited by Shaun MacMahon

2014. Hardback. 230 pages. ISBN: 978-0-9888565-0-9.

Product Code 272

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This book discusses the current research on monochloropropane-diol (MCPD) and glycidyl esters in edible oils. These potentially harmful contaminants are formed during the industrial processing of food oils during deodorization. The mechanisms of formation for these contaminants, as well as research identifying possible precursor molecules are reviewed. Strategies which have been used successfully to decrease the concentrations of these contaminants in edible oils are discussed, including the removal of precursor molecules before processing, modifications of deodorization protocol, and approaches for the removal of these contaminants after the completion of processing. Analytical strategies for accurate detection and quantitation of MCPD and glycidyl esters are covered, along with current information on their toxicological properties. This book serves as a single point of reference for the significant research related to these contaminants.

Also available as an eBook on iTunes and Amazon.

About the Editor



Shaun MacMahon is a Research Chemist with the Center for Food Safety and Applied Nutrition (CFSAN) of the U.S. Food and Drug Administration (FDA) in College Park, MD. After completing his Ph.D. in organic chemistry from New York University, Shaun worked as a chemist with the FDA's Office of Regulatory Affairs in Jamaica, NY, before coming to CFSAN in 2009. His main interest is the application of mass spectrometry to address food safety issues. Shaun has been an active member of the American Oil Chemists' Society since 2010 and has co-chaired the Trace Contaminants session at the AOCS Annual Meeting for the last three years.

Processing Contaminants in Edible Oils

MCPD and Glycidyl Esters

Editor
Shaun MacMahon



**For more analytical resources on processing contaminants,
visit www.aocs.org/3mcpd.**



May 2014

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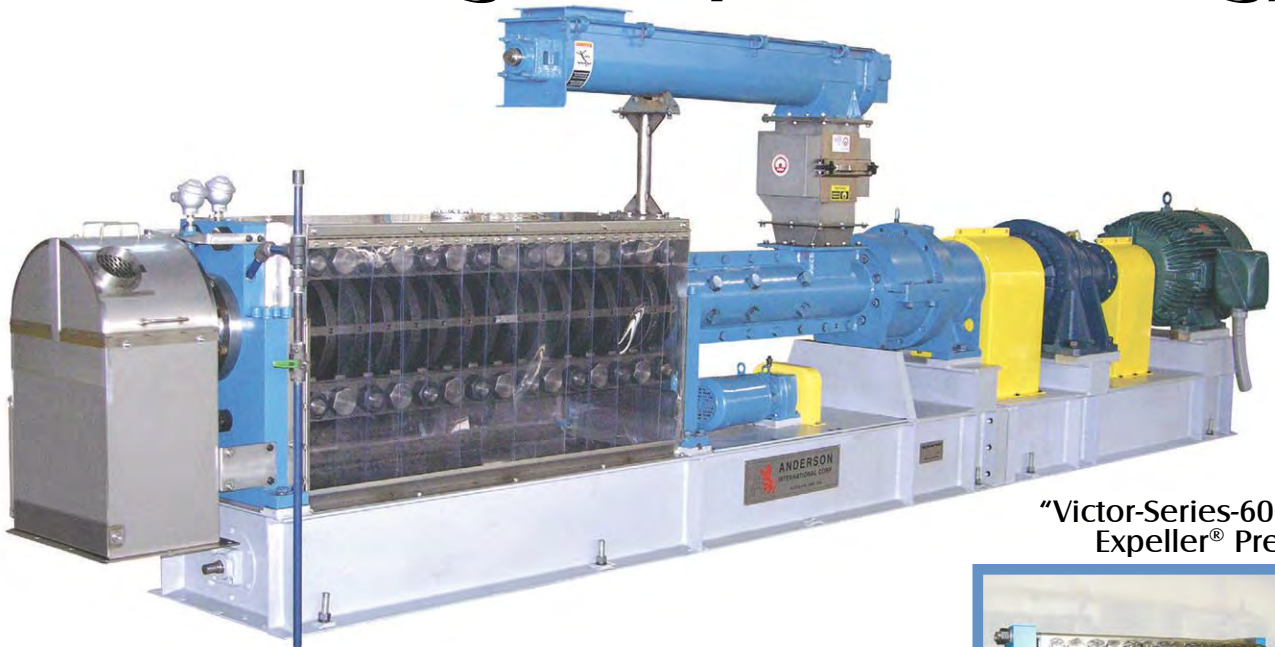
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President's profile:

Steven E. Hill

I am thrilled and honored to be elected the 106th AOCS president. It is exciting to be in a role that allows me to contribute to an organization that, in many ways, has become like a family to me. The community of AOCS has given me many opportunities to learn, grow, and develop over the years as a scientist, leader, and person. In this profile, I would like to share with you who I am and how AOCS has been part of my life for more than 25 years.

My youth was spent in Naperville, Illinois, USA—a community 20 miles west of Chicago that has become a prototype for suburban life. As a child, I enjoyed sports and science; I was the one who had a junior chemistry set, a crystal radio, an ant farm, and a massive erector construction set. I played many sports in school, but I loved track and field in particular. I remember writing a paper in my high school science class about the physics of the high jump and pole vault. Going to the Chicago Museum of Science and Industry was always a highlight, whether on a school trip or with my parents. I knew every inch of that place. Even today, I can spend many hours walking through the same sections I walked 40 years ago where science is demonstrated and explained.

With my passion for science and technology, it was only fitting I attend Iowa State University of Science and Technology. I didn't know it at the time, but while studying Food Science at Iowa State, I crossed paths with many individuals who would later become great friends and colleagues at AOCS—people such as Pam White, Larry Johnson, Deland Meyers, and Earl Hammond.

While at Iowa State, I made one of the most critical decisions of my life: to attend graduate school at the University of Illinois. At Illinois I met two very important people, my future wife, Laura, and my advisor and mentor, Dr. Ed Perkins. When I started in his lab in 1987, Dr. Perkins was a recent AOCS past president. He was an influential force at AOCS, and, as a new graduate student working for him, I quickly learned the benefits of active AOCS membership. Within a year of joining, I was presenting posters and papers. I was interfacing with the top scientists in the field and being exposed to an array of emerging areas of lipid science.

I worked in many areas of lipid chemistry while in graduate school but primarily focused on lipid oxidation. Part of my research was funded by ADM (Archer Daniels Midland, Decatur, Illinois, USA) specifically to work on the development of the Oil Stability Index (OSI). Through this research effort I had the



fortune to interact with such AOCS leaders such as Tom Smouse, Mark Matlock, and Ron Sleeter. In addition, with Dr. Perkins' vast network, I was lucky enough to engage with and learn from lipid scientists at the US Department of Agriculture lab in Peoria, Illinois, such as Tim Mounts, Gary List, Jerry King, and Kathy Warner. Not only did I gain technical knowledge from these individuals, I learned how to take maximum advantage of AOCS and its technical committees, Divisions and Sections.

As a student, I became an active member of the AOCS North Central Section, eventually moving through the officer positions prior to assuming a role on the Governing Board. One thing I will always remember as a student member of AOCS was the generosity with which long-time members shared their time and knowledge with me. They helped me learn about science, careers, and—looking back—they helped me learn about lifelong

friendships. I have been a member of AOCS for 27 years, and my links with people I met then are as strong today as they were when we first met.

One of the most important months of my life was August 1992; more specifically, the days August 20–27. In that time span I successfully defended my Ph.D. thesis, got married, and started my professional career at Kraft Foods. For anyone who may be interested, I do not recommend linking these activities so closely together unless you like stressful situations.

My career at Kraft is now in its 23rd year. I had the great fortune to work under the guidance of Dr. R.G. “Krish” Krishnamurthy, one of the first recipients of the Magee Award, the predecessor of the AOCS Honored Student Award. I will always remember Krish telling me in my first annual performance review that he did not use Kraft standards for the performance review as they were not strict enough, rather he had his own high standards he used for scientists that worked for him. I am still at Kraft, so things worked out, but similar to Dr. Perkins, Krish taught me to never be satisfied with what I know and to always seek new knowledge and continue to learn.

I have learned much while at Kraft. I started as an oil chemist who became a product developer of salad dressings, mayonnaises, and margarines. Over the years, I learned about elements of business that you don’t learn while obtaining a food science education—marketing, sales, finance, operations, and most importantly, the psychology of consumer behavior. I have been in product and process development jobs, fundamental research assignments, and even corporate affairs roles. Through it all, I stayed engaged with AOCS. Although my involvement with AOCS required commitment above and beyond my duties at Kraft, I was always able to link leadership development and technical content as strong benefits AOCS provided me and ultimately Kraft.

I was treasurer of AOCS during 2003–2008. These were financially difficult years for AOCS, and I spent a significant amount of time working on many issues of critical importance to the survival of the organization. I received many thanks for the work I did with others, but as I reflect on that time, I have come to understand that I gained tremendous experience in leadership that I never could have gained in roles at Kraft or in other areas of my external engagement.

In addition to the role AOCS has played in shaping me into the person I am, my family has brought life priorities sharply into focus for me. Even though I have missed a couple of birthdays and some Mother’s Days to attend AOCS annual meetings, my family has always come first for me. My wife Laura and I had the joy and blessings to have two beautiful daughters, Erica and Kelly. Both children share Laura’s and my passion for sports and love of family fun. I can’t count the hours we have spent traveling together on adventure trips to ski or scuba dive, or attend volleyball tournaments or track meets. Even with Erica studying at Purdue University and Kelly in her third year of high school, we still connect often as a family.

As you can now understand, AOCS is family to me. The AOCS staff are part of this family. They are true professionals and experts in their respective areas of responsibility and incredibly important to making AOCS great. I look forward to working closely with Pat Donnelly and the staff on many projects in the next year to continue helping AOCS to remain a top-notch technical society. ■



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Cannabis of the

- The legalization of cannabis for medical use has created a need for accurate and reliable testing.
- The rules for testing vary from state to state; each laboratory determines its own testing methods, and high-quality reference standards are not available—making it difficult to detect and quantify components.
- This article examines current laboratory practices and considers the evolving need for uniform methodologies.

Heather Despres

In 1996, the legalization of *Cannabis sativa* for medical use in the state of California (USA) initiated what has become an ever-growing need for testing of the plant for potency concentration as well as for contaminants such as pesticides and microbiologicals.

Since then, 20 states in the United States as well as the District of Columbia have added legislation allowing for the medicinal use of cannabis, and Colorado and Washington became the first two states to legalize the use of cannabis for adults 21 and over. Worldwide, Uruguay is the only country with legalized sale and production of cannabis. The Netherlands allows for its use by residents, and Portugal has decriminalized all drugs (for further information see http://en.wikipedia.org/wiki/Legality_of_cannabis_by_country). Of these locations,



testing: a review current landscape

only the states of Colorado, Washington, Illinois, Massachusetts, Connecticut, and Oregon require testing.

The rules for testing currently vary from state to state, but as time goes by and more states begin to add legislation allowing for medicinal and adult use of cannabis, the need for reliable and accurate analytical results from laboratories will become increasingly apparent to those outside of the testing world. While certain portions of each state's testing requirements may align with those of other states, they vary considerably in other areas. For example, both Colorado (<http://tinyurl.com/Colorado-RETAIL-testing>) and Connecticut (<http://tinyurl.com/Conn-palliative-testing>) require testing for heavy metals, with considerably different limits, while Illinois requires no testing for heavy metals. However, all six US states that have legalized cannabis for medical use require some combination of microbiological, mycotoxin, residual solvent, pesticide, and heavy metals testing.

The need for consistent legislation regarding uniform testing methodologies and acceptable contamination limits becomes higher with each state that passes laws allowing for cannabis use. There is also the need for a governing body to oversee laboratory operations and ensure that such operations are conducted within defined specifications.

When US cannabis testing laboratories first began opening, they operated under what they considered to be best practices—whether those be guidelines issued by the Food and Drug Administration, the Environmental Protection Agency (EPA), or some other regulatory body. To date there is no single entity that oversees laboratory operations from state to state; it is still up to states to decide what testing should be done, and it is up to the laboratories to determine what methods should be used for testing.

Most laboratories only offered potency testing at first, as people were seemingly interested only in knowing how strong their cannabis plants were. They routinely discarded plants that were not high in tetrahydrocannabinolic acid (THCA), the precursor to the psychoactive Δ^9 -tetrahydrocannabinol (THC), though we now know that a number of these plants contain other medicinally beneficial cannabinoids such as cannabidiol (CBD), which has been found to aid in the reduction of seizures.

CONTINUED ON NEXT PAGE



FIG. 1. Cannabis sample before it is prepared for analysis.

Analyzing extracts in marijuana-infused products

Manufacturers of marijuana-infused products tend to extract the cannabinoids into products such as butter and cooking oil because of the lipophilic nature of the cannabinoids. Other methods of extraction involve the use of solvents such as CO₂ or ethanol. For children, these are the safest forms of extracts, as other methods of extraction involve solvents such as butane and naphtha.

Analyzing these extracts presents some challenges in the laboratory, as the nature of the matrices can cause interference in instrumental analyses. While the lower limit of detection for typical flower and concentrate extracts is 0.01mg/mL, this is increased to 0.1 mg/mL for many edible products. Some sample types—including butter, coconut oil, honey, glycerin, chocolate, cookies, and caramel—need additional processing to remove any particulates that may form, especially in sample chambers that are refrigerated. This can involve additional solvent extractions or extra steps such as refrigerating the samples before they are filtered.

Medical marijuana for children

There are US families with children having seizure disorders who are relocating to states that allow for the medicinal use of marijuana to get access to it. Drug delivery to children with these disorders ranges from using eyedroppers to finding ways to get extracts down feeding tubes without having the lipophilic cannabinoids stick to the tubing.

The easiest way for parents to deliver this medicine is through the use of food products. Typical extractions for food products involve decarboxylating the flower beforehand and then extracting, generally via heating at low temperatures, into butter or cooking oils such as coconut oil. These are then tested for concentration and used in making other foods such as cookies or brownies (see sidebar on page 281), that are dosed specifically to meet the child's needs.

Marijuana and food safety: a gray area

In the United States, food safety is generally governed by federal law, federal agencies, and federal funding. While a significant portion of state-legal medical marijuana is consumed as food, marijuana is still a federally illegal substance, which begs the question:

Will such foods be covered under the US Food and Drug Administration's Food Safety Modernization Act?

On August 29, 2013, US Deputy Attorney General James Cole issued a memorandum stating the US Department of Justice's intention to step back and let the states take control of marijuana enforcement. However, the memo did not list food safety as a priority for marijuana enforcement. The interesting question is whether states are equipped to regulate food safety on their own. Read more at <http://tinyurl.com/MJ-food-safety>.

Each laboratory has its own potency testing methods, ranging from thin-layer chromatography (TLC) to gas chromatography (GC) to liquid chromatography (LC). There has been considerable debate among laboratories as to which method is best. Most laboratories have shied away from TLC in favor of GC or HPLC methods to quantify cannabinoids. Among the laboratories using GC, many have since switched to HPLC because of the ability to differentiate between the acidic and neutral cannabinoids.

The other drawback to using GC is that decarboxylation efficiency at the injection port varies from instrument to instrument. Published methods that show validation of a GC method are scarce, and even the United Nations and the American Herbal Products Association (www.AHPA.org) have declared HPLC to be the preferred method of analysis for quantitatively determining cannabinoid concentration.

HPLC methods are also quite variable, though results should be comparable between them. Methods range from under 5 minutes to over 40 minutes and from three cannabinoids to over 10 cannabinoids. Because of the inability to ship cannabis samples across state lines, laboratories are prevented from conducting ring tests and verifying to outside agencies that their methodologies and continuing operations are on par with laboratories in other industries.

Some of these variables do not plague other laboratory tests. Pesticides have been quantified by various laboratories for quite some time, and routine methods of extraction and analysis have been developed and published by several different groups. This is the same with heavy metals and microbiological testing. The EPA and United States Pharmacopeia have indicated their preferred methods of analysis for heavy metals and microbiological testing, respectively.

Laboratories often get questioned by clients about why their results are different from lab to lab, when they submitted a sample from the same plant (Fig. 1, page 281). The most common answer is that each laboratory was analyzing the sample using a different method. Without properly validated methods, laboratory certification programs, and the ability to ship ring test samples across state lines, laboratories will continually need to defend their methods to the public.

One of the main issues for cannabis-testing laboratories is the inclusion of several cannabinoid standards on the US Drug Enforcement Agency's (DEA) Schedule I list of drugs. In order to purchase these standards laboratories must be licensed by the DEA; however, cannabis laboratories cannot become licensed because cannabis is still federally illegal and are therefore operating in direct violation of federal law. Standards that are available are not provided in concentrations higher than 1mg/mL. Without high-quality reference standards, developing methods that will be able to detect and quantify each component being sought is challenging. Laboratories have taken to making their own standards, when necessary, due to this lack of availability.

As more analytical labs open and put pressure on manufacturers of cannabinoid standards, more will become available. Historically, cannabidiolic acid (CBDA) has not been available as a reference standard; however, each lab testing in a state with mandatory testing is required to quantify this cannabinoid. Owing to demand by laboratories, though, this standard will be available shortly.

Because US laboratories cannot receive standards at concentrations higher than 1 mg/mL, the ability to validate extraction methods can become quite costly. A typical extraction of marijuana-infused food products involves approximately 1 g of edible sample and 10 mL of solvent. This requires 10

mg of a cannabinoid standard per sample validated at the upper calibration limit. Validation guidelines call for multiple samples to be extracted over the course of multiple days, which leads to a seemingly excessive cost for what is a fairly standard test. Laboratories that have validated a method for the extraction and quantification of concentrates tend then to use those highly concentrated samples as their stock standards for validating edibles at higher concentrations.

Overall, testing of cannabis and the operation of cannabis testing laboratories are heading in the right direction. States and countries that are adding usage laws are also adding testing laws. The rules around testing are becoming more consistent, and the methods that laboratories are using to do the testing are becoming more uniform. The proposed reduced scheduling of cannabis, from Schedule I to Schedule II, would greatly enhance the ability of laboratories to validate methods in an efficient manner. Federal oversight may help unify the laws across all states so that consistent testing standards are applied to all those producing in this industry and those testing in the industry.

Heather Despres is the laboratory director at CannLabs, Denver, Colorado, USA, a full-service testing lab for medical and non-medical-grade cannabis products. As the previous lab director for both Full Spectrum Laboratories and Irish Canadian Bioresearch, Despres has worked on building laboratories from the ground up, implementing poli-

Certified by the Royal Canadian Mounted Police

In September 2013, Toronto's *Globe and Mail* reported that Canada's conservative government had announced its intention to establish a medical-marijuana free market that would replace home and small-scale production with licensed large indoor marijuana farms certified by the Royal Canadian Mounted Police and health inspectors.

Previously, more than 4,000 growers were licensed to produce medical marijuana for a maximum of two patients each. Under the new free-market system, private-dwelling production is banned, and imports are allowed. The government projects that the free market industry for medical marijuana will be worth \$1.3 billion a year by 2024.

cies for method validation and sample chain of custody, and ensuring that all results received by clients are accurate to the highest degree possible. Most recently, she has been a part of working groups held by the State Licensing Authority of the Marijuana Enforcement Division. She has been involved in the Labeling, Packing, Product Safety, and Marketing working group as well as the Random Testing and Mandatory Sampling working group. She can be contacted at heather@cannlabs.com.

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Omics reveals subtle changes in carbon flux that lead to increased oil biosynthesis in oil palm

David Ross Appleton, Teh Huey Fang, Neoh Bee Keat, Ooi Eng Keong, Wong Yick Ching, and Harikrishna Kulaveerasingam

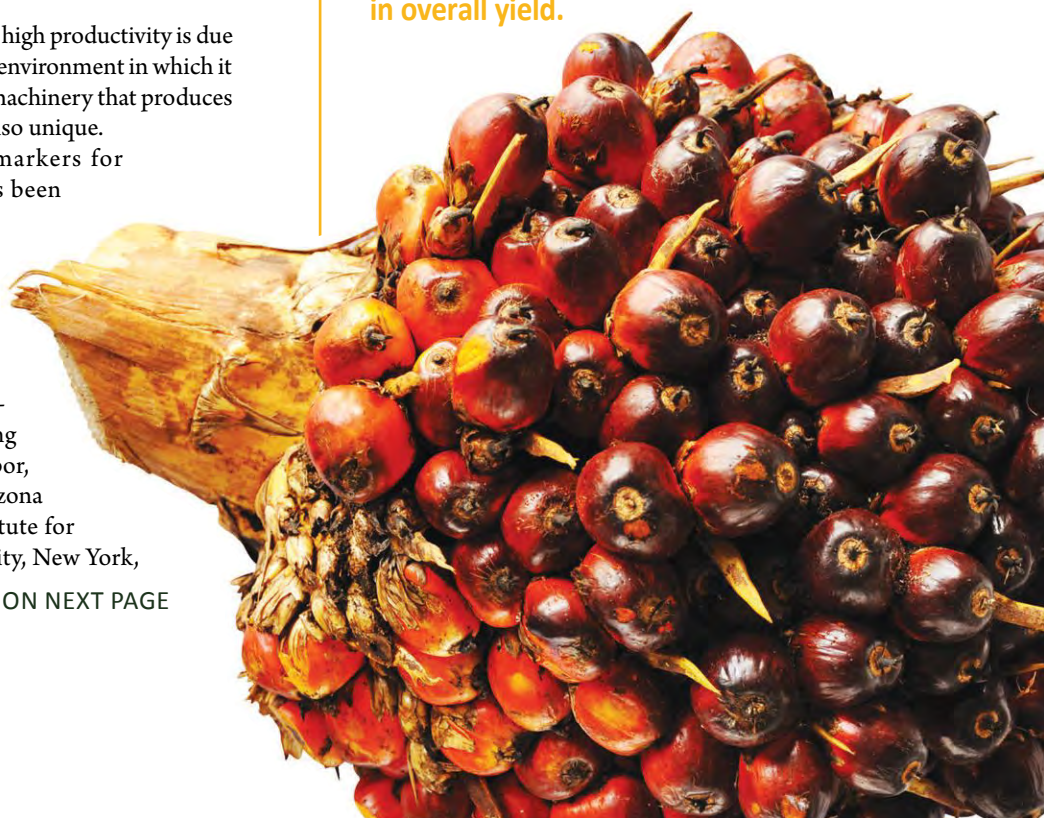
Oil palm is the most productive oil-producing crop. On a commercial basis, yields of 4–6 metric tons of oil per hectare (MT oil/ha) are produced, while yields of up to 12 MT oil/ha have been achieved in breeding trials. With yields of up to 17 MT oil/ha theoretically possible, there is much potential for oil palm to meet increased demands for biofuels and edible oils into the future without increasing new plantings.

A large proportion of the oil palm's high productivity is due to its being a perennial and the tropical environment in which it thrives. However, the oil biosynthetic machinery that produces up to 90% oil in the fruit mesocarp is also unique.

The development of genetic markers for improved selection and breeding has been reported increasingly in recent years, culminating in the publication of the oil palm genome in 2013 by a consortium including researchers with the Malaysian Palm Oil Board, Orion Genomics (St. Louis, Missouri, USA), Washington University (St. Louis, Missouri), Cold Spring Harbor Laboratory (Cold Spring Harbor, New York, USA), the University of Arizona (Tucson, USA), and the Sackler Institute for Comparative Genomics (New York City, New York,

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- Detailed biochemical analysis during plant development can help bridge the gaps between biological understanding, genetic markers, and phenotypes.
- Despite significant experimental design and interpretation challenges in a field environment for a crop such as oil palm, useful insights can be gained by conducting biochemical studies.
- Concerted changes in nitrogen metabolites to support oil biosynthesis and fruit development along with flux differences in glycolysis were observed to contribute to large increases in overall yield.



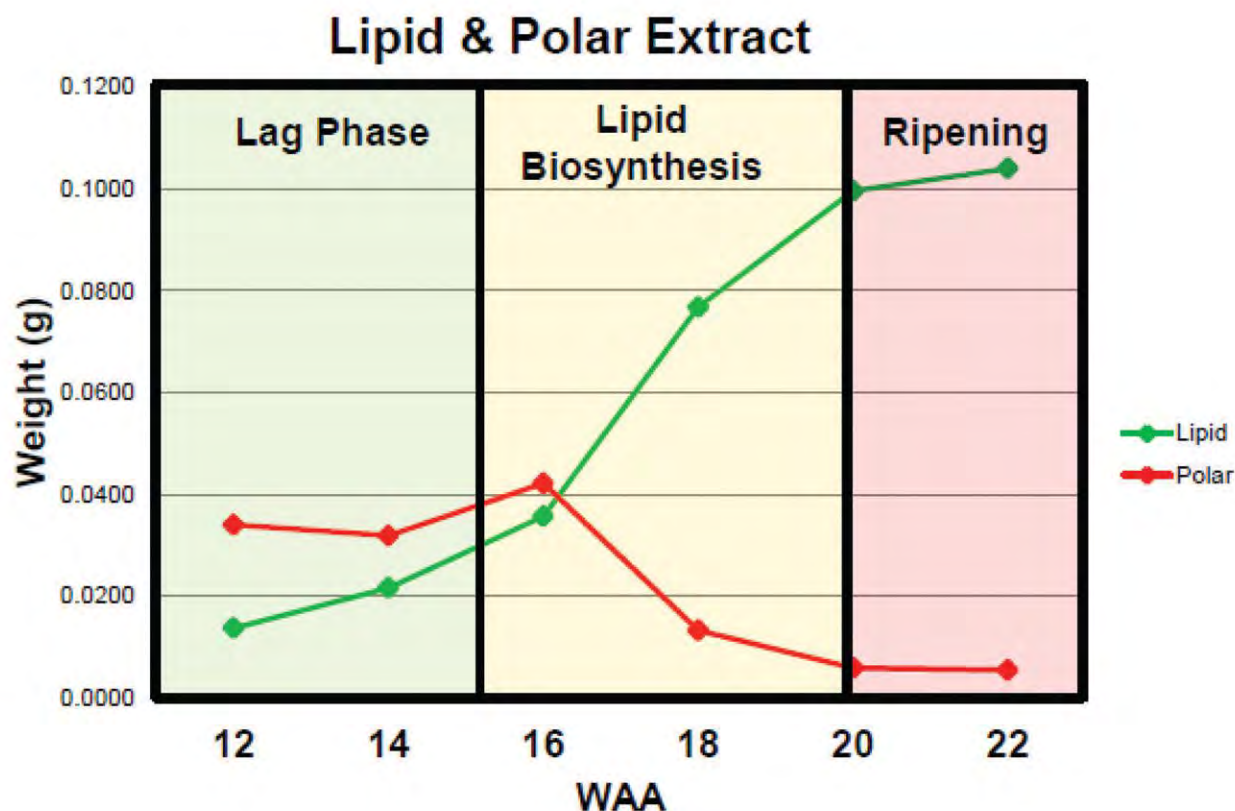


FIG. 1. Oil palm fruit ripening profile: lipid and aqueous mesocarp extract weights vs. duration in weeks after anthesis (WAA).

USA). As achieved in other crops, the use of genetic markers for oil palm crop improvement holds much promise. However, marker accuracy varies across population backgrounds depending on genetic distance of markers from controlling genes and population diversity. In addition, the development of accurate marker selection tools is especially difficult for traits that are highly polygenic and have large environment effects, such as yield.

BIOCHEMICAL RESEARCH USING OMICS AND GENETIC MARKER APPROACHES

Biochemical omics techniques can serve as a bridge between controlling genes and associated genetic markers by identifying genes and biochemical pathways that are more directly associated with the final trait. At Sime Darby (a Malaysia-based multinational conglomerate involved in, among other things, oil palm plantations and palm oil production), we took the approach of investigating the differences in biochemical regulation that distinguish highest-yielding individuals (10–12 MT oil/ha) from average performers (4–7 MT oil/ha) within a group of siblings planted in the same location. Biochemical changes before, during, and after oil biosynthesis in fruit mesocarp were compared using transcriptomics, proteomics, and metabolomics and provided insight into oil biosynthesis control in the oil palm. Genome polymorphisms surrounding

identified genes were then prioritized when conducting large-scale genome-wide association studies on larger sets of more diverse populations.

CHALLENGES IN CONDUCTING OMICS RESEARCH IN A FIELD CROP

As a perennial tree crop, the oil palm poses significant challenges for experimental design and interpretation when attempting to relate the short-term microscale cellular processes to macroscale long-term yield. While the logistics of sampling and preservation of biochemicals that change owing to enzymatic action soon after sampling is a key issue, this can be addressed through immediate washing and freezing of samples using liquid nitrogen in the field.

A more significant issue is the extremely long duration over which samples must be collected due to the destructive nature of fruit sampling. Since one bunch needs to be sampled for each time point, sampling of the 16 palms in this study took two years to complete and required six bunches per palm to be tracked from pollination until sampling between 12 and 22 weeks after anthesis (WAA; Fig. 1). Given that biochemical levels and gene expression vary greatly owing to environmental conditions, this was a significant concern. For example, there are significant changes in leaf metabolite levels over time, whereby sugar phosphates (precursors for fatty acid

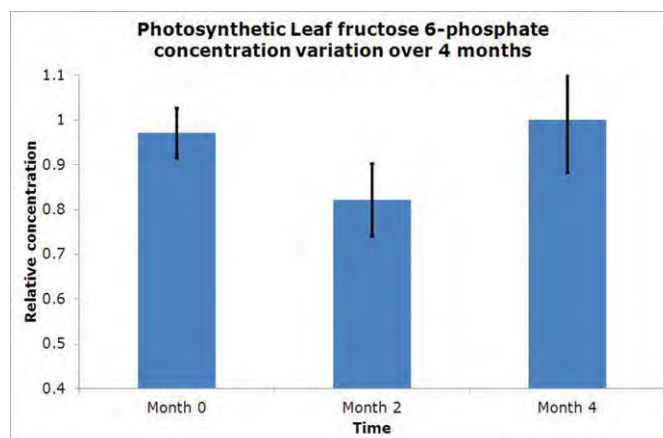
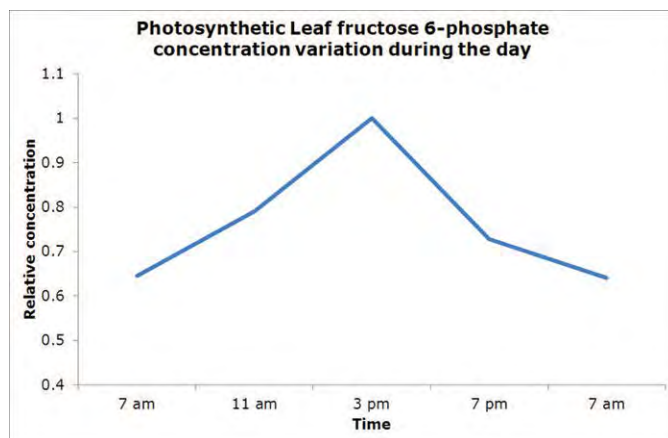


FIG. 2. Diurnal concentration changes of leaf fructose-6-phosphate in individual palms ($n = 20$) sampled over a period of one day and long-term fluctuation at 11 am–1 pm of palms ($n = 4$) sampled at 2 month intervals.

biosynthesis) vary more throughout the day than over a period of months in the same palm (Fig. 2). Fruit metabolite levels are expected to be more stable, and we confirmed that observed temporal trends were in line with expectations before further result interpretation.

OMICS RESULTS REFLECT DRIVERS OF YIELD

When studied between 12 and 22 WAA, protein concentrations and gene expression levels were consistent with metabolite changes in many cases. The three datasets were simplified by categorizing the genes, proteins, and metabolites into their cellular pathways and identifying areas of concordance. Several global trends were evident in the metabolomic results; for example, high-yielding palms have significantly higher levels of amino acids before oil biosynthesis commences, but the levels decrease to the same as average-yielding palms once the fruits are ripe.

The higher accumulation of these nitrogen-containing protein building blocks is possibly related to fueling future enzyme production and mesocarp growth. Nucleosides were generally observed to increase along with lipid concentration, with high-yielding palms again showing significantly higher levels. These data highlight the important role of nitrogen assimilation for oil production and indicate multiple processes are required to support oil production aside from lipid biosynthesis alone.

The role and regulation of these biosynthetic pathways will be a key focus in future studies. Metabolites that are more directly linked to oil biosynthesis in glycolysis and the tricarboxylic acid (TCA) cycle also exhibited differentials in high-yielding palms. We observed an apparent change in flux at a specific branch-point in the middle of the glycolytic pathway, involving four key enzymes: fructose-1,6-bisphosphate aldolase,

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INFORMATION

- Bourgis, F., A. Kilaru, X. Cao, G.F. Ngando-Ebongue, N. Drira, J.B. Ohlrogge, and V. Arondel, Comparative transcriptome and metabolite analysis of oil palm and date palm mesocarp that differ dramatically in carbon partitioning, *Proc. Natl. Acad. Sci. USA* 108:12527–12532, 2011, <http://dx.doi.org/10.1073/pnas.1106502108>.
- Dussert, S., C. Guerin, M. Andersson, T. Joet, T.J. Tranbarger, M. Pizot, G. Sarah, A. Omore, T. Durand-Gassel, and F. Morcillo, Comparative transcriptome analysis of three oil palm fruit and seed tissues that differ in oil content and fatty acid composition, *Plant Physiol.* 162:1337–1358, 2013, <http://dx.doi.org/10.1104/pp.113.220525>.
- Loei, H., J. Lim, M. Tan, T.K. Lim, Q.S. Lin, F.T. Chew, H. Kulaveerasingam, and M.C.M. Chung, Proteomic analysis of the oil palm fruit mesocarp reveals elevated oxidative phosphorylation activity is critical for increased storage oil production, *J. Proteome Res.* 12:5096–5109, 2013, <http://dx.doi.org/10.1021/pr400606h>.
- Neoh, B.K., H.F. Teh, T.L.M. Ng, S.H. Tiong, Y.M. Thang, M.A. Ersad, M. Mohamed, F.T. Chew, H. Kulaveerasingam, and D.R. Appleton, Profiling of metabolites in oil palm mesocarp at different stages of oil biosynthesis, *J. Agric. Food Chem.* 61:1920–1927, 2013, <http://dx.doi.org/10.1021/jf304561f>.
- Rajinder, S., M. Ong-Abdullah, E.-T.L. Low, M.A.A. Manaf, R. Rosli, et al., 2013, Oil palm genome sequence reveals divergence of interfertile species in Old and New worlds, *Nature* 500:335–339, 2013, <http://dx.doi.org/10.1038/nature12309>.
- Teh, H.F., B.K. Neoh, M.P.L. Hong, J.Y.S. Low, T.L.M. Ng, N. Ithnin, Y.M. Thang, M. Mohamed, F.T. Chew, H.M. Yusof, H. Kulaveerasingam, and D.R. Appleton, Differential metabolite profiles during fruit development in high-yielding oil palm mesocarp, *PLoS ONE* 8(4):e61344 (2013), <http://dx.doi.org/10.1371/journal.pone.0061344>.

triosephosphate isomerase, glycerol-3-phosphate dehydrogenase, and glyceraldehyde-3-phosphate dehydrogenase. Concordance with protein and RNA levels was evident and provided confidence in the significance of this group of enzymes. Differentials indicated that high-yielding palms divert more carbon toward the biosynthesis of glycerol than lower yielding palms (Fig. 3).

The ability to increase the levels of glycerol in cells has been previously linked in other oil crops to significantly higher yields due to its role as a lipid building block. Significant differentials were also observed in certain metabolites in the TCA cycle. The ratio of malate to citrate changed markedly during lipid biosynthesis, and high-yielding palms had a much higher ratio throughout. The energy carrier molecule ATP had lower levels in high-yielding palms during oil biosynthesis, possibly reflecting the increased demand of energy for fatty acid production, while several proteins involved in ATP metabolism were notably up-regulated using iTRAQ (isobaric tag for relative and absolute quantitation) protein analysis.

Taken together, the omics analysis of oil palm mesocarp enabled the identification of genes that play important roles leading to increased oil production. The patterns observed were in agreement with phenotypic data obtained through detailed yield records conducted over seven years prior to the biochemical analysis. Data for yields revealed simultaneous increases in the number of bunches produced per year, the average mesocarp mass per bunch, and the oil content of the mesocarp; while omics analysis indicated changes in glycolytic flux, nitrogen assimilation, and energy management (Fig. 4).

Subsequently, we have confirmed in yeast systems the effect on oil biosynthesis of several of these genes and identified over 60,000 DNA variants (SNPs; also known as single nucleotide polymorphisms) in the sequences of the ~2,000 differential genes identified. The identified SNPs were prioritized out of more than three million detected throughout the oil palm genome for the purpose of genome-wide association studies, since it was not economically feasible to genotype using all. This led to an analysis based on 200,000 SNPs across the genome with increased density near differential genes. This has enabled the identification of alleles of specific genes that can be associated with traits across the wider populations of oil palm in our collection.

The authors thank Chew Fook Tim (National University of Singapore) for consultation and their colleagues at Sime Darby Technology Centre and Sime Darby Research for their significant contributions to sample/data acquisition and discussions.

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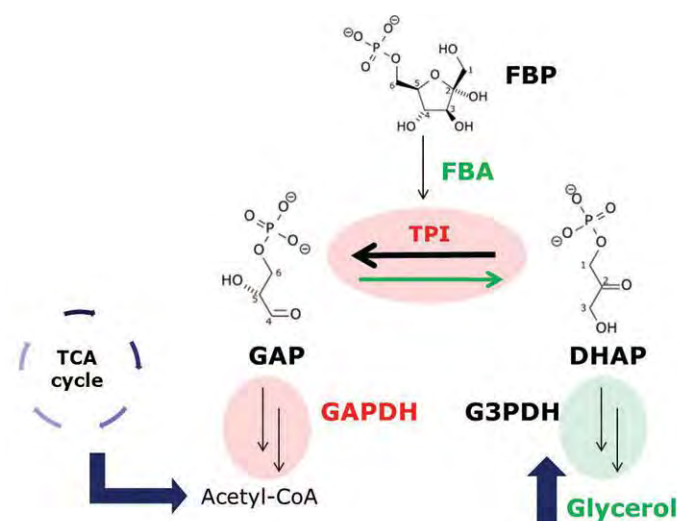
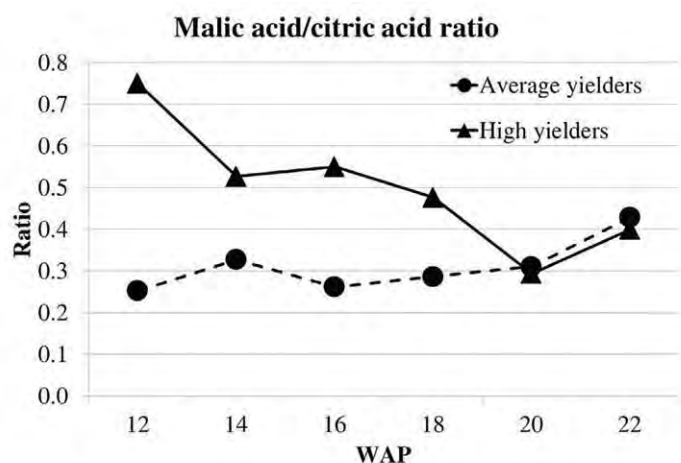


FIG. 3. Apparent glycolytic flux differences in high-yielding palms contributing to increased oil biosynthesis (green = higher in high-yielding palms, red = lower) and malate/citrate ratio. Abbreviations: FBA, fructose-1,6-bisphosphate aldolase; FBP, fructose-1,6-bisphosphate; DHAP, dihydroxyacetone phosphate; G3P, glycerol-3-phosphate; G3PDH, glycerol-3-phosphate dehydrogenase; GAP, glyceraldehyde-3-phosphate; GAPDH, glyceraldehyde-3-phosphate dehydrogenase; TCA, tricarboxylic acid; TPI, triosephosphate isomerase.

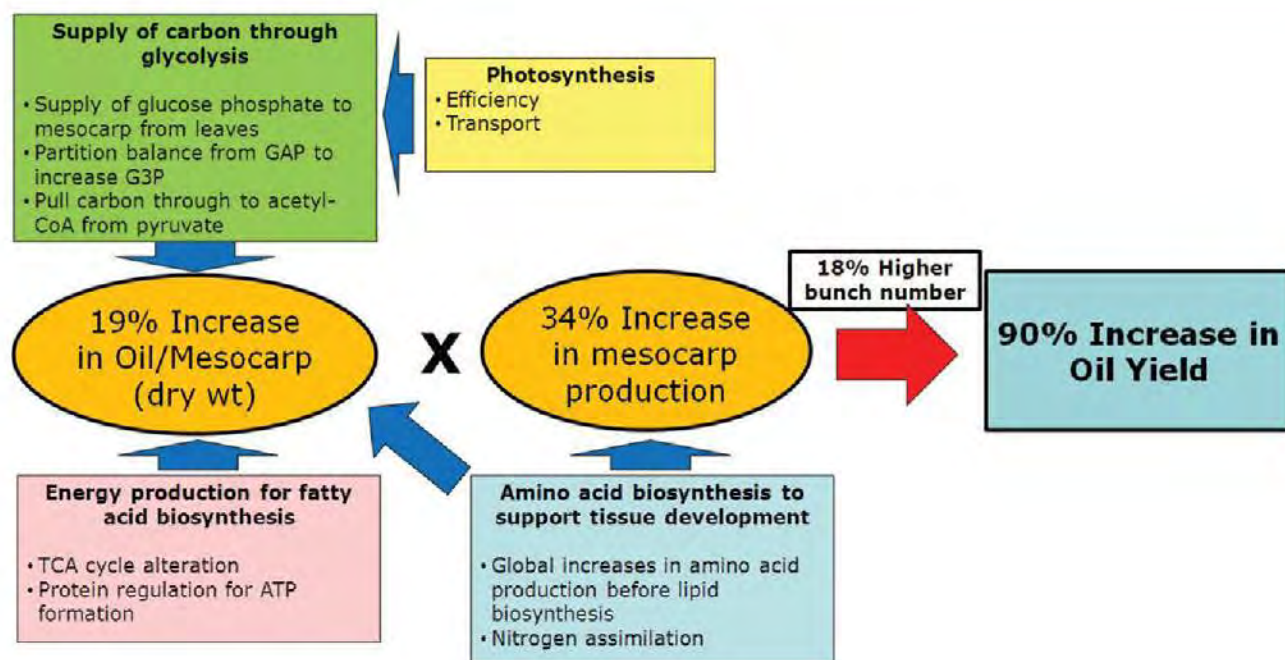


FIG. 4. Concerted biochemical changes contributing to an almost doubling of oil yield.

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Archer Daniels Midland Co. (ADM; Decatur, Illinois, USA) announced in March 2014 that it will build a soy protein production complex in Campo Grande, Mato Grosso do Sul, Brazil, representing an investment of approximately \$250 million. The complex, which will be located next to ADM's existing soybean processing facility in Campo Grande, will manufacture a range of functional protein concentrates and isolates to complement ADM's current North American production. Construction is expected to begin in the third quarter of 2014.

■ ■ ■

The average protein and oil levels in the 2013 US soybean crop ticked upward, according to the United Soybean Board (Chesterfield, Missouri, USA). Average oil levels increased to 19%, a 0.5-point increase from 2012 levels, while average protein levels grew by 0.4 percentage points to 34.7%. The study found less regional variation in protein and oil levels in 2013 than in previous years.

■ ■ ■

The European Commission has published the updated REACH test methods regulation in the *Official Journal*. The revised rule, which entered into force in late March 2014, offers several updates, including the extended one-generation reprotoxicity study. (REACH is the European regulation on Registration, Evaluation, Authorisation, and Restriction of Chemicals. It entered into force on June 1, 2007.)

■ ■ ■

Testifying before the House of Representatives Energy and Commerce Committee on February 5, 2014, US Food and Drug Administration (FDA) Deputy Commissioner for Foods and Veterinary Medicine Michael Taylor said that, while the agency has enough resources to issue the final rules for the Food Safety Modernization Act, it lacks the resources to implement them. "We will continue efforts to make the best use of the resources we have, but simply put, we cannot achieve FDA's vision of a modern food safety system and a safer food supply without a significant increase in resources," Taylor said in his testimony. ■

NEWS & NOTEWORTHY



High crop production to again challenge Brazil's infrastructure

Rabobank's Food & Agribusiness Research team says it expects another year of record production in 2014 for several of Brazil's major agricultural crops, including soybeans and, depending on weather developments, sugarcane. However, according to a recent research note, international prices for many of Brazil's agricultural commodities fell in 2013 and could decline further in 2014. Rabobank says that infrastructure and logistics remain key points of concern for the country for 2014, particularly for the export market. With production and export volumes set to rise again, and further increases in transport fuel costs implemented at the end of 2013, there is little chance of lower logistics costs in 2014.

"Due to slowing economic growth and high inflation in Brazil, the domestic market will have limited scope to drive growth in

sales in 2014," explained Rabobank analyst Andy Duff. "It is possible that some growth may come from exports, but with declining global commodity prices, revenue growth would have to come from an increase in export volumes, or a declining exchange rate, or both."

In the case of soybeans, the outlook is an increase in export volumes in 2014. If trend line yields are achieved, a harvest of 91 million metric tons (MMT) is expected for the 2013/2014 crop year, vs. 81 MMT in 2012/2013.

The decline in the value of Brazil's currency over the last year has also boosted Brazil's export competitiveness, and a further gradual decline in the Brazilian real (BRL)/US dollar (USD) exchange rate over 2014 is expected to sustain this competitive advantage.

Nevertheless, the positive impact of the weakening of the BRL/USD exchange rate on Brazil's export competitiveness has been at least partially offset by rising costs, especially in services and logistics. For example, diesel

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prices have risen three times since the beginning of 2013, with the most recent hike of 8% at the end of November 2013. Given the long distances between major crop production regions and the country's ports, sustained major investment in infrastructure over the coming years remains pivotal if the country is to continue to expand production and export volumes while remaining competitive. However, this will not happen overnight.

"Although Brazil is slowly addressing its bottlenecks, this will take years," continues Duff. "For 2014, with higher fuel costs and another large grain harvest, logistics costs for Brazilian agribusiness are unlikely to decline."

Rabobank Group is based in Utrecht, Netherlands, and provides global wholesale and retail banking, leasing, real estate services, and renewable energy project financing to the food, beverage, and agribusiness industry.

CCMAS meets in Budapest

The Codex Alimentarius Commission (CAC) Committee on Methods of Analysis and Sampling (CCMAS) met March 3–7, 2014, in Budapest, Hungary. AOCS Chief Science Officer and Technical Director Richard Cantrill attended the meeting on behalf of the global fats and oils community.

"Codex meetings offer a great opportunity for AOCS to interact with governments that use our methods to maintain the safety and quality of our food supplies," said Cantrill. "The activity of the standards development community in the work of CCMAS has always been truly appreciated."

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

CCMAS MEETING

CCMAS had its usual full agenda of discussion items; those of particular interest to AOCS members included procedures for establishing criteria, for regular updating of methods, and a discussion paper on sampling in Codex standards.

The US delegation introduced the report of the electronic working group on procedures for establishing criteria, noting that there was general interest in the idea of developing criteria for Type I (defining) methods and/or multi-analyte methods. CCMAS would need to consider a number of factors when deciding on development of criteria for either Type I methods or for multi-analyte methods, such as:

- When considering criteria for Type I methods, it may be possible to establish procedures for assessing equivalency between methods and not criteria. However, since not all Type I methods were created equal, there may be instances where equivalency could not be established.
- In the case of multi-analyte methods, CCMAS must decide how to deal with toxic equivalency factors (TEF) and whether these should be left out of the standard as in the approach taken by the Codex Committee on Fish and Fishery Products.

- Further, CCMAS must decide whether a general approach is appropriate or whether different approaches would be necessary for multi-analyte methods.

After discussion, there was general agreement that numerical criteria for Type I methods should not be developed; however, procedures for establishing equivalency to Type I should be considered. A consensus was also reached that work should continue on establishing a criteria approach for multi-analyte methods and that TEF should not be contained within a specific analytical method and could be referenced either in the standard or elsewhere where they can be regularly updated and evaluated by internationally recognized procedures.

CCMAS will pursue this work by establishing two new electronic working groups. The first, to be led by the US delegation, will work to develop procedures and guidelines for determining equivalency to Type I methods. The second, led by the United Kingdom delegation, will develop a criteria approach for methods that use a "sum of components," by evaluating and discussing current options, considering general guidelines, and assessing criteria for use on a case-by-case basis.

Another topic of discussion concerned establishing a single source (document or database) for methods of analysis. Some observers noted that every stakeholder should work toward ensuring that methods are updated, that standards development organizations should always monitor Codex standards relevant to their scope of work and check whether references within such standards falling within their scope of work require updating, and that proposals for reviews should be brought to the attention of CCMAS.

In conclusion, the committee agreed that the list—once compiled—will be used internally to update methods and that "the mechanism for this process would first be tried before examining the necessity of having it recommended for inclusion in the Procedural Manual."

SAMPLING IN CODEX STANDARDS

CCMAS agreed in 2013 that the Inter-Agency Meeting (IAM), for which AOCS' Cantrill serves as secretary, would develop a paper on sampling. (IAM organizes regular summits of international organizations working in the field of methods of analysis and sampling of food products and associated quality assurance measures prior to CCMAS meetings.)

The observer of the International Commission for Uniform Methods of Sugar Analysis noted that the paper was comprehensive and that the recommendations aimed to help CCMAS examine how best principles of sampling, such as auto-control, uncertainty of measurement results, and pragmatic approach to sampling, among others, can be demonstrated practically in standards.

After discussion, CCMAS agreed to develop practical examples of sampling plans and that these examples would be best placed as an Annex to the Principles for the Use of Sampling and Testing in International Food Trade (CAC/GL 83-2013). For this purpose, the committee agreed that other Codex committees would be requested to submit practical examples for consideration by CCMAS.

The next CCMAS meeting will be in March 2015 in Budapest.



SUSTAINABILITY WATCH

“No deforestation” palm oil

The first quarter of 2014 brought with it a wealth of stories related to sustainability, including several reports; a high-profile protest at Procter & Gamble (P&G) headquarters in Cincinnati, Ohio, USA; and “no deforestation” pledges made by various companies.

First came a report by Greenpeace (see <http://tinyurl.com/Green-P-G>), which was released on February 26. Titled “P&G’s Dirty Secret,” the report and an accompanying news release suggest that P&G is sourcing palm oil from companies connected to substantial clearance of endangered orangutan habitat in Indonesia. “Through a global campaign launched today, Greenpeace is demanding Procter & Gamble end its role in forest destruction,” Greenpeace said in a statement.

Greenpeace did not leave its protest to words alone. On March 4, nine protestors wearing business suits and carrying fake identification used rolling luggage to wheel two 60-foot banners in to P&G headquarters. Subsequently, one protester reportedly dressed as a tiger and hung from ropes or cables strung between the two P&G towers. In the end, the protesters were indicted by a grand jury on charges of burglary and vandalism with a maximum possible prison sentence of 9½ years.

A spokeswoman for P&G told the Guardian.com that the company was “strongly opposed to irresponsible deforestation.” She added that P&G has taken a “series of steps

as part of our overall sustainability program to ensure our practices and those of our partners and suppliers follow sustainable practices.”

Following the release of the report, Greenpeace announced on March 10 that US chocolate-maker Mars had “committed to remove deforestation [sic] from all of its products by the end of 2015.” On March 24, Greenpeace said Colgate-Palmolive, “a major competitor of Procter & Gamble,” had also adopted a “no deforestation” policy.

Greenpeace was not the only nongovernmental organization (NGO) putting pressure on some of the world’s largest companies to use sustainable palm oil. The Union of Concerned Scientists (UCS), an NGO based in Cambridge, Massachusetts, USA, released its palm oil scorecard on March 6 and suggested that consumers “tell America’s top brands they need to fully address the climate and deforestation risks associated with their palm oil purchases.” (See <http://tinyurl.com/UCS-Scorecard>.)

UCS found that 24 out of 30 top companies in three sectors—packaged food, personal care, and fast food—have “inadequate commitments or lack commitments altogether for sourcing sustainable palm oil for their products.” Calling the standards set by the Roundtable for Sustainable Palm Oil “inadequate,” UCS noted that “new industry standards show that palm oil can be produced in a way that protects tropical forests, peatlands, and our atmosphere—and some companies in the palm oil supply chain have begun to commit to the new standards.”

EFSA issues opinion on formaldehyde in animal feed

The European Food Safety Authority’s Panel on Additives and Products or Substances used in Animal Feed (FEEDAP) has issued an opinion on formaldehyde, currently used as a feed additive and a preservative for skimmed milk intended for pigs.

Concluding that “although there is no health risk for consumers exposed to the substance through the food chain,” FEEDAP cautions that inhalation of formaldehyde may cause cancer and appropriate measures should be taken to “ensure that the respiratory tract, skin, and eyes of any person handling the product are not exposed to any dust, mist, or vapor generated by the use of formaldehyde.” The panel also notes that formaldehyde will not accumulate in the environment and its use in animal nutrition is not expected to pose a risk for the environment. ■

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BRIEFS

The Malaysian government will fully mandate the use of B5 (a blend of 5% palm oil diesel and 95% petroleum diesel) on July 1, 2014. On that date, all 3,877 petrol stations in the country will be selling B5. This should lead to a national consumptive increase in palm oil biodiesel of 500,000 metric tons annually. Malaysia has been implementing this B5 program gradually; the Central Region adopted B5 in 2011, the Southern Region in 2013, and the Eastern and Northern Regions as well as Peninsular Malaysia earlier this year. The final phase will be implemented in Sabah, Sarawak, and the Federal Territory of Labuan in July 2014. The government plans to mandate the use of B7 by January 2015.

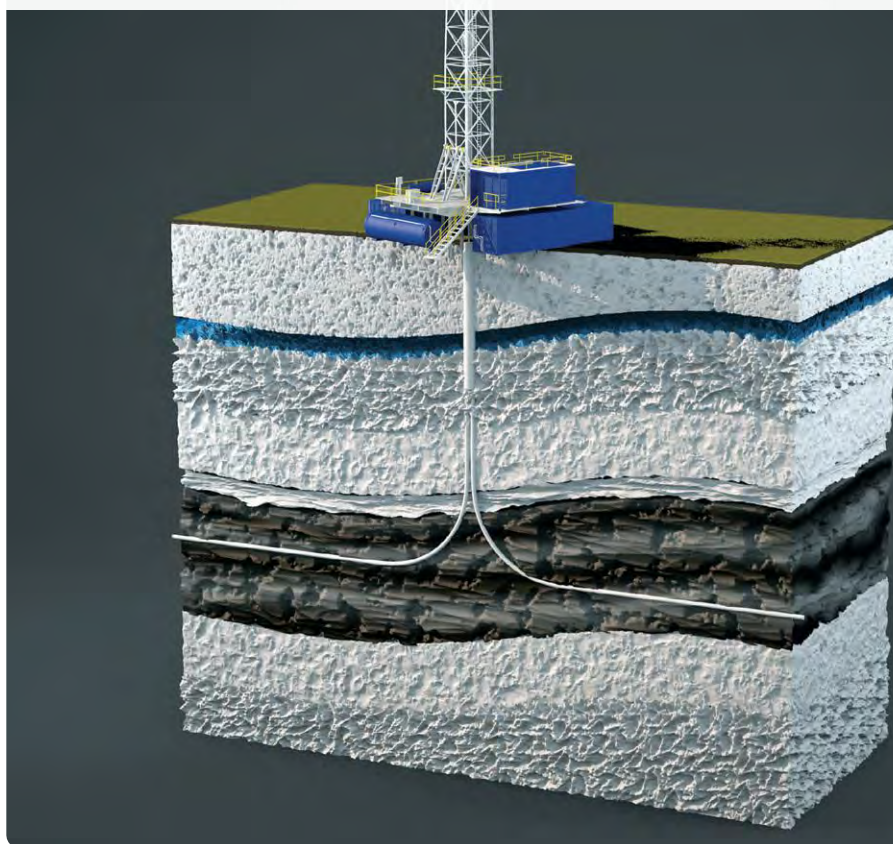
■■■

Knowing that *Arabidopsis thaliana* mutants deficient in the lipase gene *SDP1* accumulate high levels of oils in their seeds, probably due to blockage in triacylglycerol degradation, N.-H. Chua and workers applied this information to transgenic *Jatropha curcas* using RNA interference technology (M.J. Kim, S.W. Yang, H.-Z. Mao, S.P. Veena, J.-L. Yin, and N.-H. Chua, *Bio-technol. Biofuels* 7:36, 2014, <http://dx.doi.org/10.1186/1754-6834-7-36>). The resultant transgenic plants accumulated 13–30% higher total seed storage lipid, along with a 7% compensatory decrease in protein content, than control plants. Free fatty acid content in *Jatropha* seeds was reduced from 27% in control plants to 8.5% in the genetically modified plants.

■■■

Lux Research, a consulting firm providing strategic advice and intelligence for emerging technologies, forecasts that the biofuel industry is facing a slowdown through 2017 to 3.2% annual growth (<http://tinyurl.com/LuxRes-slowdown>). The industry has experienced a 19.6% annual growth rate since 2005. Lux attributes the decline to the industry transition to novel fuels and feedstocks, to the food vs. fuel debate, and to upcoming blend limits for biodiesel and ethanol. ■

BIOFUELS+



Solazyme introduces industrial lubricant, Encapso

On March 25, 2014, Solazyme Inc. (South San Francisco, California, USA) announced its intention to offer \$130 million in aggregate principal notes due in 2019 and five million shares of common stock (<http://solazyme.com/media/2014-03-25>). Immediate response in the stock market was a drop in Solazyme's share price on the NASDAQ, which could have reflected fears of a dilution of the value of Solazyme stock.

A second announcement, made a few hours later, resulted in an increase in Solazyme's share price as the company indicated it is entering a new market—the oil and gas drilling fluids additive market. Its new product is Encapso™, which Solazyme claims is the world's first encapsulated biodegradable lubricant for drilling fluids, designed

to deliver high-grade lubricant precisely at the point of friction where and when needed most.

Solazyme has a history of pursuing the production of biofuels, especially in its early days. However, Solazyme's CEO Jonathan Wolfson pointed out in the March 25 announcement: "As long as the oil and gas industry continues to extract fossil fuels, we at Solazyme view it as an imperative that it is done in a more sustainable way to protect the environment for generations to come. The drilling industry needs new high-performance and sustainable technologies to meet rising energy demand and increased drilling. Encapso's unique targeted lubricant delivery system helps reduce the costs for the oil and gas exploration and production industry and provides improved drilling performance" (<http://solazyme.com/media/2014-03-25-0>).

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According to the company's prospectus, filed with the Securities and Exchange Commission on March 25, "Encapso is a microalgae cell filled with biodegradable oil and natural emulsifiers that is designed to act as a targeted friction inhibitor when used in drilling fluid. The product can be proactively added as a dry dispersible powder into drilling fluid mud systems to help enable faster, easier and cleaner drilling" (<http://tinyurl.com/SEC-Solazyme-March2014>).

Encapso has been tested in the laboratory as well as in the field, reportedly in over a dozen commercial wells in a number of basins including the Williston Basin (located in eastern Montana, western North Dakota, South Dakota, and southern Saskatchewan), the Denver-Julesburg basin (centered in eastern Colorado), and the Permian Basin (western part of Texas and the southeastern part of New Mexico). The majority of work so far has been done in horizontal wells; Encapso is especially efficacious when it comes to "building the curve"—or the point where an unconventional well transitions from vertical to horizontal, where drilling friction is most difficult to manage. Improving the speed and efficiency of drilling translates directly to cost savings for well operators.

In announcing Encapso, Solazyme presented several testimonials for the product (<http://solazyme.com/media/2014-03-25-0>). Philip Johnson, a senior drilling engineer who worked with Encapso on behalf of a major exploration and production company, said, "After adding Encapso to the system we saw a

rate of increase in our rate of penetration from two feet [0.6 meters] per hour to 40 feet [12 meters] per hour." Kevin Quon, a stock analyst who writes for SeekingAlpha.Com, calculated that for a theoretical 40-foot segment at the critical curve of a horizontal well, this increase in penetration rate would result in an operation time savings of 19 hours (<http://tinyurl.com/Quon-analysis-solazyme>).

In the aftermath of the two announcements, pundits suggested that, if sales of Encapso take off, the company's efforts to increase the capital available to it for developing more manufacturing capacity will be well worth the effort.

One-step transesterification/degumming for biodiesel

Lipase-catalyzed biodiesel production potentially can produce environmentally friendly fuel from feedstocks such as crude soybean oil. Using lipases as catalysts in the transesterification of triacylglycerides allows mild reaction conditions and easy recovery of glycerol without need for further purification or chemical waste production.

The enzymatic process also tolerates the traces of water commonly found in crude vegetable oil and increases the biodiesel yield. Furthermore, it avoids the typical soap formation due to alkaline transesterification.

Research results out of a collaboration between Novozymes A/S (Bagsværd, Denmark) and the University of Barcelona (Spain) have described a way to reduce the high cost of the enzymatic process of making biodiesel. It allows for the use of lower-cost feedstocks (e.g., crude soybean oil) and results in greater efficiency.

Inform will present a feature article on this process in an upcoming issue.

Publication identifies choice US algae sites

Scientists from the Pacific Northwest National Laboratory (PNNL; Richland, Washington, USA) and Sapphire Energy, Inc. (San Diego, California, USA) collaborated to publish a report in February 2014 on how to identify the best sites for locating commercial algae production projects.

The authors, led by Erik Venteris of PNNL, point out that the climate must support high growth rates (see E.R. Venteris, R.C. McBride, A.M. Coleman, R.L. Skaggs, and M.S. Wigmosta, Siting algae cultivation facilities for biofuel production in the United States: trade-offs between growth rate, site constructability, water availability, and infrastructure, *Environ. Sci. Technol.* 48:3559–3566, 2014, <http://dx.doi.org/10.1021/es4045488>). Appropriate land and water resources are a requirement for outdoor cultivation ponds, utilities must be available, and adequate transportation for inputs to and outputs from the project is essential. Also, local issues must be



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taken into consideration, such as regulatory constraints, tax incentives, receptivity of local populations, and ecological constraints.

The number of practicable sites was identified by applying the Biomass Assessment Tool (BAT), first developed by PNNL in 2011. The high-resolution spatio-temporal BAT asks critical questions related to the amount of energy that can be produced, where production can occur, and how much land, water, and nutrient resources will be required. For the purpose of the study considered sites where biofuel production of one million or more gallons would be feasible.

The researchers estimated algae growth and resource availability for nearly 90,000 locations in the coterminous United States, mostly around the coast of the Gulf of Mexico (especially in the state of Florida), but also on the southern coast of Texas and Louisiana and in southern Arkansas. A total of 64,000 sites were then evaluated.

Application of BAT was predicated on open-pond cultivation of the brackish-water cyanobacteria *Arthrospira* sp. and strains of the order Sphaeropleales, which are fresh-water green algae. Strain optimization and ecological dynamics were not considered. Both strains grew maximally along the Gulf Coast, with highest values on the Florida peninsula. *Arthrospira* did well along the southern coast of Texas, and Sphaeropleales did well in Louisiana and southern Arkansas.

The lack of pipeline access turned out to be an adverse factor in Florida, and elevated salinity in waters available for algal cultivation in southern Texas adversely influenced potential yields for strains of Sphaeropleales; *Arthrospira* is more salt tolerant.

Venteris and his colleagues are continuing their research using BAT. They will present a paper in June 2014 assessing the future success of the algae biofuel industry in the coterminous United States. They will compare the importance of climate (location) and strain selection on biomass production and explore the production that is possible with lipid extraction and with hydrothermal liquefaction (HTL). In this preliminary report the researchers suggest that HTL potentially can produce about 60% more renewable diesel for a given amount of biomass than lipid extraction. They also propose that at least 5 billion gallons (19 billion liters) per year of production are likely attainable.

The paper will be presented at the TechConnect World Innovation Conference & Expo, June 15–18, 2014, in Washington, DC, USA (<http://www.techconnectworld.com/World2014/a.html?i=1282>).



Neste and DONG Energy to develop microbial oils

The Finnish renewable fuel company Neste Oil and DONG Energy announced in late February that they were joining forces to develop an integrated process to produce renewable diesel and aviation fuel based on agricultural residues. Neste is already known for its ability to produce renewable fuel on an industrial scale from more than 10 different feedstocks.

In a company statement, Lars Peter Lindfors, Neste Oil's senior vice president, technology, said, "Increasing the use of waste- and residue-based feedstocks is one of our most important goals, and microbial oil produced from forest industry and agricultural residues, such as straw, is one of our potential feedstocks."

Inbicon A/S, a subsidiary of DONG Energy, is the source of the technology that will be used in the first part of the process. It involves three steps: mechanical conditioning of biomass, hydrothermal pretreatment, and enzymatic hydrolysis. The ultimate product is cellulosic sugars, which can be converted in a bioreactor into microbial oil with Neste Oil's technology.

DONG Energy is an integrated energy company based in Fredericia, Denmark; Inbicon, also headquartered in Fredericia, has licensed its technology for biomass refineries in North America and elsewhere.

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German biodiesel exports expand, consumption declines

The German biodiesel industry set a new export record of 1,572 million metric tons (MMT) in 2013, according to an appraisal by the Agricultural Market Information Co. based on data from the German Federal Statistical Office (<http://www.ufop.de/english/news/chart-of-the-week/>, accessed March 27, 2014). Exports from Germany in 2012 were 1,214 MMT. At the same time, biodiesel imports fell from 762,000 metric tons (MT) in 2012 to 563,000 MT in 2013. The drop in imports reflects tariffs Germany imposed on imports from Argentina and Indonesia, and the increase in exports is attributable to "the competitiveness of the German biodiesel industry."

Meanwhile, German consumption of biofuel (vegetable oil, B100 biodiesel, and biodiesel in blends) fell somewhat between 2012 and 2013, declining from 2.5 MMT to 2.2 MMT. At 2.2 MMT in 2013, the use of biodiesel for blending dipped 8% from 2012. B100 use fell to 30,134 MT in 2013, from 131,032 MT in 2012. The highest values in the past seven years were recorded in 2007, when about 1.4 MMT in

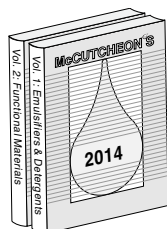
biodiesel in blends, 1.9 MMT in B100 blends, and 0.7 MMT as vegetable oil were consumed.

E85 availability expands in USA

The US Energy Information Administration reported that the number of retail fueling stations offering motor fuel that can be up to 85% ethanol (E85), has grown considerably since 2007 (<http://tinyurl.com/EIA-E85-availability>). According to the Alternative Fuels Data Center (AFDC), Minnesota continues to lead the nation, with 336 E85 retail locations. Currently, 2% of all retail stations in the United States offer E85, serving the approximately 5% of the US light-duty vehicle fleet capable of running on E85.

Only two states (New Hampshire and Alaska) currently have no E85 fueling stations, compared to nine that had none of these stations in 2007.

Growth in the number of E85 fueling stations has slowed in the past two years. The number of US E85 fueling stations almost doubled between 2007 to 2011, from 1,229 to 2,442, but only increased by 7% from 2011 to 2013, when the total reached 2,625. The nation has approximately 156,000 retail motor fuel outlets that do not offer E85. ■



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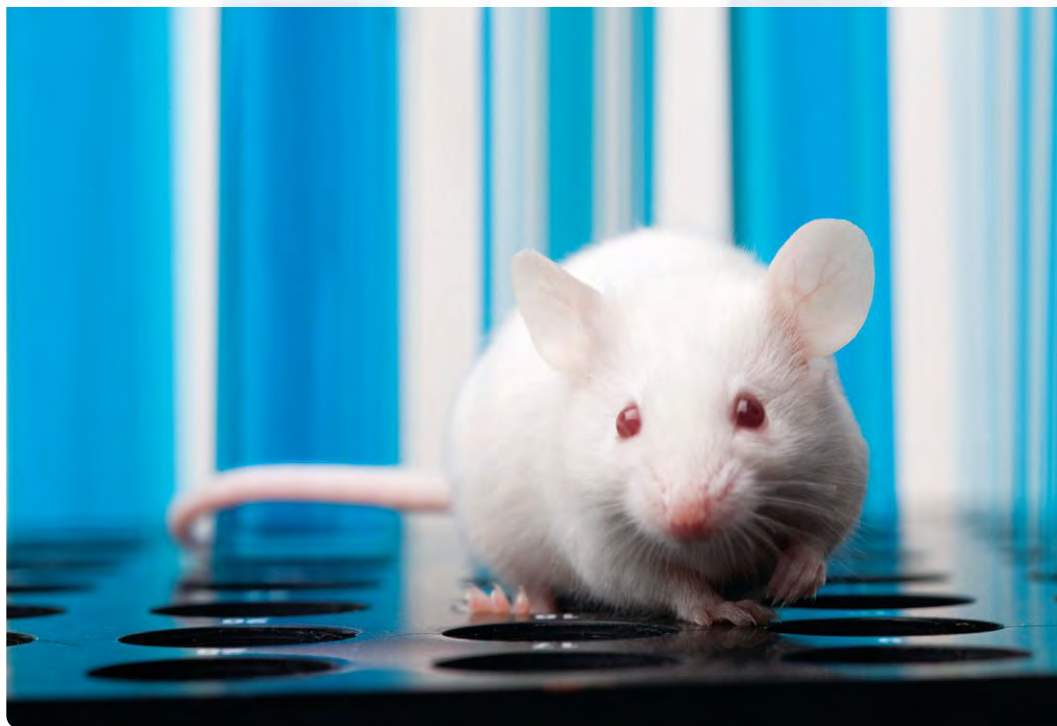
The European Food Safety Authority has issued an opinion regarding a request to broaden the approved cholesterol-lowering claim for plant sterol esters (see <http://dx.doi.org/10.2903/j.efsa.2014.3577>, 2014). In response to a request to extend the claim for plant sterol esters to an additional food matrix—powder supplements that are diluted in water—the panel reiterated its previous conclusion that, “while plant sterols added to foods such as margarine-type spreads, mayonnaise, salad dressings, and dairy products such as milk, yogurts, including low-fat yogurts, and cheese have been shown consistently to lower blood LDL-C (low-density lipoprotein-cholesterol) concentrations in a large number of studies, the effective dose of plant sterols (as powder diluted in water) needed to achieve a given magnitude of effect in a given time-frame, cannot be established with the data provided.”

■ ■ ■

In further regulatory food news from Europe, the UK's Food Standards Agency (FSA) is reviewing public comments on a novel foods application submitted by DSM seeking permission to use algal oil in infant formula. DSM says that the oil, extracted from a newly isolated strain of the microalgae *Schizochytrium* sp., is a rich source of the long-chain omega-3 fatty acid DHA (docosahexaenoic acid). FSA is also reviewing public comments on an application by Unilever, seeking permission to extend the use of cholesterol-lowering phytosterol esters. This is the third such application made by Unilever, which gained approval for margarines with added phytosterol esters in 2000, and “milk type” and “yogurt type” products with added phytosterols in 2004. The new application seeks to extend the use

CONTINUED ON PAGE 304

FOOD, HEALTH & NUTRITION



Circadian rhythm apparently affects triglyceride levels

New findings in mice suggest that merely changing meal times could have a significant effect on the levels of triglycerides in the liver. The results of this study, recently published in *Cell Metabolism* (<http://dx.doi.org/10.1016/j.cmet.2013.12.016>, 2014), not only have important implications for the potential treatment of metabolic diseases, they may also have broader implications for research in the life sciences.

Many biological processes follow a set timetable, with levels of activity rising and dipping at certain times of the day. Such fluctuations, known as circadian rhythms, are driven by internal “body clocks” based on an approximately 24-hour period—synchronized to light-dark cycles and other cues in an organism's environment. Disruption to this optimal timing system in both animal models and humans can cause imbalances, leading to such diseases as

obesity, metabolic syndrome, and fatty liver. Night-shift workers, for example, have been shown to have higher incidence of these diseases.

In studying the role of circadian rhythm in the accumulation of lipids in the liver, postdoctoral fellow Yaarit Adamovich and the team in the lab of Gad Asher at the Weizmann Institute in Rehovot, Israel—together with scientists from Xianlin Han's lab at the Sanford-Burnham Medical Research Institute, Orlando, Florida, USA—quantified hundreds of different lipids present in the mouse liver. They discovered that triglyceride levels (TAG) exhibit circadian behavior, with levels peaking about eight hours after sunrise. The scientists were astonished to find, however, that daily fluctuations in TAG levels persist even in mice lacking a functional biological clock, albeit with levels cresting at a completely different time—12 hours later than the natural schedule.

“These results came as a complete surprise: One would expect that if the

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inherent clock mechanism is 'dead,' TAG could not accumulate in a time-dependent fashion," says Adamovich. So what was making the fluctuating lipid levels "tick" if not the clocks? "One thing that came to mind was that, since food is a major source of lipids—particularly TAG—the eating habits of these mice might play a role." Usually, mice consume 20% of their food during the day and 80% at night. However, in mice lacking a functional clock, the team noted that they ingest food constantly throughout the day. This observation excluded the possibility that food is responsible for the fluctuating patterns seen in TAG levels in these mice.

When the scientists proceeded to check the effect of an imposed feeding regimen upon wild type mice, however, they were in for another surprise: After they provided the same amount of food—but restricted 100% of the feeding to nighttime hours—the team observed a dramatic 50% decrease in overall liver TAG levels.

These results suggest that the time at which TAG accumulation occurs, as well as its levels, is determined by the clocks together with timing of meals. The details of the mechanism that drives the actual fluctuating behavior are yet to be discovered.

"The striking outcome of restricted nighttime feeding—lowering liver TAG levels in the very short time period of 10 days in the mice—is of clinical importance," said Asher. "Hyperlipidemia and hypertriglyceridemia are common diseases characterized by abnormally elevated levels of lipids in blood and liver cells, which lead to fatty liver and other metabolic diseases. And yet no currently available drugs have been shown to change lipid accumulation as efficiently and drastically as simply adjusting meal time—not to mention the possible side effects that may be associated with such drugs." Mice are nocturnal animals, so in order to interpret these results for humans, the timetable would need to be reversed.

Time is a crucial element in all biological systems, so these findings are likely to impact biological research in general, the researchers said: Circadian clock mechanisms function even in cultured cells, so research results could vary depending on the time at which samples are analyzed, or, with animals, their feeding regimen might significantly affect the experimental outcomes. In other words, when it comes to designing experiments, Asher said that scientists should be aware that "timing is everything."

Why dark chocolate is good for your heart

A small study of 44 middle-aged, overweight men provides additional information about how dark chocolate positively affects vascular health.

Led by Diederik Esser of the Top Institute Food and Nutrition and Wageningen University (Netherlands), the research found that dark chocolate helps restore flexibility to arteries while also preventing white blood cells from sticking to blood vessel walls. Both arterial stiffness and white blood cell adhesion are known factors that play a significant role in atherosclerosis, or hardening of the arteries. The scientists also found that increasing the flavanol content of dark chocolate did not change this effect.

"We provide a more complete picture of the impact of chocolate consumption in vascular health and show that increasing flavanol content has no added beneficial effect on vascular health," said Esser. "However, this increased flavanol content clearly affected taste and thereby the motivation to eat these chocolates. So the dark side of chocolate is a healthy one."

To come to this conclusion, Esser and colleagues examined the study subjects over two periods of four weeks as they consumed 70 grams of chocolate per day, provided by Barry Callebaut (Lebbeke, Belgium). Study participants received either specially produced dark chocolate with high flavanol content (1,078 mg of flavanol, of which 349 mg was (–)-epicatechin) or chocolate that was commercially produced (259 mg of flavanol, of which 97 mg was (–)-epicatechin). Both chocolates had similar cocoa, caffeine, and theobromine concentrations.

"The effect that dark chocolate has on our bodies is encouraging not only because it allows us to indulge with less guilt, but also because it could lead the way to therapies that do the same thing as dark chocolate but with better and more consistent results," said Gerald Weissmann, editor-in-chief of *The FASEB Journal*. "Until the 'dark chocolate drug' is developed, however, we'll just have to make do with what nature has given us."

The findings appeared in *The FASEB Journal* (<http://dx.doi.org/10.1096/fj.13-239384>, 2014).

Meta-analysis of studies on omega-3s and blood pressure

A meta-analysis of 70 randomized controlled trials (RCT) commissioned by GOED (the Global Organization for EPA and DHA) and completed by Exponent Inc. and Van Elswyk Consulting, Inc., found that omega-3 fatty acids can be as effective or more effective in lowering blood pressure (BP) than other lifestyle interventions, including restricting sodium and alcohol intake and increasing physical activity.

The 70 RCT were conducted with both normotensive and hypertensive subjects. The researchers—led by Page Miller of Exponent Inc.—note that although a large body of literature



has examined the relationship between eicosapentaenoic acid (EPA; 20:5n-3) and docosahexaenoic acid (DHA; 22:6n-3) and BP, past systematic reviews have been hampered by narrow inclusion criteria and a limited scope of analytical subgroups. "In addition, no meta-analysis to date has captured the substantial volume of RCT published in the past two years. The objective of this meta-analysis was to examine the effect of EPA + DHA, without upper dose limits and including food sources, on BP in RCT."

Key findings include the following:

- Among all subjects, systolic BP (SBP) decreased by an average 1.52 mm Hg and diastolic BP (DBP) by 0.99 mm Hg.
- Among those with hypertension, the effect was even greater, with an average reduction in SBP of 4.51 mm Hg and an average reduction in DBP of 3.05 mm Hg.
- Among normotensive subjects, the drop in SBP was an average of 1.25 mm Hg and in DBP, 0.62 mm Hg.
- In comparison, studies with nontreated individuals with high BP have shown that dietary sodium reduction reduces SBP by 2–8 mm Hg, physical activity by 4–9 mm Hg, and alcohol by 2–4 mm Hg.
- The decrease of 4.51 mm Hg in SBP among those with high BP could prevent an individual from having to take medication to control BP levels or prevent an individual from moving toward a more serious stage of hypertension.
- A decrease of 1.25 mm Hg in SBP could prevent a pre-hypertensive person from becoming hypertensive.
- Another study found that each 2 mm Hg reduction reduces stroke mortality by 6%, coronary heart disease mortality by 4%, and total mortality by 3%.

The meta-analysis, GOED noted in a news release, is the basis for a health claim petition for EPA + DHA and the reduction of BP in the general population that the group submitted to the US Food and Drug Administration (FDA) in December 2013. "The review process will likely be lengthy," said GOED at the time of submission, "particularly given the number of studies included in the meta-analysis. FDA was clear when GOED met with the agency in August that each study included in the meta-analysis will need to be reviewed."

The meta-analysis is an open-access article that appeared in the *American Journal of Hypertension* (doi:10.1093/ajh/hpu024, 2014; <http://tinyurl.com/AJH-blood-pressure>).

Plant-based flavonoids and reduction of risk of type 2 diabetes

A large study of European men and women examined whether ingestion of plant-based flavanols and flavonols is associated with the risk of developing type 2 diabetes. The two are found together in some foods and beverages (such as tea, wine, and some fruits) and separately in others (such as chocolate and some vegetables).

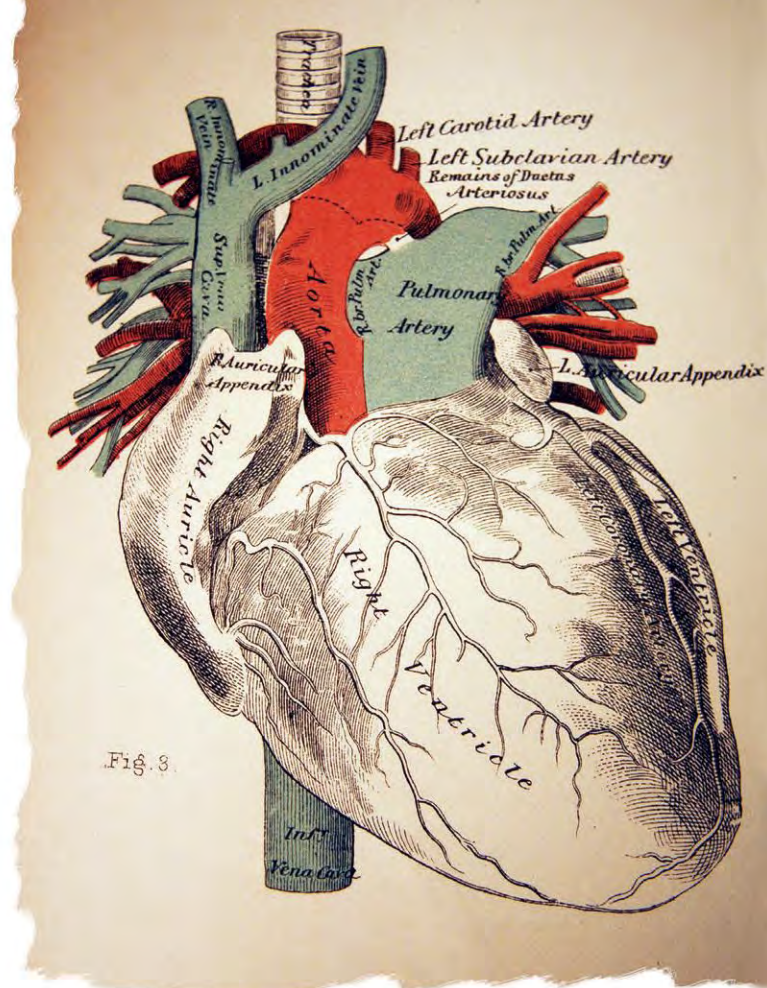


Fig. 3

The research was carried out as part of the EPIC-InterAct study and involved an international group of researchers led by Nita Forouhi and Nick Wareham at the Medical Research Council Epidemiology Unit, University of Cambridge, UK. The study encompassed eight European countries, 26 research centers, and 340,234 participants. Dietary intake was assessed at baseline using a validated questionnaire, and flavanol and flavonol intakes were estimated using comprehensive databases. The researchers then evaluated whether the individual types of flavanols and flavonols were related to risk of developing type 2 diabetes during the study.

Several inverse associations were found between individual flavanols and flavonols and the risk of developing type 2 diabetes. For instance, participants who consumed the highest levels of flavan-3-ol monomers (major food sources are tea and fruits), proanthocyanidin dimers (fruit and wine), proanthocyanidin trimers (fruit and fruit juices), and the flavonol myricetin (fruits and wine) had the lowest risk of developing diabetes. It is noteworthy that the study took account of many related factors that might also be associated with more healthful eating habits in people who tended to consume higher levels of flavonoids. The scientists concluded that their results suggest that individual flavonoids may have different roles in the prevention of type 2 diabetes. Although controlled intervention studies will be needed to test this hypothesis in a more rigorous way, Forouhi concludes that "these findings provide support for the potential beneficial effect of plant-based compounds for the prevention of diabetes."

The findings appeared in the *Journal of Nutrition* (<http://dx.doi.org/10.3945/jn.113.184945>, 2014). ■

STATISTICAL ANALYSIS FROM MINTEC

Yuliya Nam-Wright

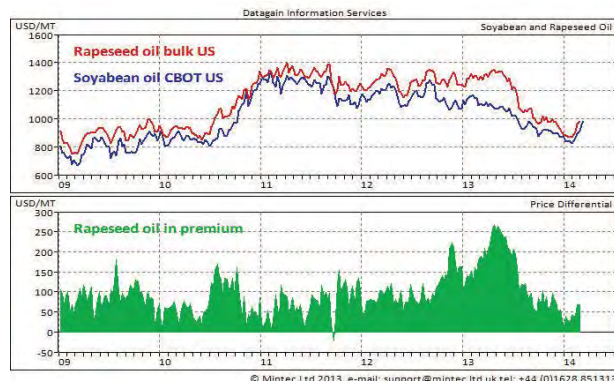
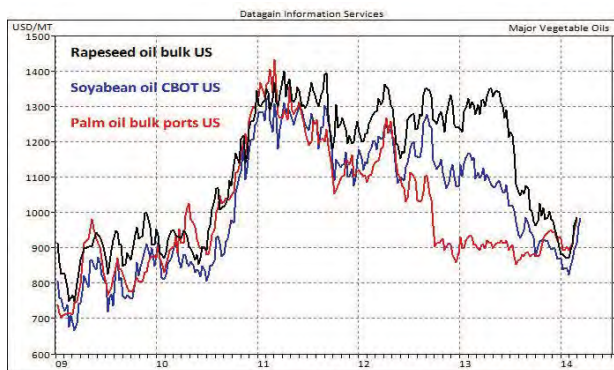
Prices for palm oil firmed in the second half of 2013 and early in 2014, driven up by good export demand due to its competitive pricing in the first half of 2013. In addition, Indonesia, the world's top exporter, increased its biodiesel mandate, lifting domestic consumption.

World palm oil production is forecast to continue to rise in 2013/14 to a record 52.4 million metric tons (MMT), up 6% year-on-year. However, unusually dry conditions that affected parts of Thailand and Malaysia in February 2014 raised concerns about the potential damage to the production in these countries.

After falling throughout most of 2013, soybean prices rose sharply in the first few months of 2014, driven by concerns that dry weather in parts of South America may reduce supply. In addition, sharp falls in the value of Argentine peso slowed the pace of exports from Argentina. Tightening supply in the United States due to strong export demand has also supported prices. World soybean production is forecast at 285.4 MMT, up 6% year-on-year.

The premium that rapeseed oil traditionally enjoys over soybean oil has narrowed in recent months, largely due to soybean oil prices falling slower than global fundamentals would suggest, driven by strong export demand from China.

However, in the first months of 2014, rapeseed oil prices also rose, lifted by increases in palm and soybean oils. In addition, export deliveries from Canada continued to be delayed by inefficiencies in the domestic transport infrastructure. This resulted in accumulation of stocks in Canada and lower than expected availability in the global market. World rapeseed production in 2013/14 is expected to grow 13% year-on-year to 70.5 MMT.



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Briefs (cont. from page 301)

of phytosterol esters in margarines to include cooking, baking, and liquid margarine products.

■■■

A review article in *The American Journal of Medicine* (<http://dx.doi.org/10.1016/j.amjmed.2013.12.014>, 2014) suggests that a whole diet approach, which focuses on increased intake of fruits, vegetables, nuts, and fish, has more evidence for reducing cardiovascular risk than strategies that focus exclusively on reduced dietary fat. The study—conducted by James E. Dalen of the Arizona College of Medicine (Tucson, USA) and Stephen Devries of Northwestern University (Chicago, Illinois, USA)—finds that while strictly low-fat diets have the ability to lower cholesterol, they are not as effective in reducing cardiac deaths. By analyzing major diet and heart disease studies conducted over the last several decades, the investigators found that participants directed to adopt a whole diet approach instead of limiting fat intake had a greater reduction in cardiovascular death and nonfatal myocardial infarction. “Mediterranean style diets are effective in preventing CHD [coronary heart disease] even though they do not decrease total serum cholesterol or LDL [low-density lipoprotein] cholesterol,” the authors write.

■■■

The latest specifications for the identity and purity of roughly 1,200 food ingredients, including test methods and key guidance on critical issues, are included in the new *Food Chemicals Codex (FCC), Ninth Edition*. Published by the US Pharmacopeial Convention, the *FCC* is a compendium of internationally recognized standards for a wide variety of ingredients including colorings, flavorings, nutrients, preservatives, and processing aids. For more information, see www.usp.org. ■

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The Times of India reported on March 21 that the government's Genetic Engineering Appraisal Committee (GEAC) has revalidated 10 varieties of genetically modified crops—including wheat, rice, maize, and cotton—and allowed multinational seed companies to plan for “confined field trials” of these varieties. Companies such as Monsanto, Mahyco, and BASF, whose applications received revalidation, will be able to proceed with these trials only after receiving the required approval to proceed from the state. Revalidation of these varieties became necessary because the previous “validity period” had lapsed. GEAC had originally granted clearance for these 10 varieties in 2011 and 2012.



Tom Dempsey, president and CEO of the Snack Foods Association, told Kacey Cull of BakeryAndSnacks.com in March that large numbers of manufacturers are announcing plans to remove genetically modified organisms (GMO)/ingredients from their products for fear of class action lawsuits (<http://tinyurl.com/GMO-Class-Action>). “Clearly in a litigious society that we have right now, whether you’re right or wrong, that litigation costs hundreds of thousands, if not millions, of dollars. So if you can do it, if you can in effect make your end product GMO-free at an attractive price then it’s a benefit to do it,” Dempsey said. He added that the US Food and Drug Administration should define what a GM product is.



On March 15, the French Ministry of Agriculture, Food and Forestry temporarily banned the sale, use, and cultivation of Monsanto’s MON810 genetically modified (GM) corn (maize), the only variety currently authorized in the European Union, in advance of guidance by the European Commission (<http://tinyurl.com/France-MON810>). This action was timed to circumvent any sowing of maize before a draft law aimed at banning the planting of GM organisms could be debated. The highest court of France has already struck down similar measures twice before. ■

BIOTECHNOLOGY



FAO report on GMO contamination in trade

A report issued by the Food and Agriculture Organization (FAO) of the United Nations in March 2014 said that a higher number of incidents of low levels of genetically modified organisms (GMO) are being detected in traded food and feed (<http://tinyurl.com/FAO-GMO>).

The incidents have led to trade disruptions between countries, with shipments of grain, cereal, and other crops being blocked by importing countries and destroyed or returned to the country of origin.

At present there is no international agreement defining or quantifying “low level.” The interpretation varies from country to country, and in many countries it is interpreted as any level at which detection is possible.

The FAO recently surveyed 193 member countries about the extent and pattern of trade disruptions caused by contaminated shipments. Seventy-five supplied responses. The survey found that:

- Respondents reported 198 incidents of low levels of GMO crops mixed into non-GMO crops between 2002 and 2012;
- Of the 198 cases, 138 occurred between 2009 and 2012.
- Shipments with low levels of GMO crops originated mainly from the United States, Canada, and China, although other countries also accidentally shipped such crops.
- Once detected, most shipments were destroyed or returned to the exporting country.
- The highest number of incidents involved linseed, rice, maize, and papaya.

CONTINUED ON NEXT PAGE

FAO Senior Food Safety Officer Renata Clarke, who was in charge of the survey, said, “We were surprised to see incidents from every region. It seems the more testing and monitoring they do, the more incidents they find.” She added, “Although testing technology is more sensitive now . . . 37 out of 75 countries responded that they have little or no capacity to detect GMOs, that is, they don’t have the laboratories, technicians, and equipment to do so.”

Other survey findings include:

- 30 countries presently produce GMO crops, either for research or commercial production or both.
- 17 countries do not have any food safety, feed safety, or environmental regulations on GMO crops.
- 55 countries have a zero-tolerance policy for unauthorized GMO crops.
- 38 countries consider the different policies on GMO crops existing between trading partners to be an important factor in contributing to the trade risk posed by the presence of low levels of GMO crops in some traded foods.

Effect of non-GMO announcement on Cheerios sales

In response to special interest groups and American retailers, General Mills, Inc. (Golden Valley, Minnesota, USA) announced in January 2014 that it would introduce a non-GM (non-genetically modified) version of its popular Original Cheerios® breakfast cereal (*Inform* 25:230, 2014). On March 19, 2014, Ken Powell, chief executive officer of General Mills, said in an interview with the Associated Press (AP) news service that the company had received supportive letters and online comments regarding this change. He also told the AP that General Mills was “not really seeing anything there that we can detect” in terms of an increase in sales following this change (<http://tinyurl.com/non-GMO-Cheerios>).

Green America, a US nonprofit consumer that promotes ethical consumerism, campaigned for this change. In response to Powell’s statement, the group indicated that it was not surprised at the lack of a sales impact since General Mills placed the label “Not Made With Genetically Modified Ingredients” on the side of the box and chose not to promote the new label.

TAG from plant leaves

Triacylglycerols (TAG) typically accumulate in seeds as storage compounds, supplying energy for germination. In contrast, levels in leaves are generally low.

A research group headed by James Petrie of CSIRO Food Futures National Research Flagship, Canberra, ACT, Australia, has reported the accumulation of more than 15% TAG (17.7% total lipids) by dry weight in senescing leaves of *Nicotiana tabacum* (tobacco) as a result of the co-expression of three genes involved in fatty acid synthesis, neutral lipid assembly,

and lipid droplet biogenesis. Plant development is not severely affected, nor is seed viability.

The increase in total leaf lipids reflects a net synthesis of TAG rather than a redistribution between storage and membrane or surface lipid pools. The researchers also found—by gas chromatography and liquid chromatography-mass spectrometry analysis of the fatty acid composition of transgenic *N. tabacum* leaf tissue—that there was a shift toward acyl chains containing fewer double bonds.

The researchers suggest that high biomass yields that have already been reported for *N. tabacum* combined with stable production of up to 16% TAG under these conditions could result in oil yields comparable to current oilseed crops. They also speculate that oil yield could be increased still more by genetic improvements leading to TAG accumulation in both seed and nonseed tissues of the same plant and suggest that this strategy could result in oil yields nearing those of oil palm.

For TAG extraction, the researchers found that acetone yielded the highest lipid recovery from fresh *N. tabacum* leaves. This method is already well studied and provides support for the possibility that this technology can be developed for industrial processing.

The original research appeared in the *Plant Biotechnology Journal* (12:231–239, 2014, <http://dx.doi.org/10.1111/pbi.12131>).

RNAi technology engineered to increase seed oil content

A group of 11 scientists out of China and the University of Arkansas (Little Rock, USA) has explored transgenic expression of $\Delta 6$ and $\Delta 15$ fatty acid desaturases as a means to enhance the accumulation of omega-3 polyunsaturated fatty acid (PUFA) accumulation in the cyanobacterium *Synechocystis* sp. PCC803. The researchers generated six homologous recombinants containing various fatty acid desaturase genes from *Synechocystis* sp. PCC603 and from the fungi *Gibberella fujikuroi* and *Mortierella alpina*.

These lines produced up to 8.9 mg/L of α -linolenic acid (ALA) and 4.1 mg/L of stearidonic acid, a metabolic intermediate in the conversion of ALA to eicosapentaenoic acid and docosahexaenoic acid. These values are more than six times the corresponding wild-type levels, at 20°C and 30°C.

Furthermore, the accumulation of linoleic acid and γ -linolenic acid was decreased.

The researchers suggest that their work establishes a foundation for technology to increase fatty acid content in cyanobacteria and for producing large amounts of PUFA using cyanobacteria (Chen, G., *et al.*, *Biotechnology for Biofuels* 7:32, 2014, <http://dx.doi.org/10.1186/1754-6834-7-32>).

Review of soybean yields

Scientists at the University of Illinois (Urbana-Champaign, USA) have traced genetic changes in soybean varieties over the last 80 years of soybean breeding and concluded that increases

in yields and the increased rate of gains over the years can be attributed to the continual release of greater-yielding cultivars by breeders. The researchers analyzed varieties released from 1923 to 2008 in field trials conducted in 17 states and one Canadian province during 2010–2011. In an email to *Inform*, Brian Diers, leader of the research group, said, “We included GMOs [genetically modified organisms] in the most recent cultivar releases. These GMOs would have only included the Roundup Ready gene.”

According to Diers, “The study has actually created quite a lot of interest among soybean breeders because they want to understand what’s happened, and when we look at physiological traits, we can see what has been changed. This gives us clues about what traits we should focus on in breeding for future increases based what has been inadvertently changed over time as we have selected for yield” (<http://tinyurl.com/soybeans-yields-rates>).

The researchers observed an increase in yields over the past 80 years for all the trial sites that is equivalent to 20–23 kilograms per hectare per year (kg/ha/yr). A two-segment linear regression model, however, provided a better fit to the data and resulted in the calculation of an average current rate of genetic yield gain of 29 kg/ha/yr.

About two-thirds of the yield increases are attributed to new varieties that breeders have introduced, and the other third to other reasons, such as improved agronomic practices.

The study also showed that plants in the new varieties are shorter in height, mature later, lodge less, and have seeds with less protein and greater oil concentration than the old varieties. Another trait that has changed over time is a move to earlier flowering time, which has resulted in an expanded reproductive period. Diers said, “We are now asking whether breeding for an even longer reproductive period could further increase yields.”

With soybean being a leading source of protein and oil for human food, animal feed, and other products, global rates of yield increases for the crop will need to keep up with demand in the future.

The original work appeared in the *Crop Science* (54:804–816, 2014, <http://dx.doi.org/10.2135/cropsci2013.06.0428>).

Pest management strategy and resistance

In a presentation to the 2014 On-Farm Network[®] Conference held in Ames, Iowa, USA, in February 2014, Aaron Gassmann, an assistant professor of entomology at Iowa State University (Ames), who studies larval damage to corn caused by western corn rootworm (*Diabrotica virgifera virgifera* LeConte) said, “Any pest management strategy that imposes mortality on a pest

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population will select for resistance.” He also pointed out that farmers need to look at a “rotation of tactics rather than layering of traits and insecticides.” These could include rotating between corn and soybeans, using pyramided events, rotating Bt events, and using non-Bt corn with a soil insecticide.

Gassman also noted in the *Proceedings of the National Academy of Sciences* (<http://dx.doi.org/10.1073/pnas.13171791119>, 2014) that western corn rootworm has developed resistance to two of the three types of Bt toxin produced by GM corn. The resistance to one Bt toxin, called mCry3A, is now conferring protection against a second, called Cry3Bb1.

Furthermore, “rootworms are tough” (<http://tinyurl.com/Nature-pests-corn>), and Bt corn does not produce enough toxin to fully control them. Bt toxins used against the European corn borer (*Ostrinia nubilalis*) kill more than 99.99% of their targets, whereas more than 2% of rootworms can survive Bt maize.

Easier genetic modification of plants

A Purdue University (West Lafayette, Indiana, USA) research team identified a gene that influences susceptibility of a plant to infection by *Agrobacterium tumefaciens*. This bacterium is

used as a tool to insert genes into plants to produce traits such as resistance to pests, diseases, or harsh environmental conditions or to improve the nutrition or shelf life of a crop.

According to research leader Stanton Gelvin, *Agrobacterium*-mediated plant transformation is widely used in the agricultural biotechnology industry, but it doesn’t work well for many varieties and species of plants. “Some of the most elite and desirable cultivars in agriculture can only be improved through the age-old genetic modification method of breeding, which is less genetically precise, requires numerous steps, and takes years,” he said (<http://tinyurl.com/Purdue-Agrobacterium>).

The team studied genes in *Arabidopsis*, a common research model that is a member of the mustard family (Brassicaceae). The researchers identified a gene that plays a central role in susceptibility to genetic transformation and discovered the mechanism and specifics of its action. Gelvin said bioinformatic analyses and gene libraries suggest this gene is also found in soybeans, corn, wheat, oilseed rape, cacao, rice, and many others; but the team needs to verify this experimentally.

For further information see N. Sardesai, *et al.*, Cytokinins secreted by *Agrobacterium* promote transformation by repressing a plant Myb transcription factor, *Science Signaling* 6, <http://dx.doi.org/10.1126/scisignal.2004518>. ■

AOCS MEETING WATCH

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

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

May 3–6, 2015. 106th AOCS Annual Meeting and Industry Showcase, Rosen Shingle Creek, Orlando, Florida, USA.

November 17–18, 2014. Edible Oil Refining: From the Fundamentals to New Technologies, Crowne Plaza Shanghai Pudong, Shanghai, China.

November 19–20, 2014. AOCS–CCOA Joint Symposium on Functional Lipids, Crowne Plaza Shanghai Pudong, Shanghai, China.

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

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

Givaudan, the Swiss manufacturer of flavors and fragrances, announced in February 2014 that it had entered into negotiations to acquire 100% of the shares of Soliance SA and its subsidiaries. At that time, Soliance was a division of ARD (Agro Industrie Recherches & Développements). Soliance manufactures active ingredients for cosmetics derived from vegetable sources, microorganisms, and microalgae. The company has two sites in France—in Pomacle and Île Grande—and employs 77 persons. The transaction is expected to close in the second quarter of 2014.

■ ■ ■

One of the online news sources we follow is the Surfactant Spectator, whose most recent quarterly edition was dedicated to Guerbet chemistry. As editor Thomas O'Lenick points out, "the Guerbet reaction, named after Marcel Guerbet (1861–1938), is an organic reaction converting a primary aliphatic alcohol into its β -alkylated dimer alcohol with the loss of one equivalent of water. While the chemistry has been around for a very long time, these materials alone or in derivatives are very interesting materials since they are liquid at very low temperature and have very interesting physical properties." A free review article on Guerbet chemistry is available on the Surfactant Spectator website at www.surfactantspectator.com.

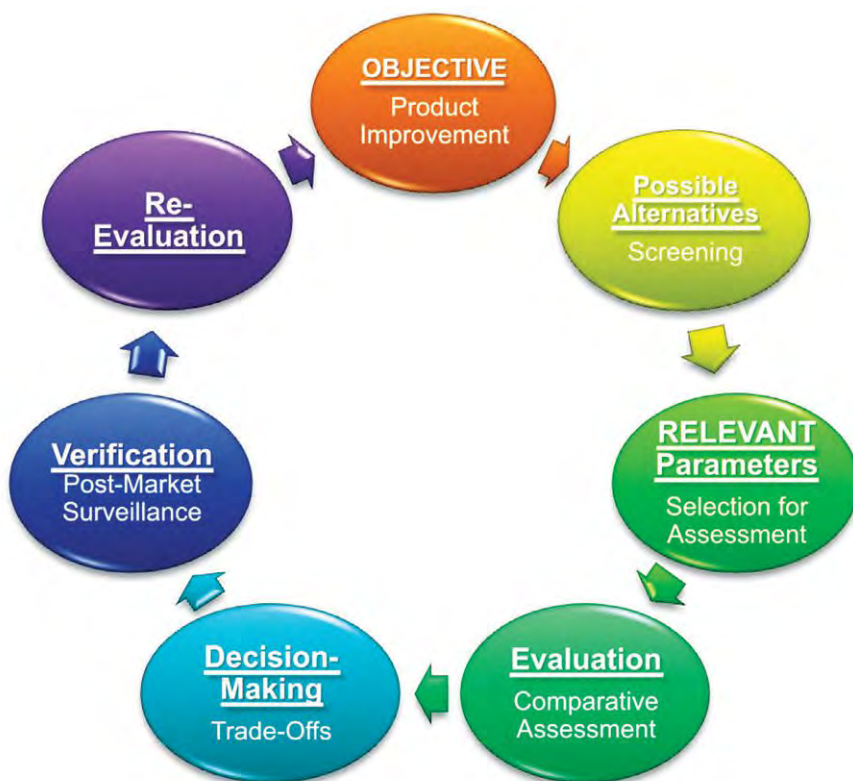
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The American Cleaning Institute (ACI) has released a voluntary guidance document for industry to help reduce the number of children exposed to liquid laundry detergent packets. (See <http://tinyurl.com/ACI-guidance>.)

■ ■ ■

The China Food and Drug Administration has published a draft version of its consolidated Inventory of Existing Cosmetics Ingredients for public comment. The inventory contains 8,641 cosmetics ingredients, compared to the current list from 2003, which lists 3,265 ingredients. If an ingredient is not on the inventory and is therefore considered to be "new," it must be registered with and approved by the government, under the country's Hygiene Supervision over Cosmetics Regulations (1990). ■

HOME & PERSONAL CARE



PRODUCT R&D PROCESS—CONTINUAL IMPROVEMENT.

Coalition announces principles for effective alternative assessments

On March 4, 2014, a diverse coalition of US manufacturing associations introduced a set of principles for assessing chemicals in consumer products and identifying possible alternatives. "If done right, alternative assessments can help policymakers and manufacturers make more informed decisions about the health and environmental impacts of some products, and guide the development of new and improved products for the marketplace," said the coalition in a news release.

They pointed out that many consumer product producers apply alternatives assessments during the research and development phase. "The principles released today reflect

some of the best practices manufacturers recommend for establishing an alternatives program that will improve public health and the environment without stifling innovation," the group suggested. "For example, an alternatives assessment should be driven by consideration of a chemical's hazard properties and the chemical's intended uses, expected exposures, and the impact of its uses in products and processes throughout the value chain."

Visit <http://tinyurl.com/Coalition-Principles> for the coalition's alternative assessment document. Members of the coalition include the American Coatings Assoc., American Chemistry Council, American Cleaning Institute, Consumer Specialty Products Assoc., Grocery Manufacturers Assoc., International Fragrance Assoc. North America, Personal Care Products Council, and the Toy Industry Assoc.

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Sophorolipids from mahua oil

Japan's Allied Carbon Solutions (ACS; www.allied-c-s.co.jp) is now marketing sophorolipid surfactant products in Asia under the ACS-Sophor brand, according to Doris de Guzman of the Green Chemicals Blog (greenchemicalsblog.com), and intends to expand into North America and Europe.

The company, which began as a biofuels producer, initially used jatropha as the feedstock for its sophorolipids but is now using oil from the *Madhuca longifolia* tree. Commonly known as mahua, mahwa, or iluppai, the tree is native to India and each tree produces between 20–200 kg of seeds per year. ACS reported that it has been producing its own mahua oil near its sophorolipids manufacturing facility in India at the rate of about 10–15 metric tons (MT)/month. That rate can increase to as much as 40–75 MT/month depending on market demand.

The company has developed the technology for a yeast fermentation of mahua oil, resulting in the production of sophorolipids, in partnership with the University of the Ryukyus and Japan's Research Institute for Innovation in Sustainable Chemistry of the National Institute of Advanced Industrial Science and Technology (AIST; see <http://tinyurl.com/AIST-Mahua> for a discussion of the work on mahua oil and structures of the sophorolipids).

The researchers investigated a number of microorganisms, settling on *Candida bombicola*. They also optimized the composition of the culture solution (oil, nitrogen, vitamins, inorganic salts, etc.) and the fermentation conditions, according to the AIST website.

Sophorolipids are a group of biodegradable surfactants with high surface tension activity, excellent detergency even at low concentration, and low-foaming properties. They can replace polyoxyethylene alkyl ether, sodium dodecyl sulfate, and trimethylglycine, according to de Guzman. Possible end-use markets include cosmetics, personal care, hair care, skin care, cleaning, household and industrial care, detergents, and other consumer care products. Although laundry detergents typically require 10–30% surfactant, de Guzman noted that a content of

only 1% of ACS-Sophor is required to achieve comparable detergency performance.

Market report: global demand for amines

World demand for amines will rise 3.8% annually to 7 million metric tons in 2017, led by robust growth in China, as well as strong gains in other developing economies throughout Asia, the Africa/Mideast region, and South America (see Table 1). Consumer-oriented markets such as cleaning and personal care products will be the primary beneficiaries of growth in these countries, according to The Freedonia Group, Inc., a market research firm based in Cleveland, Ohio, USA.

"The same impact will not be felt in pesticides, the largest market overall, as declining support for food-based biofuels in developed countries will result in a moderation in pesticide amines demand growth," said analyst Ryan Sullivan. Furthermore, the demand for amines in the developed countries of North America and Western Europe will rise at modest, below-average paces, reflecting the mature nature of these markets. These and other trends are discussed in *World Amines*, a new study from Freedonia.

Amines demand growth in pesticides will moderate following a prolonged period of strong advances. The expanded use of food-based biofuels was a strong contributor to pesticide amines demand growth from 2002 to 2012 as farmers in the Americas rapidly expanded the production of pesticide-resistant crops in an effort to boost yields and satisfy the increased biofuel crop demand. However, support for this application has declined in many countries, which will restrain future increases in pesticide-resistant crop output. Despite the more modest prospects for pesticide amines demand going forward, growth will continue to be supported by the modernization of agricultural practices in developing regions as countries strive to boost food production to meet the rising demand of their increasingly affluent populations. Rising incidence of pesticide-resistant weeds will

TABLE 1. World amines demand^a

	Demand (thousand metric tons)			Annual growth (%)	
	2007	2012	2017	2007–2012	2012–2017
North America	1,430	1,505	1,700	1.0	2.5
Western Europe	1,395	1,390	1,450	–0.1	0.8
Asia/Pacific	1,370	1,945	2,625	7.3	6.2
Central and South America	355	520	660	7.9	4.9
Eastern Europe	180	225	275	4.6	4.1
Africa/Mideast	180	220	290	4.1	5.7
Total demand	4,910	5,805	7,000	3.4	3.8

^a Source: The Freedonia Group, Inc., ©2014.

also support demand as farmers increase application rates in an effort to control weed growth and maintain yields.

Based on their versatility, relatively low cost, and widespread use in each of the major markets, ethanolamines will continue to be the largest amine product type. Advances for ethanolamines will be slower than those for alkylamines, owing in large part to alkylamines having a broader range of applications in the large pesticides market beyond glyphosate-based formulations. Specialty amines demand will benefit from increasing demand for new, more effective amine products in the developed markets of Japan, North America, and Western Europe, especially in markets such as plastics, lubricants, and personal care products.

World Amines, which was published in February 2014, is available for \$6,100 from The Freedonia Group, Inc. For more information, email pr@freedoniagroup.com or visit www.freedoniagroup.com.

FDA nixes industry's draft cosmetics legislation

The US Food and Drug Administration (FDA) has rejected draft legislation proposed by two cosmetic industry associations and terminated communications with both groups, citing bad faith negotiations. (See <http://tinyurl.com/FDA-Cosmetics-Draft>.)

"Because your proposal meets none of the safety goals on which we had all agreed last year, I have difficulty seeing a path forward in this process . . . I no longer see common ground here and thus cannot justify devoting further taxpayer resources to this negotiation," writes FDA deputy commissioner for food and veterinary medicine, Michael Taylor, in a letter to the two groups.

FDA had been negotiating with the Personal Care Products Council (PCPC) and the Independent Cosmetic Manufacturers and Distributors (ICMAD), two trade groups based in Washington, DC, on legislation to update laws and regulations governing safety in cosmetics as mandated by the Safe Cosmetics and Personal Care Products Act. The US House passed that legislation in 2013.

Taylor continues to allege that provisions of the industry draft "actually reduce FDA's current ability to take action against dangerous cosmetics. Taken together with the sweeping preemption provisions, which almost completely eliminate states' authority to protect their citizens from unsafe chemicals in cosmetics, the provisions of the draft industry bill could put Americans at greater risk from cosmetic-related illness and injury than they are today."

"We are extremely disappointed that FDA has indicated they will not participate in further discussions with the cosmetics industry regarding cosmetic legislation and have taken such a hard line approach to our efforts to operate in good faith," PCPC President and CEO Lezlee Westine said in a statement. "We believe that FDA's response misrepresents the intent of our legislative proposals and we strongly disagree with their allegation that our proposed legislation would weaken their regulatory oversight of cosmetics."

ICMAD and the Professional Beauty Assoc. (PBA) also expressed hope that FDA will reconsider its position. On the other hand, consumer activist groups were pleased by the decision: "The FDA was right to reject the cosmetics industry's draft legislation; it's radioactive and no member of Congress should go near it," said Breast Cancer Fund Program and Policy Director Janet Nudelman in a news release.



California names first priority products for alternatives assessment

The US state of California has named its first three product/substance combinations slated for tighter control under California's Safer Consumer Products Regulations (CSPR), which became effective on October 1, 2013. They are:

- Surface cleaners and paint or varnish strippers containing methylene chloride;
- Children's foam padded sleeping products containing tris (1,3 dichloro-2-propyl) phosphate; and
- Spray polyurethane foam products containing unreacted diisocyanates.

Next up: The state's Department of Toxic Substances Control (DTSC) will initiate a rule-making process, including a public comment period, which could last 12 months or more. If the three products are officially adopted as "priority products," manufacturers must perform an alternatives assessment as outlined in the regulations.

"They will need to determine if feasible safer ingredients are available if they want to continue selling the products in California," writes Martin Zook of the Chemical Watch news service. Some critics of the CSPR rules said that the search for safer chemicals will be open-ended both in the number of chemicals for which assessment could be required and in the timeframe for required assessments, Zook noted.

According to DTSC, final rules regarding this first set of assessments may not come until the end of 2016 at the earliest. ■

Focus on Bio



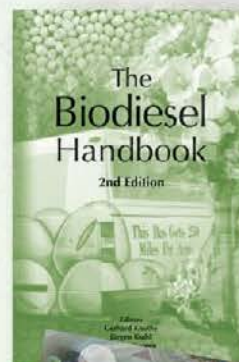
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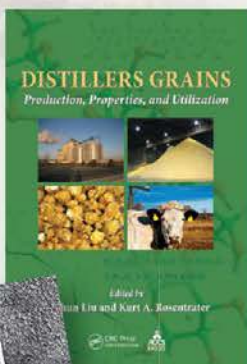


Biobased Surfactants and Detergents Synthesis, Properties, and Applications

Edited by Douglas G. Hayes, Dai Kitamoto, Daniel K.Y. Solaiman, and Richard D. Ashby

Interest in biobased surfactants and detergents is growing due to their ability to outperform synthetic, petroleum-derived surfactants when it comes to biodegradability, biocompatibility, and measures of sustainability. Consumers want eco-friendly and biobased products, leading to increased use of biobased surfactants. This must-have book covers biosurfactant synthesis and applications, as well as how to reduce manufacturing and purification costs, impurities, and by-products.

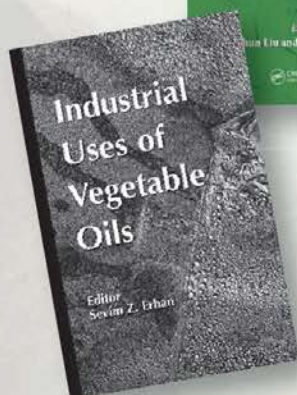
Also available as an eBook on iTunes and Amazon.



Distillers Grains Production, Properties, and Utilization

Edited by KeShun Liu and Kurt A. Rosentrater

Marketability and suitable uses of distillers dried grains with solubles (DDGS) are key to the economic viability of fuel ethanol production. As the industry grows, the importance of distillers grains has also increased. This book is divided into six parts covering a wide range of information related to DDGS. Topics covered include: DDGS lipids and mycotoxin occurrence, traditional use of DDGS as livestock feed, potential further uses of DDGS (most notably feed for fish and other animals and food ingredients for human consumption), and emerging opportunities for DDGS such as bioplastics and feedstocks for bioenergy.



Industrial Uses of Vegetable Oils

Edited by Sevim Z. Erhan

Vegetable oils have superb environmental credentials and are now used more in products such as paint and coatings, printing inks, engine oils, and biodiesel. *Industrial Uses of Vegetable Oils* offers insights into these important uses of vegetable oils and covers developments in biodegradable grease, vegetable oil-based polyols, and the synthesis of surfactants from vegetable oil feedstocks.

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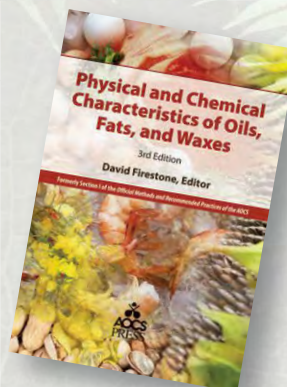
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Edited by David Firestone

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ABO Industrial Algae Measurements 6.0

AOCS members Steve Howell, MARC-IV; Lieve Laurens, National Renewable Energy Laboratory; and Gina Clapper, AOCS are part of the ABO Technical Standards Committee and are contributing authors to the *Industrial Algae Measurements 6.0* guidance document. This recommends minimum descriptive parameters and measurement methodologies required to fully characterize the economic and environmental inputs and outputs of an aquatic biomass operation.

The *Industrial Algae Measurements 6.0* recommendations contained within this document are intended to be useful in characterizing a broad range of aquatic production operations.

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PEOPLE/INSIDE AOCS

Intrexon hires Yeh



Yeh

Brian Yeh joined the Industrial Productions Division of Intrexon Corp., located in San Carlos, California, USA, in March 2014. His new title is Vice President, Research & Technology. He may be contacted by email at byeh@intrexon.com.

Intrexon is focused on collaborating with companies in health, food, energy, and the environment to create biologically based products and processes that improve the quality of life and health of the Earth. The science underlying these products is synthetic biology—an engineered approach to the field of biology. Yeh is a member of the editorial advisory board of *Inform*.

Deak assumes new position

AOCS member **Nicolas Deak** assumed the position of Innovation Portfolio Leader of projects within Protein Solutions (formerly known as Solae) at DuPont Nutrition & Health on February 1, 2014. He is located in St. Louis, Missouri, USA.

King recognized

Jerry King of the University of Arkansas, Fayetteville, USA, has been named a Fellow of the Industrial and Engineering Chemistry Division of the American Chemical Society (ACS). The award was presented to him at the spring ACS meeting, held in Dallas, Texas, in March 2014.

King was recognized for his multidisciplinary research in chemical separations, particularly in supercritical fluid technology—in the areas of chemistry, chemical engineering, and food technology—embracing physical and analytical chemistry, chemical engineering, and food and agricultural materials processing and characterization.

Sinclair to receive Leaf Award

Andrew J. Sinclair, chair in nutrition science of Deakin University's School of Medicine at the Geelong Waurn Ponds Campus, Australia, has been selected to receive the Alexander Leaf Award. The International Society for the Study of Fatty Acids and Lipids (ISSFAL) presents this lifetime achievement award to recognize and reward excellence in the areas of research of relevant to ISSFAL core interests. Sinclair will receive this recognition on June 30, 2014, prior to his award lecture at the ISSFAL Congress, being held in Stockholm, Sweden, June 29–July 2.

His research has covered a range of areas related to fatty acid metabolism in man and animals, and the composition of foods

(lipids and fat soluble vitamins). His latest research interests are in the role of essential nutrients in brain function (zinc, docosahexaenoic acid), metabolism of n-3 docosapentaenoic acid, lip-

idomic analysis of chylomicrons, and n-3 fatty acid metabolism in fish and mammals.

Sinclair received the Supelco/Nicholas Pellick AOCS Research Award in 1999 and has served on the AOCS Press Books & Special Publications committee. He also served as an associate editor and senior associate editor for *Lipids*.

Petersen promoted

Botanic Innovations LLC, headquartered in Spooner, Wisconsin, USA, has promoted **Rebecca Petersen** to the position of vice president of sales and marketing. The company cold-presses oils from food sources (e.g., pomegranate seeds, tomato seeds, cranberry seeds, raspberry seeds) and sells them for incorporation into personal care products, dietary supplements, and animal supplements. All of the seeds, except black cumin, are harvested in North America; cumin comes from Turkey.

New officers of NOPA

The National Oilseed Processors Association (NOPA) named a new slate of officers at its 2014 Annual Meeting, held February 10–14, 2014, in Miami, Florida.

Chris Nikkel, vice president, Risk Management—Oilseeds, Bunge North America, Inc., St. Louis, Missouri, was elected to a two-year term as chairman of NOPA. Other NOPA officers elected include: **Greg Morris**, president, North American Oilseed Processing, Archer Daniels Midland Co., Decatur, Illinois, as chairman-elect; **Mark Sandeen**, vice president, Processing and Marketing, Ag Processing Inc., Omaha, Nebraska, as secretary-treasurer; and **Mark Stonacek**, president and business unit leader, Grain and Oilseed Supply Chain North America, Cargill, Minnetonka, Minnesota, as immediate past chairman.

ADM names new president

On February 26, 2014, Archer Daniels Midland Company (ADM: Decatur, Illinois, USA) announced the promotion of **Juan R. Luciano** to president, effective on that date. He is the 12th person to serve as president in the company's 112-year history and assumes this role in addition to his position as chief operating officer.

Luciano oversees the commercial and production activities of ADM's corn, oilseeds, and agricultural services businesses, as well as its research, project-management, and risk-management functions. He will continue to report to ADM Chairman and CEO Patricia A. Woertz.

Luciano joined ADM in April 2011, following a 25-year tenure at The Dow Chemical Company, where he last served as executive vice president and president of the performance division. ■

PATENTS

Plant-derived seed extract rich in essential fatty acids derived from *Salvia hispanica* L. seed: composition of matter, manufacturing process, and use

Minatelli, J., *et al.*, U.S. Nutraceuticals LLC, US8574637, November 5, 2013

A *Salvia hispanica* L. derived seed oil extract composition containing from 60–88% polyunsaturated fatty acids in a ratio of from 3.1:1–3.3:1 of α -linolenic acid to linoleic acid, 4–10% of C18 monounsaturated fatty acid, 1–5% of C18 saturated fatty acid, and 4–8% of C16 saturated fatty acid in a mixed triglyceride form that is stable at room temperature of 12–24 months containing a mixture of selected antioxidants.

Lipase powder, method for manufacture thereof, and use thereof

Suganuma, T., *et al.*, The Nisshin OilliO Group, Ltd., US8580550, November 12, 2013

There is provided a lipase powder that is a granulated material comprising a lipase and at least one member selected from the group consisting of fatty acids having 8–12 carbon atoms, alcohol esters thereof, and a mixture thereof. This lipase powder has an increased lipase activity.

Method of continuous *in-situ* triglyceride stabilization and sulfur reduction of FOG (fats, oil, and grease) to optimize fuel extraction

Lenger, M. J., and G.H. Lenger, US8585901, November 19, 2013

A method for continuous *in-situ* triglyceride stabilization in FOG (fats, oil, and grease) commonly referred to as trap grease. The stabilization is achieved by eliminating hydrolysis and thus preventing the BTU-rich triglycerides breaking down into free fatty acids (FFA) or the formation of mono- and diglycerides. A closed loop aeration and recirculation of the FOG ensures sufficient dissolved oxygen not only arresting hydrolysis but also eliminating the formation of hydrogen sulfide. The method furthermore employs the formation and continuing functioning of a biofilm for the microbiological reduction of the FOG's sulfur

content. A low FFA/high triglycerides concentration as well as sulfur reduction is highly desirable, allowing for easy biodiesel fuel conversion or bio-gasification. The resulting biofuel does not exhibit the typical hygroscopic property found in B100 biodiesel.

Method for reprocessing biodiesel sludge

Seidel, E., *et al.*, Lurgi GmbH, US8580987, November 12, 2013

A method for reprocessing a phase substantially consisting of steryl glycoside/fatty acid alkyl ester/water agglomerates, which was formed when fatty acid alkyl ester generated by transesterification of vegetable oils or animal fats was washed with water, wherein the water content is evaporated by heating the phase and subsequently the steryl glycosides are split into their sterol and sugar fractions in the presence of an acid catalyst.

Nutritional composition for infants

Mace, C., *et al.*, Nestec S.A., US8586077, November 19, 2013

A nutritional composition for infants comprises a protein source, a lipid source, and a carbohydrate source wherein the lipid source includes at least 16 wt% linoleic acid and at least 2 wt% α -linolenic acid expressed as a percentage of total fatty acid content in each case and in amounts such that the ratio of linoleic acid/ α -linolenic acid is in the range from 1–10.

Composition suitable for use in baking

McNeill, G.P., *et al.*, Loders Croklaan USA LLC, US8586122, November 19, 2013

A composition comprising: (i) from about 20% to about 80% by weight of an interesterified palm oil olein; (ii) from about 5% to about 25% by weight of a liquid oil; (iii) from about 15% to about 75% by weight of a fat selected from the group consisting of palm oil stearins, interesterified palm oil stearins, palm oil oleins, fully hydrogenated oils, and mixtures thereof may be used as a bakery fat, particularly a laminating fat for products such as puff pastry.

Biobased penetrating oil

Westerman, T., *et al.*, State Industrial Products Corp., US8586518, November 19, 2013

A biobased penetrating oil for use to reduce friction between fittings. The penetrating oil composition preferably contains one or more long-chain, low-volatile esters specifically derived from a natural plant-based oil, such as a combination of methyl esters derived from soybean oil, and an unsulfurized terpene, such as a pine oil or limonene, and various orange

CONTINUED ON NEXT PAGE

terpenes as a solvent. The penetrating oil can be an aerosolized product and include a carbon dioxide propellant.

Composition for preventing and improving metabolic syndrome

Saito, S., *et al.*, J-Oil Mills, Inc., US8586529, November 19, 2013

A method for improving blood HDL/LDL [high density lipoprotein/low density lipoprotein] cholesterol ratio, reducing blood triglyceride level, reducing blood sugar level, and/or reducing body weight, that includes ingesting a composition containing a concentrated soybean germ product. The soybean germ product includes soybean germ protein; 1.0% by weight or less of saponin relative to the total weight of the soybean germ product; and 0.5% by weight or less of isoflavone relative to the total weight of the soybean germ product.

Plant-derived seed extract rich in essential fatty acids derived from *Salvia hispanica* L. seed: composition of matter, manufacturing process, and use

Minatelli, J., *et al.*, U.S. Nutraceuticals LLC, US8586104, November 19, 2013

A *Salvia hispanica* L. derived seed oil extract composition of matter containing from 60–88% polyunsaturated fatty acids in a ratio of from 3.1:1–3.3:1 of α -linolenic acid to linoleic acid, 4–10% of C18 monounsaturated fatty acid, 1–5% of C18 saturated fatty acid and 4–8% of C16 saturated fatty acid in a mixed triglyceride form that is stable at room temperature of 12–24 months containing a mixture of selected antioxidants.

Tailored oils produced from recombinant heterotrophic microorganisms

Franklin, S., *et al.*, Solazyme, Inc., US8592188, November 26, 2013

Methods and compositions for the production of oil, fuels, oleochemicals, and other compounds in recombinant microorganisms are provided, including oil-bearing microorganisms and methods of lowcost cultivation of such microorganisms. Microalgal cells containing exogenous genes encoding, for example, a lipase, a sucrose transporter, a sucrose invertase, a fructokinase, a polysaccharide-degrading enzyme, a keto acyl-ACP [acyl carrier protein] synthase enzyme, a fatty acyl-ACP thioesterase, a fatty acyl-CoA/aldehyde reductase, a fatty acyl-CoA reductase, a fatty aldehyde reductase, a fatty aldehyde decarbonylase, and/or an acyl carrier protein, are useful in manufacturing transportation fuels such as renewable diesel, biodiesel, and renewable jet fuel,

as well as oleochemicals such as functional fluids, surfactants, soaps, and lubricants.

Emulsion system derived from engkabang (illipe) fat esters

Basri, M., *et al.*, Universiti Putra Malaysia, US8598236, December 3, 2013

An isotropic or homogeneous emulsion system comprises an oil phase including fat esters of illipe fat and a solubilizer; a non-ionic surfactant; and deionized water; characterized in that the solubilizer is a mixture of polyethyleneglycol-40 hydrogenated castor oil, polysorbate-20, and octoxynol-12.

Method and compositions for production of transgenic plants

Ahmad, G.K.P., Malaysian Palm Oil Board, US8598410, December 3, 2013

The present invention relates generally to a process of producing transgenic plants and more particularly transgenic palm oil plants carrying exogenous genetic material that confers on said plants or cells of said plants particular phenotypic traits. The present invention is further directed to oil, and particularly palm oil, having beneficial and desirable characteristics, produced by the transgenic plants made in accordance with the present invention.

Method for the removal of phosphorus

Havlik, P., *et al.*, Syntroleum Corp., US8575409, November 5, 2013

A process for producing a hydrocarbon from biomass. A feed stream containing biomass having fatty acids, mono-, di-, and/or triglycerides, and a phosphorus content of between about 1 wppm [weight parts per million] and about 1,000 wppm is provided. A heated hydrocarbon solvent and a hydrogen-rich gas are provided. The feed stream, the heated hydrocarbon solvent, and the hydrogen-rich gas are combined in the presence of a low activity hydrogenation catalyst. A spent low-activity hydrogenation catalyst is recovered at the end of a run wherein the spent low-activity hydrogenation catalyst contains at least 3% by weight phosphorus.

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.



EXTRACTS & DISTILLATES

Catalytic synthesis and characterization of phenol-branched-chain fatty acid isomers

Ngo, H.L., *et al.*, *Eur. J. Lipid Sci. Technol.* 116:344–351, 2014, <http://dx.doi.org/10.1002/ejlt.201300227>.

There is significant research interest in developing new industrial materials from vegetable oils and animal fats. Such biobased materials can be more environmentally friendly because they tend to have good biodegradability and are derived from renewable resources. This paper describes a catalytic approach for the addition of phenol to the olefinic site of oleic acid using the H-ferrierite zeolite. A number of experimental parameters were examined, including different reaction components and their ratios, and reaction conditions. Under optimized conditions, phenol-branched-chain fatty acid isomers were obtained in up to 70% yield. The materials were characterized using various analytical techniques, including gas chromatography (GC), GC–mass spectroscopy (MS), and high-performance liquid chromatography (HPLC)–MS.

Influence of aqueous phase emulsifiers on lipid oxidation in water-in-walnut oil emulsions

Yi, J., *et al.*, *J. Agric. Food Chem.* 62:2104–2111, 2014, <http://dx.doi.org/10.1021/jf404593f>.

Effects of selected aqueous phase emulsifiers on lipid oxidative stability of water-in-walnut oil (W/O) emulsions stabilized by polyglycerol polyricinoleate (PGPR) were evaluated. The formation of primary oxidation products (lipid hydroperoxides) and secondary oxidation products (headspace hexanal) increased with increasing dodecyltrimethylammonium bromide (DTAB) concentration (0.1–0.2 wt% of emulsions). In contrast, the addition of sodium dodecyl sulfate (SDS) in the aqueous phase reduced lipid hydroperoxide and hexanal formation. In addition, the presence of Tween 20 in the aqueous phase did not significantly influence lipid oxidation rates in W/O emulsions compared to the control (without Tween 20). Whey protein isolate (WPI) was observed to inhibit lipid oxidation in the W/O emulsions (0.05–0.2 wt% of emulsions). Aqueous phase pH had an important impact on the antioxidant capability of WPI, with higher pH improving its ability to inhibit lipid oxidation. The combination of WPI and DTAB in the aqueous phase suppressed the prooxidant effect of

DTAB. The combination of WPI and SDS resulted in improved antioxidant activity, with inhibition being greater at pH 7.0 than at pH 3.0. These results suggest that the oxidative stability of W/O emulsions could be improved by the use of suitable emulsifiers in the aqueous phase.

Effects of emulsifier addition on the crystallization and melting behavior of palm olein and coconut oil

Maruyama, J.M., *et al.*, *J. Agric. Food Chem.* 62:2253–2263, 2014, <http://dx.doi.org/10.1021/jf405221n>.

Two commercial emulsifiers (EM1 and EM2), containing predominantly monoacylglycerols (MAG), were added in proportions of 1.0 and 3.0% (w/w) to coconut oil and palm olein. EM1 consisted of approximately 90% MAG, whereas EM2 consisted of approximately 50% MAG. The crystallization behavior of these systems was evaluated by differential scanning calorimetry (DSC) and microscopy under polarized light. On the basis of DSC results, it was clear that the addition of EM2 accelerated the crystallization of coconut oil and delayed the crystallization of palm olein. In both oils EM2 addition led to the formation of smaller spherulites, and these effects improved the possibilities for using these fats as ingredients. In coconut oil the spherulites were maintained even at higher temperatures (20°C). The addition of EM1 to coconut oil changed the crystallization pattern. In palm olein, the addition of 3.0% (w/w) of this emulsifier altered the pattern of crystallization of this fat.

Comparative study of DHA-enriched phospholipids and EPA-enriched phospholipids on metabolic disorders in diet-induced-obese C57BL/6J mice

Liu, X., *et al.*, *Eur. J. Lipid Sci. Technol.* 116:255–265, 2014, <http://dx.doi.org/10.1002/ejlt.201300407>.

Recent reports have shown that n-3 PUFA-enriched phospholipids have various beneficial effects. The proportion of docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA) in the phospholipids might affect their biological functions. In the present study, marine DHA-enriched phospholipids (DHA-PL) and EPA-enriched phospholipids (EPA-PL) were administered to high fat (HF) diet-induced obese C57BL/6J mice for 8 weeks to compare their effects on obesity-related metabolic disorders. DHA-PL and EPA-PL significantly decreased epididymal and perirenal adipose tissue weights, reduced blood pressures, and lowered serum and hepatic triacylglycerol levels in HF

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diet-induced obese mice. Serum insulin, MCP-1 [monocyte chemoattractant protein-1] and IL-6 [interleukin-6] levels were also efficiently reduced by treatment with DHA-PL and EPA-PL. The anti-obesity and lipid-lowering effects of EPA-PL were superior to DHA-PL, while DHA-PL exhibited better anti-hypertension effects than EPA-PL. The effects of DHA-PL and EPA-PL on glucose intolerance and inflammation were basically equivalent. DHA-PL and EPA-PL upregulated genes involved in insulin-sensitizing actions in the adipose tissue and suppressed hepatic sterol regulatory element binding proteins (SREBP)-1c-mediated lipogenesis. EPA-PL also significantly activated PPAR α [peroxisome proliferator-activated receptor α]-mediated fatty acid β -oxidation in the liver. These results indicate that DHA-PL and EPA-PL could efficaciously alleviate obesity-related metabolic disorders but the ameliorative degree and regulatory mechanisms are not identical.

Risks of diabetes mellitus and cancer caused by cholesterol lowering medications

Okuyama1, H., *et al.*, *Lipid Technology* 26:55–58, 2014, <http://dx.doi.org/10.1002/lite.201400010>.

Cholesterol-lowering drugs, statins, increase the incidence of newly-onset diabetes mellitus (DM), but their benefit (prevention of coronary heart disease, CHD) has been proposed to outweigh this risk. The impact of statins on cancer is also an issue. We critically evaluated the results of clinical trials and analyzed biochemical mechanisms underlying statin actions, which led us to conclude that statins are contraindicated to DM, and that they are carcinogenic in the long term but could be useful for cancer patients for whom other medications are inappropriate.

The inhibition of oleic acid induced hepatic lipogenesis and the promotion of lipolysis by caffeic acid via up-regulation of AMP-activated kinase

Liao, C.-C., *et al.*, *J. Sci. Food Agric.* 94:1154–1162, 2014, <http://dx.doi.org/10.1002/jsfa.6386>.

Caffeic acid (CA) can inhibit toxin-induced liver injury. In this study, CA is assessed for its lipid-lowering potential when oleic acid is used to induce non-alcoholic fatty liver disease in human HepG2 cells. The results showed that both the triglyceride and cholesterol contents are decreased in the HepG2 cells by using the enzymatic colorimetric method. CA enhances the phosphorylation of AMP-activated protein kinase (AMPK) and its primary downstream targeting enzyme, acetyl-CoA carboxylase. CA downregulates the lipogenesis gene expression of sterol regulatory element-binding protein-1 and its target genes, fatty acid synthase in the presence of oleic acid. In addition, CA significantly decreases cholesterol and triglyceride production via

inhibition of the expression of both 3-hydroxy-3-methylglutaryl coenzyme A reductase and glycerol-3-phosphate acyltransferase. These effects are eliminated by pretreatment with compound C, an AMPK inhibitor. These results demonstrate that CA inhibits oleic acid-induced hepatic lipogenesis and the promotion of lipolysis via up-regulation of AMP-activated kinase.

Protein-based Pickering emulsion and oil gel prepared by complexes of zein colloidal particles and stearate

Gao, Z.-M., *et al.*, *J. Agric. Food Chem.* 62:2672–2678, 2014, <http://dx.doi.org/10.1021/jf500005y>.

This paper describes the successful preparation of a protein-based Pickering emulsion, with superior stability against both coalescence and creaming, through a novel strategy of facilitating the formation of protein particles and small molecular weight surfactant complexes; these complexes are able to overcome multiple challenges including limited solubility, poor diffusive mobility, and low interfacial loading. Soluble complexes of water-insoluble corn protein, zein colloidal particles, and surfactant sodium stearate (SS) were fabricated by simple ultrasonication. Gel trapping technology combined with scanning electron microscopy was applied to characterize the adsorbed particles monolayer at the oil-water interface; results revealed an enhanced adsorption and targeted accumulation of zein particles at the interface with the increase of SS concentration. Partial unfolding of zein particles modified by SS above its critical complexation concentration triggered the aggregation and close packing of particles at the oil-water interface and endowed a steric barrier against the coalescence of oil droplets. Moreover, protein-based oil gels without oil leakage were obtained by one-step freeze-drying of the zein-stabilized Pickering emulsions, which could be developed to a viable strategy for structuring liquid oils into semisolid fats without the use of saturated or trans fats.

Application of stable isotopes to investigate the metabolism of fatty acids, glycerophospholipid and sphingolipid species

Ecker, J., and G. Liebisch, *Prog. Lipid Res.* 54:14–31, 2014, <http://dx.doi.org/10.1016/j.plipres.2014.01.002>.

Nature provides an enormous diversity of lipid molecules that originate from various pathways. To gain insight into the metabolism and dynamics of lipid species, the application of stable isotope-labeled tracers combined with mass spectrometric analysis represents a perfect tool. This review provides an overview of strategies to track fatty acid, glycerophospholipid, and sphingolipid metabolism. In particular, the selection of stable

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JOURNAL OF THE AMERICAN OIL CHEMISTS' SOCIETY

Journal of the American Oil Chemists' Society (April)

- Comparison of fatty acid methyl and ethyl esters as biodiesel base stock: a review on processing and production requirements, Yusoff, M.F.M., X. Xu, and Z. Guo
- Matching the functionality of single-cell algal oils with different molecular compositions, Co, E.D., M. Koutchekina, J.R. Carney, R. Bond, W. Rakitsky, and A.G. Marangoni
- A highly efficient automated flow injection method for rapid determination of free fatty acid content in corn oils, Ayyildiz, H.F., and H. Kara
- Multi-length-scale elucidation of kinetic and symmetry effects on the behavior of stearic and oleic TAG. I. SOS and SSO, Baker, M., L. Bouzidi, N. Garti, and S.S. Narine
- Optimization of lipase-catalyzed fractionation of two conjugated linoleic acid (CLA) isomers, Jafari, M., M. Kadivar, S.A.H. Goli, and M. Ghiaci
- Emulsifying properties of lecithin containing different fatty acids obtained by immobilized lecithase ultra-catalyzed reaction, Gan, L.-J., X.-Y. Wang, D. Yang, H. Zhang, J.-A. Shin, S.-T. Hong, S.H. Park, and K.-T. Lee
- Stability of essential fatty acids and formation of nutritionally undesirable compounds in baking and shallow frying, Hrncirik, K., and M. Zeelenberg
- 'Cobrançosa' olive oil and drupe: chemical composition at two ripening stages, Sousa, C., I. Gouveias, D. Barreira, M.T. Carvalho, A. Vilela, J. Lopes, P. Martins-Lopes, and A.I. Barros
- Quality characterization of the olive oil from var. Tosca 07[®] grown in a commercial high-density orchard, Abeñoza, M., M. Benito, R. Oria, and A.C. Sánchez-Gimeno
- Effects of deuterium oxide on the oxidative stability and change of headspace volatiles of corn oil, Kim, J., M.-J. Kim, and J. Lee
- Cultivar characterization of tea seed oils by their active components and antioxidant capacity, Wang, X., X. Liang, J. Zhao, and B. Huang
- A polymath approach for the prediction of optimized transesterification process variables of polanga biodiesel, Dhingra, S., K.K. Dubey, and G. Bhushan
- Acid value, polar compounds and polymers as determinants of the efficient conversion of waste frying oils to biodiesel, Vieitez I., N. Callejas, B. Irigaray, Y. Pinchak, N. Merlinski, I. Jachmanián, and M.A. Grompone
- Lipid estimation of surfactant-extracted microalgae oil using Nile red, Montalbo-Lomboy, M., M.N. Kantekin, and T. Wang

- High *trans,trans* conjugated linoleic acid-rich triacylglyceride production by photo-irradiation, Shah, U., A. Proctor, and R. R. Yettella
- Combination of urea complexation and molecular distillation to purify DHA and EPA from sardine oil ethyl esters, Lin, W., F.W. Wu, L. Yue, Q.G. Du, L. Tian, and Z.X. Wang



Lipids (April)

- Microglial cell activation increases saturated and decreases monounsaturated fatty acid content, but both lipid species are proinflammatory, Button, E.B., A.S. Mitchell, M.M. Domingos, J.H.-J. Chung, R.M. Bradley, A. Hashemi, P.M. Marvyn, A.C. Patterson, K.D. Stark, J. Quadrilatero, and R.E. Duncan
- 15-Lipoxygenase-mediated modification of HDL₃ impairs eNOS activation in human endothelial cells, Cutuli, L., A. Pirillo, P. Uboldi, H. Kuehn, and A.L. Catapano
- The utilization of the acyl-CoA and the involvement PDAT and DGAT in the biosynthesis of erucic acid-rich triacylglycerols in crambe seed oil, Furmanek, T., K. Demski, W. Banaś, R. Haslam, J. Napier, S. Stymne, and A. Banaś
- Analysis of cyanolipids from Sapindaceae seed oils by gas chromatography–EI-mass spectrometry, Tava, A., and P. Avato
- Alterations in membrane phospholipid fatty acids of gram-positive piezotolerant bacterium *Sporosarcina* sp. DSK25 in response to growth pressure, Wang, J., J. Li, S. Dasgupta, L. Zhang, M.Y. Golovko, S.A. Golovko, and J. Fang
- Four amino acid residues influence the substrate chain-length and regioselectivity of *Siganus canaliculatus* $\Delta 4$ and $\Delta 5/6$ desaturases, Lim, Z.L., T. Senger, and P. Vrinten
- Ether-type moieties in the lipid part of glycoinositolphospholipids of *Acanthamoeba rhyodes*, Karaś, M.A., and R. Russa
- Accumulation of hydroxyl lipids and 4-hydroxy-2-hexenal in live fish infected with fish diseases, Tanaka, R., K. Shigeta, Y. Sugiura, H. Hatate, and T. Matsushita
- Gut microbial metabolites of polyunsaturated fatty acids correlate with specific fecal bacteria and serum markers of metabolic syndrome in obese women, Druart, C., E.M. Dewulf, P.D. Cani, A.M. Neyrinck, J.-P. Thissen, and N.M. Delzenne

isotope-labeled precursors and their mass spectrometric analysis is discussed. Furthermore, examples of metabolic studies that were performed in cell culture, animal and clinical experiments are presented.

Fish oils, coronary heart disease, and the environment

Greene, J., *et al.*, *Am. J. Public Health* 103:1568–1576, 2013, <http://dx.doi.org/10.2105/AJPH.2012.300959>.

Clinical trials continue to produce conflicting results on the effectiveness of fish oils for the primary and secondary prevention of coronary heart disease. Despite many large, well-performed studies, questions still remain, made even more complex by the addition of early revascularization and statins in our coronary heart disease armamentarium. This is complicated by the reality that fish oil production has a measureable impact on reducing fish populations, which in turn has a negative impact on creating a sustainable product. We review the current data for fish oil usage in the primary and secondary prevention of coronary heart disease with an eye toward future studies, and the effects fish oil production has on the environment and efforts that are currently under way to mitigate these effects.

Biomarkers of fish oil omega-3 polyunsaturated fatty acids intake in humans

Silva, V., *et al.*, *Nutr. Clin. Pract.* 29:63–72, 2014, <http://dx.doi.org/10.1177/0884533613516144>.

A biomarker is a measured characteristic that may be used as an indicator of some biological state or condition. In health and disease, biomarkers have been used not only for clinical diagnosis purposes but also as tools to assess effectiveness of a nutrition or drug intervention. When considering nutrition studies, evaluating the appropriate biomarker is a useful tool to assess compliance and incidence of a particular dietary component in the biochemistry of the organism. Fish oil is rich in ω -3 fatty acids that have well-known beneficial effects on human health mainly through their anti-inflammatory properties. It has been widely used to improve health and as a nutritional supplement in different pathological conditions such as cardiovascular, neurological, and critically ill related diseases. Eicosapentaenoic acid and docosahexaenoic acid levels present in different biological moieties (plasma, cellular membranes, adipose tissue, etc.) are the best biomarkers of fish oil intake. Each biological source of fatty acids has its own advantages and disadvantages; thus, which biomarker to choose and where to measure it requires a comprehension of the objectives of the investigation. In this article we will review key facts about fish oil intake biomarkers to evaluate how components of a specific diet could be monitored and identified in biological samples. Having an accurate assessment of nutrition patterns could provide effective targets for intervention aimed at modifying eating habits and lifestyle towards the improvement of health.

Biomarkers of lipid peroxidation in clinical material

Niki, E., *Biochim. Biophys. Acta* 1840:809–817, 2014, <http://dx.doi.org/10.1016/j.bbagen.2013.03.020>.

Free radical-mediated lipid peroxidation has been implicated in a number of human diseases. Diverse methods have been developed and applied to measure lipid peroxidation products as potential biomarkers to assess oxidative stress status *in vivo*, discover early indication of disease, diagnose progression of disease, and evaluate the effectiveness of drugs and antioxidants for treatment of disease and maintenance of health, respectively. However, standardized methods are not yet established. Characteristics of various lipid peroxidation products as biomarkers are reviewed on the basis of mechanisms and dynamics of their formation and metabolism and also on the methods of measurement, with an emphasis on the advantages and limitations. Lipid hydroxides such as hydroxyoctadecadienoic acids (HODE), hydroxyeicosatetraenoic acids (HETE), and hydroxycholesterols may be recommended as reliable biomarkers. Notably, the four HODEs—9-*cis,trans*, 9-*trans,trans*, 13-*cis,trans*, and 13-*trans,trans*-HODE—can be measured separately by LC-MS/MS (liquid chromatography-tandem mass spectroscopy) and the *trans,trans*-forms are specific markers of free radical-mediated lipid peroxidation. Further, isoprostanes and neuroprostanes are useful biomarkers of lipid peroxidation. It is important to examine the distribution and temporal change of these biomarkers. Despite the fact that lipid peroxidation products are nonspecific biomarkers, they will enable to assess oxidative stress status, disease state, and effects of drugs and antioxidants.

Plastids with or without galactoglycerolipids

Botté, C.Y. and E. Maréchal, *Trends Plant Sci.* 19:71–78, 2014, <http://dx.doi.org/10.1016/j.tplants.2013.10.004>.

In structural, functional, and evolutionary terms, galactoglycerolipids are signature lipids of chloroplasts. Their presence in nongreen plastids has been demonstrated in angiosperms and diatoms. Thus, galactoglycerolipids are considered as a landmark of green and nongreen plastids, deriving from either a primary or secondary endosymbiosis. The discovery of a plastid in *Plasmodium falciparum*, the causative agent of malaria, fueled the search for galactoglycerolipids as possible targets for treatments. However, recent data have provided evidence that the *Plasmodium* plastid does not contain any galactoglycerolipids. In this opinion article, we discuss questions raised by the loss of galactoglycerolipids during evolution: How have galactoglycerolipids been lost? How does the *Plasmodium* plastid maintain four membranes without these lipids? What are the main constituents instead of galactoglycerolipids?

More Extracts & Distillates can be found in this issue's supplement (digital and mobile editions only).

Richard W. Hartel

In what ways did your previous career and publishing experiences prepare you for the job, and how has being an editor of the journal shaped your career?

Except for a short stint in industry, my entire career has been in academics, teaching classes and conducting research. As such, becoming involved in journal editorship is natural, involving a progression from writing research articles to reviewing them to guiding the direction of a journal. In one way of thinking, people who publish research articles in journals have a responsibility to give back to those same journals as reviewers and editors. I'm simply doing what I see as my responsibility.

What do you like most about being an editor?

The best part about being an editor is that I get to see the wide range of interests in our field. From biodiesel to fat crystal networks, we publish articles across a wide array of fascinating topics.

What do you like the least?

Sometimes hard decisions need to be made about whether to accept or reject. These are often the hardest calls to make. And it still amazes me that some people don't seem to understand the rules of ethical publication. Comparing each and every manuscript with a similarity checker is now standard practice because it's better to catch duplications ahead of time rather than have to retract papers once they're out in the public domain.

In what ways has scientific publishing changed during your editorship, and what changes do you foresee during the next five years?

When I started with the journal as an Associate Editor, we were still mailing hard copies of manuscripts back and forth in those blue bags. Researchers still went to the library with copy card in hand to make paper copies of articles of interest. Now, everything is readily available online with electronic downloads of articles made easy. During our review process, we now pass only electronic copies of articles from person to person. I think we'll see more of the same in the future with much more material readily available online. We're already seeing new types of information transmission, from videos to simulations, appear within articles, and this will continue to grow and develop.

Is there a particular non-scientific interest or activity you enjoy, and what bearing has it had on your life and career?

I'm pretty fond of my bicycles. They get me to work just about every day of the year, get me to the grocery store when necessary, and provide hours of enjoyable solitude out on the nicely paved dairy roads of southern Wisconsin.



Thanks to the Editor is a regular Inform column that recognizes those who work on AOCS journals. Richard W. Hartel has been the editor-in-chief of the Journal of the American Oil Chemists' Society since 2006. He is a professor of food engineering at the University of Wisconsin–Madison, USA, where his research focuses on phase transitions in foods. He is particularly interested in the crystallization of ice, sugars, and lipids, as well as glass transition events that are important to the proper design, development, control, stability, and shelf life of foods such as ice cream, confections, chocolate and compound coatings, and dairy products.

Thanks to the Editor is a regular *Inform* column that recognizes those who work on AOCS journals.

Professional Pathways

Professional Pathways is a regular Inform column in which AOCS members discuss their professional experiences and share advice with young professionals who are establishing their own careers in oils and fats-related fields.

Vishal Jain is an innovation team manager for Bunge North America (St. Louis, Missouri, USA). A young professional himself, he has worked for several oils and fats-related companies in his career to date.



Why did you join AOCS?

As a student in college I had heard about AOCS as a reputable society for professionals in the field of oils and fats. When I started working on my graduate degree I remember my Ph.D. research adviser outlining the benefits of being associated with the society: networking, job opportunities, recognition, leadership development, personal growth. At the time it just felt as if he wanted me to work harder and present my work sooner at the annual meeting. Ten years later, I have gotten everything out of the society that he indicated and more, though I am still waiting for the golden eggs.

Describe your career path.

I received a bachelor's degree in Oils, Oleochemicals, and Surfactants from the Mumbai University Institute of Chemical Technology in 2003. After graduating I worked for Godrej Consumer Products Ltd. before getting a Ph.D. in food science from the University of Arkansas, Fayetteville (USA) in 2008. I worked at Oil-Dri Corp. and Mars Chocolate before being hired by Bunge North America in 2012.

What do you love about your job?

As an innovation team manager I have the freedom to think out of the box. It provides me an opportunity to play with the breadth and width of the oils and fats arena and beyond. It starts with creating a vision and developing details around that vision for that technology or specific product. The chal-

lenges vary with the day and I get to spend time in the lab, the pilot plant, the production facilities, at our customers' sites, or with third-party suppliers. Having an energetic and vibrant team to lead makes my job even more enjoyable.

How do you see the industry changing in the next five years?

The current trend of healthy fats and food in general will gain momentum in years to come. Low saturates and non-hydrogenated fats will be the norm of the day and cost-effective structured lipids will be readily available.

Describe memorable job experiences.

A very difficult time in the jungles of Indonesia was also one of the most rewarding times. We were 10 hours away from relatively modern civilization working in cocoa fields and running experiments at the collection station. Although 20-hour work days and less-than-optimal climatic conditions made our work extremely challenging, the opportunity to experience a rich culture and natural beauty of that island was very satisfying. Getting to experience the celebrity status from the locals is probably a story for another day.

Please describe a course, seminar, book, mentor, or speaker that has inspired you in ways that have helped you advance your career.

I have been fortunate to work with individuals who are at the forefront in their respective arenas who have helped me grow as a professional; however, I always reserve a special mention for my Ph.D. adviser, Andrew Proctor, for being instrumental in my development as a scientist and providing me the opportunities to develop my network.

Do you have any advice for young professionals who are trying to develop an effective network of other professionals?

Professional societies are your best tools to develop an effective professional network. Get involved with divisional, sectional, or common interest group activities early in your career and keep it high on your priority list just as you would prioritize attending presentations. As a member of the Networking Value Center for Bunge we are targeting “young professionals” and providing them with effective networking and mentoring opportunities along with providing avenues for leadership development. I remember going to my very first AOCS Processing Division roundtable as a student and I immediately got involved with division activities. Most of the people I met that day are still on my contact list and I know I can count on them when needed.

If you were starting your career again, what would you do differently?

I would try to learn more from each opportunity that I got. Never miss an opportunity to talk to a colleague about a project that you may not be part of or never miss attending a year-end project review by another colleague. You never know when a new job opportunity would come by and you would change ships or you are given a new role within the same company taking you to a different site or country for that matter.

What are the opportunities for advancement in your career/field and how can someone qualify for such advancements?

The one thing that I have noticed with professionals at senior positions in the industry is their ability to manage and provide expertise in several key areas. Some of it obviously comes with experience, but a lot of it is acquired by choice. Either during education or your career you should try to pick up new skills. Whether sensory, statistics, or project management, at some stage of your career it will provide you the impetus to jump to the next level.

Several companies have started providing technical and managerial career tracks and are becoming more focused

on talent management and advancement. Opportunities are available, but they depend on your passion.

How would you describe the culture in your field, and how has it developed?

My perception is that the culture is very traditional and passionate. We have a relatively large group of people who are experienced and seasoned in their art. You spend a few minutes talking to some of these professionals and you can immediately realize the passion they have for this field. However, at the same time the culture is open and welcoming and quickly engages a new professional.

In your area/field and considering today's market, is it more important to be well rounded or a specialist?

Let me give you a baseball analogy. You can be a Cy Young Pitcher but you still have to field well. You may even need to go out to bat. At the same time you need your teammates to defend well and provide you the run support to win the game.

Take the same analogy to the oils and fats field. It's a team environment, and although you are expected to perform individually you have to support and get support from your colleagues. Production of oils and fats itself is an elaborate network, and each step affects several others in that network. On the other hand, oils and fats are integral ingredients in food products and require the application of a wide range of functional chemistry. Although subject matter expertise is necessary, having well-rounded professionals is the key to success in such a dynamic industry.

What is your opinion toward the value of obtaining or possessing a graduate degree during a challenging economy?

What's most important in today's economy is what sets you apart from others in your field of expertise. Is a graduate degree sufficient to get a job or get the next promotion? No, not even close. The most important factors that will help you distinguish yourself from others are what you have gained during your graduate degree and how well you have utilized that. A graduate degree to me is not just focused research but attaining the art of research, interacting with your peers and gaining from their experience, and developing the ability to influence professionals. I have come across several R&D directors and vice presidents who have various levels of education (B.S./Ph.D./MBA). The degree has had some role to play in their success, but it's the broader skill set that has helped them progress in their careers. So the trick is to acquire subject matter expertise along with such advanced skill sets that set you apart and make you an attractive candidate for a job opening. ■



Harnessing ancient bacteria to make industrial chemicals

Emmanuel Petiot

Deinococcus is one of the oldest and most resilient life forms. The bacterium originated about 3.5 billion years ago (when life on earth was just arising), and it has been characterized as the most radiation-resistant organism on the planet (Fig. 1). Members of

the genus can withstand about 3,000 times more radiation than humans. One species, *D. radiodurans*, is 50 times more resistant than *Escherichia coli* to ionizing radiation. In fact, *D. radiodurans* was first isolated in 1956 from a can of meat that had spoiled even after being “sterilized” by radiation.

◀ The Morning Glory pool at Yellowstone National Park in Wyoming, USA, is just one example of the extreme environments in which *Deinococcus* thrives. The temperature of this particular hot spring is a toasty 171.6 degrees Fahrenheit.

Deinococcus radiodurans can withstand massive doses of radiation and can even survive being completely dried out, according to Miroslav Radman, a professor at the Faculty of Medicine at the Paris Descartes University, who discovered the molecular basis of the bacteria's extreme resistance to ionizing radiation and desiccation (*Nature* 443:569–573, 2006; <http://dx.doi.org/10.1038/nature05160>) and cofounded the company DEINOVE to develop commercial applications. “The genome is shattered into hundreds of pieces. It is a dead cell,” Radman says. “But out of this horrendous damage, it can resurrect.”

The seemingly indestructible bacterium is also extremely resistant to drought, heat, cold, nutrient deprivation, toxins, acidic conditions, and other stress factors. However, its most interesting feature from an industrial standpoint is its ability to convert non-food biomass into high-value chemicals. Potential products include not only ethanol and other bioalcohols for use as biofuels but also high-value organic compounds such as isoprenoids.

A wide range of feedstocks can be converted, including agricultural residues such as corn stover, wheat straw, and bagasse, as well as wood products, energy crops, and industrial and urban waste.

The conversion process accomplished with *Deinococcus* includes two main interlinked steps:

hydrolysis of lignocellulosic biomass to fermentable sugars and a concurrent fermentation of these sugars into chemical compounds or chemical intermediates for use in the chemical industry.

WHY IS THE *DEINOCOCCUS* BACTERIUM A PRIME CHOICE TO DO “GREEN CHEMISTRY”?

Deinococcus bacteria have exceptional intrinsic properties that make them perfect microfactories for industrial applications:

- Their genome is very stable even after being optimized; consequently the process is highly reproducible.
- They are particularly resistant to common industrial process stress molecules, such as furfural and hydroxymethylfurfural, which usually affect fermentation performance.
- They simplify production with an “all-in-one” Consolidated BioProcessing process (CBP) by jointly



▲ FIG. 1. *Deinococcus* bacteria. This organism is known to have existed about 3.5 billion years. Courtesy of Dr. Michael Daly, Uniformed University of the Health Sciences, Bethesda, Maryland, USA.

managing the hydrolysis and fermentation steps of the process allowing for a substantial reduction in the amount of costly exogenous enzymes commonly used in the hydrolysis step (Fig. 2, page 326).

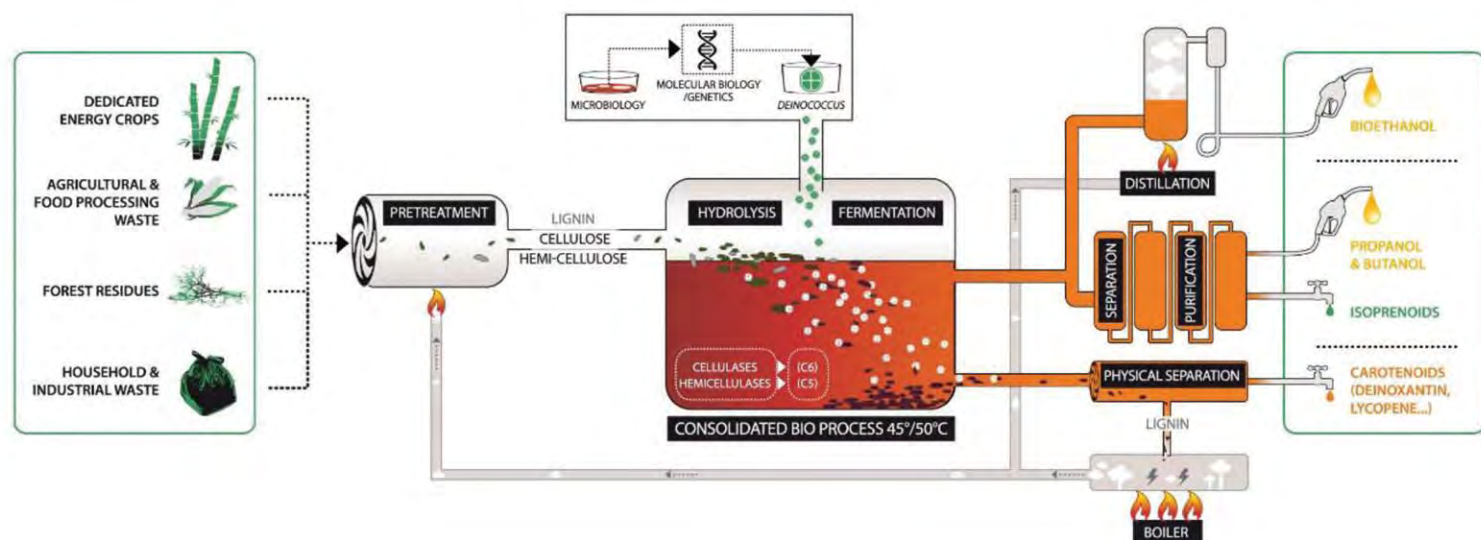
- They are capable of simultaneously fermenting different types of simple sugars, such as C5 and C6—derived from the hydrolysis of cellulose and hemicellulose—and other organic compounds, such as glycerol and acetic acid, thus increasing the final yield of the process.

CONTINUED ON NEXT PAGE

- The *Deinococcus* bacterium is one of the oldest life forms on earth.

- Intrinsic properties of *Deinococcus* allow it to convert non-food biomass into high-value chemicals and organic compounds.

- Now, DEINOVE, a company headquartered in Paris, France, is using genetic engineering to turn these ancient bacteria into microfactories that produce chemical compounds and intermediates at an industrial scale.



▲ **FIG. 2.** Creating a cost-effective consolidated bioprocess based on *Deinococcus*. In considering the example of one potential product, geraniol, a fragrance isoprenoid, DEINOVE's scientists will select, according to various criteria, the best fitted strain for the production of this specific product. Then, they will optimize this strain by modifying its genome and selecting the optimal fermentation conditions.

One industrial partner who has expressed interest in this technology plans to use the strain to hydrolyze a pretreated biomass, for example, pretreated corn stover, and then ferment the resulting sugars into geraniol. The latter will be extracted from the fermentation broth and used as a constituent in essential oils.

- They can overcome certain constraints relative to temperature imposed on “classic” organisms: In a “classical” process, the heat generated by the fermentation kills off the microorganisms. This makes it necessary to control the reactor temperature, resulting in considerable energy cost and waste of time. *Deinococcus* makes this unnecessary as it is thermophilic and works at temperatures up to 48°C.

In summary, *Deinococcus* bacteria have properties that are unique and fully advantageous in industrial conditions geared for maximum efficiency. DEINOVE's scientific results suggest that the benefits listed above represent only a fraction of what the bacteria can deliver.

DEINOVE'S TECHNOLOGICAL PLATFORM

During the early stages of their work, members of DEINOVE's research team spent the majority of their time collecting samples from around the world—especially from mainland France and French overseas



territories. They were targeting particularly resistant strains of higher value for industrial applications, so they collected samples from extreme environments such as deserts, glaciers, hot springs, volcanoes, lagoons, and tropical forests. The company has since built a *Deinococcus* library containing more than 6,000 sequenced and annotated strains, and it has developed a technology platform (Fig. 3) that enables it to:

- Select the best strain profile in terms of growth and metabolic capacity.
- Optimize these strains by genetic engineering (overexpression of the targeted metabolic pathways, elimination of competing pathways) and fermentation engineering (optimization of culture and fermentation processes, optimization of substrates).
- Validate these new production systems by scaling up processes.

DEINOVE's biotransforming platforms directly benefit from the intrinsic properties of the bacterial strains and their pathways optimization via DEINOVE proprietary techniques. These properties are key success factors as DEINOVE develops targeted industrial applications by allowing each platform to be customized for specific commercial partners, independent of either the starting feedstock or pretreatment technology that is used.

ISOPRENOIDS AND APPLICATIONS

Isoprenoids (also called terpenoids) are the largest family of natural substances in the world (more than 22,000 isoprene compounds have been listed) and are key components in numerous industrial applications. Here are some examples of molecules and their target markets:

- Carotenoids (β -carotene, lycopene, ...) are key components in cosmetics and animal feed formulations.

- Pinene, linalool, geraniol, citral, and myrcene are often found in essential oils, perfumes, flavors, and food coloring, and as building blocks for polymers.
- Polyisoprenes are the building blocks of pneumatic tires, medical gloves, and adhesive resins.

The isoprenoids are included in the composition of many products, commodities and specialty chemicals. When extracted from plants or produced by chemical synthesis, they suffer from low yields and/or high production costs.

Deinococcus bacteria are ideal for these types of developments due to their natural expression of isoprenoids such as carotenoids. Interestingly, their carotenoid-containing lipid membranes explain their red pigmentation and allow for their remarkable resistance (Fig. 4, page 336).

The intrinsic expression of isoprenoids in *Deinococcus* demonstrates both that the pathway for isoprenoid biosynthesis is already present and active and that these bacteria are an ideal host for the industrial production of such compounds. Furthermore, DEINOVE's demonstrated capacity to genetically modify *Deinococcus* to be hyperproducers of a specific product of interest is an ideal synergy: improving already naturally occurring metabolic pathways in order to reach industrially and economically viable levels.

PROGRESS TOWARD COMMERCIALIZATION

Regarding ethanol production, DEINOVE has demonstrated the technological and economic viability of its production process based on *Deinococcus* bacteria, which can produce ethanol a 9% v/v titer. The company has initiated a test campaign in bioreactors up to 300 liter capacity (Fig. 5, page 336).

CONTINUED ON PAGE 336

OPTIMISATION / OPTIMIZATION

INGÉNIERIE GÉNÉTIQUE ET MÉTABOLIQUE

Insertion/délétion de gènes
Surexpression voie métabolique cible, élimination voies compétitrices
Optimisation de séquence

GENETIC & METABOLIC ENGINEERING

Insertion / Deletion of genes
Overexpression of targeted metabolic pathways, elimination of competing pathways
Sequence optimization

INGÉNIERIE FERMENTAIRE

Optimisation des procédés de culture et de fermentation
Optimisation des intrants à l'aide de la plateforme biomasse
Analyse du sucre contenu dans le substrat

FERMENTATION ENGINEERING

Optimization of culture and fermentation processes
Optimization of process inputs through the biomass platform
Analysis of sugar content in the substrate



SCALE UP

INGÉNIERIE INDUSTRIELLE

Essais laboratoire
Test of integration

INDUSTRIAL ENGINEERING

Lab Assays
Test & Integration

Deinococcus candidat / *Deinococcus* candidate

POC

Pilote de laboratoire / Laboratory Pilot

Pilote industriel / Industrial Pilot

PRODUCTION

◀ **FIG. 3.** DEINOVE proprietary technology platform, guiding *Deinococcus* toward enhanced performance. Abbreviations: PCR, polymerase chain reaction; S1, S2, S3, Selection 1, Selection 2, Selection 3; POC, proof of concept.

Trans fat issues after discontinuation of industrially produced trans fats

Noelia Aldai and John K.G. Kramer

In our recent review (Aldai, N., *et al.*, 2013) we considered whether trans fatty acids (TFA) in the human diet will be of concern once industrially produced TFA (iTFA) are discontinued. If so, we wanted to know what the sources would be, and how one can reduce the contribution of harmful TFA in the human diet. For this discussion, we concurred with the evidence that iTFA are undesirable and with the recommendation that the consumption of harmful TFA be kept as low as possible. We reviewed the other remaining

sources of TFA in our food supply, that is, fully refined and deodorized vegetable oils, those that are produced during frying of foods, chemically synthesized food supplements, and ruminant fats. While some scientists are now beginning to question whether further research on trans fat is needed, we believe this may be premature considering several remaining issues.

TFA FORM AS THE RESULT OF HEATING UNSATURATED FATS AND OILS

Processing fats and oils involves heat, which leads to isomerization of the *cis* to *trans* double bonds in unsaturated fatty acids (geometric isomerization) without much positional isomerization. The latter is extensively observed during partial hydrogenation.

The deodorization step during vegetable oil refining produces up to 4% TFA (as percentage of total fat) mainly due to geometric isomerization of linoleic and linolenic acids at temperatures above 200°C. Deep frying and wok cooking likewise produce geometric isomerization of linoleic and linolenic acids at temperatures above 200°C.

Before the trans fat regulation was implemented in 2003, the *trans*-18:1 isomers generally predominated in fully refined vegetable oils. After this date, the total trans content in the refined oils decreased slightly mainly due to a decrease of the 18:1 isomers, while the content of the 18:2 and 18:3 isomers remained about the same (Kramer, J.K.G., unpublished data).

This suggests that milder deodorization conditions were used, but the greater susceptibility to isomerization of polyunsaturated fatty acids (PUFA) compared to monounsaturated fatty acids (MUFA) was evident. Fish frying and deodorization of fish oils also produce geometric isomers of PUFA. It is expected that lowering the temperature during oil refining and cooking, and eliminating contact of fats and oils with metals wherever possible, could reduce the content of total TFA from these sources to less than 2%.

This article discusses the need:

- for the label declaration of trans fatty acid (TFA) to be based on chemical structure and biological activities rather than origin
- to establish appropriate methodologies to distinguish between beneficial and harmful TFA and to develop strategies to increase the content of desirable TFA in ruminant fats
- to create an accurate database of TFA-containing foods complemented with specific surveys that can be accessed by regulatory agencies and health professionals, so they can make appropriate TFA recommendations

CHEMICALLY SYNTHESIZED CONJUGATED TFA IN FOOD AND FEED SUPPLEMENTS

The discovery that conjugated linoleic acid (CLA) may be involved in cancer protection and body fat loss has sparked interest in introducing CLA as a food supplement and including it in ruminant feeds. CLA is chemically synthesized from linoleic acid by alkali isomerization and consists primarily of an equal mixture of two isomers, *c9,t11*-18:2 (rumenic acid) and *t10,c12*-18:2 plus minor amounts of other *cis/trans*-, *cis,cis*-, and *trans,trans*-18:2 isomers. Most of the CLA isomers contain a *trans* double bond and hence will need to be included in any TFA discussion. There are recent reports indicating that synthetic *t/t*-CLA mixtures have been included into potato chips, and other CLA supplements have been fed to ruminants. However, the biological effects of some of these CLA isomers and their metabolites may not be beneficial, much like the *t10,c12*-18:2 isomer that was reported to have negative health effects.

TFA NATURALLY PRODUCED IN RUMINANTS

Many surveys have shown that the main sources of human TFA intake, excluding iTFA, are those derived from dairy and meat products from ruminants. The question then becomes, are ruminant TFA (rTFA) safe? It is generally assumed that rTFA consist mainly of vaccenic acid (VA; *t11*-18:1) and rumenic acid (RA; *c9,t11*-18:2). These TFA are associated with health benefits, and therefore there appears to be no reason for concern. Others have argued that rTFA may not be safe, but since their consumption is so low, they do not pose a risk factor for developing cardiovascular disease (Brouwer, I.A., *et al.*, 2013). This explanation may need to be reconsidered since consumption of the same amount of dairy and meat products has repeatedly been shown to provide health benefits.

We believe that rTFA are a concern, not because of the content of VA and RA in ruminant products, but because of the content of TFA other than VA and conjugated fatty acids other than RA in ruminant products currently available at the retail level in some countries. To better understand the altered rTFA composition requires a closer examination of the factors involved in their formation in ruminants.

Trans fats are produced in the rumen by microbiota metabolizing dietary PUFA by enzymatic and chemical isomerization processes leading to conjugated fatty acids that are subsequently reduced to intermediates with decreased unsaturation. This process is referred to as biohydrogenation. Rearrangements of double bond positions can occur that involve hydration/dehydration reactions. The intermediates formed are absorbed and further desaturated, elongated, or chain-shortened in the animal's tissues. The result is a mixture of many MUFA and PUFA metabolites with different *cis* and *trans* double-bond configurations depending on the original unsaturated fatty acids fed. However, unlike partial hydrogenation that leads to a random formation of isomers, the double bonds in the enzymatically produced metabolites are in specific positions.

Biohydrogenation involves the interaction of many rumen bacteria and complex processes that are not totally understood.

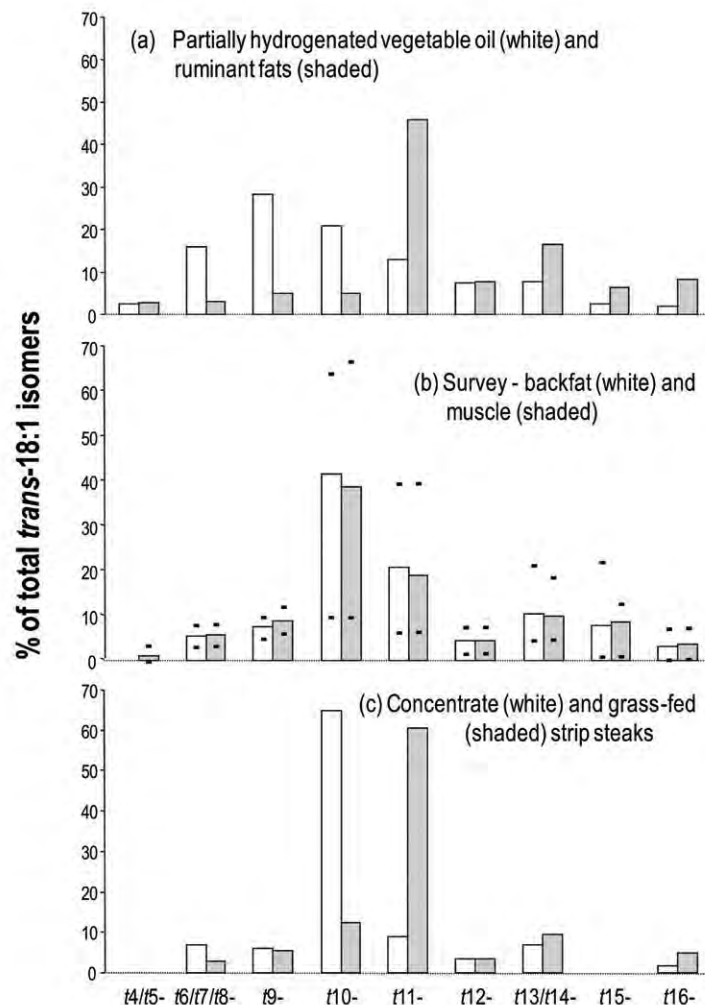


FIG. 1. Relative isomeric distribution of individual *trans*-18:1 isomers. (a) Comparison of a typical partially hydrogenated vegetable oil and a ruminant fat from pasture-fed animals; (b) backfat and longissimus lumborum samples from a survey conducted in Canada ($n = 60$; maximum and minimum values are represented as a dash) (Aldai, N., *et al.*, 2009); (c) survey results of beef strip steaks from concentrate ($n = 9$) and grass-fed ($n = 41$) animals (Leheska, J.M., *et al.*, 2008). Permission granted by the *Canadian Journal of Animal Science* and authors.

Its outcome is largely modulated either by basal diet (the forage/concentrate ratio and the type of starch), lipid supplementation (type and content of PUFA), and other species and/or individual unknown responses. For instance, when ruminants are primarily forage-fed they will produce mainly VA and RA as the major *trans*-18:1 and conjugated fatty acid isomers, respectively. On the other hand, when ruminants are fed high concentrate/forage diets containing high amounts of digestible cereals/grains and unsaturated fatty acids, they will produce *t10*-18:1 rather than *t11*-18:1 and conjugated fatty acids other than RA, that is, *t7,c9*-, *t9,c11*-,

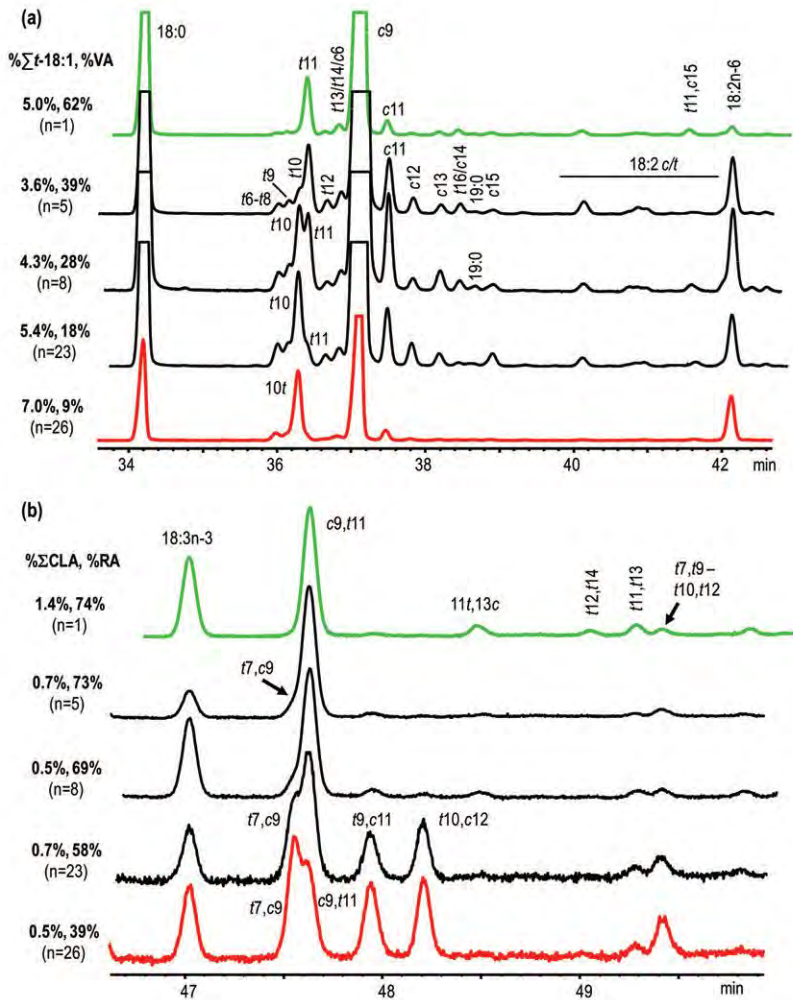


FIG. 2. Gas chromatography analysis of the backfat from beef steaks surveyed in Ontario, Canada ($n = 33$) and Cleveland, Ohio, USA ($n = 30$). Partial separation of the 18:1 (a) and conjugated linoleic acid (CLA) (b) regions of the same backfat samples. The samples were selected based on their *trans*-18:1 profile. Along the y-axis, the total *trans* and CLA contents of the represented samples in the figure are provided as percentage of total fatty acid methyl esters, while vaccenic acid (VA; t_{11} -18:1) and rumenic acid (RA; c_9 , t_{11} -18:2) are expressed as percentage of total *trans*-18:1 and CLA, respectively. The values in brackets represent the number of retail sample of the 63 collected that showed the representative profile (Kramer, J.K.G., unpublished data).

t_{10} , c_{12} -, and t_{11} -18:2. The resultant shift in the *trans*-18:1 profile has been described as the t_{10} -shift and is clearly recognizable.

In several surveys of retail beef sampled in Alberta, Canada (Aldai, N., *et al.*, 2009) and the United States (Leheska, J.M., *et al.*, 2008) (Fig. 1, 329), in Ontario/Ohio (Fig. 2), or in lambs sampled in Spain (Aldai, N., unpublished data), the characteristic shift of the *trans*-18:1 and conjugated fatty acids is evident. Levels from 9 to 25% of total *trans* MUFA were reported in ruminant tissues. This increase in t_{10} -18:1 in ruminant fats is exacerbated when several feeding factors are combined, such as the inclusion of highly fermentable starch and of oils or oilseeds rich in linoleic or linolenic acids. A comparison of retail beef and hamburger products conducted in Alberta showed hamburger meat

to have a healthier TFA profile than steak, possibly due to the inclusion into hamburger of meat from older animals (cull cows) that had received a higher forage intake, or meat from other countries/regions characterized by extensive (forage) beef production systems.

Two additional dietary ingredients have been shown to affect the quality and content of rTFA: marine oils and ionophore antibiotics. The addition of fish or algae sources to the diet with the intent to increase docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA) levels in ruminant-derived products has not been very successful because of the low ($\leq 4\%$) transfer efficiency of EPA and DHA. However, DHA and EPA are known to inhibit the reduction of *trans* MUFA to saturated fatty acids, which results in the accumulation of *trans* MUFA in the rumen and ruminant products. Therefore, depending on the basal diet fed, the increase is either VA and RA, or undesirable rTFA (t_{10} -18:1, t_{7} , c_9 -18:2, t_{9} , c_{11} -18:2, t_{10} , c_{12} -18:2). Marine PUFA fed to ruminants are also subject to isomerization and reduction by rumen bacteria, producing numerous *trans*-containing unsaturated metabolites that are subsequently absorbed and deposited in ruminant products (meat, milk).

The other dietary ingredient of concern is antibiotics, notably monensin. This antibiotic is extensively used to control ketosis and increase feed efficiency in beef and dairy cattle production. However, VA-producing rumen bacteria, specifically *Butyrivibrio fibrisolvens*, are known to be sensitive to monensin. The addition of monensin to a diet high in PUFA was shown to increase the content of total *trans*-18:1 to 25% of total fatty acids in milk fat, and since the basal diet consisted of digestible starch, most of the *trans*-18:1 was t_{10} -18:1 (Cruz-Hernandez, C., *et al.*, 2006). On the other hand, non-ionophore antibiotics do not specifically affect VA-producing bacteria and therefore do not alter the *trans*-18:1 content and profile.

STRATEGIES TO REDUCE TFA

Strategies to deal with *trans* fats in the food supply are country dependent and are influenced by a country's definition of *trans* fats. For example,

Denmark and Switzerland limited the total content of iTFA to $<2\%$ of total TFA derived from industrially produced fats, and ignored the contribution of ruminant *trans* fats, which they assumed to be all beneficial. The advantage of this approach is the elimination of any source of industrially produced *trans* fat from the food supply. However, ignoring the *trans* fats from ruminants may not be justified in all jurisdictions since that depends primarily on animal feeding practices. Furthermore, it gives the erroneous impression that TFA have different physiological effects on humans depending on their origin.

In the USA, Canada, and at CODEX a limit of total *trans* fat per serving was set for foods, and only foods below this value can be declared "trans free." In these jurisdictions, *trans* fat was defined

as any fatty acid that has isolated non-conjugated trans double bonds; conjugated fatty acids were excluded. This definition was adopted to exclude ruminant fats based on the evidence that RA, the major conjugated fatty acid in ruminant fats, had not shown adverse effects on blood lipids and lipoprotein. The benefit of this regulation was that the trans fat content in every food had to be declared on product labels. However, by permitting the continued production of industrial trans fats, some foods could still retain high trans levels, particularly where—to date—no specific regulation to declare the trans fat content is required (e.g., bakery products). It also allows their inclusion in food products provided the total trans fat content remains below 0.5 g/serving in the United States or 0.2 g/serving in Canada. This is based on the legal definition of 0 grams trans fat per serving in the respective countries. It should also be noted that consuming more than one serving of such product(s) will incur higher intakes of trans fats.

Australia and New Zealand have opted to declare the total trans fat content based on a strict chemical definition of trans fats, which includes all fatty acids having a trans double bond in the molecule, including conjugated fatty acids, and irrespective of the source. In one sense, this definition is correct since the chemical properties and physiological effects of any given fatty acid are the same regardless of its origin. However, such a regulation ignores the demonstrated biological and nutritional differences between the individual TFA and conjugated fatty acid isomers. Therefore, summing up all TFA is misleading.

Industry's voluntary initiative to reduce the total TFA in the fats they produce has been successful, especially in some regions where no official regulations are currently in place. It is very encouraging to see that the trade association representing margarine and vegetable fats makers in the European Union has agreed for the third time since 1995 to reduce trans fat levels in foods and fats at the retail level. In February 2013, the International Margarine Association of the Countries of Europe agreed to a code of practice to reduce the level of trans fats in all margarines and spreads to $\leq 2\%$ on a fat basis.

In summary, the reduction of industrial trans fats has been successful in many countries largely owing to the scientific recognition that trans fats are harmful and to implementation of trans fat regulations (Downs, S.M., *et al.*, 2013). For this reason, these regulations should remain in effect to avoid a resurgence of industrial trans fat products. However, the definition of trans fat may need to be modified. We propose that a more accurate definition would include all TFA regardless of origin and structure (isolated or conjugated double bonds) but exclude those with a demonstrated health benefit (Aldai, N., *et al.*, 2013). This will require implementing improved methods of gas chromatographic separation and identification of the different TFA and conjugated fatty acid isomers for labeling purposes. Such methods are currently available and will require specific training to implement. Furthermore, it will require a renewed assessment of the nutritional/health effects of many TFA isomers and trans-containing metabolites to correctly sort them. The limit at which products are declared "trans free" also needs to be revisited. A limit of 0.2 g/serving might be more appropriate than 0.5 g/serving, since this might prevent the production and sale of ruminant products with high levels of undesirable TFA.

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INFORMATION

- Aldai, N., M.E.R. Dugan, D.C. Rolland, and J.K.G. Kramer, Survey of the fatty acid composition of Canadian beef: 1. Backfat and longissimus lumborum muscle, *Can. J. Anim. Sci.* 89:315–329, 2009, <http://dx.doi.org/10.4141/CJAS08126>.
- Aldai, N., M. de Renobales, L.J.R. Barron, and J.K.G. Kramer, What are the trans fatty acid issues in foods after discontinuation of industrially produced trans fats? Ruminant product, vegetable oils, and synthetic supplements, *Eur. J. Lipid Sci. Technol.* 115:1378–1401, 2013, <http://dx.doi.org/10.1002/ejlt.201300072>.
- Brouwer, I.A., A.J. Wanders, and M.B. Katan, Trans fatty acids and cardiovascular health: research completed? *Eur. J. Clin. Nutr.* 67:541–547, 2013, doi:10.1038/ejcn.2013.43.
- Cruz-Hernandez, C., J.K.G. Kramer, J.J. Kennelly, E.K. Okine, and R.J. Weselake, Effect of sunflower oil and monensin on the CLA and 18:1 isomers composition of milk fat in dairy cows, in: 4th Euro Fed Lipid Congress, Workshop on Rumen Biohydrogenation, Madrid, Spain 2006, Abstract 5860_0434, <http://tinyurl.com/EFL-monensin> (accessed Feb 21, 2014).
- Downs, S.M., A.M. Thow, and S.R. Leeder, The effectiveness of policies for reducing dietary trans fat: a systematic review of the evidence, *Bull. World Health Organ.* 91:262–269H, 2013, <http://dx.doi.org/10.2471/BLT.12.111468>.
- Leheska, J.M., L.D. Thompson, J.C. Howe, E. Hentges, J. Boyce, J.C. Brooks, B. Shriver, L. Hoover, and M.F. Miller, Effects of conventional and grass feeding systems on the nutrient composition of beef, *J. Anim. Sci.* 88:3575–3585, 2008, <http://dx.doi.org/10.2527/jas.2007-0565>.

Country (UPV/EHU) in Vitoria-Gasteiz, Spain. She was the recipient of the 'Marie Curie IOF' Fellowship and is currently a 'Ramón y Cajal' Fellow. She is the co-chair on the Lipids in Animal Science Division of the Euro Fed Lipid since 2012. Her main research interests are ruminant fats, evaluating relevant factors influencing their composition, developing strategies to manipulate and improve the nutritional quality of meat, and assessing analytical methods that demonstrate the value of these products. She has authored 50 peer-reviewed publications and five book chapters. She can be contacted at noelia.alдай@ehu.es.

John K.G. Kramer, now retired, was a senior research scientist with Agriculture & Agri-Food Canada for 39 years, specializing in the nutritional and toxicological evaluation of fats and oils from animal and plant sources for human and animal consumption. He has identified, characterized and synthesized numerous lipid components to support the conclusions. Among his main interests were canola oil, conjugated fatty acids, and trans fatty acids. He has published >250 peer reviewed publications, 5 books, 19 chapters, and continues to serve as Associate Editor of Lipids. He can be contacted at jkgkramer@rogers.com.

Palm and lauric oil price outlook 2014: with particular focus on India

Dorab E. Mistry

This is only the third time in the last 10 years that vegetable oil prices have traded **below** the price of mineral oil for a substantial period. The norm is for vegetable oil prices to trade above or well above mineral oil prices. The government of Indonesia has taken quite a gamble on its 10% palm biodiesel mandate. The test will come when palm prices rise considerably above the price of mineral oil. The Indonesian government will then have to subsidize the producers of palm biodiesel. The producers who sell hundreds of thousands of metric tons of palm biodiesel under

long-term contracts linked to Singapore Gas Oil will need to hedge themselves fully, and this action itself can exert a powerful bullish influence on palm prices—as we have been witnessing recently.

Let there be no doubt. The Indonesian mandate is a powerful bullish factor, and we are just beginning to see its impact. The Indonesian government has let the genie out of the bottle and there will be consequences.

THE MACRO ECONOMY

The biggest single factor to impact commodity prices as well as equities was the phenomenon called quantitative easing, or QE. Thanks to the strong steps taken by the US Federal Reserve, we have had rising and record equity markets and strong commodity prices.

We have just entered what is called the tapering phase. The conventional wisdom was that interest rates on US government debt would rise as tapering began. In reality, the opposite has happened. One reason could be that the liquidity of about \$10 billion lost each month as a result of the taper has been made up by the repatriation of dollar funds from emerging markets.

It remains to be seen how markets react to a world without QE and how interest rates behave. I believe this will be a very challenging moment in history and a major financial moment or crisis is conceivable.

INDIA

We had a great monsoon season in 2013. In fact, the rains in the soybean belt were too good and led to some crop losses. Overall, Indian crops did well in 2013. The rape-mustard crop to be

TABLE 1. India's production of vegetable oils^a ('000 metric tons)

	2013/14 estimates	2012/13 actual	2011/12 actual	2010/11 actual	2009/10 actual
Soybean oil	1,350	1,580	1,575	1,600	1,150
Cottonseed oil	1,240	1,140	1,150	1,050	1,100
Groundnut oil	500	150	400	500	450
Sunflower oil	240	220	240	230	350
Rapeseed oil	2,300	2,100	1,770	2,250	1,700
Sesameseed oil	110	120	120	150	160
Coconut oil	350	400	400	400	400
Rice bran oil	900	850	800	720	700
Others	450	400	345	250	250
Total	7,440	6,960	6,800	7,150	6,260

^aOil year: November to October.

harvested shortly is also doing very well. Even so, India is now heavily dependent on imports, and its domestic production is inconsequential.

The Indian government continued its total indifference to the fortunes of the refining industry. The export tax structures of Malaysia and Indonesia made life extremely difficult for Indian refiners. Recently, the Indian government finally raised the import duty on RBD [refined, bleached, deodorized] olein, but even that is not enough to rescue Indian refiners.

Let us first look at India's production of vegetable oil (Table 1). (As in previous years, I am indebted to Govindbhai Patel of GGN Research and to the Solvent Extractors Association for their help in compiling Indian statistics.) During the past 12 months palm oil has become less competitive compared with its soft oil rivals.

Let us now look at India's consumption (Table 2, page 334) and imports of vegetable oils (Table 3, page 335) as well as its surfactants and detergents market (Table 4, page 335).

INDIA IN THE NEAR FUTURE. I am frequently asked what impact a Modi government is likely to have on the Indian oils and oilseed scenario. (Narendra Modi is running as a candidate for prime minister of India representing the Bharatiya Janata Party; the election will take place in May.) I expect the government to move quickly to give some protection to India's refining industry. However, the major impact will be long term. Modi comes from Gujarat and knows the oilseed industry extremely well. Under his leadership Gujarat state engineered big growth in cotton production. The growth came mainly through higher productivity from genetically modified seeds, better irrigation, and non-stop supply of electricity.

India's northern states today produce surplus wheat, which is exported. Over a five-year period, a dynamic government will likely create conditions (e.g., high minimum support price) to enable a massive switch from wheat to rape-mustard seed. At last, the long-term scenario for oilseed production in India could give us some hope.

GLOBAL SCENARIO

SUPPLY SIDE

Palm. The low cycle that began in February 2013 may end only in May 2014. A new high cycle may start in June 2014. If the current dry spell is prolonged or an El Niño develops later this year, all forecasts of crude palm oil (CPO) production and price will need to be revised.

If we assume normal rains for the rest of 2014, I estimate Malaysia will produce 19.5–19.7 MMT of CPO in 2014. For Indonesia I forecast 2014 production to expand to 30.5 MMT; most of the growth will come in the last quarter. Overall for the oil year October 2013 to September 2014, world palm oil production will grow by 3 MMT or less.

Rapeseed. The canola crop has been very good in Canada, but logistics are a problem. Ukraine will continue to expand rapeseed cultivation. The India crop exceeds 7.4 MMT this year. With normal weather conditions, Europe should have a good crop.

Sunflowerseed. Sunflowerseed crops in Ukraine, Russia, and Europe were great in 2013. In the current oil year (2013/14) there will be an increase of about 1.6 MMT in sunflowerseed oil.

Soybeans. During the last 12 months, soybean oil has shed its premium over palm olein and moved to a small discount on

CONTINUED ON NEXT PAGE

This article is based on a paper presented at the Palm and Lauric Oils Conference & Exhibition Price Outlook (POC). The POC was organized by Bursa Malaysia and held March 3–5, 2014, in Kuala Lumpur. This discussion provides:

- an overview of supply and demand for various vegetable oils
- statistics for the production and consumption of vegetable oil in India
- a global price outlook and forecast for palm and lauric oil



TABLE 2. India's consumption of vegetable oils ('000 metric tons)

	2013/14 estimates	2012/13 actual	2011/12 actual	2010/11 actual	2009/10 actual
Soybean oil	2,900	2,700	2,600	2,550	2,700
Cottonseed oil	1,200	1,100	1,150	1,050	1,050
Groundnut oil	500	150	400	500	450
Sunflower oil	1,540	1,200	1,320	1,000	950
Rapeseed oil	2,300	2,100	1,850	2,250	1,850
Sesameseed oil	110	120	120	150	160
Palm oil	7,950	8,370	7,385	6,750	6,460
Laurics	650	740	600	600	650
Rice bran oil	900	850	800	720	700
Others	350	350	350	250	250
Total	18,400	17,680	16,575	15,820	15,220
Population ^a	1,275	1,260	1,240	1,220	1,175
Consumption ^b	14.43	13.92	13.36	12.96	12.95

^a Population, in millions.^b Consumption, in kilograms, per capita per annum.

an FOB price level. Soybean oil prices have also been saved from further erosion by the demand for soy biodiesel.

Lauric oils. As a result of Typhoon Haiyan in 2013, the supply of coconut oil (CNO) will fall. Exports of CNO will fall by a lesser tonnage because Philippines will import more palm oil and release CNO for export.

DEMAND SIDE

I estimate world food demand will grow by 3.5 MMT, mainly as a result of better growth prospects.

Biodiesel demand is also a factor. The Indonesian mandate can take up to 3.1 MMT of extra palm oil, but I forecast that Indonesia will only consume an extra 1 MMT of palm biodiesel. US and European biodiesel consumption will remain more or less unchanged. I expect mandates in Brazil and Argentina to be expanded, as well as in several smaller countries. Total demand will increase by about 6.5 MMT (see Table 5).

PRICE FORECASTS

I am making an assumption that Brent crude will trade during the year in a band between \$100 and \$110 per barrel. I am also assuming a relatively stable US dollar.

Given the current dry weather and the possibility of an El Niño, I shall give a forecast under El Niño conditions and another under more normal conditions.

Palm. Palm oil production is underperforming and stocks are tight. A lot of biodiesel business was already locked in while spreads were workable. Therefore, the job of the market until

June is to push demand away from palm. Palm does not need to buy demand by price discounts.

I believe CPO futures on the BMD need to rise quickly to 3,000 Ringgits so as to control demand and enable stocks in Malaysia and in Indonesia to be maintained at a workable level.

If the rains come by next week [second week of March], the price outlook up to June 2014 will not be altered. The job of demand rationing needs to be done.

However, if rains come as normal and the high cycle kicks in from July onward, prices can trade in a range between 2,900 and 2,600 Ringgits from July until October.

In the event that an El Niño develops, I believe CPO futures will cling to 3,000 Ringgits beyond June. Production is likely to be affected from late 2014 onward, and we may be staring at 3,500 Ringgits. We shall kill all discretionary biodiesel demand. Indonesia will find it very difficult to implement its biodiesel mandate.

A new dynamic in the palm oil market is the pending expansion of biodiesel capacity in Indonesia. This capacity will require biodiesel producers to lock in palm oil prices at least one year in advance. Almost all of them will be plantation linked. Hence the availability of freely tradable palm oil will become somewhat restricted. This expansion will also require maintenance of much larger stocks. Therefore, palm oil stocks will need to be much larger before they begin to exert any pressure on prices.

For these reasons, I believe the Indonesian mandate is truly a game changer and will keep palm oil prices relatively high for a long time.

TABLE 3. India's imports of vegetable oil ('000 metric tons)

	2013/14	2012/13	2011/12	2010/11	2009/10
Soybean oil	1,550	1,090	1,080	1,000	1,660
Palm oil	7,880	8,240	7,680	6,665	6,700
Sunflower oil	1,330	980	1,140	800	630
Laurics	300	340	200	200	250
Others		30	100		
Total	11,060	10,670	10,200	8,665	9,240

TABLE 4. Surfactants and detergents in India ('000 metric tons)

	2013/14	2012/13	2011/12	2010/11
Opening stocks	1,500	1,650	1,325	1,430
Production	7,440	6,960	6,800	7,150
Imports	11,060	10,670	10,200	8,665
Consumption	18,400	17,680	16,575	15,820
Exports	100	100	100	100
Ending stocks	1,500	1,500	1,650	1,325

TABLE 5. Global incremental supply and demand ('000 metric tons)

	Oct. 2012/Sept. 2013	Oct. 2013/Sept. 2014
Soybean oil	+100	+1,600
Rapeseed oil	+500	+400
Sunflowerseed oil	-1,200	+1,600
Groundnut and cottonseed oil	-250	—
Palm oil	+1,500	+3,000
Lauric oils	+350	+200
Total increase	+1,000	+6,800
Total demand	+4,500	+6,500

Other vegetable oils. Soybean oil share has been depressed as a result of the buoyant demand for meal. I believe oil share is due for an improvement. I expect soybean oil futures to climb gradually to \$0.47 and for prices to trade in a range between \$1000 and \$1050 by October 2014. If an El Niño develops, prices will need to go higher, possibly toward \$1200–\$1300. Soybean oil will lose a lot of biodiesel demand in that case.

I expect sunflower oil to command a premium over soybean oil from now onward. The premium could be between \$30 and

\$100 until August 2014. After that it will depend on new crops in Russia and Ukraine.

Rapeseed oil will remain level with soybean oil until the new crop in Europe.

Coconut oil and palm kernel oils (CPKO) have already moved to very high levels. I believe CPKO is enjoying the expectation that so much new capacity is coming on stream that there

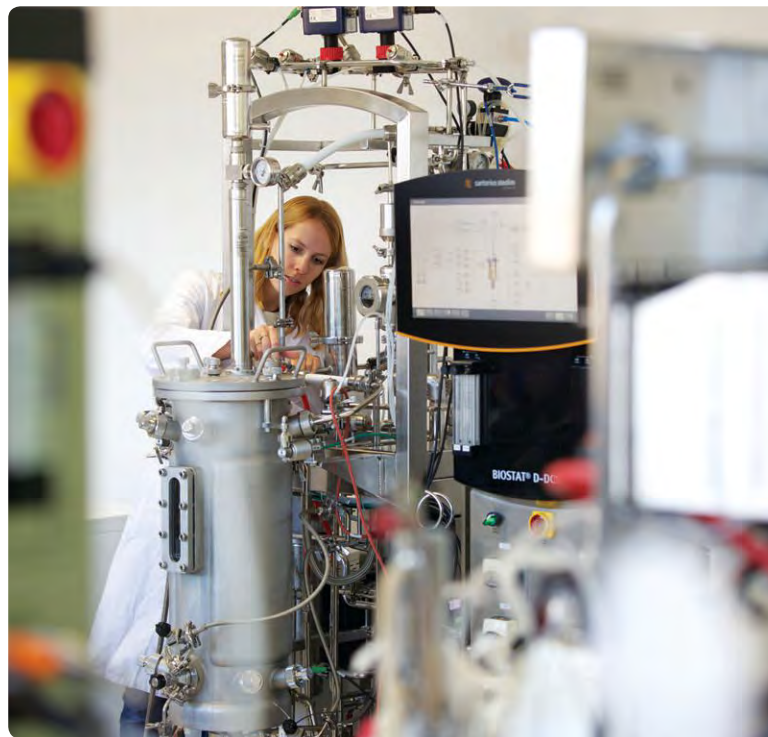
CONTINUED ON NEXT PAGE

Ancient bacteria (cont. from page 327)



▲ FIG. 4. Petri dish showing red color of *Deinococcus carotenoids*

► FIG. 5. DEINOVE 20-L pre-industrial fermentor used to perform optimization of the process.



This is one of the two final validation steps before moving to the industrial stage in 2015/2016.

Leveraging on its experience in this field and its high feedstock conversion rates, the company now plans to accelerate the production of bio-based chemicals and intermediates.

Emmanuel Petiot became chief executive officer of DEINOVE in January 2013. Prior to that, he was director of sales at Novozymes North America Inc., the world leader in enzymes

and microorganisms. During his nine year with Novozymes, he held executive positions in marketing, sales, and business development, both in Europe and the United States; he was also general manager for the French subsidiary of Novozymes. Before that, he held senior marketing and sales positions at Dow Chemical (2000–2004) and Air Liquide (1996–2000). Petiot graduated from École des Hautes Études Commerciales du Nord (business school) and the École Centrale Paris. He may be contacted at emmanuel.petiot@deinove.com.

Outlook 2014 (cont. from page 335)

will not be enough to go around. Again there is very little freely tradable CPKO because most new oleochemicals are plantation linked. The market for oleochemicals is not going to expand exponentially. Therefore, I believe CNO prices at current levels will be sustained due to lower production, but CPKO price will need to move lower after July 2014 and narrow the premium over palm oil.

PRICE OUTLOOKS

Which is the oil with the most bullish price outlook? That distinction belongs to Indian castor oil, where there has been a

smaller crop and a lower carryover. Demand for castor oil is virtually inelastic. After many years of poverty and exploitation (which is why production is declining), Indian castor seed farmers will see remunerative prices.

In conclusion, problems with the macro economy could easily derail the oncoming bull market. This year, weather holds the key—one can never take Mother Nature for granted.

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International News on Fats, Oils, and Related Materials

SUPPLEMENT

Biopolymers defined

Personal thoughts (referenced) on
the demonization of saturated fat

World vegetable oils supply and
distribution, 2009/10–2013/14

More Extracts & Distillates

The many faces of BIOPOLYMERS

Masha Petrova

What exactly is a “Biopolymer”? Is your definition of this term the same as that of your colleague down the hall? “Biopolymer” is a relatively new term currently used to describe everything from biodegradable plastic bottles, to bags made out of corn, to biocompatible parts used in knee replacement surgeries, to proteins.

As the marketing trend for all things “green” continues to climb, it seems that everything but the kitchen sink gets thrown into the “biopolymers” bucket. To further complicate things, biopolymer products span a variety of seemingly unrelated industries, such as commodities (e.g. packaging, containers and additives), medical applications (e.g. drug casings and prosthetics) and food applications (sugar and starch are in fact biopolymers).

So what is the “correct” definition of a biopolymer? Wikipedia will have you believe that a biopolymer is a type of polymer produced by living organisms, in other words a macromolecule produced in nature. While that

statement is technically correct, this is only a part of the definition. According to Pat Smith, a Sci-Mind™ expert and a research scientist at the Michigan Molecular Institute, some describe biopolymers not only as materials of a “green birth” but polymers with a “green death” as well. In addition to the bio-derived definition, a polymer is considered to be a “biopolymer” if it is said to be biodegradable according to international standards on biodegradability (which, by the way, are also ever-changing). This means that a biodegradable polymer material created solely from fossil fuel feedstocks may, in fact, be described as a “biopolymer”.

Which means that a bottle made 100% from corn starch but that happens not to be biodegradable (and might sit in a landfill for decades) and a bottle that is made from fossil fuel feedstock but biodegrades under similar conditions - are both “biopolymer” products. So which biopolymer side is “greener”?

Smith has seen his share of biopolymer companies emerge, merge, and disappear. He was involved in the Cargill Dow joint venture that launched NatureWork™ poly(lactic acid) and in the Metabolix joint venture with Archer Daniels Midland which attempted to commercialize polyhydroxyalkanoates. Smith has a message for the biopolymer industry: “Stop wasting money trying to create novel commodity polymers from bio-

sources, but instead, focus on synthesizing traditional and well-established polymer materials from bio-based monomers.”

According to Smith, developing the market for new polymer materials is significantly more difficult than inventing the technology to produce them. Monomers for conventional polymers like poly(ethylene), poly(acrylic acid) and poly(ethyleneterephthalate) can be derived from bio-sources and already have a commercial outlet. They simply need to meet price and purity metrics to succeed. This latter strategy is well defined and is faster to the market.

In contrast, Richard Gross, a Professor at Rensselaer Polytechnic Institute and a Sci-Mind™ expert, believes that both routes are potentially viable and have their own challenges. For example, developing conventional monomers from biobased feedstock has been slower than anticipated due to the challenge of competing strictly on cost at equivalent performance. Gross believes there is plenty of room for new innovations by using the functionality inherent in biobased feedstock to develop new materials.

While the commodities industry might be concerned with high yields and low cost-per-unit, the situation could not be more different for the medical industry research. Professor Sujata Bhatia, the assistant director for undergraduate studies in Biomedical Engineering at Harvard and a Sci-Mind™ expert, works with students to develop naturally-derived biopolymers for medical applications in wound healing, drug delivery, and tissue regeneration.

Bhatia says that for biomedical applications, where many materials are custom-tailored for a handful of patients, the cost-per-unit is not much of a concern. However, the biocompatibility and specialized properties of a particular material certainly are.

Not only do biopolymers have such varying roles in different industries, but with evolving globalization of economy and research, paying attention to how biomaterials are positioned around the world is becoming more relevant.

Bhatia's advice to professionals working in the medical field concerns globalization issues: “We need to recognize that countries in Africa, Southeast Asia, and Latin America have something unique to contribute to biomedical materials. Because these countries have diverse and abundant agricultural materials, they can develop biopolymers and participate in the biomedical revolution in ways that were not previously possible.”

No matter in what line of work you might come in contact with biopolymers, one thing always remains constant—the importance of solid knowledge of fundamental science. Tim Long, a professor of Polymer Chemistry at Virginia Tech and a Sci-Mind™ expert, knows the significance of understanding the basics. His

work involves integrating fundamental research in novel macromolecular structure and polymerization processes for development of high performance macromolecules. According to Long, a good knowledge of fundamental science is essential for anyone interested in bio-derived, biocompatible or biodegradable polymers.

For those working in biopolymers, that knowledge becomes even more diverse for the “bio” counterparts of the polymer molecules. According to Gross, aside from the basics of polymers science, one must be familiar with biochemical processes, such as fermentation and bio-catalysis. Gross is currently working on routes to monomer and biopolymers using cell-free and whole-cell biocatalysts. He also is an avid proponent of combining chemical and biocatalytic steps in biopolymer process development.

“The synthesis of biopolymers via biocatalytic routes requires an understanding of how cells are engineered to produce different chemicals, the properties of enzymes that are important catalysts for cell-free processes, and an understanding of fundamental principles in cell biology and biochemistry. It's critical that scientists interested in biopolymers learn the language of biocatalysis since biocatalytic processes are fundamentally important to many developments in the general area of biopolymers,” says Gross.

The rapidly growing field of biopolymers is indeed exciting and diverse. In order to assure that researchers and industry professionals can stay up-to-date on the latest research trends, science fundamentals, regulations, and real-world case studies in order to be able to answer questions like those presented above, the American Chemical Society has created Sci-Mind™ Biopolymers – a community based, online learning curriculum for industry professionals. This article highlights the knowledge of just a few of the experts involved in the ACS Sci-Mind™ Biopolymers program. Find out more about the program at <http://proed.acs.org/products-services/sci-mind/biopolymers/>.

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Some personal thoughts on the demonization of saturated fat

Editor's note: Following is a blog post written by *Inform's* associate editor, Catherine Watkins (cwatkins@aocs.org) and posted at www.lipidsfatsoilssurfactantsohmy.com. Her opinions are personal and in no way speak for AOCS. Additionally, it should be noted that although she holds a bachelor's degree (albeit *summa cum laude*), it is in communications and not chemistry.

Catherine Watkins

If I were to step outside AOCS headquarters here in Urbana, Illinois, USA, and ask the next 20 persons I encountered to give me one word to describe saturated fat, I would wager that at least 19 of the 20 would use some variant of the word “bad.” Seldom has received wisdom—knowledge that people generally believe is true but often is not—been so close to unanimous on any facet of nutrition as is the case with the idea that “saturated fat is bad for you.” (A close second would be the blind acceptance of the cholesterol/lipid hypothesis and, third, that dietary fat in general is suspect . . . even the so-called “good fats.”)

How saturated fat became so universally feared is a long and complicated story that is part politics, part US dietary policy based on preliminary findings, and part bad science. At the root, however, is what I find to be a false premise—the idea that the immensely complicated human metabolic system (that is still further complicated by variations among individuals) can be reduced to its individual working parts and that scientific research can tease out truths about what is “good”

and what is “bad” in dietary terms. A corollary to this premise is that the effect of a whole food is merely the sum of its individual components; there is no synergistic (or, alternatively, antagonistic) relationship among all the individual components (and an individual's personal biology and microbiome).

If you are interested in an alternative view of saturated fat, then by all means read articles and/or books by the noted science writer Gary P. Taubes. His 2002 article for *The New York Times*, “What If It's All Been a Big, Fat Lie?” was one of the first widely disseminated salvos in the war to reclaim an honorable position for dietary fat in general and saturated fat in particular.

A new book by investigative journalist Nina Teicholz, *The Big Fat Surprise*, will be released on May 13 by Simon & Shuster. Teicholz says the book, which I have yet to read, “traces the origins of the bias against saturated fats and how overzealous researchers—through a combination of ego, bias, and premature institutional consensus—have allowed dangerous misrepresentations to become dietary dogma.”

Michael Pollan, an award-winning author and journalism teacher at the University of California, Berkeley, has written extensively about “nutritionism” and the damage done by a reductive approach to food and eating. (Remember the “French paradox,” wherein scientists puzzle over the fact that the French—a culture well known for indulging in long, leisurely, and often fat- and cholesterol-laden meals—have a low incidence of heart disease?) To reductionism can be added the difficulty of accurately assessing an individual's diet over time outside of a research setting where intake is strictly controlled. (If you have ever taken a food frequency questionnaire, then you know just how flawed those instruments are.) Why not toss another log on the fire and raise the problems inherent with meta-analyses (the grouping together and analysis of data from a number of studies) as well as the limitations of observational studies (research in which groups of people are observed and outcomes are noted minus intervention by the researchers)? A point

that the popular press and lay public often forget about observational studies is that they are not randomized and cannot point to cause and effect.

So, where are we today, on the first day of April 2014, as I write this blog post? Official dietary guidelines such as the *Dietary Guidelines for Americans 2010* (PDF) continue to call for reduced consumption: "Consume less than 10% of calories from saturated fatty acids by replacing them with monounsaturated and polyunsaturated fatty acids." Most if not all diabetes groups advise against consumption of saturated fat despite the wealth of research showing benefit to both serum glucose and triglyceride levels as well as lipid profiles for diabetics on ketogenic (fat-burning) diets that include copious amounts of saturated fat.

The latest in a continuing series of epidemiological meta-analyses finding no association between ingestion of saturated fat and coronary heart disease (CHD) was released on March 17, 2014, and the popular press has had a grand time acting as if this were a new finding. (See the June 2009 issue of *Inform*, the *American Journal of Clinical Nutrition*, or the *British Medical Journal* for proof that it is not a new idea.) However, having observed the fats and oils scene now for almost 15 years as associate editor of *Inform*, I think the current media brouhaha may signal that we are at a tipping point. Indeed, it is possible that we are witnessing the beginning of the end of the dogmatic demonization of saturated fat.

The new study in the *Annals of Internal Medicine* went beyond previous meta-analyses that found no association between dietary saturated fat and incidence of CHD or stroke. It also questioned whether polyunsatu-

rated oils from plants and fish are inherently more healthful than saturated fats from animal or dairy sources. "Current evidence does not clearly support guidelines that encourage high consumption of polyunsaturated fatty acids and low consumption of total saturated fats," the authors write.

Critics quickly pointed out errors in the data and data collection; some called for the paper's retraction. After the study's authors corrected those errors, lead author Rajiv Chowdhury of the University of Cambridge in the UK told *Science Magazine* that he feels the paper's conclusions are valid even after the corrections.

So, what is a person concerned about things dietary to do? Here are my thoughts . . . not that anyone has asked for them. To be clear: I speak only for myself and not for AOCS. First off, I would suggest being less concerned about each bite of food, because a puritanical focus on "good" and "bad" foods sucks all the pleasure out of what should be a communal celebration of life (taking us back to the French paradox). Assuming you are eating plenty of fresh fruits, vegetables, and other foods that spent some time in the sun (including meat from grass-fed animals and fatty coldwater fish, if you are so inclined and able to afford them), you are likely to do well by yourself. (Michael Pollan's pithy aphorism comes to mind: "Eat food. Not too much. Mainly plants.")

Beyond that, here's a thought: Don't monitor reporting by the popular press on nutrition, which seldom puts incremental findings in context. Either read the papers yourself, which is why we have provided links in this post, or follow Ralph Waldo Emerson's famous advice: "Moderation in all things, especially moderation."



World vegetable oils supply and distribution, 2009/10–2013/14

Item	2009/10	2010/11	2011/12	2012/13 ^a	2013/14 ^b
Million metric tons					
Production					
Coconut	3.52	3.70	3.41	3.65	3.54
Cottonseed	4.59	4.96	5.25	5.27	5.11
Olive	3.08	3.25	3.24	2.67	3.28
Palm	46.04	48.73	51.95	55.77	58.43
Palm Kernel	5.60	5.73	6.14	6.51	6.86
Peanut	4.89	5.33	5.32	5.55	5.67
Rapeseed	22.56	23.52	24.22	24.90	25.76
Soybean	38.80	41.30	42.59	42.81	44.66
Sunflowerseed	12.28	12.42	15.34	13.53	15.67
Total	141.36	148.94	157.46	160.66	168.98
Imports					
Coconut	2.28	1.78	1.82	1.88	1.82
Cottonseed	0.07	0.07	0.08	0.08	0.06
Olive	0.52	0.55	0.62	0.65	0.63
Palm	35.20	36.30	38.82	42.33	42.95
Palm kernel	2.55	2.43	2.54	3.02	2.81
Peanut	0.19	0.20	0.16	0.16	0.19
Rapeseed	2.92	3.31	4.01	3.88	3.84
Soybean	8.64	9.40	7.96	8.43	8.81
Sunflowerseed	3.73	3.64	5.64	4.96	6.40
Total	56.10	57.68	61.65	65.39	67.51
Exports					
Coconut	2.17	1.71	1.88	1.90	1.79
Cottonseed	0.11	0.14	0.17	0.15	0.14
Olive	0.68	0.75	0.85	0.78	0.79
Palm	35.47	36.87	39.02	42.65	43.29
Palm kernel	2.49	2.54	2.44	2.74	2.92
Peanut	0.19	0.17	0.17	0.20	0.22
Rapeseed	2.73	3.42	3.97	3.93	4.07
Soybean	9.10	9.56	8.47	9.25	9.28
Sunflowerseed	4.47	4.52	6.41	5.48	7.03
Total	57.41	59.68	63.38	67.08	69.53

Consumption					
Coconut	3.84	3.67	3.53	3.78	3.68
Cottonseed	4.59	4.78	5.16	5.24	5.06
Olive	2.97	3.03	3.07	2.85	3.01
Palm	45.15	47.90	51.05	54.94	56.91
Palm kernel	5.47	5.70	5.95	6.62	6.84
Peanut	5.04	5.32	5.37	5.53	5.61
Rapeseed	22.61	23.50	23.78	23.69	24.66
Soybean	38.20	40.70	41.99	42.45	44.33
Sunflowerseed	11.79	11.76	13.11	13.32	14.55
Total	139.66	146.36	153.01	158.42	164.65
Ending stocks					
Coconut	0.64	0.75	0.57	0.42	0.32
Cottonseed	0.16	0.27	0.26	0.22	0.20
Olive	0.60	0.62	0.57	0.27	0.37
Palm	5.61	5.87	6.57	7.08	8.26
Palm kernel	0.89	0.81	1.10	1.27	1.18
Peanut	0.10	0.13	0.08	0.05	0.07
Rapeseed	1.29	1.19	1.67	2.82	3.70
Soybean	3.37	3.81	3.90	3.43	3.30
Sunflowerseed	1.51	1.28	2.74	2.44	2.92
Total	14.17	14.73	17.46	18.00	20.32

^aPreliminary

^bForecast Source: US Department of Agriculture, Foreign Agricultural Service, *Oilseeds: World Markets and Trade*, updated on March 31, 2014. See <http://tinyurl.com/World-Oilcrops>.

EXTRACTS & DISTILLATES

Ionic liquid-based extraction of fatty acids from blue-green algal cells enhanced by direct transesterification and determination using GC × GC-TOFMS

Kilulya, K.F., *et al.*, *Chromatographia* 77:479–486, 2014, <http://dx.doi.org/10.1007/s10337-014-2632-x>.

Blue-green algae, commonly referred to as cyanobacteria, are known to grow in freshwater bodies when they are provided with suitable growth conditions such as nutrients, temperature and light. Algae biomass is known to contain a large amount of lipids, such as saturated and unsaturated fatty acids. In this study, fatty acids from algal cells were extracted using a newly developed extraction protocol using ionic liquid enhanced by direct transesterification at an elevated temperature. The identification and quantification of fatty acids were performed using gas chromatography coupled to a time-of-flight mass spectrometer (GC × GC-TOFMS). The extracted fatty acids were dominated by those with carbon chains of C16 and C18 [i.e., 7-hexadecenoic acid (C16:1) and hexadecanoic acid (C16:0) for C16, whereas C18 includes γ -linolenic acid (γ -C18:3), linoleic acid (C18:2), linolenic acid (C18:3), 6,9,12,15-octadecatetraenoic acid (C18:4), oleic acid (C18:1), and octadecanoic acid (C18:0)]. The obtained fatty acid composition was then compared with that obtained by organic solvent extraction using a mixture of chloroform and methanol. Statistical evaluation was performed using one-way ANOVA and there was no statistically significant difference ($P = 0.908$) between the two extraction methods, a finding which indicates the usefulness of ionic liquid as a solvent to replace volatile organic solvent to minimize environmental pollution.

Liposomes: versatile and biocompatible nanovesicles for efficient biomolecules delivery

Mallick, S., and J.S. Choi, *J. Nanosci. Nanotechnol.* 14:755–765, 2014, <http://dx.doi.org/10.1166/jnn.2014.9080>.

Since the revolutionary discovery that phospholipids can form closed bilayered structures in aqueous systems, liposomes have become a very interesting topic of research. Because of their versatility and amazing biocompatibility, the use of liposomes has been widely accepted in many scientific disciplines. Their applications, especially in medicine, have yielded breakthroughs with anticancer-drug carriers over the past few decades. Specifically, their easy preparation and various structural aspects have given rise to a broadly usable way to internalize biomolecules such as drugs, DNA, RNA and even imaging probes. This review article reports recent developments in liposomal drug delivery and gene delivery and thoroughly covers the synthesis and different kinds of liposomal surface modification techniques that have resulted in higher stability and efficiency with respect to the use of liposomes in tumor cell targeting, site-specific release, and extending blood retention times.

Analysis of oil-biodiesel samples by high performance liquid chromatography using the normal phase column of new generation and the evaporative light scattering detector

Fedosov, S.N., *et al.*, *J. Chromatogr. A* 1326:56–62, 2014, <http://dx.doi.org/10.1016/j.chroma.2013.12.043>.

Conversion of vegetable oil to biodiesel is usually monitored by gas chromatography. This is not always convenient because of (i) an elaborate derivatization of the samples, (ii) inhibition of this process by methanol and water, and (iii) low stability of the derivatives under storage. High-performance liquid chromatography (HPLC) methods are apparently more convenient, but none of the described variants had won a wide recognition so far. This can be ascribed to the problems of reproducibility (in the case of normal-phase chromatography) and limited separation of some analytes (in the case of reverse-phase chromatography). Here we report an HPLC procedure suitable for separation of biodiesel, free fatty acids, glycerides, glycerol, and lecithin. The normal phase column of new generation (Poroshell 120 HILIC) and the novel gradient were used. The method was tested on both the artificial mixtures and the crude reaction samples. Elution of the analytes was monitored by an evaporative light scattering detector. This method is usually confined to a very limited range of masses, where only a part of the complex calibration curve is used. We have analyzed the light-scattering signal within a very broad range of masses, whereupon the calibration curves were produced. The data were approximated by the appropriate equations used afterward to recalculate the signal to the mass in a convenient way. An experimental conversion of rapeseed oil to biodiesel was performed by a liquid lipase formulation. This process was monitored by HPLC to illustrate advantages of the suggested registration method.

Chemical and microbiological considerations of phytosterols and their relative efficacies in functional foods for the lowering of serum cholesterol levels in humans: A review

Wong, A., *J. Funct. Foods* 6:60–72, 2014, <http://dx.doi.org/10.1016/j.jff.2013.10.023>.

The controversy of the relative efficacies of sterols and stanols in the lowering of blood cholesterol in humans

continues without resolution. Basic physical, chemical, and microbiological characteristics of phytosterols were reviewed in the context of the animal physiology and study design. Not all sterols are alike chemically. Shape and size of the test molecule do matter. Involuntary microbial transformation of sterols into stanols in the human gut would inevitably afford different outcome, even if clonal humans were available as test subjects. The current discourse on the relative merits of different forms of phytosterols for lowering serum cholesterol levels in humans might be a futile exercise if the different physical, chemical and microbiological reactivities of the molecule being studied were ignored. Theoretical considerations and clinical study evidence suggest that stanol would be the principal bio-reactive species to cause the lowering of serum cholesterol in humans.