

# **Palm fatty acid distillate considered as biodiesel feedstock**



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

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# Calendar

**Bold type:** *new listing*For details on these and other upcoming meetings, visit [www.aocs.org/meetings](http://www.aocs.org/meetings).

## June

June 1–4, 2010. AchemAsia, 8th International Exhibition, Congress on Chemical Engineering and Biotechnology, Beijing, P.R. China. Information: [www.achemasia.de](http://www.achemasia.de).

June 2–5, 2010. European Fat Processors and Renderers Association, Kempinski Hotel Corvinus Budapest, Hungary. Information: [www.efpra2010.org](http://www.efpra2010.org).

June 3–4, 2010. Third European Workshop on Lipid Mediators, Pasteur Institute, Paris, France. Information: <http://workshop-lipid.eu>.

June 6–11, 2010. Bioactive Lipids: Biochemistry and Diseases, Westin Miyako Kyoto, Kyoto, Japan. Information: [www.keystone-symposia.org/Meetings/ViewMeetings.cfm?MeetingID=1024](http://www.keystone-symposia.org/Meetings/ViewMeetings.cfm?MeetingID=1024).

**June 6–11, 2010. Processing and Marketing Soybeans for Meat, Dairy and Baking Applications, University of Illinois, Urbana-Champaign, USA. Information: [www.nsrl.illinois.edu/INTSOY/courses](http://www.nsrl.illinois.edu/INTSOY/courses).**

**June 8–10, 2010. 2nd International MoniQA Conference, Emerging and Persisting Food Hazards, Krakow, Poland. Information: <http://krakow.moniqa.org>.**

**June 9–10, 2010. HPCI [Home and Personal Care Ingredients] Congress, Istanbul, Turkey. Information: [www.hpci-congress.com](http://www.hpci-congress.com).**

June 10–11, 2010. International Lecithin & Phospholipid Society, Lecithin Short Course, Ghent University, Ghent, Belgium. Information: email: [ilps@lecipro.nl](mailto:ilps@lecipro.nl); [www.ilps.org](http://www.ilps.org).

**June 11, 2010. 6th Jornada de Grasas Animales y Rendering (Conference on Animal Fats and Rendering), Buenos Aires, Argentina. Information: [gabrielapage@asaga.org.ar](mailto:gabrielapage@asaga.org.ar) or [asaga@asaga.org.ar](mailto:asaga@asaga.org.ar).**

June 12–15, 2010. National Lubricating Grease Institute Annual Meeting, Bonita Springs, Florida, USA. Information: [www.nlgi.org/annual\\_meeting](http://www.nlgi.org/annual_meeting).

June 12–15, 2010. International Oil Mill Superintendents Association Convention, Marriott Hotel, Williamsburg, Virginia, USA. Information: phone: +1 817-297-4668; email: [paukert.linda@sbcglobal.net](mailto:paukert.linda@sbcglobal.net).

June 14–17, 2010. International Fuel Ethanol Workshop & Expo, America's Center, St. Louis, Missouri, USA. Information: [www.fuelethanolworkshop.com](http://www.fuelethanolworkshop.com).

June 15–17, 2009. International Probiotic Conference 2010, Kosice, Slovakia. Information: [www.probiotic-conference.net](http://www.probiotic-conference.net).

June 17–18, 2010. CosmeticBusiness 2010, M.O.C. (Münchener Order Center), Munich, Germany. Information: [www.cosmetic-business.com/en/tradefair](http://www.cosmetic-business.com/en/tradefair).

June 19–24, 2010. HPLC 2010: 35th International Symposium on High Performance

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### CORRECTION

In the article titled "64th Annual Convention & International Conference on Oils, Fats, Fuels & Surfactants (ICOFFS)" (*inform* 21:117–119) the name and affiliation of one of the conference speakers was listed incorrectly. The correct name and affiliation are: Camillo Holecek (SPEC Engg.–New Delhi).



## AOCS Meeting Watch



July 11–16, 2010. 19th International Symposium on Plant Lipids, Cairns Convention Centre, Cairns, Australia. Information: [www.ispl2010.org](http://www.ispl2010.org).



October 4–7, 2010. 7th World Conference on Determinants: New Strategies in a Dynamic Global Economy, Montreux Music & Convention Centre, Montreux, Switzerland. Information: [www.aocs.org/meetings/montreux](http://www.aocs.org/meetings/montreux).



October 16–19, 2010. 9th International Symposium on the Role of Soy in Health Promotion and Chronic Disease Prevention and Treatment, Capital Hilton, Washington, DC, USA. Information: [www.SoySymposium.org](http://www.SoySymposium.org).

May 1–4, 2011. 102nd AOCS Annual Meeting and Expo, Duke Energy Convention Center, Cincinnati, Ohio. Information: phone: +1 217-359-2344; fax: +1 217-351-8091; email: [meetings@aocs.org](mailto:meetings@aocs.org); <http://AnnualMeeting.aocs.org>.

For in-depth details on these and other upcoming meetings, visit [www.aocs.org/meetings](http://www.aocs.org/meetings).

Liquid Phase Separations and Related Techniques, The Hynes Convention Center, Boston, Massachusetts, USA. Information: [www.casss.org/displayconvention.cfm?conventionnbr=6136](http://www.casss.org/displayconvention.cfm?conventionnbr=6136).

June 19–24, 2010. FEBS Workshop: Eucaryotic Lipids; treasure of regulatory information, Spetses, Greece. Information: <http://web.science.uu.nl/spetses2010>.

June 20–23, 2010. 84th Colloid & Surface Science Symposium, The University of Akron, Akron, Ohio, USA. Information: [www.uakron.edu/colloids2010](http://www.uakron.edu/colloids2010).

June 20–25, 2010. Lipoprotein Metabolism, Gordon Research Conference, Waterville Valley Resort, Waterville Valley, New Hampshire, USA. Information: [www.gordonresearchconferences.org/programs.aspx?year=2010&program=lipopro](http://www.gordonresearchconferences.org/programs.aspx?year=2010&program=lipopro).

June 21–23, 2010. 14th Annual Green Chemistry & Engineering Conference, Washington, DC, USA. Information: [www.gcande.org](http://www.gcande.org).

June 21–26, 2010. Eukaryotic Lipids; Treasure of Regulatory Information, Spetses, Greece. Information: [g.vanmeer@uu.nl](mailto:g.vanmeer@uu.nl).

**June 22–23, 2010. Global Advanced Biofuels Scale-Up Summit 2010,**

**Washington, DC, USA. Information: [www.advanced-biofuels-scale-up.com](http://www.advanced-biofuels-scale-up.com).**

June 23–24, 2010. Symposium on Breeding for Disease Resistance, Krasnodar, Russian Federation. Information: [www.isa.cetiom.fr/event.htm](http://www.isa.cetiom.fr/event.htm).

June 27–30, 2010. World Congress on Industrial Biotechnology and Bioprocessing, Washington, DC, USA. Information: [www.bio.org/events](http://www.bio.org/events).

June 27–July 2, 2010. Tribology, Gordon Research Conference, Colby College, Waterville, Maine, USA. Information: [www.gordonresearchconferences.org/programs.aspx?year=2010&program=t+ribology](http://www.gordonresearchconferences.org/programs.aspx?year=2010&program=t+ribology).

## July

**July 2, 2010. 5th Jornada Lípidos, Nutrición y Salud (Conference on Lipids, Nutrition, and Health), Buenos Aires, Argentina. Information: email: [gabrielapage@asaga.org](mailto:gabrielapage@asaga.org) or [asaga@asaga.org](mailto:asaga@asaga.org).**

**July 5–9, 2010. 44th APCC (Asian and Pacific Coconut Community)**

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# Palm fatty acid distillate biodiesel:

K.Y. Cheah, T.S.Toh, and P.M. Koh

Two years ago we looked at the challenges faced by the biodiesel industry (Building plants for biodiesel and co-products, *inform* 19:302–305, 2008) and also examined the co-products that could improve the economic viability of the industry. In the interval, the situation for the biodiesel industry has not improved, with the high cost of feedstocks continuing to be the bane of biodiesel producers. The promise of alternative low-cost non-food feedstocks such as jatropha has yet to

materialize, and there seems to be, at the current moment, no light at the end of the tunnel in the search for low-cost feedstock alternatives.

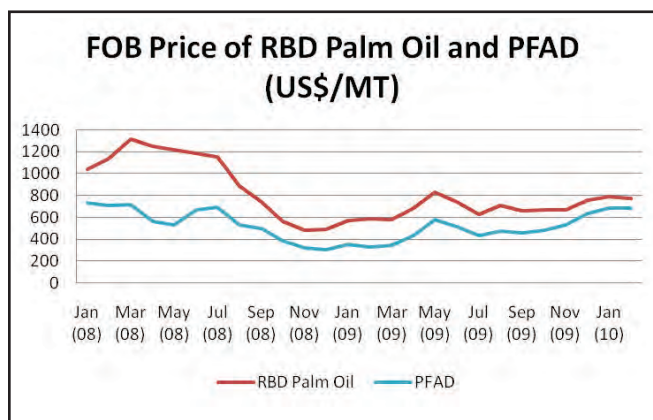
Most biodiesel plants use the conventional sodium hydroxide/sodium methoxide-based transesterification process, which requires highly priced refined oil feedstock. Although palm oil is one of the more competitive feedstocks for biodiesel production, it can be expensive because its price is linked to that of crude petroleum (Fry, 2010). However, during the refining of palm oil, a lower-value by-product known as palm fatty acid distillate (PFAD) is generated in the fatty acid stripping and deodorization stages. PFAD is potentially a valuable, low-cost feedstock for the production of biodiesel. It also makes the much-debated “food vs. fuel” argument a non-issue as PFAD is generally sold as a source

*A palm fatty acid distillate (PFAD) biodiesel plant as viewed from the control room.*

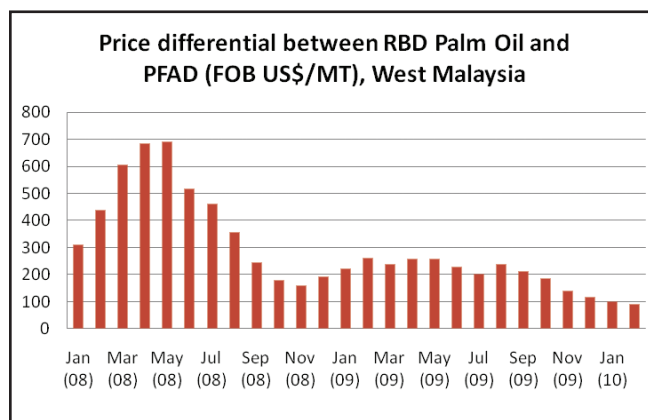




# Next-generation palm biodiesel



**FIG. 1.** FOB price of RBD palm oil and PFAD. Abbreviations: RBD, refined, bleached, deodorized; PFAD, palm fatty acid distillate; MT, metric ton. Source: Malaysian Palm Oil Board.



**FIG. 2.** Price differential between RBD palm oil and PFAD. For abbreviations, see Figure 1. Source: Malaysian Palm Oil Board.

of industrial fatty acids for non-food applications. It has also been used as a fuel in power plants and industrial boilers.

Malaysia and Indonesia are the largest producers of palm oil. In 2009, Malaysia and Indonesia produced about 17.5 and 20.9 million metric tons of crude palm oil, respectively (Mielke, 2010). In Malaysia, most of the crude palm oil is refined locally for export to overseas markets, mainly for food applications. Almost 700,000 metric tons (MT) of PFAD were produced in Malaysia as a by-product of the refining process (MPOB, 2010).

## PFAD—THE LOW-COST FEEDSTOCK FOR BIODIESEL

The amount of readily available PFAD is not insignificant, and it presents biodiesel producers with excellent access to a low-cost, non-food source of feedstock. PFAD is always traded at a discount to crude or refined, bleached, and deodorized (RBD) palm oil (Fig. 1). Before October 2009, the discount typically exceeded \$200/MT, and it was as high as \$680/MT in May 2008. However, since November 2009, the price differential between PFAD and RBD palm oil has narrowed. In early 2010 the discount of PFAD over RBD palm oil was less than \$100 per ton (Fig. 2).

## PFAD BIODIESEL PLANTS

Although the basic process for the conversion of high-acid oil feedstock to biodiesel is well known, it has been carried out mainly in small-scale batch-type processes. A breakthrough came in October 2009 with the successful operation of the world's first continuous large-scale 200 MT/day PFAD biodiesel plant

(in Sumatra, Indonesia). In this plant, owned by a large Asian-based multinational palm oil group, fresh PFAD from the refineries is sent directly to the PFAD biodiesel plant for conversion to biodiesel.

The benefits of a continuous PFAD biodiesel process include single person control room operations and a fully automated and tightly controlled management of all process parameters for consistent biodiesel product quality. The biodiesel yield from this plant approaches 100%, and it fully meets EN (European Standards) specifications. After distillation, the PFAD biodiesel also passes the ASTM Cold Soak Filtration Test, introduced in 2008.

Two more PFAD biodiesel plants using the above process technology will be operational in Pasir Gudang, Malaysia, and Kalimantan, Indonesia by May 2010. These plants can also operate using refined oil feedstocks.

## NEW GENERATION MULTIPLE FEEDSTOCK BIODIESEL PLANTS

By incorporating a continuous esterification section, a biodiesel producer with a conventional sodium hydroxide/sodium methoxide-based transesterification process now has the opportunity to possess a new, truly multiple feedstock plant able to handle different raw materials including PFAD. By using the above processes, combined with pretreatment and other processes, the variety of feedstock can be further expanded to include low-quality and high free-fatty-acid (FFA) oils, thereby ensuring that a very wide range of low-cost feedstocks are available to the biodiesel processor, thus ensuring the profitability of the plant.



**TABLE 1.** General characteristics of Malaysian PFAD<sup>a</sup>

	Mean	Range
FFA—palmitic (%)	86.4	72.7–92.6
Unsaponifiable matter (%)	1.61	1.0–2.5
Saponification value (mg KOH/g)	209.5	200.3–215.4
Titer (°C)	46.7	46.0–48.3
Specific gravity @ 50°C (g/cc)	0.8725	0.8640–0.8880
Water content (%)	0.104	0.03–0.24
Iodine value, Wijs (g/100 g)	54.8	46.3–57.6

<sup>a</sup>PFAD, palm fatty acid distillate; FFA, free fatty acids. Source: Bonnie and Mohtar (2009).

## PHYTOCHEMICALS FROM PFAD

PFAD also provides a source of value-added co-products for the biodiesel producer. PFAD contains 72.7–92.6% FFA, with a small amount of unsaponifiable components (1–2.5%) and the remainder neutral oil. The general characteristics of Malaysian PFAD are shown in Table 1. Modern palm oil refineries consistently produce PFAD with FFA content higher than 88%, and crude palm oil also contains non-glyceride minor components that have been associated with health benefits, some of which are distilled off together with the FFA as unsaponifiable components.

The unsaponifiable materials of PFAD have long been considered a potential source of highly valuable phytochemicals (Gapor, 2000). Vitamin E, phytosterols, and squalene are of particular interest, and their beneficial effects are well documented.

In fact, tocotrienol from PFAD is being produced commercially. The vitamin E profile of Malaysian PFAD is 10.3 wt%  $\alpha$ -tocopherol, 18.7 wt%  $\alpha$ -tocotrienol, 49.8 wt%  $\gamma$ -tocotrienol, and 14.6 wt%  $\delta$ -tocotrienol (Bonnie and Mohtar, 2009). Depending on the feedstock and processing conditions, some samples of PFAD can have as much as 0.5% vitamin E, 0.4% phytosterols, and 0.8% squalene. These high-value co-products further improve the profitability of PFAD biodiesel plants.

The initial step in the extraction of phytochemicals from PFAD is conversion of the fatty acids into a methyl ester, that is, biodiesel. The methyl ester is then distilled in a short-path evaporator where the phytochemicals are concentrated in the residues. The residues are further processed to produce the high-value-added phytochemicals. The distilled methyl ester is a high-quality biodiesel that will meet all biodiesel EN and ASTM specifications, including the Cold Soak Filtration Test. Furthermore, other parameters such as mono-, di-, and triglycerides content are reduced significantly, further enhancing the fuel properties of the biodiesel.

## CONCLUSIONS

The challenge for biodiesel producers is to remain profitable, and one solution is to operate a new-generation biodiesel plant that is truly multiple-feedstock capable. PFAD is one alternative low-cost feedstock that is available today. PFAD also gives a producer the ability to produce high-value co-products. Going one step further, these new-generation truly multiple-feedstock biodiesel plants can be designed to accept low-quality and high-FFA oil feedstocks using proven process technologies that are already operational in several plants today.

K.Y. Cheah is technical director, Lipochem Bio-Tech Sdn. Bhd. He has worked as a petroleum refining technologist in the Shell Petroleum Company (Singapore), a research officer for the Malaysian Palm Oil Board (MPOB), and as head of Palm Oil Milling and Palm Oil Processing Unit for MPOB. T.S. Toh, general manager of Lipochem Pte. Ltd. (Singapore), has more than 18 years of experience in the oils and fats industry as a project engineer and engineering manager in Scandinavian and Singaporean multinational companies where he managed the design, construction, and commissioning of edible oil refining plants in Southeast Asia. P.M. Koh is managing director of Lipochem (M) Sdn. Bhd. & Lipochem Bio-Tech Sdn. Bhd., Malaysia. He worked for over 20 years in various European multinational fats and oils engineering companies in the areas of design, project management, plant start-up and commissioning before moving into management of these companies. For more information, visit [www.lipochem.com](http://www.lipochem.com).



## information

### FOR FURTHER READING:

- Fry, J., Is it smooth sailing or choppy waters ahead? Paper presented at the Palm and Lauric Oils Conference & Exhibition Price Outlook (POC), Kuala Lumpur, Malaysia, March 8–10, 2010.
- Mielke, T., The price outlook of palm and lauric oils and impacts from the global vegetable oil markets—A fundamental approach, Paper presented at the Palm and Lauric Oils Conference & Exhibition Price Outlook (POC), Kuala Lumpur, Malaysia, March 8–10, 2010.
- Malaysian Palm Oil Board, 2010. Website: [www.mpob.gov.my](http://www.mpob.gov.my).
- Gapor, A.M.T., A study on the utilization of PFAD as a source of squalene, *Proceedings of the 2000 National Seminar on Palm Oil Milling, Refining Technology, Quality and Environment*, Malaysian Palm Oil Board, Selangor, 2000, pp. 146–151.
- Bonnie, T.Y.B., and Y. Mohtar, Characteristics and properties of fatty acid distillates from palm oil, *Oil Palm Bulletin* 59:5–11 (2009).

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# Atlantis Program allows EU, US students to focus on biorenewable resources

**Howell Medders, Andrew Proctor, Lawrence A. Johnson, Ronald L. Madl, and Raj Raman**

Amanda Ashworth, Kerry Campbell, and Doug Ingersoll are among students from the United States and Europe taking advantage of the EU (European Union)-US Atlantis student exchange program to study in a broad range of disciplines related to biorenewable resources and bioproducts for food and nonfood use ([www2.ed.gov/programs/fipseec/index.html](http://www2.ed.gov/programs/fipseec/index.html)).

EU-US Atlantis is an umbrella program for a variety of innovative educational opportunities for students and faculty to study and conduct research abroad and for curriculum development. The Integral Valorization of Bio-Production (IVBP) program, funded for 2008–2012, provides financial assistance for US students to study in Europe and for EU students to study in the United States.

*Professor Charles West and graduate student Amanda Ashworth in a switchgrass plot that is providing data for her M.S. thesis research. She worked on a Miscanthus research project in Toulouse as an undergraduate.*



Ashworth, Campbell, and Ingersoll are at the University of Arkansas (U of A; Fayetteville), Iowa State University (ISU; Ames), and Kansas State University (KSU; Manhattan), respectively, which are the three US partners in the current Atlantis Program.

Andrew Proctor, professor of food science at U of A, is co-director of the current Atlantis IVBP program along with Koen Dewettinck, professor at the University of Ghent, Belgium. Other US campus coordinators are Lawrence Johnson, director of the Center for Crops Utilization at ISU, and Ronald Madl, director of the Bioprocessing and Industrial Value-Added Program at KSU. The other European partners are Anton Huber at Karl Franzens University in Graz, Austria, and Carlos Vaca-Garcia at the National Polytechnic Institute of Toulouse in France.

Roland Verhe of Ghent originated the concept and secured the initial grant from the European Commission's Directorate for Education and Culture in 2004. US partners submitted the same grant to the Atlantis Program at the Department of Education's Fund for Improvement of Postsecondary Education to obtain parallel funding. The first of the two biorenewable resource projects, in 2004–2009, was entitled Renewable Resources and Clean Technology.

## THE CURRENT PROGRAM

"Integral valorization" means the essential or true nature, value, or cost. The term relates to the life cycle or "carbon footprint" of all energy and material inputs and outputs of a particular energy source or other biomaterial. The program description says, "Integral valorization must be the basic concept driving the design of new processes for food, biomaterials, and bioenergy production to achieve sustainable development. This will necessitate the optimal utilization of all co-products and waste streams."

Each of the participating universities is a leader in renewable resources research. The three European universities have premier programs in biorenewables and/or biofuels. The US universities are leaders in agricultural, food, and environmental sciences.

For instance, ISU initiated the first graduate program in biorenewable resources in the United States. The Bioeconomy Institute at ISU seeks to advance the use of biorenewable resources for the production of chemicals, fuels, materials, and energy.

At KSU, the Bioprocessing & Industrial Value Added Program specializes in developing biomaterials processing technology and using agricultural-based materials to produce higher-value products for economic development. The Feed Science and Management degree, within the department of grain science and industry, offers a Biofuels Production option, and there is an interdisciplinary graduate certificate program in Biobased Products and Bioenergy through the graduate school.

The U of A Division of Agriculture emphasizes multidisciplinary research and extension projects to develop the state's biofuels and bioenergy infrastructure. Development of value-added food products and use of co-products from the food industry are major areas of food science research at U of A.

At a recent presentation for prospective exchange students at the U of A, Anton Huber said seniors and graduate students can work with a faculty mentor to select courses, a research project, or a combination of both in the semester program. The program provides up to \$5,000 for US students. EU students receive up to €1,000 toward the cost of an airline ticket and €850 per month. Students enroll at their home university and have their tuition waived at the host institution. Students may also attend two-week intensive study programs consisting of lectures and field trips followed by a final examination.

Fifty-two students—21 from the United States and 31 from Europe—have participated or are scheduled for 2010 in the semester program. Thirty-eight students and 33 faculty members from the United States have attended two-week intensive programs in Europe.

A broad range of interests for students in any agricultural-, science-, or engineering-based discipline can be accommodated, Proctor said. Arkansas students have come from the disciplines of food science; agricultural economics; biological engineering; animal science; horticulture; chemical engineering; and crop, soil, and environmental sciences.

A few examples of previous and current courses of study and projects include use of algae for biofuel; biorenewable resources in gastronomy and nutrition; biorenewables economics and law; and the chemistry, physics, and biology of various biorenewable materials. More information on the program at each campus is available at [www.uark.edu/ua/biorenew/](http://www.uark.edu/ua/biorenew/) (U of A); <http://www.biorenew.iastate.edu/academics/international-exchange-program.html> (ISU); and <http://www.sustainable-energy.ksu.edu/DesktopDefault.aspx?tabid=85> (KSU).

The program also promotes faculty exchanges.



*Professor Anton Huber of Karl Franzens University (Graz, Austria) explains the Atlantis Program opportunities to students at the University of Arkansas.*

## A SPACE FOR COLLABORATION AND EXCHANGE

Ya-Jane Wang, a food science professor at the U of A, spent four months in the pharmacy department at the University of Ghent in 2006. She conducted research on the use of modified starch in controlled-release applications for pharmaceutical products. Her graduate student, Stephen O'Brien, studied in the same department in 2006, funded by the Atlantis Program. Wang then hosted a student from Ghent, Thomas Quentin, for two visits to study and work in her lab at the U of A.

"It was a great opportunity to learn from leading scientists in the area of controlled-release applications in pharmaceuticals," Wang said. "We developed a very good, continuing working relationship."

Raj Raman, director of graduate education for the Biorenewable Resources and Technology graduate program at Iowa State, taught a two-week intensive study in the summer of 2008 in Tarbes, France, on modeling fermentation processes and optimizing microbial conversion of sugars and starches into biochemical products.

"It was a great way to interact with a range of really outstanding students from the EU and US, as well as other scientists," Raman said. "It was a catalyst for us to organize our own version of an intensive course," he added. Fifty students from the United States and EU attended the short course on biorenewables at ISU in June 2009, including presentations by US and EU scientists.

"It is a wonderful way to create collaborations and to expand the academic and cultural horizons of our students," Raman said.

Amanda Ashworth is now a graduate student of Charles West in the Department of Crop, Soil and Environmental Sciences at the U of A. Her master's thesis research is on switchgrass as a potential biofuels feedstock. As a senior in the spring of 2008, she spent a semester in Toulouse conducting life-cycle analyses of *Miscanthus*, a fast-growing grass, and natural gas for comparison as energy feedstocks.

Ashworth also participated in a two-week intensive study in the summer of 2009. The one she attended was "Sustainable Utilization of Biorenewable Resources" in Graz.

"Both the semester and intensive study were great experiences," Ashworth said. "It was great to work with the faculty and other students from several countries. I believe we made significant



*Professor Roland Verhe of Ghent and his wife, Monique. Verhe originated the concept for the Atlantis Program on biorenewable resources and bioproducts. He secured the initial grant from the European Commission's Directorate for Education and Culture in 2004.*



contributions through our research projects.”

Ashworth added that Toulouse and Graz are beautiful cities with large student populations and lively social and entertainment scenes. Most faculty members speak English, and students can function well with a minimum of host-country language skills, but “the more the better,” especially in France, she said.

Kerry Campbell, who received his Ph.D. degree in January 2010, and his wife spent about five months in Toulouse with a

research team trying to develop a water-based process for extracting oil from sunflowerseed. His dissertation research at ISU was with a team working on water-based extraction of oil from soybeans.

“I gained a better understanding of the differences in cellular geometry of soybeans and sunflower seeds,” Campbell said. The work in Toulouse provided a chapter in his doctoral dissertation. He now has a postdoctoral appointment with the research team on water-based oil extraction at ISU.

Campbell took his road bike on the trip, joined a local cycling group, and participated in a local bike race, which was a highlight of his experience. He and his wife also enjoyed sightseeing and hiking in the Pyrenees. He had spent a year in France as an undergraduate student and could already speak French.

“Speaking French makes it much easier, but people respond well if you show a strong interest in learning French, and they can tell you are making the effort,” he said.

Doug Ingersoll, a junior majoring in mechanical engineering at KSU, is at the University of Ghent for the spring semester of 2010. He is taking classes in the physics department in astronomy, nuclear astrophysics, radiation shielding and measurement, and an intensive Dutch language class. Two of his courses are self-study with textbooks in English because the lectures are in Dutch, Ingersoll said. Most people speak English, but he said host-country language skills would be a great advantage.

“The exchange program here is amazing,” Ingersoll said, in terms of taking care of the students and providing opportunities for socializing and entertainment. “I have met many people from different countries, and we all hang out together,” he said.

CONTINUED ON PAGE 323



Students at a banquet at the end of a two-week intensive course 2008.

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# Optimizing formulation blending for product success

Ram Chaudhari

The functional beverage category is generating new and exciting concepts, from a variety of “shot” type single-dosage products that can address multiple health concerns to the standard 16-oz drink focusing on areas ranging from weight management to stress reduction to cognitive function. Multiple ingredients can be incorporated into a beverage product; but functional beverage formulation goes beyond just adding a few vitamins here, a cupful of antioxidants there, and tossing in some botanicals. Understanding proper ingredient selection, specific to finished product composition, along with processing conditions employed to manufacture a marketable product, and how to blend them into a nutrient premix are key points manufacturers must take into consideration at the very beginning of the product development process.

## INGREDIENT SELECTION

Consumers are more aware than ever about the role certain nutrients can play in their overall health or in the management of specific health conditions. Two ingredients that are currently popular in the consumer mindset are omega-3 fatty acids and vitamin D. Each of these ingredients poses certain formulation challenges that product formulators must address in order to successfully incorporate them into a beverage.

Three market forms of omega-3 are available: alpha-linolenic acid (ALA), primarily from flax or algae; eicosapentaenoic acid (EPA), primarily marine-sourced; and docosahexaenoic acid (DHA), also primarily from fish. Depending on shearing effect, one has to select the appropriate type of encapsulated omega-3. The duration of the blending process and types of blenders used will also have a bearing on the finished product stability and other quality control attributes (e.g., fishy odor, rancidity, etc.). Blending is not an exact science. Trial and error is still the best practice, especially for highly sensitive nutrients such as omega-3s, which are very sensitive to shearing and other factors.



Vitamin D is available in two market forms, vitamin D<sub>2</sub> (ergocalciferol) from plant and vegetable origins and vitamin D<sub>3</sub> (cholecalciferol) from animal origins. Both of these are microencapsulated and stabilized with appropriate antioxidant systems. Vitamins D<sub>2</sub> and D<sub>3</sub> are more stable and easier to handle than omega-3s; however, it is important to consider factors affecting their physical and chemical stability. Factors such as moisture, heat, exposure to air or light, and an alkaline or acidic environment would have adverse effects on the nutrient as well as physical stability.

## PROCESSING CONSIDERATIONS

Criticism of nutritional products often arises from tests showing they do not contain the quantities of nutritional ingredients stated on the label. These problems vary from product to product. Sometimes potency is too low or too high, and sometimes the product is devoid of the nutrients listed on the label. There may be many reasons for these deficiencies; but inadequate blending is often the source, due to sensitivities associated with defective microencapsulated ingredients, or damage of coated material during the handling of the ingredient itself.

Blending and processing techniques can make the difference between producing a reliable, high-quality, homogeneous, shelf-stable nutrient premix and an inferior one that may cause poor con-

sumer confidence—meaning no repeat purchase, potential regulatory issues, or recall situations.

Particle size blending equipment and the type of ingredients used are primary blending and processing considerations. The challenge in blending ingredients with different particle sizes is that bulk density and variable particle sizes can lead to segregation. Therefore, minor nutrients should be diluted with another carrier to get the two different materials to blend well in order to make a homogeneous product. Within the functional/fortified food and beverage industries, combination products have become the norm. The average premix formulation contains at least 10 to 14 active nutrients and three to six functional ingredients, or carriers (excipients). Some formulations contain more than 30 active nutrients and carriers.

There are basic steps to follow when dry-blending a multiple-ingredient formula to make a homogeneous premix:

- Identify and test all active ingredients for potency limits. If raw materials are not tested prior to use, it may be difficult to determine whether a problem with the final product is related to blending or to the ingredients.
- If possible, render all ingredients free-flowing. This can be done with milling, particle coating, granulation, making pre-blends, trituration, spray drying, and other techniques.
- Purchase ingredients that have consistent particle size distributions or that have a narrow range of variation.
- Screen lumpy or cohesive ingredients as they are added to the blender to reduce agglomeration during mixing.

- Always add a portion of the largest quantity ingredient to the blender first. It will coat the blender and prevent lesser ingredients from sticking to the walls.

Before adding small-quantity active nutrients to the blend, be sure each one is geometrically diluted to assist with adequate blending. That helps prevent loss from ingredients adhering to the blender wall or because the material had not been dispersed enough for uniform blending. Never add ingredients that account for less than one percent of the total blend into an empty blender.

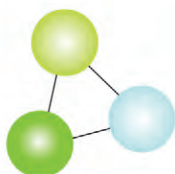
When using a V-type blender, divide the ingredients into equal parts, and then add one portion to one side and the other portion to the other side. This improves distribution and blending time, and the level of fill in the vessels plays a critical role in determining the adequacy of blending. These parameters should be established during the product development stages.

Finally, take adequate samples from the top, bottom, and center of the blender. List at least three of the lower potency ingredients to determine the adequacy of the blend. Take samples again after discharge to identify any segregation that may have occurred during material transfer.

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*Ram Chaudhari, Ph.D., FACN, CNS, is the senior executive vice president and chief scientific officer at Fortitech, Inc., Schenectady, New York, USA. He can be contacted at [chaudhari.ram@fortitech.com](mailto:chaudhari.ram@fortitech.com). For more information visit [www.fortitech.com](http://www.fortitech.com). Reprinted with permission.*

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# AOCS Technical Services update

**Catherine Watkins**

In March and April 2010, AOCS Technical Director Richard Cantrill attended a number of meetings of interest to the fats and oils community. Included among the topics discussed were the evaluation of accepted methods of analysis and sampling for the detection of foods derived from biotechnology.

“AOCS, as a global provider of methods of analysis, is pleased to support the trade of fats and oils by ensuring that the relevant methods are referenced in Codex standards,” Cantrill said. “Codex recognizes the value of consensus-driven standards development and the work of nongovernmental organizations in the food quality/safety arena.”

## INTER-AGENCY MEETING

Cantrill attended the 22nd meeting of the International Organisations Working in the Field of Methods of Analysis and Sampling (IAM). AOCS is secretariat for the group, which met March 5, 2010, in Budapest. Attendees are representatives from various international standard-setting organizations.

The IAM had considered the criteria approach and how standard-setting organizations deal with Horwitz Ratio values in determining the acceptability of methods of analysis containing precision data.

Following the discussion on proprietary methods at the 2009 committee meeting, the IAM prepared a first draft paper for the Codex Committee on Method of Analysis and Sampling (CCMAS). The paper noted that proprietary methods were not clearly defined by Codex and highlighted some concerns that could arise from their use: They might prevent further development of new and better techniques, distort competition between companies producing the reagents, or create difficulties for government authorities if particular reagents were not readily available for official methods. The IAM noted that the method for the determination of gluten illustrated some of these problems, as the reagents were not generally available. Several approaches were proposed to address this issue, including the use of the criteria approach by Codex.

IAM agreed to proceed with its consideration of proprietary methods and consider a wider contribution than from only IAM members; IAM will provide an update to the next session of the CCMAS.

IAM also discussed the fact that ISO (International Organization for Standardization) 5725 (Accuracy (trueness and precision) of measurement methods and results) is being revised. The revised document will contain four parts. Further, IAM members acknowledged the contributions of ISO/Technical Committee 34/Subcommittee 16 to the description of molecular biomarker analysis.

IAM and MoniQA (Monitoring and Quality Assurance in the Food Supply Chain) held a workshop on March 7, 2010, on Codex methods of analysis, which many CCMAS delegates attended. Cantrill invited CCMAS participants to make proposals for a future workshop in 2011. (Funded by the European Union, MoniQA brings



together 33 organizations from around the world that are working together to help food manufacturers, retail outlets, and regulatory bodies to cope with the challenges posed by a globalized food economy.)

The International Union of Pure and Applied Chemistry and MoniQA are undertaking some modeling exercises concerning the validation of qualitative methods; some of the results were presented to the IAM/MoniQA workshop.

The next meeting of the IAM will be held prior to the 32nd Session of the CCMAS in March 2011.

## CODEX COMMITTEE ON METHODS OF ANALYSIS AND SAMPLING

The 31st Session of the CCMAS was held March 8–12, 2010, in Budapest, Hungary, with 162 participants—including Cantrill—representing 46 member countries, one member organization, and 15 international organizations. CCMAS defines criteria for Codex methods of analysis and sampling and coordinates the work of Codex with other international groups working in methods of analysis and sampling and quality assurance systems for laboratories.

CCMAS also specifies reference methods of analysis and sampling for Codex Standards and considers and endorses methods of analysis and sampling proposed by Codex committees, except those related to pesticide residues and veterinary drugs in food, and the

The Codex Alimentarius Commission (Rome, Italy) was established in 1963 by the Food and Agricultural Organization of the United Nations (FAO) and the World Health Organization (WHO) to protect the health of consumers and ensure fair practices in food trade through the development of standards, codes of practice, guidelines, and other recommendations relating to foods, food production, and food safety.

The *Codex Alimentarius* (Latin for “food code”) is the result of the work of the Commission and its almost 20 technical committees. The *Codex Alimentarius* is recognized by the World Trade Organization as an international reference point for the resolution of disputes concerning food safety and consumer protection.

assessment of microbiological quality and safety in food and food additives. It also considers issues submitted to it by the Codex Alimentarius Commission and defines procedures, protocols, and guidelines for quality assurance systems and assessment of proficiency for food laboratories.

At the session, the committee agreed to:

- Advance to Step 5/8 the Draft Guidelines on Performance Criteria and Validation of Methods for Detection, Identification, and Quantification of Specific DNA Sequences and Specific Proteins in Foods;
- Advance to Step 5 the Draft Revised Guidelines on Measurement Uncertainty;
- Endorse or update the status of several methods of analysis in Codex standards, and proposed methods of analysis; and
- Consider further at its next session procedures for conformity assessment and resolution of disputes, taking into account measurement uncertainty, sampling uncertainty, and other relevant issues.

The 31st Session of the Codex Committee on Methods of Analysis and Sampling will be held in Hungary, March 7–11, 2011. The agenda will be available at [www.codexalimentarius.net/web/current.jsp](http://www.codexalimentarius.net/web/current.jsp).

## FOSFA AND IOC MEETINGS

Cantrill also met informally with John Hancock, technical manager of the Federation of Oils, Seeds and Fats Association Ltd. (FOSFA; London, UK). The two discussed the performance and accreditation tests that AOCS administered for FOSFA.

On April 15–16, Cantrill participated as a member of the Chemists’ Committee of the International Olive Council (IOC) in Madrid, Spain. Agenda items included:

- An update on the methods of analysis included in the IOC trade standard;
- A discussion of their harmonization with methods issued by other entities; and
- A review of data from a study on the composition of olive oils produced from different varieties.

## THE CODEX STEP PROCESS

**Step 1**—A project proposal for new work prepared by a Codex subsidiary body is reviewed by the Executive Committee and compared against the criteria and priorities established by the Commission. The proposal is then referred to the Commission for approval as a new standard, guideline, or related text for development. The Commission approves and decides who will undertake work.

**Step 2**—The Secretariat arranges for the preparation of a proposed draft standard. This may be through a working group of the relevant committee, an international organization, or other expert bodies.

**Step 3**—The draft text is circulated to member governments and relevant international organizations for comment.

**Step 4**—Comments are reviewed at Committee level and incorporated into the draft standard for discussion.

**Step 5**—The Commission reviews the progress made and determines whether the draft standard should be made final. Sometimes the text is considered to be ready for final adoption at this stage, which is then called Step 5/8.

**Step 6**—The approved draft is circulated to member countries for another round of comments and put into final form by the relevant Committee.

**Step 7**—Amendments are made by the committee to the revised draft based on comments received and the proposed standard is referred to the Commission for adoption.

**Step 8**—Following a final round of comments, the Commission adopts the draft as a formal Codex text. The Codex Secretariat then publishes the standard, guideline, or other text.

*Catherine Watkins is associate editor of inform. She can be reached at [cwatkins@aocs.org](mailto:cwatkins@aocs.org).*



An editorial in *Nature Methods* (see <http://tinyurl.com/y96r37c>) looks at iPhone applications (apps) targeted to scientists.

“There are apps to calculate how to prepare solutions, view restriction enzyme information, search online databases for papers, and even store downloaded papers. Well-known product vendors for biological research are also beginning to release laboratory apps for the iPhone. Promega has an app with product information, tutorials, protocols, and unit conversion calculators, and Bio-Rad has a quantitative PCR [polymerase chain reaction] app.”

■ ■ ■

The European Food Safety Authority has published an analysis of the levels of dioxins and related substances in food and animal feed. The report is based on over 7,000 samples collected by 21 European countries between 1999 and 2008. The highest average levels of dioxins and dioxin-like PCBs in relation to fat content were observed for liver and liver products from animals. The highest average levels in relation to total product weight were for fish liver and products derived from fish liver. In animal feed, the highest average levels were found in fish oil. The report is available at <http://tinyurl.com/yfxmnmk>.

■ ■ ■

The California Environmental Protection Agency’s Office of Environmental Health Hazard Assessment (OEHHA) said in late February that it intends to list acrylamide as a reproductive toxicant under the Safe Drinking Water and Toxic Enforcement Act of 1986 (informally known as Proposition 65). The proposed Maximum Allowable Dose Level (MADL) for acrylamide is 140 micrograms/day. (See <http://tinyurl.com/ylzs23e>.)

■ ■ ■

In late February, The Procter & Gamble Co. filed with the US Food and Drug Administration for GRAS (Generally Recognized as Safe) status for its fat replacement Olestra as a “total replacement for fats and oils in pre-packaged foods including prepackaged meat and vegetable pies.” ■

# News & Noteworthy



## Palm oil pundit speaks

Dorab E. Mistry, director of Godrej International Ltd. in Mumbai, India, spoke about palm oil on March 15, 2010, during the 2010 Annual Convention of the National Institute of Oilseed Products in Palm Springs, California, USA.

Mistry noted that the introduction on May 24, 2010, of dollar-denominated palm oil futures by the Chicago Mercantile Exchange Group (CME), in cooperation with Bursa Malaysia Derivatives Bhd, “is likely to put palm oil trading within reach of thousands of investors and commodity market participants. It will demystify palm oil to players in North America and will make the market more liquid.”

Mistry pointed out that 3.5 million metric tons (MMT) of palm oil and palm kernel oil (PKO) were produced in 1976, which constituted 7.25% of total production of the 17 major fats and oils tracked by Oil World ISTA Mielke GmbH in Hamburg. By 2008, palm and PKO production constituted 30.5% of total world production of fats and oils.

“Over the same period, production of soybean oil expanded from 9.6 MMT in 1976 (20%) to 36.8 MMT in 2008 (23%),” Mistry said. “This growth in consumption has been possible due to the prodigious productivity and low cost-basis of palm oil.”

Why is palm oil so popular? Mistry suggested a number of reasons, beginning with location. “Palm oil has the advantage of being grown within 8° north and south of the equator. The principal producer countries are Malaysia and Indonesia and surrounding islands. This area also happens to be on the doorstep of major population concentrations in China, India, Pakistan, Bangladesh, and the whole of Southeast Asia. Sailing time to most . . . markets is just about a week, and smaller ships of 6,000–8,000 metric tons have been used in most cases,” Mistry noted.

Growth in production has been matched by the creation of an efficient refining and processing industry that has either been integrated with larger plantation owners or by export customers, he added.

“Palm oil is unique in the large proportion of refined and processed, value-added products that are exported,” Mistry

## Acquisitions/mergers

**Crown Iron Works Co.** (Minneapolis, Minnesota, USA) has acquired Ebertec Ltd. (South Newbald, UK), which offers design, equipment supply, and consulting services to the edible oils and oleochemical industries. Ebertec holds several UK and USA patents including a novel deodorizer design, fatty acid stripping, pre-stripping and deodorizing tray designs. Crown's UK office, Europa Crown Ltd., said it has incorporated this tray design into its Diflow Deodorizer.

## Commodities

### CACAO/CHOCOLATE

**Archer Daniels Midland Co.** announced in March that it will close its cacao processing plant in Hull, UK, on July 1, 2010. The plant produces cocoa butter, cocoa powder, and cocoa liquor. A company statement said the closing "is based on overcapacity in the cocoa processing market; even with consolidation the demand for semi-finished cocoa processing is shifting from the United Kingdom to Central and Eastern Europe, where market growth is strongest."

Switzerland's **Barry Callebaut AG** and the Malaysian Cocoa Board will cooperate on developing superior-quality cacao and chocolate from Malaysia using Callebaut's controlled fermentation technology. The collaboration aims to improve Malaysian cocoa bean quality, focusing on optimizing taste, enhancing the amount of functional

components, altering color, and optimizing processing.

### CANOLA/RAPSEED OIL

Canadian farmers will plant a record-high number of canola acres this spring, according to Agriculture and Agri-Food Canada (AAFC). AAFC's planting estimate is up 3% from its January report to 16.8 million acres (6.8 million hectares). Corn acres are expected to rise by about 6% and soybean area will increase by 4%. The report is available at <http://tinyurl.com/y9t669r>.

### COCONUT OIL

Philippine's coconut oil exports increased by more than five times in January 2010 from January 2009 levels on improved demand. Shipments rose to 130,000 metric tons (MT) from 24,579 MT for January 2009, the United Coconut Associations of the Philippines, Inc. said in a report. UCAP said that it expects coconut oil exports this year to rise more than 21% to 980,000 MT. The United States and Europe together buy four-fifths of the Philippines' coconut oil shipments; the rest goes to Asia.

A "major interstate racket" that was trading **adulterated coconut oil** was arrested in February in India after police seized 16 MT of adulterated oil from the municipal town of Tripunithura. Special Branch Assistant Commissioner M. Shamsu Illikkal told the *India Express* newspaper that the seized oil contained "certain chemicals [that] were highly injurious to health." A preliminary laboratory report revealed that the iodine value of the oil was around 12.5%, "which is much higher than the permissible limit of 7–8%," Illikkal reportedly said.

### PALM OIL

Palm oil giant **Wilmar Indonesia** is building an oleochemical processing facility at a cost of \$500 million in Gresik, East Java, according to Indonesian news agency Antara. The oleochemical complex will have a number of production facilities, including an edible oil refinery, a fatty-acid oleochemical plant, two biodiesel plants, and a packing plant. The oleochemical plant will have an annual capacity of 200,000 MT and the two biodiesel plants

will have a combined annual capacity of 400,000 MT, Antara said.

**CTP Holdings**, a **Cargill** majority-owned company, announced in late February that it had signed an agreement to sell its interest in oil palm plantations it owned and operated in Papua New Guinea (PNG) to **New Britain Palm Oil**. The sales agreement covers only CTP's oil palm assets in PNG. CTP Holdings continues to own and operate two oil palm plantations in Indonesia. New Britain is the largest oil palm plantation owner and operator in PNG.

Reuters reported in March that Singapore-listed **Indofood Agri Resources Ltd.** (IndoAgri) expects to more than double its new oil palm plantings in 2010, as part of \$200 million of capital spending slated for this year. "Our target new planting for 2010 is 25,000 hectares for oil palm and 6,000 hectares for sugar," IndoAgri CEO Mark Wakeford said in email to Reuters.

### PEANUT (GROUNDNUT) OIL

**Cargill** will resume peanut oil processing during the third quarter of 2010 at its plant in Fayetteville, North Carolina, USA, according to the *Fayetteville Observer* newspaper. The plant, which also refines soy oil, stopped processing peanut oil in 2009.

### SUNFLOWER OIL

Researchers at the **National Council of Scientific Research** of Spain, together with **Advanta Semillas** in Argentina, have been developing Nutrisun™ sunflower seed for the past 14 years. According to the **National Sunflower Association** (Mandan, North Dakota, USA), commercial production has already begun in Spain and Argentina; commercial production in the United States will begin in 2010. The fatty acid profile of oil from this traditionally bred seed consists largely of stearic and oleic acids.

### FISH OIL

BioDiesel International AG (Graz, Austria) and its German subsidiary, UIC, announced in March that they have developed a "plant [facility] concept" for short-path distillation of omega-3 fatty acids from fish oil. ■





suggested, “quite in contrast to soy oil or sunflower oil or rapeseed oil, which are largely exported in crude form. Even today, most price comparisons are made between the price of RBD (refined, bleached, and deodorized) palm olein and crude degummed soybean oil. This at once puts palm at an advantage because the importer gets a refined, readily salable product. This emphasis on export of refined products has made palm extremely popular with smaller importers and traders who can very quickly and conveniently turn their purchase into cash.”

Other factors leading to the success of palm oil include the lack of a large home market, the lack of a by-product (such as meal), and its low cost-basis.

“For example, one hectare of plantation land in Malaysia produces 4.5 metric tons (MT) of palm oil plus another 0.5 MT of PKO. In the United States, one hectare produces almost 2.7 MT of beans or 0.3 MT of soy oil,” Mistry said.

He also did some crystal ball-gazing to determine whether palm oil production will continue to expand at the same rate as in the past 10 years. With recent inflation

and higher commodity prices, two questions arise.

Mistry believes that the rate of expansion of palm oil production will decelerate in the short term, largely because expansion of acreage in Malaysia “is now almost over.” In Indonesia, “the scope for [an] increase in productivity is large because almost 30–40% of planters are smallholders. However, it is a big task to get smallholders to embrace new technology and improve productivity,” he noted.

“My prognosis is that we shall have to look to higher prices in the future to attract acreage to oilseeds and to palm and that consumers will have to get used to paying higher prices,” he concluded.

In the meantime, Mistry thinks that per capita consumption increases will continue at the current pace for the foreseeable future. “The first reason is population growth,” he said. “Secondly, the big population countries like China, India, Bangladesh, Pakistan, and Indonesia have low per capita consumption rates as compared to developed countries. On the other hand, their economies are growing fast and [the] living standards of their populations, almost 3 billion people

in all, are rising fast. That factor is likely to keep consumption growing at the current pace.”

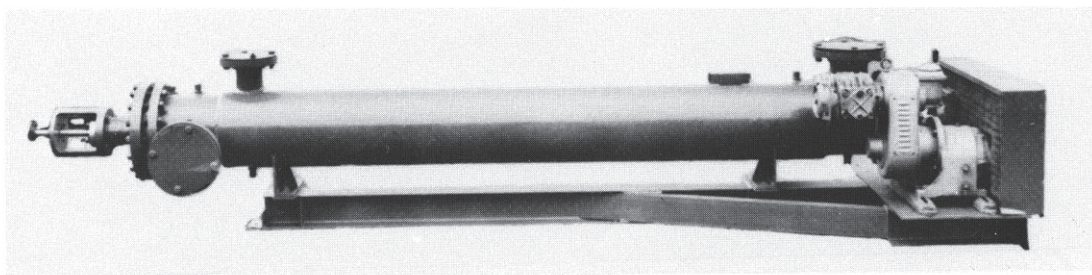
In the past, countries such as China and India artificially held down consumption by imposing high import taxes on vegetable oil imports. The entry of China and India into the World Trade Organization has led to the abolishment of high import taxes and import quotas. “This has lowered the price and led to fast growth in consumption,” Mistry said. “The most recent example is India, which abolished all import taxes on unrefined vegetable oil in late 2007. This led to a massive growth in per capita consumption of almost 13%, or some 2 MMT.”

## Rabobank on USDA planting report

Rabobank, the international agribusiness banking cooperative, has the following insights about the March 31, 2010, US Department of Agriculture (USDA) Prospective Plantings report (<http://tinyurl>.

CONTINUED ON NEXT PAGE

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com/ydrk4qs) by the National Agricultural Statistics Service.

**Key points:**

- The results were mostly in line with trade expectations.
- The March 1 Quarterly Grain Stocks report for the most part showed higher-than-expected inventories.
- The USDA forecast corn plantings to increase to 88.8 million acres (almost 36 million hectares), up from 86.48 million acres in 2009. The increase was mostly expected by the trade, with the official figure coming in only 300,000 acres below the average trade estimate.
- The corn stocks figure was surprisingly high, coming in at the upper end of analyst expectations. March 1 corn stocks were reported at 7.694 billion bushels (195.4 million metric tons), up 11% from 2009.
- Soybean plantings were also higher year on year, although below what many analysts were predicting. The USDA forecasts soybean plantings at 78.1 million acres (38.6 million hectares), up 650,000 acres from 2009.
- Soybean stocks were reported by the USDA at 1.270 billion bushels (34.56 million metric tons), down 2.5% from 2009 but—importantly—66 million bushels above trade expectations.

## ACCC opposes Cargill acquisition

The Australian Competition and Consumer Commission announced at the end of March

2010 that it intends to oppose the proposed acquisition of Goodman Fielder's edible fats and oils business by Cargill Australia. Goodman Fielder is the largest refiner of edible fats and oils in Australia, supplying a wide range of products, including margarines, oils blends, bakery fats, and liquid oils. Cargill Australia is also a refiner of edible fats and oils and is the largest supplier of crude oils to Australian edible fats and oils refiners.

"The ACCC investigation found that the proposed acquisition of the Goodman Fielder assets by Cargill would lead to a significant concentration of refining assets in Australia and remove one of only a small number of competing refiners that offer a wide range of fats and oils products," ACCC Chairman Graeme Samuel said.

"The ACCC also concluded that any potential competitors face significant difficulties in viably obtaining certain inputs necessary to supply a number of edible fats and oils products, limiting their ability to provide an effective competitive constraint post-acquisition," Samuel added.

"Inquiries by the ACCC indicated that for a number of fats and oils products, Goodman Fielder and Cargill have been each other's closest competitor, and that both companies vigorously compete to supply bulk fats and oils products to a number of large customers.

"The findings led the ACCC to conclude that the proposed acquisition would likely result in a substantial lessening of competition in markets for the supply of certain refined oil products, in particular those products used by industrial food manufacturers to make a range of food products," he said.

For its part, Cargill said that it remains committed to serving its customers in Australia and New Zealand and to growing its local business after the ACCC rejected the company's planned acquisition.

"We respect and accept the ACCC's decision on the proposed acquisition, and are now considering the implications and next steps," said Bram Klaijsen, president and regional director, Cargill Asia-Pacific.

## GAO: FDA lax on GRAS oversight

The US Food, Drug, and Cosmetic Act (FDCA) exempts Generally Recognized as Safe (GRAS) substances, which include spices, artificial flavors, emulsifiers and binders, vitamins and minerals, and preservatives, from the general requirement that companies obtain Food and Drug Administration (FDA) approval before marketing food additives.

Currently, companies may determine a substance is GRAS without FDA's approval or knowledge. The Government Accountability Office (GAO) notes in a recent report, however, that "a few substances previously considered GRAS have later been banned" and that "concerns have been raised about the safety of other GRAS substances, including those containing engineered nanomaterials, [or] materials manufactured at a tiny scale to take advantage of novel properties." The GAO report can be found at <http://tinyurl.com/yjtylc4>.

The US Congress asked GAO to review the extent to which:

- FDA's oversight of new GRAS determinations helps ensure the safety of these substances;
- FDA ensures the continued safety of current GRAS substances; and
- FDA's approach to regulating engineered nanomaterials in GRAS substances helps ensure the safety of the food supply.

According to GAO, FDA's oversight process does not ensure the safety of all new GRAS determinations. FDA reviews only the GRAS determinations submitted to its voluntary notification program, and FDA generally does not have information about other GRAS determinations that companies have made because companies are not required to inform FDA of them. Furthermore, FDA has not taken steps that could





help ensure the safety of GRAS determinations, particularly those about which the agency has not been notified. GAO notes that FDA has not issued guidance to companies on how to document their GRAS determinations, or monitored companies to ensure that they have conducted GRAS determinations appropriately. FDA also has yet to issue a final regulation for its 1997 proposed rule that sets forth the framework and criteria for the voluntary notification program.

FDA is not systematically ensuring the continued safety of current GRAS substances. Although the GRAS status of a substance must be reconsidered as new scientific information emerges, according to FDA regulations, FDA has not systematically reconsidered GRAS substances since the 1980s. According to GAO, “FDA officials said they keep up with new developments in the scientific literature and, on a case-by-case basis, information brought to the agency’s attention could prompt them to reconsider the safety of a GRAS substance.” GAO notes, however, that FDA has largely not responded to concerns about GRAS substances, such as salt and *trans* fats in partially hydrogenated vegetable oils, that individuals and consumer groups have raised through 11 citizen petitions submitted between 2004 and 2008. In fact, GAO states, FDA has decided on the validity of these concerns in only one of 11 cases. In addition, FDA does not know to what extent, or even whether, companies track evolving scientific information about their GRAS substances.

According to GAO, FDA’s approach to regulating nanotechnology allows engineered nanomaterials to enter the food supply as GRAS substances without FDA’s knowledge. While some uses of engineered nanomaterials have the potential to help ensure food safety, GAO states that “uncertainties remain about how to determine their safety in food.” After reviewing the uncertainties associated with the safety of engineered nanomaterials, FDA has decided that it does not need additional authority to regulate products containing such materials. Rather, FDA encourages, but does not require, companies considering using engineered nanomaterials in food to consult with FDA regarding whether such substances might be GRAS. Because GRAS notification is voluntary and companies are not required to identify nanomaterials in their

GRAS substances, FDA does not know the full extent to which engineered nanomaterials have entered the US food supply as part of GRAS substances. GAO states: “In contrast to FDA’s approach, all food ingredients that incorporate engineered nanomaterials must be submitted to regulators in Canada and the European Union before they can be marketed.”

GAO offered the following recommendations, all of which are in process, to ensure better oversight of the safety of GRAS substances:

- FDA should develop a strategy to require any company that conducts a GRAS determination to provide FDA with basic information—as defined by FDA to allow for adequate oversight—about this determination, such as the substance’s identity and intended uses, and to incorporate such information into relevant FDA databases and its public website;
- FDA should develop a strategy to minimize the potential for conflicts of interest in companies’ GRAS determinations, including taking steps such as issuing guidance for companies on conflicts of interest and requiring information in GRAS notices regarding expert panelists’ independence;
- FDA should develop a strategy to monitor the appropriateness of companies’ GRAS determinations through random audits or some other means, including issuing guidance on how to document GRAS determinations;
- FDA should develop a strategy to make the rule that governs the voluntary notification program final, including taking into account the experience of the program to date, incorporating input from a new public comment period, and reporting to Congress and the public FDA’s timeline for making it final;
- FDA should develop a strategy to conduct reconsiderations of the safety of GRAS substances in a more systematic manner, including taking steps such as allocating sufficient resources to respond to citizen petitions in a timely manner, developing criteria for the circumstances under which the agency will reconsider the safety of a GRAS substance, and considering how to collect information from companies on their reconsiderations; and

- To ensure better oversight by FDA of the safety of GRAS substances, the Commissioner of FDA should develop a strategy to help ensure the safety of engineered nanomaterials that companies market as GRAS substances without FDA’s knowledge. Steps that might be taken include issuing guidance recommended by FDA’s nanotechnology taskforce, developing an agency definition of engineered nanomaterials, and requiring companies to inform FDA if their GRAS determinations involve engineered nanomaterials.

## FDA cracks down on food label claims

In related news, FDA’s Center for Food Safety and Applied Nutrition sent warning letters in February to 16 different companies for making false or misleading food label claims. Violations cited in the warning letters included:

- Use of claims that food products can treat or mitigate disease; FDA views foods that carry such claims as unapproved new drugs.
- Nutrient content claims made on foods intended for infants or children less than two years of age; such claims are not allowed.
- Improper use of “0 g *trans* fat” claims: When “0 g *trans* fat” is stated outside the Nutrition Facts panel for a product that exceeds threshold levels of total fat, saturated fat, cholesterol, and sodium, then the disclosure statement “See Nutrition Information for [name of nutrient] Content” is required.

The FDA also cited website statements that describe products inappropriately, adding that such statements are subject to the same regulations as product labels. Further, the agency is examining the use of specific nutrient content claims to ensure they meet regulated definitions and conditions for use. For example: “high antioxidant” is not allowed without qualification; “high in monounsaturated fats” is not allowed because there is no Daily Value for them; label claims for “healthy” and “light” were cited because the foods did not meet qualifying criteria for the definitions.

For more details, see the FDA’s open letter to the food industry (<http://tinyurl.com/y1phg7w>) and view the individual warnings (<http://tinyurl.com/ybghcm6>). ■

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Twenty-five percent of all advanced biofuels expected to be online by 2013 will be using an algal fuel-based platform, according to BiofuelsDigest.com on March 15. (<http://biofuelsdigest.com/bdigest/2010/03/15/biggie-smalls-microbes-and-micro-crops-shine-at-biofuels-big-dance>).

■ ■ ■

Brazil's Petrobras Biocombustível, the biofuel subsidiary of the state-run energy company Petrobras, posted a net loss in 2009 of \$51.7 million. This was the first year of operation for the subsidiary, which was created to concentrate Petrobras' operations in ethanol, biodiesel, and other renewable fuels. So far, only biodiesel production is running. The three biodiesel plants that Petrobras Biocombustível currently is operating came online in the second quarter in 2009, with a combined installed capacity of 326 million liters per year. Better results are anticipated for biodiesel in 2010, with all three plants in operation.

■ ■ ■

During the first week of March, Brazil built its 10-millionth flex-fuel vehicle. In response to this announcement Marcos Jank, president of UNICA (the Brazilian Sugarcane Industry Association), commented, "We congratulate the auto industry in Brazil for its vision and the boldness shown when it chose to invest heavily in flex technology, to the point that many of these industries do not even produce vehicles powered exclusively by gasoline any more. The next step is to take this technically proven and highly successful project to the rest of the world."

■ ■ ■

Reuters news service reported on March 18 that KLM Royal Dutch Airlines wants to make commercial flights using biofuel from 2011 onward. On November 23, 2009, KLM flew a Boeing 747 on a passenger flight that fueled one engine with 50% standard jet fuel and 50% derived from camellina oil (see *inform* 21:21, 2010); the other three engines ran on standard jet fuel only. The exact date for implementing the use of biofuel has not yet been decided.

CONTINUED ON NEXT PAGE

# Biofuels News



## BIODIESEL

### Shipping looks to biofuels

With the goal of diversifying their fuel supply, five Moller-Maersk business units are carrying out tests using biodiesel as the fuel for large container vessels. Fuel tanks and engines are being evaluated with petrodiesel containing 5–7% biodiesel made from crops grown in temperate regions or from re-used oils.

In a company statement, Jacob Sterling of the Maersk Line sustainability team said, "To the best of our knowledge, we are the first to test biodiesel in a large container vessel. We want to be ready when sustainable biofuels become available in large volumes."

Maersk Line, headquartered in Copenhagen, Denmark, used more than 9 million metric tons of bunker fuel in 2009. Maersk Line has set a voluntary target to reduce CO<sub>2</sub> emissions from its container vessels by 20% per container moved during 2007–2017.

### Canada's largest biodiesel plant to start construction

During the second half of 2010, construction is scheduled to start in Vegreville, Alberta, Canada, on the country's largest biodiesel plant. The facility has been designed to crush 500,000 metric tons of canola seeds each year and supply about 25% of national demand in 2012.

According to the *Edmonton Journal*, Canada currently produces less than 150 million liters of biodiesel annually, with the rest coming from the United States, which largely uses soybeans for biodiesel instead of canola.

BioStreet Canada Inc., located in Kelowna, British Columbia, has been working on this venture for five years. Increases in mandated uses of biodiesel have driven the effort to accomplish this project.

Production will be used in part to meet the government mandate that Canadian diesel fuel contain 2% biodiesel by 2012. Angela Reid, vice president of BioStreet Canada, told the Resource Industry



According to BiofuelsDigest.com (March 19), the largest advanced bio-fuels plant currently under construction in the United States is the AltAir camelina biofuel facility in Anacortes, Washington. AltAir Fuels plans to buy camelina oil from Sustainable Oils (Bozeman, Montana), refine it using technology from Honeywell-UOP, and blend it with petroleum-based jet fuel diesel. When completed in 2012, AltAir's facility will have the capacity to produce 100 million gallons (380 million liters) of fuel annually. The Shell Puget Sound Refinery, also located in Anacortes, can produce 100 million gallons of fuel—as gasoline, aviation fuel, diesel fuel, and liquefied petroleum gas—in 18 days. BiofuelsDigest.com pointed out that, of refineries in the United States, the Shell Puget Sound Refinery is 50th in size.



Alternative Petroleum Technologies S.A. (APT) announced on March 21 that it had completed contractual arrangements and is beginning a diesel emissions control technology demonstration at the Port of Los Angeles. The goal of Luxembourg-based APT is to demonstrate the efficacy in Port cargo handling equipment of an emulsified biodiesel blend (a blend of water, B-20 biodiesel, and a proprietary additive system) that mitigates the increase in NO<sub>x</sub> emissions generally associated with the use of biodiesel fuel. (Biodiesel increases NO<sub>x</sub> emissions from 2% to 10% compared with traditional diesel fuel.)



BP is introducing a new advanced biorace fuel using isobutanol and ethanol in the 2010 American LeMans Series (ALMS). Experience gained on the racecourse could influence how biofuels are developed for broader transportation use by everyday drivers. BP and DuPont are making the isobutanol component through their Butamax™ Advanced Biofuels joint venture. BP has worked together with Mazda North America to develop a viable biorace fuel for the Mazda entry in the ALMS as well as with the International Motor Sports Association. ■

Suppliers Association on March 18, "With these federal standards . . . there will be a demand for one billion liters. And some provinces are going further, with B.C. [British Columbia] requiring 5% biodiesel by 2012."

Reid added, "Our plant will produce 225 million liters, and will also produce canola meal, glycerine, and potassium fertilizer."

Key equipment will come from Europe, and Austria's BDI Biodiesel will provide the refinery. The canola crusher is being supplied by Belgium's DeSmet Ballestra.

## GENERAL

### New fuel economy standards for USA

On April 1 the US Department of Transportation (DOT) and the US Environmental Protection Agency (EPA) jointly established new federal rules that set first-ever national greenhouse gas (GHG) emissions standards and that will significantly increase the fuel economy of all new passenger cars and light trucks sold in the United States. Manufacturers will be able to build a single, light-duty national fleet that satisfies all federal requirements as well as the standards of California and other states.

Starting with the 2012 model year, automakers must improve fleet-wide fuel economy and reduce fleet-wide GHG emissions by about 5% each year. By the 2016 model year, the combined industry-wide fleet should reach an estimated 34.1 miles per gallon (= 6.9 liters per 100 km in the Canadian system).

Specifically, the new national program:

- Reduces CO<sub>2</sub> emissions by about 960 million metric tons over the lifetime of the vehicles regulated, equivalent to taking 50 million cars and light trucks off the road in 2030
- Conserves about 1.8 billion barrels of oil over the lifetime of the vehicles regulated
- Allows the average car buyer of a 2016 model year vehicle to have a net savings of \$3,000 over the lifetime of the vehicle, as upfront technology costs are offset by lower fuel costs

## Two uses for *Moringa oleifera*

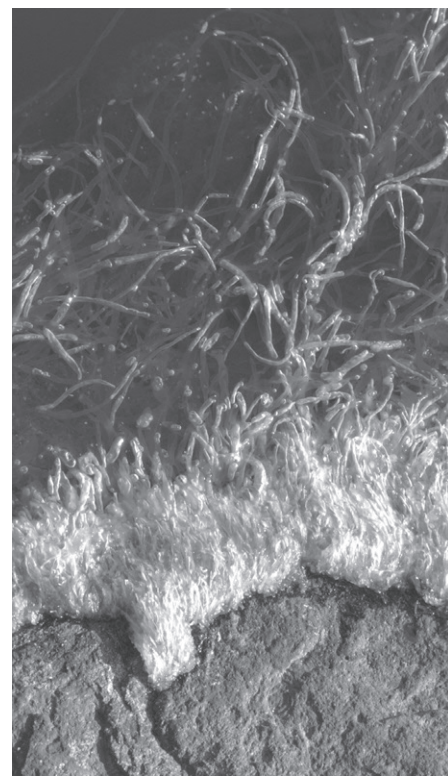
The plant known in Africa, Asia, and Latin America variously as benzolive-tree, drumsticktree, moringa, or ben (*Moringa oleifera*) produces seeds containing 35–40% oil by weight. Oil isolated from the seeds can be used for cooking, lamp fuel, and the manufacture of soap.

Powdered seeds of *Moringa* have been used too as a natural clarification agent for highly turbid and untreated pathogenic surface water in poor countries where the plant grows. A recent paper (*Current Protocols in Microbiology*, doi: 10.1002/9780471729259.mc01g02s16) points out that oil can be isolated from the seeds in a boiling water extraction, and the remaining presscake can be used as a coagulant owing to its polypeptide content. This method of water treatment in poor communities can contribute to improved quality of life through provision of higher-quality drinking water.

## ALGAE

### Genetics of biofuel-producing algae

The green alga *Botryococcus braunii* produces triterpene compounds called





botryococenes that are structurally similar to petroleum. According to Timothy Devarenne, a research scientist with Texas A&M University (College Station, USA), these compounds are also found in petroleum and coal deposits around the world, indicating that green algae have been producing hydrocarbon oils for millions of years.

Devarenne says that some races of *B. braunii* typically “accumulate hydrocarbons from 30% to 40% of their dry weight, and are capable of obtaining hydrocarbon contents of up to 86% of their dry weight.”

Devarenne and colleagues from the University of Kentucky and the University of Tokyo are working to characterize the genetic sequences of *B. braunii*. Their goal is to identify the genes of the organism that are involved in cell division and manipulate them to reduce the doubling rate. Hydrocarbon-producing *B. braunii* has a doubling rate of about 4 days, which is much less than that of algae that produce triglyceride oils. The latter have a doubling rate as short as 6–12 hours.

To date, only six species of algae have had their genomes fully sequenced and annotated, according to Devarenne, and *B. braunii* is not one of the six.

## British in the race to produce algal biofuel

The Carbon Trust, a British not-for-profit company with the mission to accelerate the move to a low carbon economy, announced plans in March to fund the development of biofuel from algae. Eleven UK institutions will work together with the Carbon Trust in developing plans to cultivate 70 billion liters of algae biofuel a year by 2030, which is equivalent to 6% of the road transport diesel.

Five key challenges have been identified by the Carbon Trust: (i) isolation and screening of algae strains; (ii) maximization of solar conversion efficiency; (iii) attainment of both high oil content and high productivity; (iv) sustained cultivation in open ponds; (v) design and engineering of cost-effective production systems.

In 2011, the Carbon Trust plans to start construction of a pilot demonstration plant in an equatorial region, where algae can be most productive. A statement from

the Carbon Trust indicated, “Production of 70 billion liters will require man-made algae ponds equivalent to a landmass larger than Wales to be built in optimum locations across the world.”

The Carbon Trust is also looking for possible locations for large-scale plants that are adjacent to industrial facilities that could serve as a source for CO<sub>2</sub> for algal growth and that are located near the sea, as a water source.

One goal of the Trust is to bring the cost of algal biofuel down from the current estimate of \$5–\$10 per liter to less than \$1 per liter.

Funding of £8 million (\$12 million) over three years will be provided to the Trust for this project through the Departments for Transport and for Energy and Climate Change.

## Growing algae and making cement

In light of concern over the release of greenhouse gases, companies such as Pond Biofuels (Scarborough, Ontario, Canada) are developing technologies to capture waste CO<sub>2</sub> that would otherwise be vented to the open air and make it an asset, not a liability, for an industrial process.

For example, the International Energy Agency estimates that the manufacture of 1 metric ton (MT) of cement produces an average of 0.83 MT of CO<sub>2</sub>. Pond Biofuels and St. Marys Cement Inc. are growing algae on high-CO<sub>2</sub>-containing flue gases from the cement plant, located about 50 km west of Waterloo, Ontario. The CO<sub>2</sub>-consuming algae are continually harvested from the 1,500 square foot (140 square meter) pilot project, dried using waste heat from the plant, and then burned as a fuel inside the plant’s cement kilns. Alternatively, the algae can be processed into biofuels for the company’s truck fleet.

In recycling its CO<sub>2</sub> emissions, St. Marys is producing what could be called “green” cement. Algae are being grown in photobioreactors, and patent applications have been submitted for the growth and harvesting processes. No date for scale-up has been announced.

The facility began operations in the third quarter of 2009. The *Toronto Star* said the plant is likely the first in the world to demonstrate that CO<sub>2</sub> from a cement plant can

be captured to grow algae, although GreenFuel Technologies was in the process of developing a similar process with Aurantia, SA (Madrid, Spain) at the Holcim cement plant near Jerez, Spain—until GreenFuel ran out of money in May 2009 (*inform* 19:802, 2008; 20:420, 2009).

## Harvesting algal oil

Cyanobacteria, also known as blue-green algae, have been genetically manipulated by researchers Xinyao Liu and co-workers at Arizona State University’s Biodesign Institute (Tempe, USA) to secrete the oils they synthesize directly into their growth medium. Getting the cells to release the oil without having to isolate the cells and extract the oil represents a much greener route to biofuel production than more traditional methods of oil collection.

Liu persuaded algal cells to release their overproduction of fatty acids to the growth medium by diffusion through the cell membrane. To do this, Liu introduced a thioesterase into the cyanobacteria, which acts to “clip” the bonds associating the fatty acids with more complex molecules. Another modification that enhanced the secretion process was the genetic deletion of two key layers of the cellular envelope, which allows fatty acids to escape more easily outside the cell. There, their low water solubility causes the fatty acids to precipitate out of solution. Genetic modification of the membrane layers afforded a threefold increase in fatty acid yield.

The project has been underway for less than a year. Liu and co-workers Roy Curtiss, Daniel Brune, and Wim Vermaas are working to increase fatty acid yields even further.

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## JATROPHA

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### Jatropha oil reported somewhat inferior

In an evaluation of oil from *Jatropha curcas* as an alternative to petrodiesel, B.S. Chauhan and co-workers used a dual fuel engine test rig to determine the performance and emission characteristics of an engine fueled with jatropha oil. Results suggested



the engine performance with jatropha oil was slightly less than with diesel fuel. The thermal efficiency of the engine was lower, and the brake-specific fuel consumption was higher with jatropha oil. On the other hand, levels of nitrogen oxide emissions were lower than with petrodiesel. Emissions of carbon monoxide, carbon dioxide, and hydrocarbons were higher with jatropha oil than with diesel fuel. Lower thermal efficiency and higher fuel consumption of jatropha oil compared with petrodiesel were attributed to the higher density and viscosity of jatropha oil. See the *Journal of Mechanical Science and Technology* 24:529–535 (2010); DOI: 10.1007/s12206-010-0101-5.

## Growing jatropha in Hawaii

The state of Hawaii (USA) has set a goal of reducing its dependence on petroleum, with a target of meeting 70% of its current energy needs by 2030 with clean energy and use of alternative energy.

Father and son farmers Christian and James Twigg-Smith hope to contribute to this goal. Their venture, called HIPPO (Hawaii Pure Plant Oil), is the first commercial biofuel plantation in the state. Two years ago, they planted 250 acres (100 hectares) in Keaau on Hawaii island with jatropha; they also have leased 750 more acres that can be put into production if the first planting succeeds.

Christian Twigg-Smith pointed out to the *Honolulu Star-Bulletin* that growing

jatropha is similar to growing coffee, because both are row crops, and the nuts must be husked and dried before the oil can be extracted. About 100 pounds of jatropha nuts produce one gallon of biodiesel (100 kg produce 8.3 liters).

The Twigg-Smiths do not expect to have a firm idea of the commercial viability of their plantation until 2012.

Kelly King, vice president of Pacific Biodiesel, which will refine the jatropha oil that HIPPO produces, told the *Honolulu Star-Bulletin* that Hawaii has the potential to grow enough fuel crops to refine 20 million to 22 million gallons (76 million–83 million liters) of biodiesel a year.

## ETHANOL

### Blend-at-the-pump technology now UL-approved

The Ovation Eco Fuel model dispenser has been certified by the Underwriters Laboratory (UL) for use with ethanol blends up to E25 (i.e., 25% ethanol/75% gasoline), according to a mid-March announcement by the manufacturer, Dresser Wayne (a subsidiary of Dresser Inc., Addison, Texas, USA). The UL approval comes as the market prepares for possible changes in US federal energy policy that would shift the standard gasoline blend from the current E10 to higher levels of ethanol, at least in part

to meet the requirements of the Renewable Fuel Standard. The Dresser Wayne Ovation Eco Fuel dispenser is compatible with this higher blend rate without any dispenser modifications, so retailers may not have to upgrade equipment if the federal government increases ethanol blend levels. Currently, E10 is the highest blend of ethanol allowed for sale for standard, non-flex-fuel vehicles and is sold across the United States as standard gasoline.

UL approval is also pending for two new Ovation Eco Fuel dispenser capabilities: high ethanol-grade blending at the dispenser and support for up to E85. This blending design allows retailers to pump blended products from two hoses at the same fueling point. Dual hose blending enables separation of low- and high-blend ethanol products and allows retailers to offer a range of fuel grade options based on their customers' vehicle compatibility and existing ethanol supply logistics.

## Prediction for global ethanol production

The Global Renewable Fuels Alliance (GRFA), headquartered in Toronto, Canada, released its 2010 production forecast for ethanol on March 22. GRFA predicts global production will reach 85.9 billion liters in 2010—growing by 16.2% from 2009 production. Ethanol production in 2010 will displace the need for 370 million equivalent barrels of oil globally. The United States is still the world leader in ethanol manufacturing with more than 45 billion liters of ethanol production projected for 2010.

In 2009, the International Energy Agency, an intergovernmental organization that acts as energy policy advisor, called the build-out of global biofuels production a necessary component of meeting future global energy needs. "In a world of diminishing crude oil supplies and increasing energy demand, this increased renewable fuel production will have a profound effect on the world's energy security—reducing the global dependence on crude oil and fuel imports," said GRFA spokesperson Bliss Baker. Biofuels production will reach more than one million barrels per day in 2010, reducing the world's reliance on crude oil.

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## Briefs

Docosahexaenoic acid (DHA) protects neural cells from stress-induced apoptosis (programmed cell death). In victims of the childhood cancer neuroblastoma, however, endogenous DHA levels are greatly reduced and an exogenous supply induces apoptosis. Led by Helena Gleissman of the Karolinska Institutet in Stockholm, Sweden, researchers have shown how the metabolites of the neural tumor cells differ from those of healthy cells to produce such different effects. Their work appears in *The FASEB Journal* 24:906–915, 2010.



Another study from the Swedish medical university Karolinska Institutet shows that the blood vessels and muscles of the heart can regulate the



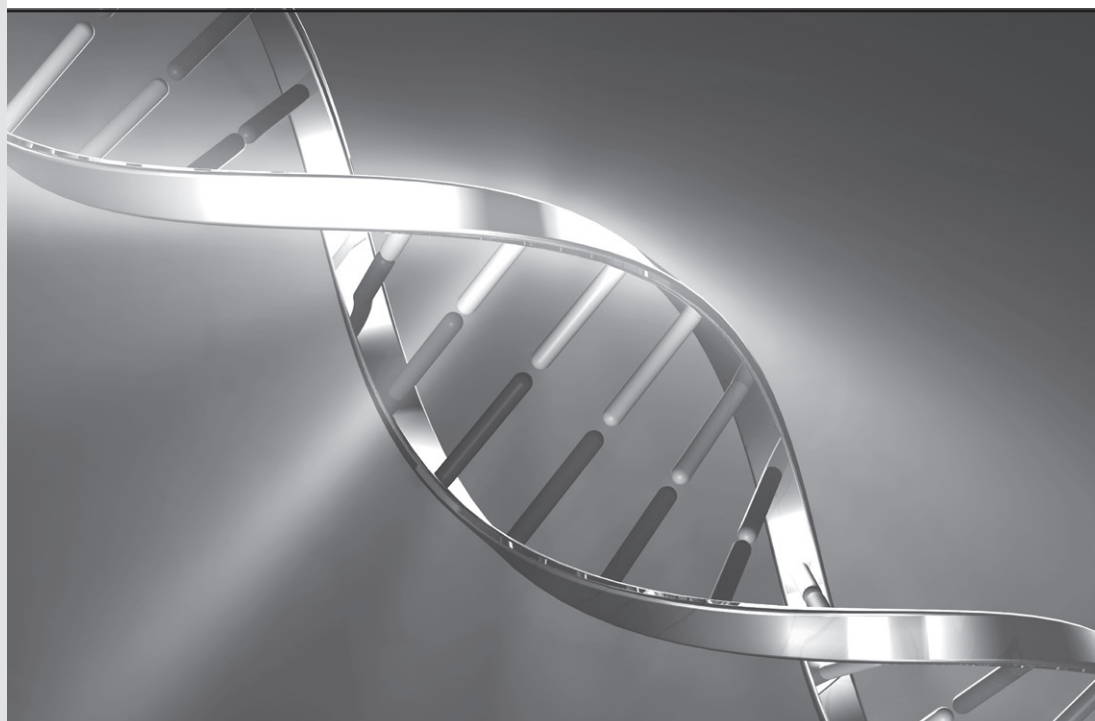
uptake of fatty acids that are ingested from food. The researchers, led by C.A. Hagberg, also identified the way in which regulation is governed by the muscles themselves. The results open the way for new forms of treatment for pathological fat accumulation in the muscles that, in turn, increases the risk of type 2 diabetes and cardiovascular disease. The work appears in *Nature* (doi:10.1038/nature08945).



The European Food Safety Authority (EFSA) Panel on Dietetic Products, Nutrition and Allergies has established dietary reference values (DRV) for the intake of carbohydrates, dietary fiber, fats, and water. DRV specify

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# Health & Nutrition



## Gene deletion = metabolic improvements

When researchers created mice lacking an enzyme that breaks down and releases stored triacylglycerols (TG), they expected to see animals with better serum lipid profiles. But according to a report in *Cell Metabolism* (11:183–193, 2010), the researchers got more than they bargained for. The triacylglycerol hydrolase (TGH)-deficient mice showed global metabolic benefits, with essentially no downside.

“It was a surprising and unexpected finding,” said Richard Lehner of the University of Alberta in Canada, corresponding author on the study and a colleague of research leader Enhui Wei, also of the University of Alberta. “With this gene deleted, not only was there a decline in very low-density lipoproteins in the whole mouse, it also affected metabolism in fat tissue. The insulin-secreting cells became smaller, suggesting that they did not have to work as hard to secrete insulin, and the mice became more insulin sensitive.” The animals ate more, but they also expended more energy and showed no change in body weight.

Very low-density lipoproteins (VLDL) are a form of “bad” cholesterol. TGH normally frees up TG from their storage place in the liver, releasing them for assembly into VLDL. Therefore, one might expect that loss of TGH would have ill effects on the liver, as triglycerides would build up there. Indeed, he says, similar experiments with other enzymes have shown such an effect.

“We didn’t observe that here,” Lehner said. “Instead of being stored in liver, triglycerides were directed for oxidation.” The liver also compensated by synthesizing less fat, he noted.

The study demonstrates the potential of TGH as a therapeutic target for lowering blood lipid levels, with possible far-reaching beneficial side effects throughout the body. That may be especially worthy of note, given that drug companies already have a TGH blocker. In fact, Lehner’s team earlier showed that the TGH-inhibiting drug can lower the secretion of VLDL from liver cells. But it was not clear whether the drug was really acting only on TGH. The new findings add support to the notion that loss of TGH activity alone can have very significant and positive effects.

“But there is still a lot more work to do,” Lehner says. He and his colleagues plan to see what happens when mice on a high-fat diet lose the enzyme, noting that the mice in

the amount of an individual nutrient that persons need for good health, depending on their age and gender. In brief, the opinions on fats suggest that intake should range between 20 and 35% of total energy intake, with different values given for infants and young children. EFSA also recommends limiting the intake of saturated and *trans* fats, with replacement by mono- and polyunsaturated fatty acids. The panel also found that a daily intake by adults of 250 mg of long-chain omega-3 fatty acids may reduce the risk of heart disease.

■ ■ ■

Seven months of CLA supplementation in children was shown to reduce body fat mass by 0.5% and total body weight by 0.1%, compared with increases of 1.3% and 0.4% in the placebo group, respectively, according to findings from a randomized, double-blind, placebo-controlled trial published in the *American Journal of Clinical Nutrition* (doi:10.3945/ajcn.2009.28404). This apparently is the first study on body fat-lowering effects of CLA in overweight and obese children. Dale Schoeller of the University of Wisconsin—Madison (USA) led the research.

■ ■ ■

New research out of Hong Kong suggests that common hydrocolloids may inhibit the formation of acrylamide in French fries (crisps). Writing in *Food Chemistry* (121:424–428, 2010), researchers led by X. Zeng report on eight hydrocolloids (alginic acid, carrageenan, carob gum, hydroxypropyl distarch phosphate, pectin, xanthan gum, agar, and gelatin) added at a 2% concentration. Pectin and alginic acid reduced acrylamide levels by more than 50% and xanthan gum by 20%; the others required a 5% concentration to produce an effect. ■



the current study were eating regular chow. They also want to find out what happens when the enzyme is lost only in specific tissues—fat tissue, for example—instead of throughout the body.

One would also want to be careful that the chemical inhibitor targets TGH and not other enzymes in the same family. For the most part, scientists do not know what those other enzymes are doing, Lehner says, and—at least until they do—specificity will be key.

“We’ve answered a small piece of the puzzle, and this is or could be a good target,” Lehner says, although he emphasizes caution. “Would it be a magic bullet? Now, that’s something else that has yet to be seen.”

## Dietary fat and endometriosis

A team of scientists from a number of medical schools and universities in Boston, Massachusetts, USA, examined the connection between dietary fat intake and the risk of endometriosis. Led by Stacey A. Missmer, the team analyzed 12 years of prospective data from the Nurses’ Health Study II.

“Dietary fat intake was assessed via a food frequency questionnaire from three separate years and adjusted for total energy intake, parity, race, and body mass index at age 18,” *RSSL Food eNews* noted. “The cumulatively averaged fat intake was assessed across the three diet questionnaires. During the 586,153 person-years of follow-up, 1,199 cases of confirmed endometriosis were reported.”

Although total fat consumption was not linked with endometriosis risk, those women in the highest quintile of long-chain omega-3 fatty acid consumption were 22% less likely to be diagnosed with endometriosis compared with those in the lowest fifth of intake. “In addition, those in the highest quintile of *trans*-unsaturated fat intake were 48% more likely to be diagnosed with endometriosis,” *RSSL* said.

The study authors conclude that specific types of dietary fat are associated with the incidence of endometriosis and that these relations may indicate modifiable risk. They further argue for removal of *trans* fat from the food supply.

The study appeared in *Human Reproduction* (doi:10.1093/humrep/deq044).

## Let there be light

Gene E. Lester, a plant physiologist with the US Department of Agriculture’s Agricultural Research Service in Weslaco, Texas, had a eureka moment in the produce aisle of his local grocery store. And even though his research does not relate to fats and oils, it remains interesting to all who purchase fresh food from grocery stores.

As Lester gazed at the clear plastic tubs of fresh spinach basking under fluorescent light for 24 hours/day, he wondered how the continuous light affected the nutrient content of the leaves. Back to the laboratory he went, where he exposed two varieties of spinach (flat- and crinkle-leaf) to simulated supermarket conditions. The spinach was stored in clear sealed plastic at 39°F (almost 4°C) under continuous fluorescent light for up to nine days. Then he tested the leaves for their vitamin content, comparing the results with spinach that had been stored in darkness.

Sure enough, leaves exposed to light had higher levels of all vitamins except some from the vitamin A family, showing that photosynthesis was occurring. After three days, concentrations of some vitamins rose by between 10 and 20%. After nine days, folate and vitamin K levels had increased by as much as 100%. In spinach stored in an opaque paper bag, nutrient content stayed the same or diminished over time.

Lester was quick to note to *The New York Times* that the amount of photosynthesis would vary, with leaves packed on top exhibiting more and bottom leaves less. But his work suggests changing packaging to use shallower boxes or bags could be of benefit to consumers, he said.

The study appeared in the *Journal of Agricultural and Food Chemistry* (58:2980–2987, 2010). ■

## information

Did you know that *inform* provides news updates on the AOCS homepage at [www.aocs.org](http://www.aocs.org)? As well as alerts on Twitter at [www.twitter.com/theAOCS](http://www.twitter.com/theAOCS) and Facebook at [www.facebook.com/AOCSFan?](http://www.facebook.com/AOCSFan?)





## Briefs

Evogene Ltd. (Rehovot, Israel) and Biogemma SAS (Paris, France) announced in March the signing of a licensing agreement for the development and commercialization by Biogemma of hybrid corn lines, displaying improved yield and drought tolerance. The improved corn lines will incorporate certain Evogene-discovered genes that have been jointly evaluated by the parties through a collaboration initiated in 2006. Under the newly signed licensing agreement, Biogemma receives worldwide exclusive commercialization rights to the genes for corn; financial terms of the agreement were not disclosed.



Syngenta Seeds, Inc. (Minnetonka, Minnesota, USA) announced in April that it had received deregulation from the US Department of Agriculture (USDA) for its Agrisure Viptera trait. The Agrisure Viptera trait will be combined with the Agrisure 3000GT trait stack to form the new Agrisure Viptera 3111 trait stack for corn.

The Agrisure Viptera 3111 trait stack is able to provide its spectrum of above-ground insect control because of Vip3A, the industry's first non-Cry (noncrystalline) insect control protein. Vip3A has demonstrated control of the multipest complex of 14 insects, including corn earworm, fall armyworm, western bean cutworm, black cutworm, dingy cutworm, stalk borer, and sugarcane borer, among others. Beyond in-field yield and grain quality reductions, the damage from the multipest complex also allows spores from fungi to gain access, proliferate, and produce mycotoxins. In research conducted by Texas A&M University (College Station, USA) and Syngenta, the Agrisure Viptera trait demonstrated an ability to reduce development of molds and mycotoxins.

Corn hybrids containing the Agrisure Viptera trait will be available for planting in the United States in 2011, following receipt of key import market approvals. Growers in selected areas

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# Biotechnology News



## Insect behavior affects evolution of Bt resistance

Bt-cotton has been cultivated on a large scale in countries such as China, India and the United States for more than 13 years. According to research carried out by the Plant Sciences Group of Wageningen University and Research Centre (WUR; Netherlands) in collaboration with the University of North Carolina (Chapel Hill, USA), the crops' resistance has rarely been broken during this period. This can likely be attributed to the fact that some insect pest individuals have a preference for laying eggs on other plants. The larvae from those eggs will develop normally, giving them a selective advantage. The results were accepted for publication in the journal *Evolutionary Ecology* (DOI 10.1007/s10682-010-9368-3) in early February.

The scientists made their discovery using computer models. "These models show that the cultivation of, for instance, moth-resistant cotton is evolutionarily beneficial for female moths that prefer laying their eggs on other plant species," says

Marcel Dicke, professor of entomology at the Plant Sciences Group. "As a result, the majority of the moth population will acquire a genetic composition that makes them avoid laying their eggs on cotton and prefer to do so on other host plants. This implies that the cotton plants will remain durably resistant and free from pest insects, while the moths can survive elsewhere in nature."

This is the first time that research has been performed into the effect of insect behavior on the durability of plant resistance against insects in genetically modified (GM) crops.

"It is actually quite remarkable that this issue has never been investigated in this way," says Maarten Jongsma, scientist at Plant Research International of the Plant Sciences Group. "Based on other modeling studies, it was generally believed that the resistance to insects was not durable and could only be made to last longer by planting both resistant and non-resistant plants together in order to reduce the selection pressure. This is why US professor Fred Gould, who has also been involved in the research, developed the refuge strategy, which was adopted as official policy. But our research shows that the chance of breaking the resis-

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will, however, have the opportunity to view the Agrisure Viptera trait at Syngenta field trials in summer 2010.



In early April, Monsanto Co. (St. Louis, Missouri, USA) broke ground on a multimillion dollar expansion of the company's Asgrow® soybean seed production facility in West Fargo, North Dakota, USA. The site had previously been a sunflowerseed production facility. With the sale of Monsanto's sunflower business to Syngenta in August 2009, the site is now being converted and expanded to support Monsanto's growing soybean business.



At the end of March, the University of Illinois (Urbana-Champaign, USA) announced that Chromatin, Inc., a biotechnology company that has occupied space in the University's Research Park since 2005 as part of the EnterpriseWorks incubator, is expanding operations and graduating to a 5,000-square-foot (460-m<sup>2</sup>) facility in the Research Park. With the larger laboratory and office space, the company will continue to expand its research and development activities, which enable the development of new seed products and the delivery of multiple genetic traits in plants through gene-stacking, while widening its focus to pursue new applications, such as improved feedstocks targeting the bio-energy sector.

Chromatin has licensed its technology through commercial agreements with leading agbiotech companies—including Syngenta, Monsanto, Dow AgroSciences, and Bayer CropScience—for applications including corn, soybeans, cotton, sugarcane, and canola. ■

tance may be much smaller than the chance of changing insect behavioral preferences.”

## INCREASE IN GM CROPS

Bt-cotton and Bt-maize genetically engineered for resistance to the larvae of specific moths have successfully been introduced worldwide. The introduced genes code for toxins that are naturally present in *Bacillus thuringiensis* bacteria. In the United States, China, and India, the method is used to protect nearly all cotton against the main pest insects, resulting in increased yields and lower costs for combating insects.

There has always been a concern, however, that pest insects would eventually become insensitive to the plants' resistance and undo the progress made. This is why computer models were used 15 years ago to predict the likely effect of the presence of insensitivity genes in insect populations, which would allow them to survive on the Bt crop. Those models predicted that such genes would surface in insect populations within 10 generations in case of dominant genes. Should these insensitivity genes be inherited recessively, the majority of the population would be insensitive to the plants' within only 30 generations.

## REFUGE APPROACH

By planting resistant plants mixed with non-resistant plants, the development of insensitive insects was expected to slow down due to reduced selection pressures. This concept is the rationale behind the refuge strategy, which has been applied over the past 13 years, forcing farmers to sow 20% of their acreage with susceptible plants. As a result a susceptible insect pest population is maintained, in order to maintain an effective plant resistance.

Meanwhile, some 50 generations of moths have now been exposed to Bt-cotton without the insect becoming notably insensitive to the resistance. Although this success was until recently attributed to the refuge strategy, this research suggests that this was not the most important factor. The egg-laying behavior of female moths may have had a much larger impact.

## DEVELOPMENTS IN INDIA

In March, Monsanto Co. (St. Louis, Missouri, USA) reported that, during field monitoring of the 2009 cotton crop in the Indian state of Gujarat, Monsanto and Mahyco (Maharashtra Hybrid Seeds Co.

Ltd., Dawalwadi, India) scientists detected unusual survival of pink bollworm to first-generation single-protein Bollgard cotton. Monsanto reported that testing was conducted to assess for resistance to Cry1Ac, the Bt protein in Bollgard cotton, and pink bollworm resistance to Cry1Ac was confirmed in four districts in Gujarat: Amreli, Bhavnagar, Junagarh, and Rajkot. The company stated that, to date, no insect resistance to Cry1Ac has been confirmed outside the four districts in Gujarat.

This has been reported to the Indian Genetic Engineering Approval Committee. Mahyco-Monsanto Biotech in collaboration with the Central Institute of Cotton Research and other agricultural research institutes have been conducting field monitoring research across India since 2003, the second season of Bt cotton in India.

Single-protein Cry1Ac products continue to control bollworm pests other than pink bollworm in the four districts in Gujarat where pink bollworm resistance has been confirmed. In addition, no instance of insect resistance in any of India's cotton-growing states, including the four districts in Gujarat, has been observed with Bollgard II, the second-generation Bt cotton technology. Bollgard II, introduced in 2006, contains two proteins, Cry1Ac and Cry2Ab.

The company reported that current monitoring efforts to manage insect resistance by an Indian-expert network will be expanded.

## Canola research zeroes in on plant hormone, nectar production

Rapeseed is one of the 10 most important agricultural crops worldwide. This past winter, rapeseed was cultivated on 1.46 million hectares in Germany; at least 2.2 million metric tons of rapeseed oil is anticipated. Beekeepers set up their beehives in the vicinity of rapeseed fields, so that the worker bees can gather nectar. This ensures that the rapeseed flowers are pollinated and a high crop yield will be obtained. During her Ph.D. studies at the Max Planck Institute for Chemical Ecology (Jena, Germany), Venkatesan Radhika has discovered that the plant hormone jasmonic acid—known as a signaling molecule after herbivory—not



only regulates flower development in the bud stage but also triggers nectar production.

Jasmonic acid and related molecules are constituents of molecular signal transduction chains in plant tissues. These compounds—generally referred to as jasmonates—are synthesized when caterpillars feed on plants; they are signaling substances and belong to the group of plant hormones.

By producing jasmonates, the plant regulates its defense against herbivores, for example, by stimulating the synthesis of toxins. Moreover, previous studies have shown that jasmonates regulate the production of “extrafloral nectar.” This particular nectar, which is produced by special glands called “extrafloral nectaries,” has nothing to do with pollination, but attracts ants to the herbivore-attacked plants as defenders against their pests. The sugars in the nectar reward the ants for defending the plant. The same principle applies to floral nectar: Nectar production in the flowers attracts and rewards pollinators, which in turn contribute substantially to the seed yield. However, up to now, it has not been clear how nectar production is regulated in the flowers.

## DIFFERENT EFFECTS IN FLOWERS AND LEAVES

Radhika studied oilseed rape (*Brassica napus*). She found that when its flower tissues produced jasmonates during an early developmental stage, nectar production was immediately activated, regardless of whether the plant had been attacked by herbivores or not.

“When we put caterpillars on the rapeseed leaves to elicit jasmonic acid production, the nectar secretion of the flowers was not affected,” Radhika said.

Spraying jasmonic acid on the green leaves also had no impact on the production of nectar in the flowers. However, when the scientist sprayed jasmonic acid directly on the flowers, nectar production increased dramatically. This clearly indicates that jasmonic acid has different functions in the different plant tissues: Whereas the hormone activates defense mechanisms against herbivores in the leaves and the shoot of the plant, it regulates nectar production in the flower tissue.

The correlation between the production of jasmonic acid and nectar accumulation was demonstrated in experiments with an inhibitor: If the flowers were treated with phenidone, an inhibitor of jasmonic acid synthesis, nectar production failed. If

the substance was sprayed on young, still-closed flower buds, however, their opening was inhibited, which confirms the importance of jasmonic acid also during the development of the flowers.

“The fact that jasmonic acid regulates so many functions, such as plant defense and pollination, is extremely interesting and raises new questions, especially concerning the evolution of these control mechanisms,” says Martin Heil, the leader of the study.

Wilhelm Boland, director at the Max Planck Institute in Jena, emphasizes: “The more we know about the hormonal effects on flower development and nectar production in agricultural crops like rapeseed, the better we can use this knowledge to ensure high yields.”

The research was published in *PLoS ONE* 5:e9265 (2010).

## Seasonal changes and flowering time in maize

In a research report published in the March 2010 issue of the journal *Genetics* (184:799–812, 2010), scientists used tropical maize from Mexico and Thailand to discover chromosome regions responsible for detecting seasonal changes in flowering time (called the “photoperiod response”). This discovery may lead to higher crop yields, improved disease resistance, and heartier plants able to withstand severe weather. Corn is used for food, feed, sweetener, fuel, plastics, and more.

“Photoperiod response is the major barrier to using tropical maize for the improvement of temperate maize varieties,” said James B. Holland, a researcher involved in the work from the US Department of Agriculture, Agricultural Research Service, Plant Science Research Unit at North Carolina State University (Raleigh). “By understanding the genetics of this barrier, we hope to be able to overcome it more quickly to broaden the genetic diversity of temperate maize.”

To discover these regions of the plant’s genome, researchers interbred two tropical, photoperiod-sensitive corn lines (one from Mexico; one from Thailand) with two photoperiod-insensitive corn lines from the United States and grew out hundreds of progeny lines in North Carolina (long day-length summers) and in Florida

(short day-length winters). Lines with strong photoperiod response were identified as those flowering much later in North Carolina, compared to Florida. Researchers then genetically mapped all of the lines and identified DNA markers associated with the photoperiod response. The genomic regions carrying the major photoperiod response genes were then identified.

In addition to allowing for improved strains of domestic corn, the research also is important because it suggests that the genes controlling the photoperiod response in corn are at least partly distinct from those believed to control photoperiod response in model plant species such as *Arabidopsis* (mustard weed) and rice. Future studies to pinpoint specific genes involved in the photoperiod response, however, will be necessary to draw definitive conclusions.

## NRC report cites biotech pro, con

Many US farmers who grow genetically engineered (GE) crops are realizing substantial economic and environmental benefits—such as lower production costs, fewer pest problems, reduced use of pesticides, and better yields—compared with conventional crops, says a report from the National Research Council (NRC). However, GE crops resistant to the herbicide glyphosate—a main component in Roundup and other commercial weed killers—could develop more weed problems as weeds evolve their own resistance to glyphosate. GE crops could lose their effectiveness unless farmers also use other proven weed and insect management practices.

The report provides the first comprehensive assessment of how GE crops are affecting all US farmers, including those who grow conventional or organic crops. The new report follows several previous NRC reports that examined the potential human health and environmental effects of GE crops.

“Many American farmers are enjoying higher profits due to the widespread use of certain genetically engineered crops and are reducing environmental impacts on and off the farm,” said David Ervin, professor of environmental management and economics, Portland State University (Oregon, USA), and chair of the committee that wrote the report. “However, these benefits are not universal for all farmers. And as more GE traits

are developed and incorporated into a larger variety of crops, it's increasingly essential that we gain a better understanding of how genetic engineering technology will affect US agriculture and the environment now and in the future. Such gaps in our knowledge are preventing a full assessment of the environmental, economic, and other impacts of GE crops on farm sustainability."

First introduced in 1996, GE crops now constitute more than 80% of soybeans, corn, and cotton grown in the United States. GE soybeans, corn, and cotton are designed to be resistant to the herbicide glyphosate, which has fewer adverse environmental effects compared with most other herbicides used to control weeds. In addition to glyphosate resistance, GE corn and cotton plants also are designed to produce an endotoxin from *Bacillus thuringiensis* (Bt), a bacterium that is deadly when ingested by susceptible insect pests.

The report finds that farmers need to adopt better management practices to ensure that beneficial environmental effects of GE crops continue. In particular, farmers who grow GE herbicide-resistant crops should not rely exclusively on glyphosate and need to incorporate a range of weed management practices, including using other herbicide mixes.

At least nine species of weeds in the United States have evolved resistance to glyphosate since GE crops were introduced, largely because of repeated exposure. Federal and state government agencies, technology developers, universities, and other stakeholders should collaborate to document weed resistance problems and develop cost-effective ways to control weeds in current GE crops and new types of GE herbicide-resistant plants now under development.

## ENVIRONMENTAL BENEFITS

Improvements in water quality could prove to be the largest single benefit of GE crops, the report found. Insecticide use has declined since GE crops were introduced, and farmers who grow GE crops use fewer insecticides and herbicides that linger in soil and waterways. In addition, farmers who grow herbicide-resistant crops till less often to control weeds and are more likely to practice conservation tillage, which improves soil quality and water filtration and reduces erosion.

However, no infrastructure exists to track and analyze the effects that GE crops may have on water quality. The report

suggested that the US Geological Survey, along with other federal and state environmental agencies, should be provided with financial resources to document effects of GE crops on US watersheds.

The report also noted that although two types of insects have developed resistance to Bt, there have been few economic or agroeconomic consequences from resistance.

## ECONOMIC AND SOCIAL EFFECTS

In many cases, farmers who have adopted the use of GE crops have either lower production costs or higher yields, or sometimes both, due to more cost-effective weed and insect control and fewer losses from insect damage, the report says. Although these farmers have gained such economic benefits, more research is needed on the extent to which these advantages will change as pests adapt to GE crops, other countries adopt GE technology, and more GE traits are incorporated into existing and new crops.

The higher costs associated with GE seeds are not always offset financially by lower production costs or higher yields, the report notes. For example, farmers in areas with fewer weed and pest problems may not have as much improvement in terms of reducing crop losses. Even so, studies show that farmers value the greater flexibility in pesticide spraying that GE crops provide and the increased safety for workers from less exposure to harmful pesticides.

Farmers have not been adversely affected by the proprietary terms involved in patent-protected GE seeds, the report says. However, some farmers have expressed concern that consolidation of the US seed market will make it harder to purchase conventional seeds or those that have only specific GE traits. With the exception of the issue of seed industry consolidation, the effects of GE crops on other social factors of farming—such as labor dynamics, farm structure, or community viability—have largely been overlooked, the report says. More research is needed on the range of effects GE crops have on all farmers, including those who do not grow GE crops or farmers with less access to credit. Studies also should examine impacts on industries that rely on GE products, such as the livestock industry.

To purchase the full report, titled "Impact of Genetically Engineered Crops on Farm Sustainability in the United

States," visit [www.nap.edu/catalog.php?record\\_id=12804](http://www.nap.edu/catalog.php?record_id=12804).

## Soybean drought resistance sees possible advance

Research funded by the United Soybean Board (USB; Chesterfield, Missouri, USA) and soybean checkoff has identified two drought-tolerant soybean traits that perform well in US soybean varieties under moderate drought and normal conditions.

According to Larry Purcell, a professor and soybean researcher at the University of Arkansas (Fayetteville, USA), previous research into drought-tolerant plants has predominantly produced the same result: Drought-tolerant plants grow better than most plants during drought conditions, but they grow poorly under optimal growing conditions.

"For the two traits with which we have worked, we have sidestepped this problem," Purcell said. "This is a significant project that has produced many important discoveries for finding soybeans with agroeconomic advantages under moderate drought conditions."

Purcell said one of the traits allows the soybean plant to continue to accumulate nitrogen during moderate drought conditions while the other allows the plant to conserve water before the onset of a drought, helping it to be slow to wilt when the weather turns dry. Packaging these two traits in the same variety could be one of the more significant advances in drought-tolerant soybean research.

Public and private breeders now have these two traits available to them to incorporate into their varieties. Purcell says he has already received interest from breeders to begin doing so.

## Aluminum tolerance in sorghum, maize

A Cornell University researcher, in collaboration with Brazilian scientists, has cloned a unique sorghum gene that is being used to develop sorghum lines that can withstand toxic levels of aluminum in the soil,

CONTINUED ON PAGE 302



Anglo-Dutch consumer products giant Unilever and Solazyme, Inc. (South San Francisco, California, USA) have signed a research and development agreement to develop oil derived from algae for use in soaps and other personal care products. The agreement is the culmination of a year-long collaboration between the two companies, in which Solazyme's algal oils were tested successfully in Unilever product formulations.

Solazyme and Unilever are working to demonstrate a process to incorporate targeted algal oils into personal care products at a commercially relevant scale. Be sure to read the full-length feature story on algal oil in nonedible applications, scheduled for the June issue of *inform*.



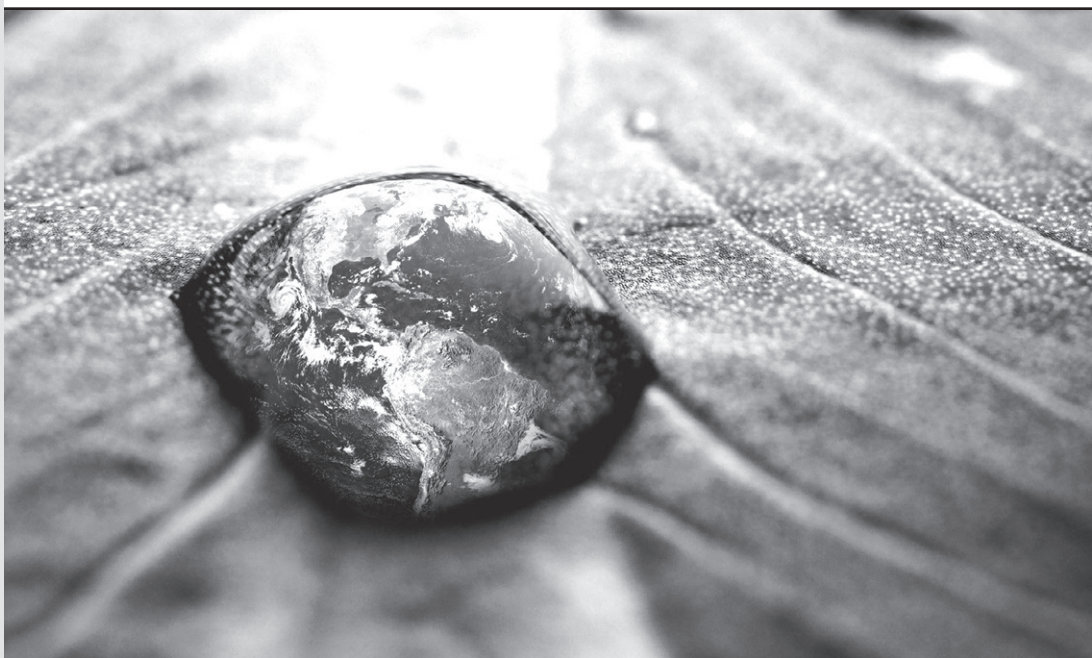
*HAPPI* magazine is reporting that the US Food and Drug Administration "may finally issue a final word on the Sunscreen Monograph. According to our source, that ruling may come as early as May . . . that is May 2010, not 2020.

"Call us cynical, but we've been waiting for this document since 1978 and while the US has waited, incidences of skin cancer have soared, and European companies and consumers have benefited from the introduction of new [ultraviolet] filters," Vice President/Editorial Director Tom Branna added.



US consumer confidence in the safety of cleaning products remains strong, according to a survey by The Soap and Detergent Association (Washington, DC, USA). Eighty-eight percent of adults believe that the cleaning products they buy are either safe or very safe when used as directed, results show. This is up from a 2008 SDA survey that showed 85% of Americans believed their cleaning products were safe or very safe when used as directed. The 2010 survey also shows that while 80% of respondents have read a cleaning product label at least once, only 8% always read the label. Echo Research questioned 1,008 US consumers via telephone February 25–28, 2010, for SDA ([www.cleaning101.com](http://www.cleaning101.com)). ■

# Surfactants, Detergents, & Personal Care News



## P&G talks sustainability before US House committee

*Len Sauers of The Procter & Gamble Co. testified before the US House Science and Technology Committee on March 17, 2010. Following is an excerpt of that testimony, as distributed by Federal Information and News Dispatch, Inc. The subject of Sauers' testimony was "The Future of Manufacturing: What Is the Role of the Federal Government in Supporting Innovation by US Manufacturers?"*

I am the vice president, global sustainability at Procter & Gamble (P&G; Cincinnati, Ohio, USA). I am responsible for the company's sustainability efforts. Four billion times a day, P&G brands touch the lives of people around the world. The company has one of the strongest portfolios of trusted, quality, leadership brands, including Pampers, Tide,

Pantene, Duracell, Olay, Gillette, and Braun. The P&G community includes approximately 135,000 employees working in about 80 countries worldwide.

I want to thank you, Mr. Chairman and Ranking Member Hall, for champion roles in supporting the America COMPETES Act, authorizing federal funding for basic research and development (R&D) and science, technology, engineering, and mathematics education [that] creates the opportunity for P&G to find future skills to effectively innovate. P&G is a member of the Task Force on American Innovation, whose mission it is to support basic research in the physical sciences and engineering.

Innovation is P&G's lifeblood. When we look at innovation, we are faced with three critical questions:

- How can we put consumer-driven innovation at the center of everything we do?
- How can we use innovation as a competitive advantage?
- How can we manage the risks of innovation?

CONTINUED ON NEXT PAGE

P&G invests over \$2 billion in innovation annually. We have 24 innovation centers on four continents with over 9,000 people in our R&D facilities. Over 1,000 Ph.D.s represent more than 120 scientific disciplines and hold over 35,000 patents globally. A few years ago, we set a goal for innovation, moving to an open innovation model. Our goal was that 50% of all initiatives needed to have at least one significant external partner.

We wanted to “turbo-charge” our innovation capacity. We built the capability to reach nearly two million researchers, entrepreneurs, and companies doing work in areas relevant to our businesses. Today, we’ve met and exceeded our 50% goal and we are now building the next generation of our “connect and develop” capability. Another key component of our innovation model is to develop an understanding of the consumer. Since 2001, we have spent over \$3 billion, more than double the industry average, to learn about the consumer. This leads us to breakthrough innovation, where we have delivered 110 new initiatives in the last 14 years that have made the Information Resources, Inc. (IRI) Pacesetter’s top 25 list. In 2008, P&G had five of the top 10 product launches in the United States and 10 of the top 25. We are expecting similar results when IRI announces [its] 2009 Pacesetter list.

At P&G, we focus our sustainability efforts to innovate improvements that matter to the consumer, making the most meaningful impact possible. . . . In 2007, we established five sustainability strategies and goals for 2012. In March, 2009 we increased our goals to reflect our progress and to demonstrate our ongoing commitment to sustainable, responsible growth. Our five sustainability strategies are:

- **Products**—Delight the consumer with sustainable innovations that improve the environmental profile of our products.
- **Operations**—Improve the environmental profile of P&G’s own operations.
- **Social responsibility**—Improve children’s lives through P&G’s social responsibility programs.
- **Employees**—Engage and equip all P&Gers to build sustainability thinking and practices into their everyday work.
- **Shape the future** by working transparently with our stakeholders to enable continued freedom to innovate in a responsible way.

## SUSTAINABLE PRODUCT INNOVATION

Our goal is to develop and market at least \$50 billion in cumulative sales of “sustainable innovation products,” which are products with a significantly reduced (>10%) environmental footprint versus previous or alternative products. We combine two key strengths—consumer understanding and science—to deliver sustainable innovations that do not require trade-offs in performance or value.

One example is helping consumers save energy and reduce their own greenhouse gas emissions through the development of sustainable products. We developed Tide Coldwater, a new product technology [that] focused on coldwater washing, which delivers the same cleaning performance consumers expect from hotwater washing. If every household in the United States used cold water for laundry, the energy savings would be 70–90 billion kilowatt hours per year, which is 3% of the total nation’s household energy consumption, while reducing CO<sub>2</sub> emissions by 34 million metric tons per year, which is about 7% of the US’s Kyoto target.

In 2007, we began to convert our North American liquid laundry detergent portfolio to a 2× concentrated formulation. This innovation created the following benefits: less water (saving 500 million liters a year); reduced CO<sub>2</sub> emissions by more than 100,000 metric tons (MT) a year; reduced the amount of packaging materials by 15,000 MT per year; and reduced the number of truck loads by 40,000 per year. And through our open innovation model, we partnered with one of our suppliers, which led to the development of a new polymer to be used in our powdered laundry detergent, which reduces surfactant levels while improving product performance.

## SUSTAINABLE OPERATIONAL IMPROVEMENT

We continue to drive conservation efforts in manufacturing. Between raw materials and the creation of a product, we strive to reduce waste, water, energy, and CO<sub>2</sub> through systematic conservation efforts. We apply smart eco-design through innovative construction process improvements. And we reuse where feasible, giving new life to what was once waste. We have expanded our work from

a focus on the core of our manufacturing operations to a holistic end-to-end view of opportunities. Our goal is to deliver an additional 20% reduction (per unit of production) in CO<sub>2</sub> emissions, energy consumption, water consumption, and disposed waste from P&G plants, leading to a total reduction over the decade of at least 50%.

We are proactively putting green technologies—including solar, wind, and geothermal—in our plants, where it makes good business sense. Examples of successful initiatives include the installation of a roof-mounted photovoltaic solar energy system at our Oxnard, California, USA, facility that is projected to produce more than 1.9 million kilowatt hours during the first year of operation. Over 20 years, this system is estimated to produce enough electricity to power over 3,200 homes for a year. Heat exchange units that capture heat for reuse at our paper plant in Mehoopany, Pennsylvania, USA, reduce carbon emissions by 13,600 MT/year, and the energy savings will be greater than the per-site energy consumption at 80% of our other facilities around the world. Finally, we have designed eco-efficiencies at our new paper plant facility being built in Box Elder County, Utah.

For decades, P&G has transported product in “multi-modal” fashion; that is, by using multiple forms of transport. But today, we are shifting toward “intermodal” transportation, which uses shipping containers that transfer smoothly from one mode to another. An intermodal approach optimizes the transportation process. A transportation program in North America, P&G’s first to incorporate an intermodal component, has reduced transportation costs and improved sustainability, saving 11 million liters of diesel fuel annually.

## OPPORTUNITIES FOR THE FEDERAL GOVERNMENT

We have identified five areas where the role of the US government is critical to innovation and manufacturing:

- The government needs to drive research in the area of renewable energy to develop more alternatives and a grid that can deliver the renewable energy sources to manufacturers.
- The America COMPETES Act needs to be reauthorized, which will lead to the creation of new markets and technologies.



- There is a need to continue to focus on science, technology, engineering, and mathematics education and training. These skills are needed so that we can attract and build the best and brightest workforce.
- There is a need to increase the collaborative government/industry innovation through the national laboratories. P&G has a successful partnership with Los Alamos National Lab, where a comprehensive approach was developed to reduce operating costs and minimize capital expenditures by predicting, preventing, and reducing equipment failures in our manufacturing operations.
- Finally, the best way to preserve and create US manufacturing jobs and innovation . . . is through sound and predictable policies, legislation, and regulation that will foster a competitive manufacturing environment. Innovation cannot move forward without a science-based regulatory framework in place. If not handled with care, the cumulative effect of new legislation and regulation will result in added cost, regulatory burden, and less rather than more flexibility for business.

## First US gel detergent debuts

Church & Dwight has introduced the first gel laundry detergent to the US market.

The product, Arm & Hammer Plus OxiClean Power Gel, is being advertised as having “more power in every drop,” with many word plays, such as “people everywhere are getting gel-ous” and statements that the product has “maximum gel-osity.”

Kevin Kuchinski, vice president—fabric care for Church & Dwight, told *Brandweek* magazine that the hope is that consumers will associate the gel format with “something we’ve seen in the medicine cabinet—faster pain relief, stronger action.” Kuchinski added that the concentrated gel form is 50% less expensive than comparable liquid detergents.

David Lockwood, director of consumer insights at market research company Mintel, thinks the other detergent majors will be watching closely. Most major detergent manufacturers sell gel-based products elsewhere in the world and presumably could

quickly roll out their own gel products if the Arm & Hammer product is a hit.

Kuchinski told the magazine he would “not be surprised” to see other gels on the US market soon.

## Crude oil production to peak earlier than expected?

In a finding that may speed work on alternative fuel sources, scientists in Kuwait predict that world conventional crude oil production will peak in 2014—almost a decade earlier than some other predictions. Their study

appears in *Energy & Fuels* (DOI:10.1021/ef901240p; <http://tinyurl.com/yb8tsjj>).

Using a new model, the scientists evaluated the oil production trends of 47 major oil-producing countries, which supply most of the world’s conventional crude oil. They estimated that worldwide conventional crude oil production will peak in 2014, years earlier than anticipated. The scientists also showed that the world’s oil reserves are being depleted at a rate of 2.1% a year. The new model could help inform energy-related decisions and public policy debate, they suggest.

The new numbers could also affect uptake by the major oil companies of chemically enhanced oil recovery methods that include surfactant flooding (see *inform* 20:682–685, 2009). ■

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# People News/ Inside AOCS

## USB recognizes Erhan, Galloway

At the Commodity Classic, held March 4–6 in Anaheim, California, USA, the United Soybean Board (USB) presented its Outstanding Achievement Award to AOCS member **Sevim Z. Erhan** for her research in



Erhan

expanding markets for soybean oil in the areas of soy-based printing inks, hydraulic fluids, and soy-based composites; her 200-plus publications; and her six US patents on printing inks. An example of her impact on the soybean industry is the development of soybean oil-based hydraulic fluids that have been incorporated into over 144,000

elevators by the US National Park Service.

Erhan, who is center director of the Eastern Regional Research Center, US Department of Agriculture, Agricultural Research Service, Wynd-



Galloway

moor, Pennsylvania, was recently elected to a two-year term as secretary of AOCS (*inform* 21:245, 2010). The USB Excellence in Domestic Marketing Award went to **Richard Galloway**, of the consulting firm Galloway and Associates LLC, for his work on soybean checkoff initiatives such as the Better Bean Initiative and QUALISOY. He has been instrumental in USB's efforts to bring improved soy oils to the market, including low-linoleic, high-oleic and, soon, high-stearic and omega-3.

er, Penn-

sylvania, was recently elected to a two-year term as secretary of AOCS (*inform* 21:245, 2010).

## Oilseed Processors elect new officers

At the annual meeting of the National Oilseed Processors Association (NOPA) in mid-February, new officers were elected.

**Tom Malecha**, vice president of protein sales for CHS, Mankato, Minnesota (USA), was elected to a two-year term as chairman. Other NOPA officers elected were: **Mark Van Emon**, vice president and general manager, oilseed processing division, Bunge North America, Inc., St. Louis, Missouri, as chairman-elect; **Mark Stonacek**, president, grain & oilseed supply chain, North America, Cargill, Wayzata, Minnesota, as secretary-treasurer; and **Greg Webb**, vice president, state government relations, Archer Daniels Midland Company, Decatur, Illinois, as immediate past chairman.

## Goodall, Maddox, Sanchez join BioCentric Energy

The new chief executive officer for BioCentric Energy Holdings (Santa Ana, California, USA) is **Brian Goodall**. He assumed this position on March 16 after more than 30 years with companies such as the Royal

## AOCS Corporate Member profile



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

N. Hunt Moore & Associates Inc.  
436 E. South Street  
Collierville, Tennessee 38017 USA  
Email: rich@nhmoore.com  
Phone: +1 901-362-3267

N. Hunt Moore & Associates Inc. offers solutions for the oil refining industry.

The company gets its name from a pioneer of the oilseed business, Hunt Moore, who founded the company in 1951. Today, N. Hunt Moore & Associates supplies equipment and engineering for oilseed preparation and extraction as well as for oil refining.

The company is partnered with OHMI Engineering, a global supplier of oil refining equipment. N. Hunt Moore & Associates further adds value through pre-engineering as well as engineering and technical support after the sale.

The owner and president of the company, Rich Barton, has over 28 years of experience in the oilseed industry. Most of that time has involved firsthand plant

experience as a process engineer, project manager, and plant superintendent.

The scope of work conducted by the company includes:

- Process layout/drawings
- Process design
- Equipment selection
- Equipment procurement
- Consultation during construction phase
- Start-up assistance
- Liaison between vendors and project management

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



Dutch/Shell group in Amsterdam and BF Goodrich. While working for US biofuels producer Imperium Renewables (Seattle, Washington), Goodall led the team that made the jet fuel for the first-ever commercial test flight of biofuel (Virgin Atlantic, London) in February 2008.

Goodall was most recently the vice president of downstream technology for Sapphire Energy (located in San Diego, California), where he was instrumental in enabling the use of algal-derived jet fuel in the first US commercial test flight (Continental Airlines, Houston, Texas) in January 2009 and algal-derived fuel for the Algaeus cross-country drive in the third quarter of 2009. Sapphire is known in the algae sector for its use of open-pond algae systems to generate green crude and drop-in replacement diesel, jet fuel, and gasoline.

**Domini Maddox** also joined BioCentric as an algae specialist on March 15. She formerly was with the University of Texas at Austin. **Jose Sanchez** began work with BioCentric on March 18 as its field operations director. Goodall commented that Sanchez assumed a “highly specialized position requiring proven experience in all aspects of microalgae production including the selection of production sites, procurement of the appropriate permits, validation of commercial algae production operations, and development of profitable algae products.”

## Skyberg now president of SANA

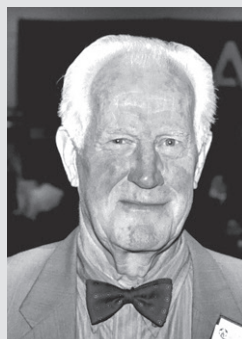
Aaron Skyberg of SK Food International (Fargo, North Dakota, USA) was recently elected president of the Soyfood Association of North America (SANA). Last year he served as vice president, and he has previously served on the board of directors for SANA. Kent Holt of Solae (St. Louis, Missouri) is the new vice president, and Deb Wycoff of Devansoy (Carroll, Iowa) is treasurer. SANA promotes and upholds the benefits of soy-based foods to consumers, health professionals, researchers, media, government officials, and industry partners. ■

### Interested in contributing to *inform* magazine?

Do you have a story that would be perfect for the pages of *inform*? A new development in your field that is sure to generate widespread interest? A profile of a colleague or institution? Been to a meeting whose hot topics stirred great debate? *inform* magazine is actively seeking the contributions of you and your colleagues. Contact *inform*'s managing editor at [jeremyc@aocs.org](mailto:jeremyc@aocs.org) for more information.

## In Memoriam

### JOHN M. DEMAN



Fats and oils researcher John M. deMan died on January 12, 2010, in Guelph, Ontario, Canada, at the age of 84. Born in the Netherlands, deMan earned a degree in chemical engineering and diploma in analytical chemistry despite the turmoil in Europe during and after World War II. His first professional job was with the Unilever Research Laboratory in Zwijndrecht, the Netherlands, where he worked for five years. With Unilever, he was involved in some of the first infrared spectrometry studies of butter flavor and of fatty acids.

deMan emigrated to Canada in 1954 and took a position at the University of Alberta (Edmonton) in the Dairy Science Department. There, he received the first Canadian Ph.D. granted for dairy research. His work included the study of the structure and function of fat crystals in butter, using polarized microscopy. After completing his doctorate he joined the faculty of the University and pursued research into the melting and solidification of milkfat, using some of the first differential thermal analysis instruments on the market. The advent of commercial gas-liquid chromatography instruments allowed his research to expand into studies of milkfat crystallization as a function of temperature and pressure.

In 1968 deMan left Alberta to become chairman of the new food science department at the University of Guelph. He continued his interests in the chemistry and analysis of fats and oils, crystal structure, polymorphism and rheological properties of fats; oxidative stability of fats, oils, margarines and shortenings; effect of light on vitamin stability; composition and properties of soybeans and soymilk; technology of tofu production; hydrogenation of canola oil; and palm oil utilization. He retired from the University of Guelph in 1990, but continued to participate in academic committees and to provide advice to students.

The North Central Section of AOCS presented the Alton E. Bailey Award to deMan in 1991 for his work on crystallization and textural characteristics of fats and oils. The presentation also recognized that he had written over 200 research publications during his career, including the book *Principles of Food Chemistry*, which went through three editions and became a standard text at many universities. He received the Lifetime Achievement Award from the Canadian Section of AOCS in 1995, as well as the Stephen S. Chang Award in Lipid Chemistry from the Institute of Food Technologists in 1997 and the Kaufmann Memorial Award from the International Society for Fat Research in 1997.

At the 98th AOCS Annual Meeting & Expo, one of the Hot Topics was the Dr. John deMan Honorary Session. deMan himself talked about points in his career that he considered important, and three other presentations by invited speakers reflected the influence of his work on our understanding fats and oils.

deMan joined AOCS in 1964.

He is survived by his wife Lena, with whom he frequently published; three children; and six grandchildren. ■

# Book Review

## *Dairy Fats and Related Products*

Adnan Y. Tamime (ed.)

Wiley-Blackwell, 2009, 344 pages

ISBN: 978-1-4051-5090-3, \$194.99

Tania Dey

*Dairy Fats and Related Products* serves as a useful technical reference for the scientific community. But because Chapters 4–8 focus on processing, a title such as *Processing of Dairy Fats and Related Products* would have been more appropriate. Those chapters have considerable information in common, which is understandable since dairy products are derived from the same source, i.e., milk. Several different products are discussed, but it is not clear why two of the most important products—cheese and ice cream—were not included.

Chapter 1 offers useful insight on the physical principles of milk lipids. According to the authors, the fatty acids in milk fat are from two sources: (a) *de novo* synthesis in the mammary gland and (b) uptake from circulating blood. The fatty acid profile of milk lipids is dynamic and is influenced by physiological and nutritional factors. This chapter also elucidates the colloidal stability of milk lipid globules (MLG), the numerical relationship between homogenization pressure and MLG particle size, and the crystallization of milk triacylglycerols, from a physical stand point. This concise, informative chapter serves as a nice gateway for the text.

Chapter 2 indicates that the most important bioactive component in milkfat is conjugated linoleic acid (CLA), the *cis*-9, *trans*-11, 18:2 isomer also referred to as rumenic acid; recent studies have demonstrated the anticancer properties of CLA. Sphingolipids, butyric acid, and branched-chain fatty acids may exhibit anticancer properties as well. This increases the importance of milkfat intake from sources such as whole milk and butter.

Chapter 3 notes that standardization of milkfat content is mainly achieved by centrifugation and, in certain cases, micro-filtration. The process of adjusting the fat content of a milk processing stream to a predefined concentration is called standardization. Readers should benefit from the physical model of this centrifugation-based separation process.

Chapter 4 covers in detail the four basic steps of cream production: separation, standardization, heat treatment, and homogenization. Production of different types of creams (whipping cream,

aerosol-whipped cream, cream liqueur, coffee cream, sour cream, etc.) are discussed. In addition, the effects of processing techniques, milk fat composition, and additives on the properties of milk cream products are presented.

Chapters 5–8 discuss the similar processing techniques used for butter, anhydrous milkfat, yellow fats/spreads and cream cheese, respectively. In my opinion, the chapters could be improved with more physical insight about processing and the use of schematics to illustrate those physical principles rather than flowcharts showing consecutive processing steps. However, readers with interests primarily in processing may benefit more from the flowcharts.

Chapter 9 describes the two major metabolites obtained by microbial reactions. The first metabolite is short-chain fatty acids, which have substantial beneficial health effects such as a reduction in colonic pH, an increase in colonic blood flow, an increase in calcium absorption in the gut, an increase in the modulation of intestinal mobility, regulation of the expression of the proglucagon gene, and the like. The second is  $\gamma$ -aminobutyric acid, which can exert positive effects such as growth hormone secretion control, modulation of cardiovascular functions, anti-proliferative properties of some cell types, and a stimulatory effect on the immune response.

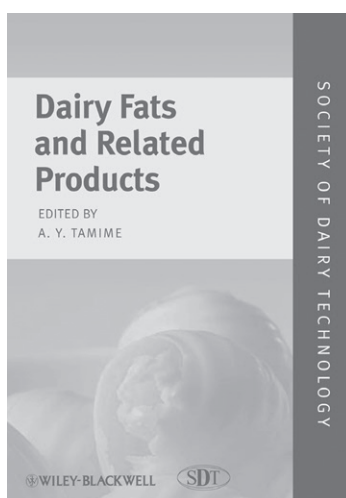
Chapter 10 is well written and provides insight on one of the typical problems associated with milk products, the occurrence of off-flavors. The sources can be amazingly varied such as transmitted flavors (from feedstocks, the barn and the cow itself), chemical flavors, flavors associated with oxidation, flavors associated with thermal processing, bacterial-induced flavors, lipolysis-derived flavors, proteolysis-derived flavors, and off-flavors derived from antibiotics. Some of these off-flavor defects can occur in cream, butter, dairy spreads, and other milk products. This chapter offers some food for thought for scientists interested in solving these problems.

Overall, the book is comprehensive, coherent, and informative, with a substantial amount of technical detail related to dairy fats and products—with an emphasis on processing techniques. The text editor, Adnan Y. Tamime, is a consultant in dairy science and technology from the United Kingdom. The book is targeted toward scientists and technologists working in the area of dairy processing. Faculty and students with research interests in this subject area should find it useful as well.

Interested readers may also want to consult the following online, full-text documents:

- [http://www.ilri.org/InfoServ/Webpub/Fulldocs/ILCA\\_Manual4/MilkProcessing.htm](http://www.ilri.org/InfoServ/Webpub/Fulldocs/ILCA_Manual4/MilkProcessing.htm)
- [nzic.org.nz/ChemProcesses/dairy/3B.pdf](http://nzic.org.nz/ChemProcesses/dairy/3B.pdf)
- [www.gea-westfalia.no/arch/\\_img/9044529.pdf](http://www.gea-westfalia.no/arch/_img/9044529.pdf)

*Tania Dey is a physical chemist by training. After completing her Ph.D. in 2002, she worked in the United States as a postdoctoral scientist for five years. Her research interests include surface science, polymer chemistry, and nanotechnology. Currently, she is a research associate at the University of Guelph in Canada, and she serves as an associate editor for the Central European Journal of Chemistry. She can be reached at [taniadey@hotmail.com](mailto:taniadey@hotmail.com).*





# Patents

## Published Patents

### Purification of biodiesel with adsorbent materials

Cooke, B.S., *et al.*, Dallas Group of America Inc., US7635398, December 22, 2009

A method of purifying a biodiesel fuel by contacting the biodiesel fuel with at least one adsorbent material such as magnesium silicate. Such method removes impurities such as soap formed during the production of biodiesel fuels.

### Method of producing liquid developer and liquid developer produced by the method

Teshima, T., Seiko Epson Corp., US7635550, December 22, 2009

A method of producing a liquid developer that comprises an insulation liquid and toner particles dispersed in the solution is provided. The method comprises the steps of: (i) preparing a kneaded material containing a coloring agent and a resin material; (ii) dispersing the kneaded material into an insulation liquid to obtain a molten state kneaded material dispersed liquid in which the kneaded material in a molten state is finely dispersed; and (iii) cooling the molten state kneaded material dispersed liquid to solidify the molten state kneaded material; wherein the insulation liquid contains as its major component an unsaturated fatty acid. According to the method it is possible to provide a liquid developer in which toner particles having a small particle size distribution and a uniform shape are dispersed so that properties of each component of the toner particles can be exhibited sufficiently. The liquid developer mentioned above is also harmless to environment.

### Process for the production of triacylglycerols

Dahlqvist, A., *et al.*, BASF Plant Science GmbH, US7635582, December 22, 2009

The present invention relates to the isolation, identification, and characterization of nucleotide sequences encoding an enzyme catalyzing the transfer of fatty acids from phospholipids to diacylglycerol in the biosynthetic pathway for the production of triacylglycerol, to said enzymes and process for the production of triacylglycerols.

### Micro-particle fatty acid salt solid dosage formulations for therapeutic agents

Opawale, F., and R. Soltero, Biocon Ltd., US7635675, December 22, 2009

Fatty acid salt particles having a size distribution wherein the particles are from about 1 to about 1,000 microns in diameter, use of the particles in pharmaceutical compositions, as well as methods of making and using the particles and compositions.

### Cellulosic-thermoplastic composite and method of making the same

Sigworth, W.D., *et al.*, Chemtura Corp., US7635731, December 22, 2009

Provided is a composition comprising fatty acid bis-amide, inorganic particulate such as pumice, cellulosic particulate, thermoplastic and maleic anhydride grafted polyolefin. The combination of an ethylene bis-amide and a minor amount of pumice produces cellulosic-thermoplastic composite that has superior extrusion properties over conventional metal stearate/ethylene bis-stearamide compositions such as improved flex strength and resistance to water absorption.

### Triacylglycerol based wax for use in container candles

Murphy, T.A., Elevance Renewable Sciences Inc., US7637968, December 29, 2009

A triacylglycerol-based wax, which may be used to form container candles, is disclosed. The triacylglycerol-based wax includes a triacylglycerol component and a polyol fatty acid partial ester component. The triacylglycerol-based wax typically has a melting point of about 49°C to 58°C. The triacylglycerol-based wax also generally has an iodine value of about 45 to 65. The triacylglycerol component tends to have a fatty acid composition including 5 to 13 wt% 16:0 fatty acid. Further, the fatty acid composition generally comprises about 45 to 60 wt% 18:1 fatty acid. The fatty acid composition also generally comprises about 30 to 45 wt% 18:0 fatty acid. The wax preferably contains little or no paraffin and free fatty acid. The polyol partial ester component is preferably a glycerol monoester of palmitic and stearic fatty acids, and is commonly present as less than about 5 wt% of the wax.

### Procedure to obtain biodiesel fuel with improved properties at low temperature

Delgado Puche, J., Industrial Management S.A., US7637969, December 29, 2009

Procedure to generate biodiesel fuels with improved properties at low temperature by the transesterification of triglycerides with alcohols such as methanol or ethanol, optionally in the presence of methyl or ethyl acetates of fatty acids and an inert solvent to produce methyl or ethyl esters of fatty acids, glycerine, and, where appropriate, glycerine triacetate, followed by the separation of crude glycerine that is reacted with aldehydes, ketones, and/or acetic acid or methyl or ethyl acetates to produce acetals, glycerine cetals, and/or glycerine acetates. The acetals, glycerine cetals, and/or glycerine acetates are mixed with methyl or ethyl esters of fatty acids in con-

centrations of approximately 0.5–20 wt% to obtain a biodiesel with improved properties at low temperatures.

## Antimicrobial and antiviral composition

Chandler, W., Global Life Technologies Corp., US7638147, December 29, 2009

An antimicrobial and antiviral barrier composition for topical application to the proximal anterior nares includes an antiseptic solution in combination with *Cocos nucifera* (coconut oil) and one or more citrus oils such as, for example, *Citrus sinensis* (orange oil). Various embodiments may also include one or more of the following additional ingredients: lauric acid; *d*-limonene; soy oil; emu oil; grapefruit seed extract; glycine soja; aloe vera; and a preservative, such as sodium benzoate.

## Pan spray formulation and delivery system

Paul, L., and P. Friedman, HAP International, Inc., US7638154, December 29, 2009

By combining lecithin and oil as the principal ingredients, a highly effective, uniform, widely dispersed, pan release spray product is achieved with the lecithin comprising a de-oiled powdered lecithin. The liquid lecithin and/or combinations thereof are blended with the vegetable oil, water, and/or alcohol to form a stable emulsion that exhibits superior pan release properties. Furthermore, the lecithin emulsions of the present invention are easily formulated with a variety of blending agents to make flavorful salad dressings, marinades, and pet flavor-enhancing products, as a nonaerosol finger pump-based product or as an aerosol product.

## Process for making soy protein products having reduced off-flavor

Irwin, A., *et al.*, Solae LLC, US7638155, December 29, 2009

Novel processes for the production of soy protein products, such as soy protein isolates and soy protein flour, having reduced off-flavors are disclosed. One process includes a three-step process including extraction utilizing a mixture of supercritical carbon dioxide and an organic solvent. The soy protein isolates produced by the processes described herein are suitable for use in numerous food products, including soymilk.

## Method

De Krijg, A., *et al.*, Danisco A/S, US7638293, December 29, 2009

Provided is a method of producing one or more of a carbohydrate ester, a protein ester, a protein subunit ester, or a hydroxyl acid ester. The method comprises admixing an acyl donor, an acyl acceptor, and water to produce a high water environment comprising 5–98% water. Preferably, the acyl donor is a lipid substrate selected from one or more of the group consisting of a phospholipid, a lysophospholipid, a triacylglyceride, a diglyceride, a glycolipid, or a lysoglycolipid. Preferably, the acyl acceptor is selected from one or

more of the group consisting of a carbohydrate, a protein, a protein subunit, or a hydroxyl acid. The method further comprises contacting the admixture with a lipid acyltransferase, such that said lipid acyl transferase catalyzes alcoholysis and/or transesterification.

## Production of biodiesel and other valuable chemicals from wastewater treatment plant sludges

Zappi, M.E., *et al.*, Mississippi State University, US7638314, December 29, 2009

A process for producing biodiesel has been invented by first extracting lipids from the sludges generated during primary and/or biological treatment of municipal, agricultural, and industrial wastewaters using primary, secondary, and tertiary treatments followed by the transesterification of the extracted lipids using transesterification conversion into alcohol-based esters. The resulting products from this process include biodiesel, glycerol, lipid-free proteins, various other useful chemicals, and an aqueous-based substrate well suited for optimized digestion within subsequent biological digestion (either aerobic or anaerobic). The lipids extracted from the sludges containing high levels of microorganisms are phospholipids, which can also be directly used as lecithin. The extraction of the lipids from the sludges will be performed using chemical extraction techniques with the transesterification of the extracted lipids accomplished using basic, acidic, and/or a combination of the two transesterification techniques.

## Lipolytic enzymes variants

Borch, K., *et al.*, Novozymes A/S, US7638317, December 29, 2009

The inventors have developed improved polypeptides by substituting or deleting specified amino acids in fungal lipolytic enzymes. More particularly, the polypeptides result in a reduction of dough stickiness when they are added to a dough. The polypeptides may particularly have activity on polar lipids.

## Assay and method for quantifying the levels of sterol esters and free sterols in starch-containing food products

Lewandowski, D.J., *et al.*, General Mills Inc., US7638336, December 29, 2009

The present invention relates to an assay for determining the levels of sterols, stanols, sterol esters, fatty acid derivatives, and combinations thereof in a starch-containing food product. The assay is particularly useful in supporting product health and/or nutritional claims in manufacturing products intended for human or animal consumption. The present invention describes a method for extracting sterol-related compounds and uses as an internal standard a sterol ester, preferably cholesteryl oleate. By using the present extraction technique the process enables the recovery of substantially all of the sterol-related compound in the sample.



## Thinners for invert emulsions

Mueller, H., *et al.*, Halliburton Energy Services, Inc., US7638466, December 29, 2009

A method of reducing the viscosity of invert emulsions and oil-based drilling fluids and well service fluids comprising such emulsions over a broad temperature range is disclosed. The method comprises adding to said invert emulsions of the invention a non-ionic surfactant alone or in combination with a co-thinner having the formula:  $R'''-(C_2H_4O)_n(C_3H_6O)_m(C_4H_8O)_k-H$  where  $R'''$  is a saturated or unsaturated, linear or branched, alkyl radical having about 8 to about 24 carbon atoms,  $n$  is a number ranging from about 1 to about 10,  $m$  is a number ranging from about 0 to about 10, and  $k$  is a number ranging from about 0 to about 10. The nonionic surfactant is a reaction product of ethylene oxide, propylene oxide, and/or butylene oxide with  $C_{10-22}$  carboxylic acids or  $C_{10-22}$  carboxylic acid derivatives containing at least in position 9/10 and/or 13/14 structural units of general formula (I) where  $R_1$  is a hydrogen atom or an OH group or a group  $OR_2$ ,  $R_2$  is an alkyl group of about 1 to about 18 carbon atoms, an alkenyl group of about 2 to about 18 carbons atoms, or a group of the formula (II):  $R_3$  is a hydrogen atom, an alkyl group of about 1 to about 21 carbon atoms or an alkylene group of 2 to 21 carbon atoms.

## Method for producing alcohol

Sakamoto, T., *et al.*, Kao Corp., US7642386, January 5, 2010

The invention relates to a process for producing an alcohol from fats and oils including: step 1 of reacting starting fats and oils with water to produce a reaction product containing a glycerin unit and step 2 of subjecting the reaction product obtained in step 1 to a hydrogenation reaction in the presence of a catalyst in the coexistence of water in an amount of 0.5 mole or more relative to 1 mole of the glycerin unit contained in the reaction product.

## Compositions and methods for targeting cancer cells

Kucera, L.S., *et al.*, University of North Carolina at Chapel Hill and Wake Forest University School of Medicine, US7638528, December 29, 2009

The invention includes compositions and methods useful for treatment of a virus infection in a mammal by double-targeting the virus (i.e., targeting the virus at more than one stage of the virus life cycle) and thereby inhibiting virus replication. The compositions of the invention include compounds that comprise a phosphocholine moiety covalently conjugated with one or more antiviral agents (e.g., nucleoside analog, protease inhibitor, etc.) to a lipid backbone. The invention also includes pharmaceutical compositions and kits for use in treatment of a virus infection in mammals. The methods of the invention comprise administering a compound of the invention, a pharmaceutically acceptable salt thereof, or a pharmaceutical composition of the invention, in an amount effective to treat the infection, to a mammal infected with a virus. Additionally, the invention includes compositions and methods useful for combating a cancer in a mammal and for facilitating delivery of a therapeutic agent to a mammalian cell. The compositions of the invention include compounds that comprise an alkyl lipid or phospholipid moiety

covalently conjugated with an anticancer agent (e.g., a nucleoside analog). The invention also includes pharmaceutical compositions and kits for combating a cancer and for facilitating delivery of a therapeutic agent to a mammalian cell. The methods of the invention comprise administering a compound of the invention, a pharmaceutically acceptable salt thereof, or a pharmaceutical composition of the invention, in an amount effective to combat a cancer or to facilitate delivery of a therapeutic agent to a mammalian cell.

## Polycarboxylic acid concrete admixture

Nishikawa, T., *et al.*, Nippon Catalytic Chem Ind, US7638563, December 29, 2009

The polycarboxylic acid concrete admixture of the present invention exhibits properties such as decreasing the concrete viscosity, improving the slump-retaining ability, and suppressing bleeding water and is improved in the ability to cement compositions or the like. The above-mentioned polycarboxylic acid concrete admixture comprises a polycarboxylic acid polymer containing a polyalkylene glycol in the side chain, wherein the polycarboxylic acid polymer is obtained by polymerizing monomer components containing an alkyl (meth)acrylate monomer and a specific polyalkylene glycol unsaturated monomer and unsaturated carboxylic acid (salt) monomer, and it has a specific weight average molecular weight.

## Tooth whitening compositions and delivery systems therefor

Gebreselassie, P., and N. Boghani, Cadbury Adams USA LLC, US7641892, January 5, 2010

Stain-removing oral compositions such as gum compositions are herein provided. The compositions include an orally acceptable carrier and a stain-removing anionic surfactant. The surfactant includes a fatty acid salt having at least one hydroxyl functionality. The fatty acid salt may be a salt of ricinoleic acid and may be combined with a chelating agent and/or an abrasive. The chelating agent may be a polyphosphate, and the abrasive may be a silica abrasive.

## Chocolate products and ingredients and methods for producing novel oil-in-water suspensions

Hanselmann, W., The Hershey Co., US7641930, January 5, 2010

The invention provides novel means and methods for manipulating cocoa and milk ingredients, for example, to produce edible oil-in-water suspensions. In one embodiment, cocoa products are used to produce a gel network formed by cocoa starches and/or proteins. The suspension is formed with milk proteins and cocoa solids and also comprises crystallized cocoa butter as a dispersed component, and water or skim milk as the continuous phase or aqueous phase. The compositions, products, and ingredients possible according to the invention provide novel methods and components for low- or reduced-calorie or sugar-free chocolate products or ingredients having the same cocoa content as conventional chocolate and/or falling within the standard of identity for chocolate products.

In addition, the production and packaging options for chocolate products are expanded by the use of the invention as the viscosity of the chocolate product or ingredient can be varied easily without specific reliance on cocoa butter content.

## Processes for coating an animal feed to obtain coated animal feed products

Harris, J.M., and P. Mostyn, Westway Trading Corp., US7645471, January 12, 2010

A process of coating an animal feed to obtain a coated animal feed product is provided. The process includes the step of applying a first coating to the animal feed, wherein the first coating comprises at least 20% by weight of sugar selected from the group consisting of monosaccharide, disaccharide, and any combination thereof in any proportion. The process also includes the step of applying a second coating to the animal feed, wherein the second coating comprises at least 20% by weight of phospholipid.

## Fat composition

Herzing, A.G., *et al.*, Loders Croklaan USA LLC, US7645473, January 12, 2010

A vegetable fat composition comprises glycerides, wherein the triglyceride content of the composition is: 6 to 20% SSS, 5 to less than 20% SUS, 5 to less than 25% SSU, 10 to 39% SU<sub>2</sub>, and at least 20% U<sub>3</sub>, wherein S is a saturated fatty acid residue having 16 to 24 carbon atoms and U is an unsaturated fatty acid residue having at least 18 carbon atoms and all percentages are by weight based on the total triglycerides present in the composition, the weight ratio SUS/SSU

is between 0.5 and 2.0, the weight ratio of (saturated fatty acid residues having 18 to 24 carbon atoms)/(saturated fatty acid residues having 16 carbon atoms) in the total S content of the triglycerides is less than 0.2, and the triglycerides contain less than 3% of arachidic and behenic acid residues based on the total fatty acid residue content of the triglycerides, and wherein the saturated fatty acid residue content of the triglycerides is less than 45% by weight of the total fatty acid residues in the triglycerides. The composition may be used to produce baked products and iced confectionery products.

## $\Delta$ -9 elongases and their use in making polyunsaturated fatty acids

Damude, H.G., *et al.*, E.I. Du Pont de Nemours and Co., US7645604, January 12, 2010

The present invention relates to  $\Delta$ -9 elongases, which have the ability to convert linoleic acid [18:2] to eicosadienoic acid [20:2]. Isolated nucleic acid fragments and recombinant constructs comprising such fragments encoding  $\Delta$ -9 elongase along with methods of making long-chain polyunsaturated fatty acids (PUFA) using these  $\Delta$ -9 elongases in plants and oleaginous yeast are disclosed. ■

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@admworld.com](mailto:scott_bloomer@admworld.com).



## BIOTECHNOLOGY NEWS (CONTINUED FROM PAGE 292)

a consequence of acidic soils. Acidic soils limit crop production in half the world's potentially arable land, mostly in developing countries in Africa, Asia, and South America, said Leon Kochian, Cornell adjunct professor of plant biology and director of the US Department of Agriculture-Agricultural Research Service Robert W. Holley Center for Agriculture and Health at Cornell (Ithaca, New York, USA). He hopes that the research will one day help farmers in developing countries significantly boost their crop.

Kochian's work has included identifying and characterizing an aluminum tolerance gene in certain lines of sorghum and using molecular breeding techniques to introduce this gene into lines used for sorghum breeding in Africa. He and Jurandir Magalhaes, of the Embrapa Maize and Sorghum lab in Brazil, started this project for Magalhaes' Ph.D. research at Cornell in Kochian's lab. He added that they have also found evidence for a number of variants of this tolerance gene that underlies the wide variation in sorghum aluminum tolerance.

Aluminum tolerance is found in a small number of sorghum varieties, he said, where this gene encodes a novel membrane transporter protein in the root tip that mediates the release of citric acid into the soil when the roots are exposed to aluminum. The citric acid binds aluminum ions and prevents the toxic metal from entering the roots.

Since Kochian and colleagues identified this gene, they have found evidence for other genes that also play a role in aluminum tolerance, he said. In work led by Magalhaes, the researchers introduced the region of the sorghum genome that harbors their aluminum tolerance gene from a number of tolerant sorghum lines into a common breeding line that is aluminum sensitive. When they did this, a significant degree of the tolerance in the donor line was lost, which strongly suggests that other genes are also needed for full expression and function of their aluminum tolerance gene.

Kochian's lab has used this information from sorghum to identify the first aluminum tolerance gene in maize, and in collaboration with Embrapa, similar molecular genetic approaches are being used to improve maize tolerance on acidic soils. ■

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# Extracts & Distillates

## Oxidative stability at high temperatures of oleyl and linoleoyl residues in the forms of phosphatidylcholines and triacylglycerols

Le Grandois, J., *et al.*, *J. Agric. Food Chem.* 58:2973–2979, 2010.

An investigation was carried out into the stability of fatty acyl groups to heat-induced oxidative changes as affected by their chemical environment. The behavior of oleic and linoleic acyl groups when esterified in triacylglycerols (TAG) and phosphatidylcholines (PC) was evaluated. Monitoring of the oxidative degradation using liquid chromatography–mass spectrometry showed that fatty acyl groups are less likely to be oxidized when in the form of PC than when in the form of TAG. In addition, oxidation products from PC were more stable than those from TAG. This finding strengthens the idea that the choline group in PC increases the stability of fatty acyl groups to oxidation in comparison to TAG.

## Docosahexaenoic acid metabolome in neural tumors: identification of cytotoxic intermediates

Gleissman, H., *et al.*, *FASEB J.* 24:906–915, 2010.

Docosahexaenoic acid (DHA) protects neural cells from stress-induced apoptosis. On the contrary, DHA exerts anticancer effects; and we have shown that DHA induces apoptosis in neuroblastoma, an embryonal tumor of the sympathetic nervous system. We now investigate the DHA metabolome in neuroblastoma using a targeted lipidomic approach to elucidate the mechanisms behind the DHA-induced cytotoxicity. Liquid chromatography–tandem mass spectrometry (LC-MS/MS) analysis was used to identify DHA-derived lipid mediators in neuroblastoma cells. Presence of the 15-lipoxygenase enzyme was investigated

using immunoblotting, and cytotoxic potency of DHA and DHA-derived compounds was compared using the MTT [3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide] cell viability assay. Neuroblastoma cells metabolized DHA to 17-hydroxydocosahexaenoic acid (17-HDHA) via 17-hydroperoxydocosahexaenoic acid (17-HpDHA) through 15-lipoxygenase and autoxidation. In contrast to normal neural cells, neuroblastoma cells did not produce the anti-inflammatory and protective lipid mediators, resolvins and protectins. 17-HpDHA had significant cytotoxic potency, with an  $IC_{50}$  of 3–6  $\mu$ M at 72 h, compared to 12–15  $\mu$ M for DHA.  $\alpha$ -Tocopherol protected cells from 17-HpDHA-induced cytotoxicity. DHA inhibited secretion of prostaglandin  $E_2$  and augmented the cytotoxic potency of the cyclooxygenase-2-inhibitor celecoxib. The cytotoxic effect of DHA in neuroblastoma is mediated through production of hydroperoxy fatty acids that accumulate to toxic intracellular levels with restricted production of its products, resolvins and protectins.

## Comparative study of high-linoleic acid vegetable oils for the production of conjugated linoleic acid

Gammill, W., *et al.*, *J. Agric. Food Chem.* 58:2952–2957, 2010.

Conjugated linoleic acid (CLA) is found in small quantities in dairy and beef products. Obtaining optimal dietary CLA levels from these sources requires an increased intake of saturated fat. A 20% CLA soy oil was produced by ultraviolet photoisomerization of soy oil linoleic acid (LA), which is naturally low in saturated fat, but no other high-LA vegetable oils have been studied for their potential as CLA-rich oils. The objectives of this research were (i) to compare flax, sunflower, corn, soy, and high-LA safflower oils as sources of CLA-rich vegetable oils using laboratory-scale equipment, (ii) to compare CLA yields obtained by laboratory-scale and pilot-scale equipment, and (iii) to compare the oxidative stabilities of laboratory-scale processed oils. High-LA safflower oil produced the most CLA; soy oil produced slightly less, followed by corn, with flax producing very little and sunflower none at all. Minor oil components and turbidity reduced CLA yields, suggesting that oils should be highly refined before CLA production. The

pilot-scale system was more effective than the laboratory-scale system due to greater light exposure and larger surface-area-to-volume ratio of the oil samples. The oxidative stabilities of high-LA safflower oil and soy oil were similar before or after irradiation, indicating that these oils are the most suitable for high-CLA production.

## Cholesterol and lipid oxidation in raw and pan-fried minced beef stored under aerobic packaging

Feroli, F., *et al.*, *J. Sci. Food Agric.* 90:1050–1055, 2010.

The type of packaging atmosphere has been reported as a technological factor that consistently affects the quality of lipid fraction in meat. Oxidation of cholesterol and lipids was evaluated before and after pan-frying in commercial refrigerated minced beef stored under aerobic atmosphere for 1 and 8 days. The present research showed that in raw beef, cholesterol and lipid oxidation developed at a slow rate. Cholesterol oxidation products (COP) did not significantly vary ( $\sim 8 \mu$ g COP  $g^{-1}$  of fat) over 8 days, whereas in the same period thiobarbituric acid-reactive substances (TBARS) less than doubled (from 0.7 to 1.2 malondialdehyde equivalents  $kg^{-1}$  of muscle). Pan-frying did not influence the oxidative degree in the fresh product but consistently catalyzed cholesterol oxidation in stored beef. A significant increase was assessed in beef at the end of storage: from 8.6 to 30.0  $\mu$ g COP  $g^{-1}$  of fat in raw and cooked beef, respectively. Thus, aerobic packaging did not appear as a pro-oxidant factor in fresh minced beef with a good oxidative quality during a short period of refrigerated storage.

## Replacement of acetonitrile by ethanol as solvent in reversed phase chromatography of biomolecules

Brettschneider, V., *et al.*, *J. Chromatogr. B* 878:763–768, 2010

Acetonitrile, which is a by-product of acrylonitrile synthesis, is the commonly used solvent in ion-pair reversed-phase chromatography. In consequence of the decreasing demand for acrylonitrile due to the financial crisis, a worldwide shortage of acetonitrile is observed. Therefore, the aim of

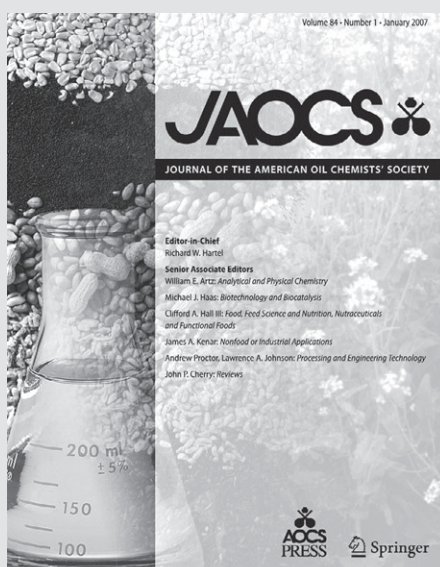
this study was to establish ion-pair reversed-phase chromatographic assays using alternative eluents for acetonitrile and to decrease costs incurred hereby. We compared the performance of ion-pair reversed-phase chromatography using acetonitrile with the alternative eluents methanol, ethanol, and *n*-propanol, using monolithic reversed phase C5 as well as C18 chromatography columns. We used triethylammonium acetate (TEAA) and tetrabutylammonium sulfate (TBA) as representative cationic ion-pair reagents and trifluoroacetic acid (TFA) as a representative anionic ion-pair reagent. For covering a large field of applications, we fractionated representative low-, middle-, and high-molecular weight biomolecules, in particular dinucleoside polyphosphates, peptides, proteins, and tryptic-digested human serum albumin. Whereas the chromatographic characteristics of both methanol and *n*-propanol were partly insufficient, ethanol was characterized equally or partly even better in the matter of elution strength and separation quality compared with the eluent water–acetonitrile. In conclusion, ethanol is an appropriate alternative for acetonitrile in ion-pair reversed phase chromatography of biomolecules.

### Influence of linolenic acid content on the oxidation of milk fat

Liu, Q., *et al.*, *J. Agric. Food Chem.* 58:3741–3746, 2010.

Increasing the content of  $\alpha$ -linolenic acid in milk fat might be desirable to meet consumer concerns about dietary healthfulness. However, enriching the content of polyunsaturated fatty acids (PUFA) will influence the oxidative stability of milk fat. This experiment was carried out to determine the effects of infusion with different amounts of high-linolenic perilla fatty acid (HLPFA) emulsion into the duodenum of dairy cows on milk fatty acid profile and the susceptibility of milk fat to oxidation. In a crossover design, four multiparous Holstein cows were infused duodenally with increasing amounts (0, 40, 80, 120, or 160 g/day) of free fatty acids from HLPFA emulsion or with carrier alone. Continuous infusions (20 to 22 h/day) were for 7 days at each amount. Infusions were homogenates of HLPFA with 15 g/day of xanthan gum, 5 g/day sodium alginate, and 25 g/day Tween 80; controls

## AOCS Journals



### Journal of the American Oil Chemists' Society (April)

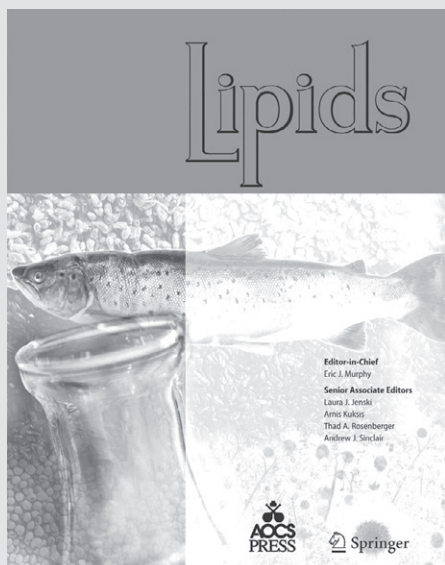
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- A new chemiluminescence method for detecting lipid peroxides in vegetable oils, Szterk, A., and P.P. Lewicki
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- Mesoporous silica-supported diarylammonium catalysts for esterification of free fatty acids in greases, Ngo, H.L., N.A. Zafiroopoulos, T.A. Foglia, E.T. Samulski, and W. Lin
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- Production of high oleic palm oils on a pilot scale, Lin, S.W., C.K. Yoo, and M.R. Ramli

### Lipids (April)

- Genetic ablation of CD36 does not alter mouse brain polyunsaturated fatty acid concentrations, Song, B.J., A. Elbert, T. Rahman, S.K. Orr, C.T. Chen, M. Febraio, and R.P. Bazinet
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- The Influence of n-3 PUFA supplements and n-3 PUFA enriched foods on the





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- Resolving an enhanced oil recovery challenge: Optimum formulation of a surfactant-oil-water system made insensitive to dilution, Arandia, M.A., A.M. Forgiarini, and J.-L. Salager
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- Effects of triglyceride molecular structure on optimum formulation of surfactant-oil-water systems, Phan, T.T., J.H. Harwell, and D.A. Sabatini
- Emulsion properties and phase equilibrium and of new asymmetric gemini surfactants consisting of fatty acid esters of polyethoxylated alcohol or phenol, Nowicki, J.
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- Acid-base equilibrium of dodecyl-dimethyl-amine-*N*-oxide micelles in water-butanol binary at 298 K, Bouguerra, S., P. Letellier, and M. Turmine
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received carrier only. The concentration of n-3 PUFA, especially  $\alpha$ -linolenic acid, in milk fat increased linearly as HLPFA infusion increased, but the saturated fatty acids decreased linearly. Milk production and the activities of superoxide dismutase, glutathione peroxidase, and catalase in milk tended to decrease quadratically. The milk fat percentage, however, tended to increase. The concentration of malondialdehyde increased quadratically in milk fat. Results suggest that infusion with HLPFA emulsion at varying amounts enhanced the content of n-3 PUFA in milk fat over the length of experiment but decreased the oxidative stability of milk fat.

## Fish oil: production and use now and in the future

Pike, I.H., and A. Jackson, *Lipid Technol.* 22:59–61, 2010.

The global production of fish oil is around one million metric tons. This production is expected to be maintained. Rich in long-chain omega-3 fatty acids, especially eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), fish oil can supplement diets inadequate in these fatty acids such as those in many Western countries. Farmed fish, especially oily fish such as salmonids fed on fish oil, provide an excellent source of these acids. Fish oil can be used directly in a purified form (nutraceuticals) in a wide range of foods. The daily recommended intake of EPA plus DHA of 0.25 to 0.50 g can then be met.

## Soxhlet extraction: Past and present panacea

Luque de Castro, M.D., and F. Priego-Capote, *J. Chromatogr. A* 1217:2383–2389, 2010.

An overview of Soxhlet extraction, the advantages and shortcomings of this century technique, as well as the attempts to improve its performance and achievements reached are presented. Use of high pressure, ultrasound, or microwaves has decreased or minimized the negative characteristics of the conventional extractor. Automation of Soxhlet performance opened the door to commercialization of a number of different approaches. The evolution of the Soxhlet extractor is discussed critically, and the conclusion from this overview is that the adoption of new technologies to improve its performance converts Soxhlet extraction into almost a “panacea” in this field.

## Supercritical fluid extraction: Recent advances and applications

Herrero, M., *et al.*, *J. Chromatogr. A* 1217:2495–2511, 2010.

Among the different extraction techniques used at analytical and preparative scale, supercritical fluid extraction (SFE) is one of the most used. This review covers the most recent developments of SFE in different fields, such as food science, natural products, by-product recovery, and pharmaceutical and environmental sciences during the period 2007–2009. The revision is focused on the most recent advances and applications in the different areas; among them is the remarkably strong impact of SFE in extracting high-value compounds from food and natural products as well as its increasing importance in areas such as heavy metals recovery, enantiomeric resolution, or drug delivery systems.

## Virgin coconut oil: emerging functional food oil

Marina, A.M., *et al.*, *Trends Food Sci. Technol.* 20:481–487, 2009. Virgin coconut oil (VCO) is growing in popularity as a functional food oil, and public awareness of it is increasing. It is expected that VCO will experience a dramatic growth in the market. The introduction of VCO has opened up new research that reveals new things besides what has already been known on commercial coconut oil. This paper mainly discusses some of the findings associated with VCO up to date. Physicochemical properties, antioxidant activity, clinical and authentication studies of VCO are some of the topics addressed in this review.

## Eicosanoids and cancer

Wang, D.Z., and R.N. Dubois, *Nat. Rev. Cancer* 10:181–193, 2010.

Eicosanoids, including prostaglandins and leukotrienes, are biologically active lipids that have been implicated in various pathological processes, such as inflammation and cancer. This review highlights our understanding of the intricate roles of eicosanoids in epithelial-derived tumors and their microenvironment. The knowledge of how these lipids orchestrate the complex interactions between transformed epithelial cells and the surrounding stromal cells is crucial for understanding tumor evolution, progression, and metastasis. Understanding

the molecular mechanisms underlying the role of prostaglandins and other eicosanoids in cancer progression will help to develop more effective cancer chemopreventive and/or therapeutic agents.

## Antiobesity mechanisms of action of conjugated linoleic acid

Kennedy, A., *et al.*, *J. Nutr. Biochem.* 21:171–179, 2010.

Conjugated linoleic acid (CLA), a family of fatty acids found in beef, dairy foods, and dietary supplements, reduces adiposity in several animal models of obesity and some human studies. However, the isomer-specific antiobesity mechanisms of action of CLA are unclear, and its use in humans is controversial. This review will summarize *in vivo* and *in vitro* findings from the literature regarding potential mechanisms by which CLA reduces adiposity, including its impact on (i) energy metabolism, (ii) adipogenesis, (iii) inflammation, (iv) lipid metabolism, and (v) apoptosis.

## Kinetic study of $\beta$ -carotene and lutein degradation in oils during heat treatment

Achir, N., *et al.*, *Eur. J. Lipid Sci. Technol.* 112:349–361, 2010.

The kinetics of *trans*- $\beta$ -carotene and *trans*-lutein degradation were individually investigated in palm olein and Vegetaline® at four temperatures ranging from 120 to 180°C. HPLC-DAD [high-performance liquid chromatography–diode array detector] analysis was carried out to monitor *trans*- and *cis*-carotenoid variations over the heating time at each temperature. In both oils, initial *trans*- $\beta$ -carotene and *trans*-lutein degradation rates increased with temperature. *trans*-Lutein was found to degrade at a slower rate than *trans*- $\beta$ -carotene, suggesting a higher thermal resistance. The isomers identified were 13-*cis*- and 9-*cis*- $\beta$ -carotene, and 13-*cis*-, 9-*cis*-, 13'-*cis*-, and 9'-*cis*-lutein. In spite of the higher number of lutein *cis* isomers, their total amount was lower than that of  $\beta$ -carotene *cis* isomers. *Trans*- and *cis*-carotenoids were involved in degradation reactions at rates that increased with temperature. All degradation rates were generally found to be lower in Vegetaline than in palm olein. These results were explained by the initial composition of the two oils and especially their peroxide and vitamin E contents. ■



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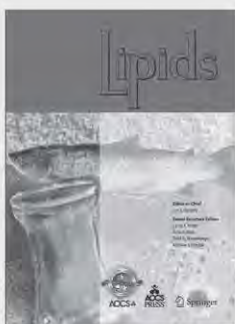


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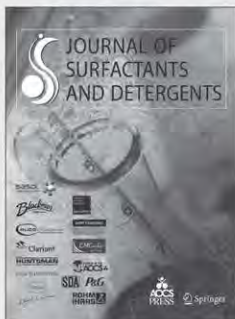
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# Home and fabric care industries to meet in Montreux

Catherine Watkins

The list of presenters at the 7th World Conference on Detergents in Montreux, Switzerland, 4–7 October, 2010, reads like an industry Who's Who, beginning with keynote speeches by the heads of the world's top three detergents companies—Henkel, Procter & Gamble, and Unilever.

Indeed, Montreux 2010 promises to deliver “new strategies in a dynamic global economy,” with presentations by 25 top-level executives on subjects ranging from the new role of China in global research and development to neuromarketing (a new field of marketing that studies consumers' sensorimotor, cognitive, and affective response to marketing stimuli) to 21st-century research and development tools. The program has been shaped by an executive committee headed by incoming AOCS President J. Keith Grime of JKG Consulting LLC, Cincinnati, Ohio, USA, that includes Manfred Trautmann, co-chair, vice president and general manager, BU Detergents & Intermediates, Clariant International, Muttentz, Switzerland; Thomas H. Müller-Kirschbaum, co-chair, corporate senior

## Meeting at a glance

**Montreux 2010: New Strategies in a Dynamic Global Economy**  
4–7 October 2010  
Montreux Music and Convention Centre, Montreux, Switzerland

**Registration deadlines**

- 25 June 2010—Last day to receive the special online discount
- 20 August 2010—Last day to receive the early rate
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vice president, Henkel AG & Co. KGaA, Düsseldorf, Germany; and David Duncan, past chair, president, DRD Consulting, Virginia Water, Surrey, UK.

The conference schedule will provide plenty of opportunity to conduct business without having to miss key presentations. In fact, the 9:00 a.m. start time and extended midday breaks allow for breakfast and lunch meetings with some of the more than 750 executives expected to attend. Business interests represented by attendees include business management, research and product development and formulation, technical services, processing, production, marketing, and raw materials.

The meeting exposition, which will feature more than 30 companies, will showcase key suppliers of equipment, chemicals, and services in the detergents industry. The exposition

CONTINUED ON PAGE 311



# Tentative Program (as of April 1, 2010)

## Tuesday, 5 October 2010— Defining the Future

### *Morning session*

**Keynote: The Power of Purpose-Inspired Strategy for Business Growth** • Robert McDonald, chairman of the board, president and CEO, The Procter & Gamble Co., USA

**Soap and Mirrors—The Future of the Consumer Products Industry** • Bill Schmitz, cosmetics, household and personal care products analyst, North American Equity Research, Deutsche Bank Securities Inc., USA

**Innovation—The Future of the Textile Business** • Chris DeSoiza, vice president, Milliken Research, USA

### *Afternoon session*

**Keynote: Is There a New Normal? Future Strategies for Our Industry** • Paul Polman, CEO, Unilever, United Kingdom

**What Every CEO Should Know about the New Role of China in Global R&D** • Max von Zedtwitz, professor, Tongji University, China

**The Responsibility Revolution: How the Next Generation of Businesses Will Win** • Jeffrey Hollender, executive chairman and co-founder, Seventh Generation, Inc., USA

**The Future of the Future** • Richard Seymour, co-founder and director, Seymourpowell, United Kingdom

## Wednesday, 6 October 2010— Innovations in the Value Chain

### *Morning session*

**Keynote: Innovative Sustainable Consumption: A Challenge for the Entire Value Chain** • Kasper Rorsted, CEO, Henkel AG & Co. KGaA, Germany

**Crossing the “Valleys of Despair”—Successfully Integrating Acquired Businesses** • Michael Heinz, general manager/global integration manager Ciba, BASF SE, Germany

**The Art of Being Chosen—Secrets of Success from the Giants of Retail** • Martin Butler, retail lecturer and author, United Kingdom

### *Afternoon session*

**Is Civilization Headed for Collapse? Channeling the Forces of Nature** • Emile H. Ishida, professor of the study on environmentally friendly materials, Graduate School of Environmental Studies, Ecomaterial Design and Process Engineering, Tohoku University, Japan

**REACH—The Complexity of Communication in the Supply Chain** • Erwin Annys, director REACH/chemical policy, CEFIC, Belgium

**The Reset Economy and the Rise of the Rest** • Julian Ho, assistant managing director—Industry Development, Singapore Economic Development Board, Singapore

**Defining the Future of Highly Eco-Friendly Washing Through Innovation** • Koichi Nakamura, principal researcher, Global R&D—Fabric & Home Care, Kao Corp., representing the Japan Soap and Detergent Association

## Thursday, 7 October 2010— Smarter Ways of Doing Things

### *Morning session*

**Cleaner Clothes and a Cleaner Planet: What Are You Going to Tell Your Grandchildren About What You Did to Save the Planet?** • Keith Weed, executive vice president, Laundry, Household Care and Hygiene, Global, Unilever, United Kingdom

**Silver, Foam, and Beyond** • Dochul Choi, senior vice president, head of R&D team, Digital Appliance Division, Digital Media & Communication Business, Samsung Electronics Co., Ltd., Korea

**From Now to Now What: The Changing Consumer Landscape** • Paul Bennett, managing partner and chief creative officer; and Simon Blyth, head global category CMI (Consumer Market Insight), IDEO, United Kingdom

**Bringing Tomorrow to Today's Product Development Lab: Giant Steps in Innovation Productivity from Advanced High Throughput and Informatics Technology** • John Senaldi, president, HPR Business, Freeslate, Inc., USA

### *Afternoon session*

**The Emerging Global Standard for Sustainability Measurements and Reporting** • Jay Golden, assistant professor, Arizona State University, USA

**Mind the “Mind”: How Neuromarketing Reshuffles Brand Management** • Hans-Willi Schroiff, corporate vice president, Global Market Research, Henkel AG & Co. KGaA, Germany

**The Curious Case of Modeling Clean—Computational Chemistry and Everyday Life** • Thomas J. Lange, director, Modeling & Simulation, Corporate R & D, The Procter & Gamble Co., USA

**Motivation and the Psychology of Winning** • Mark McGregor, Leadership Center GmbH, Switzerland



will serve as the center for Montreux 2010 networking activities, including breaks and receptions. In addition, poster presentations will provide the perfect opportunity to review current research projects, innovative work in progress, and continuing research projects that may not yet be complete, but whose preliminary results are already of interest.

Co-sponsoring organizations include AOCS, CESIO (Comité Européen des Agents de Surface et de Leurs Intermédiaires Organiques), AISE (International Association of the Soap, Detergent, and Maintenance Products Industry), JOCS (Japan Oil Chemists' Society), JSDA (Japan Soap and Detergent Association), and SDA (The Soap and Detergent Association).

Catherine Watkins is associate editor of *inform* and can be reached at [cwatkins@aoacs.org](mailto:cwatkins@aoacs.org).

Incoming AOCS President J. Keith Grime has been involved since 1992 with AOCS' World Conference on Detergents—often called the Montreux conference—in all aspects of planning, chairing, and committee work. This involvement will culminate in October 2010 with his role as the general chair of the Montreux 2010 meeting.

The progress of the conference from its inception in 1977 to its current status as a world-class event is a source of pride to Grime. "The Montreux conference has truly become the strategic conference of the global fabric and home care business and all the businesses that support it. So, for those of you in any of those businesses, please follow the request that you'll see in all of the conference publications to Meet Me in Montreux!"



The Montreux Music & Convention Centre (M2C2) is located on the beautiful shores of Switzerland's Lake Geneva, surrounded by gardens, and is just a few steps from the train station, restaurants, and major city hotels. Photo courtesy of M2C2.



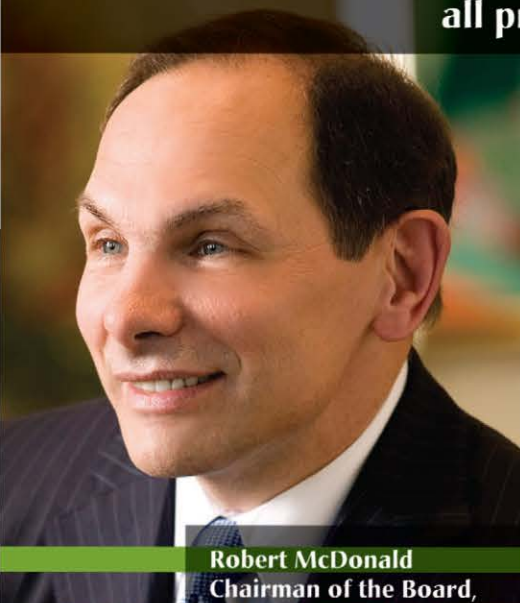
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# Montreux 2010

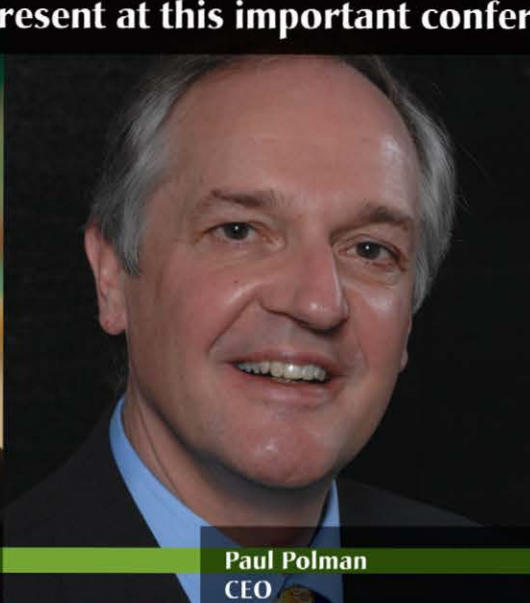
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## History will be made at Montreux 2010

For the first time ever, the CEOs of the top three detergent manufacturers will all present at this important conference.



**Robert McDonald**  
Chairman of the Board,  
President and CEO  
The Procter & Gamble  
Company  
Presenting Tuesday  
morning, 5 October



**Paul Polman**  
CEO  
Unilever  
Presenting Tuesday  
afternoon, 5 October



**Kasper Rorsted**  
CEO  
Henkel AG Co. KGaA  
Presenting Wednesday  
morning, 6 October



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# What Lipids Are For



*Note: The following article is based on the address given by William W. Christie, the 2010 Supelco/Nicholas Pelick–AOCS Research Award winner, at the 2010 AOCS Annual Meeting & Expo, held in Phoenix, Arizona, USA, May 16–19.*

## William W. Christie

Every single lipid class has been found to have some unique biological role that is distinct from its function as a source of energy or as a simple construction unit of a membrane.

For many years, lipids were considered to be intractable and uninteresting oily materials with two main functions—to serve as a source of energy and as the building blocks of membranes. They were certainly not considered to be appropriate candidates for such important molecular tasks as intracellular signaling or local hormonal regulation. In 1929, George and Mildred Burr demonstrated that linoleic acid was an essential dietary constituent, but it was many years before the importance of this finding was recognized by biochemists in general. In the 1960s, it was shown that the essential fatty acid arachidonate was the biosynthetic precursor of the prostaglandins. Then, the first biologically active phospholipid, platelet-activating factor, was discovered. About the same time there arose an awareness of the distinctive functions of phosphatidylinositol and its metabolites.

All multicellular organisms use chemical messengers to send information between organelles and to other cells, and as relatively small hydrophobic molecules, lipids are excellent candidates for signaling purposes. Their fatty acid constituents have well-defined structural features, such as *cis*-double bonds in particular positions, which can carry information by binding selectively to specific receptors. In esterified form, they can infiltrate membranes or be translocated across them to carry signals to other cells. During transport, they are usually bound to proteins so their effective solution concentrations are very low, and they can be considered to be inactive until they reach the site of action and encounter the appropriate receptor.

Fatty acids are one of the defining constituents of lipids and are in large part responsible for the distinctive physical and metabolic properties of the latter. However, they are also important in nonesterified form, that is, as free (unesterified) fatty acids, which can interact with the cell nucleus to regulate the activities of genes concerned with lipid metabolism. The essential fatty acids, especially

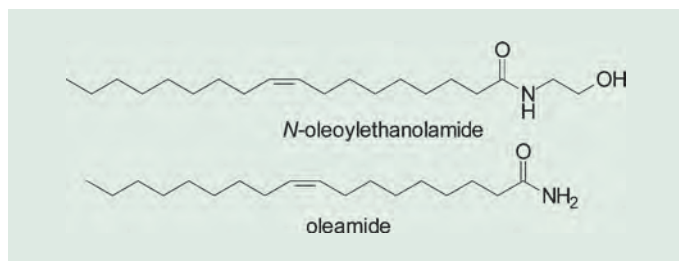


*William W. Christie, 2010 Supelco/Nicholas Pelick–AOCS Research Award winner.*

arachidonate, are precursors of many different types of eicosanoids, including the hydroxyeicosatetraenes, prostanoids (prostaglandins, thromboxanes, and prostacyclins), leukotrienes (and lipoxins), and resolvins, not to forget the isoprostanes, which are formed by nonenzymic means. It is surely no coincidence that plant hormones, such as the jasmonates, are also derived from the essential fatty acids.

Among the simplest derivatives of fatty acids, long-chain *N*-acylethanolamines are ubiquitous trace constituents of animal and human cells with important pharmacological properties. The nature of the fatty acid controls the biological functions. Anandamide (*N*-arachidonylethanolamine) has attracted special interest because of its marked biological activities, exerting its effects through binding to and activating specific cannabinoid receptors. It is an endogenous cannabinoid, or endocannabinoid. In contrast, oleylethanolamide is an endogenous regulator of food intake with potential as an anti-obesity drug, while palmitoylethanolamide is an anti-inflammatory agent, and stearoylethanolamide is a proapoptotic agent. Similarly, changing the nature of the amide moiety also changes the function. Thus, the simple “oleamide” molecule, or *cis*-9,10-octadecenamide, isolated from the cerebrospinal fluid of sleep-deprived cats, has been identified as the signaling molecule responsible for initiating sleep (Scheme 1).

Triacylglycerols are the main storage forms for lipids, and they are largely chemically inert. This is why nature may have selected

**Scheme 1**

such hydrophobic molecules for transport in an aqueous medium in the form of lipoproteins. However, subcutaneous depots serve as insulation in many terrestrial animals, as is obvious in the pig, which is surrounded by a layer of fat, and it is especially true for marine mammals. In the latter, and in fish, the lipid depots are less dense than water and so aid buoyancy. More surprisingly, perhaps, triacylglycerols together with the structurally related glyceryl ether diesters and wax esters are the main components of the sonar lens used in echolocation by dolphins and some whales.

Lipids are the key building blocks of all biological membranes, which provide structural integrity to cells and their organelles and control solute transport. The main lipid components are the polar complex lipids, such as phospholipids, together with cholesterol. These are organized in a bilayer with the fatty acid chains pointing inward and held together by hydrophobic forces, with the polar moieties interacting with the aqueous layer. However, within the membrane, lipids have functions other than simply being inert building blocks in that they activate and direct membrane proteins for specific biological tasks.

To consider just a few representative examples, phosphatidic acid is a minor component of cells in higher organisms but is important as the precursor of other phospholipids. In plants, it is a key signaling molecule, of special importance during germination and senescence, and has a role in stress damage and pathogen attack when generated via phospholipase D. In animals, it has been implicated in many aspects of animal cell biochemistry and physiology, including cell proliferation and differentiation, cell transformation, tumor progression, and survival signaling. It also regulates some membrane trafficking events.

Lysophosphatidic acid is present at very low levels only in animal tissues, but it is extremely important biologically, influencing many biochemical processes. It is an intercellular lipid mediator with growth factor-like activities and is rapidly produced and released from activated platelets to influence target cells. It is significantly elevated in the plasma of ovarian cancer patients, compared to healthy controls, especially in the first stages, and may represent a useful marker for early detection of the disease.

Phosphatidylinositol is important as a participant in essential metabolic processes in plants and animals (and in some bacteria). It is the primary source of the arachidonic acid required for biosynthesis of eicosanoids, including prostaglandins, via the action of the enzyme phospholipase A<sub>2</sub>, and it is the main source of diacylglycerols that serve as signaling molecules in animal cells and are produced via the action of phospholipase C. In turn, diacylglycerols regulate the activity of a group of at least a dozen related enzymes known as protein kinase C, which control many key cellular processes, including differentiation, proliferation, metabolism, and

apoptosis. Also released by phospholipase C from the polyphosphoinositides are water-soluble inositol phosphates, which are extremely important biologically. Each has distinct functions.

Phosphatidylserine is an essential cofactor for the activation of protein kinase C, a key enzyme in signal transduction, and for many other enzymes. It is involved in the blood coagulation process in platelets, where it enhances the activation of prothrombin to thrombin (the vital molecule for the blood-clotting cascade). It functions in the process of apoptosis as a “recognition” molecule on the surface of cells to facilitate their removal, following transfer from the inner membrane leaflet, and it chelates calcium to form the foundation for bone growth.

Sphingomyelin (and other sphingolipids) and cholesterol are located together in specific domains of membranes, termed “rafts.” As sphingolipids containing long saturated acyl chains, they pack more tightly together and have much higher melting temperatures than glycerophospholipids. This leads to phase separation in the membrane, giving rise to sphingolipid-rich regions surrounded by glycerophospholipids. The rafts are believed to be thicker than normal membranes and contain glycerophosphoinositol-linked proteins and receptor kinases. Interactions between cellular proteins and lipids in these rafts are believed to be important in signaling. Also, sphingomyelin serves as a precursor for ceramides, long-chain bases and sphingosine-1-phosphate, and many other important sphingolipids as part of the sphingomyelin cycle. Some of these have functions as intracellular messengers and others are essential membrane constituents. For example, sphingosine-1-phosphate is an important cellular metabolite, derived from ceramide, that is synthesized *de novo* or as part of the sphingomyelin cycle. It is a potent messenger molecule that operates both intra- and intercellularly, but with very different functions from ceramides and sphingosine, in that it promotes cellular division (mitosis) and inhibits cell death (apoptosis) in contrast to ceramides, which have opposing actions. The correct balance between these various sphingolipid metabolites is essential for health. Ten years ago, it would have been difficult to find a single scientific paper on sphingosine-1-phosphate, and now there are hundreds every year.

Although it may seem strange, cholesterol should be regarded as a vital health-giving molecule. It is by far the most abundant member of the sterol family in human tissues, and it is essential, for example, for brain function—25% of body cholesterol is in the brain. One of its main functions is to modulate the fluidity of membranes by interacting with their complex lipid components, such as phospholipids. In addition, it is the biosynthetic precursor of steroidal hormones, vitamin D, and bile acids. Only in excess is it troublesome, when it has detrimental effects on the cardiovascular system.

Of course, this has of necessity been a very brief overview of the subject. I have not been able to discuss many of the phospho- and sphingolipids (including oligoglycosylceramides and gangliosides), eicosanoids and resolvins, proteolipids, lipoproteins, sulfolipids, tocopherols, and waxes, all of which have distinct functions.

A lengthier discussion of this topic is available at <http://lipidlibrary.aocs.org/Lipids/whatdo/index.htm>.

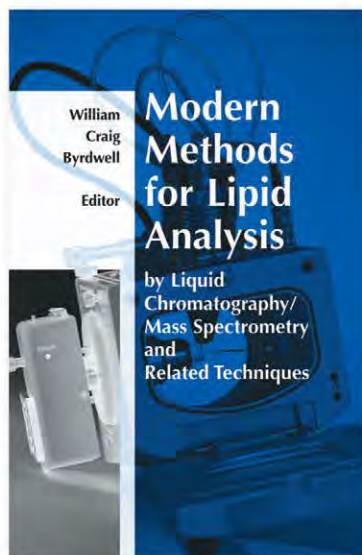
*William W. Christie, formerly of the Scottish Crop Research Institute (and Mylnefield Lipid Analysis Unit), Invergowrie, Dundee, Scotland, is the creator of The Lipid Library. Contact him at [billchristie@blueyonder.co.uk](mailto:billchristie@blueyonder.co.uk).*



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# New world economy drives shift in global cosmetics & toiletries retailing

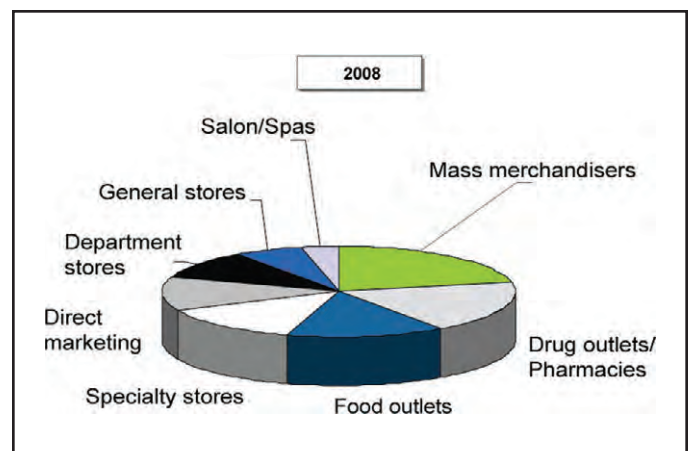
**Karen Doskow**

Despite the global recession, the cosmetics and toiletries market posted a respectable 3.9% growth in sales in 2008, affirming that consumers will keep up their personal grooming and beauty habits no matter how dire the financial outlook may seem. But perhaps more important than the overall growth, the latest numbers indicate a significant shift in where consumers are shopping in nearly all of the major markets around the world. Channels that are posting declines in one market are experiencing growth in another. Marketers looking to compete on a global scale must stay ahead of the shift and examine local trends in retail patterns in order to compete in this complex market.

While the United States remains the dominant nation in the global beauty retailing equation with an 18.4% share, the emerging markets of the BRIC countries—Brazil, Russia, India, and China—continue to gain momentum, posting double-digit gains, according to Kline's Beauty Retailing 2008 Global Series. As these markets develop, consumers there are discovering the emergence of traditionally more Western retail formats. This delicate balance among distribution channels has enabled the industry to weather the economic storm fairly well, while other consumer goods markets have suffered worse (Fig. 1).

## DIRECT SALES DRIVEN BY EARNINGS POTENTIAL

As the fastest-growing channel worldwide, direct marketing posted an impressive 8.6% compound annual growth rate from 2003 to 2008. The current economic situation has made person-to-person sales an attractive earnings opportunity to help offset job losses. This, combined with the strong presence of the channel, has driven direct sales up by nearly 27% in China over the last five years. In Russia and Brazil, where direct marketing is still considered the primary purchase channel for high-quality cosmetics, sales have increased



**FIG. 1.** Global sales of cosmetics and toiletries by retail outlet, 2008. Source: Kline & Company's Beauty Retailing 2008 Global Series.

almost 20%, prompting leading marketers like Avon and Oriflame to launch their pricier skin care products into these markets.

Meanwhile, in the largest, yet mature, direct sales market of Japan, the channel is losing share to other outlets—namely, department stores, drug outlets/pharmacies, and specialty retailers as new, Western-style stores multiply.

## MASS MERCHANDISERS' SHARE SURGES IN BRIC MARKETS

Typically somewhat isolated from the effects of a dismal economy, the mass merchandisers' channel might have suffered a tougher blow had it not been for stellar growth in the BRIC markets. Faced with a declining share from erosion by drug outlets/pharmacies and direct marketing, this channel eked out less than 2.5% growth in the United States. However, the developing BRIC economies posted double-digit growth in the channel: 14.1% collectively and around 25% each in Russia and India. The leading international retailers, Walmart and Carrefour, dominate in Brazil and China, with Walmart launching an aggressive expansion in Brazil through the acquisition of local chains.

Also contributing to growth through the channel, mass merchandisers have fine-tuned their product offerings and revamped store space to appeal to consumers and boost cosmetics and toiletries



sales. By devoting more shelf space to naturally positioned brands, luxury products, and male grooming products (especially in India), the mass channel will continue to grow at a moderate rate.

## DEPARTMENT STORE DICHOTOMY

Perhaps the biggest dichotomy of all can be found in the department store channel. The much-maligned stalwart of the American shopping mall experienced a sharp decline in recent years, even before the economy began to falter. Shifting consumer patterns saw traffic move from the traditional mall to the strip mall and stand-alone stores, with specialty retailers offering a more intimate shopping experience, especially in the cosmetics and toiletries arena. Suffering the cost of high overhead and expensive real estate, the number of department stores in the United States and Europe has dwindled steadily—some closing up shop in the United States and others consolidating in Europe. Despite the notorious contraction, the United States is the only market to actually see sales decline in the channel, losing less than 1% of share.

On the other side of the globe, however, department stores are blossoming, with shoppers in India and China discovering this decidedly Western concept. Economic expansion in both countries has spurred new interest in shopping center developments anchored by major department store retailers. With more than 5,000 stores in China and 150 in India, the channel has become synonymous with the shopping “experience.” Department store sales of cosmetics and toiletries are up by 21.3% in India, albeit from a small base, and just over 19% in China, the third-largest market in the channel. Clearly, all is not lost for department store brands on a global scale.

## MARKET HOT SPOTS

The Chinese market stands out as the hands-down global growth leader for cosmetics and toiletries sales, with double-digit gains in every channel. However, key hotspots exist in each of the top 11 markets examined in this report. Double-digit growth in every channel in Brazil also provides new opportunities for marketers, even in the absence of an established department store channel. Food outlets command a strong presence here, particularly in rural areas where there are few other options for consumers. Robust growth in the Russian market benefits modern retail establishments, such as the direct sales, specialty, and mass channels, at the expense of the more traditional general store. Conversely, the Indian general stores channel, known as kiranas, maintains an overwhelming presence in the market with a 78% share and 9% growth, despite intensified competition from the department store and mass channels.

With overall sales growth for the global market expected to peak at 3.6% over the next five years, the outlook may seem a bit dim on the surface. But, as the individual channels continue to evolve, big gains are expected, particularly in developing nations. The key to success in this shifting global marketplace is to stay ahead of the curve for product and consumer trends with a diversified product portfolio and distribution strategy that allows for a nimble approach to strike while the iron is hot in a variety of channels and markets.

*Karen Doskow is an industry manager for the Consumer Products practice of Kline & Co. Contact her via email at [Karen.Doskow@klinegroup.com](mailto:Karen.Doskow@klinegroup.com). The preceding article was reprinted with permission; for more information visit [www.klinegroup.com](http://www.klinegroup.com).*

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# Algae promise biofuel solutions

Increasing investments support microalgae research to solve biofuel process and productivity issues.

**Tim Studt**

Second-generation biofuels, such as cellulose-based ethanol and biodiesel, have a few problems. First, there is not enough arable developed land to grow the amount of second-generation feedstocks for the ethanol or diesel biofuels needed to offset imported petroleum (60% of total US use) and meet our gasoline and diesel requirements. Biofuels can and do offset some petroleum usage, but the upside scalable volumes are severely limited.

Then there is the fact that second-generation feedstocks do not have the high energy densities of the petroleum-based fuels they are being asked to replace [76,000 Btu/gallon vs. 116,000 Btu/gallon typically (21.2 MJ/L vs. 32.3 MJ/L)]. The total costs of current bio-ethanol and biodiesel processes are not competitive with petroleum-based processes, and, while progress is being made, they are still substantial sources of greenhouse gases. Finally, these feedstocks offset the food stocks that could be grown in their place.

These issues and the complex processing requirements to convert them into usable biofuels also create a cost structure that is not competitive with that of traditional fuels. As such, an alga is being considered as a viable alternative biofuel feedstock.

In a recent report by *The Wall Street Journal*, the editors picked nuclear energy, wind-based energy, and algae-based biofuels as the most likely alternative energy sources of the future. Numerous supporters believe algae could replace all US liquid fuel requirements in the future while offsetting the carbon dioxide generation of other greenhouse gas sources—when converted into a biofuel and burned, algae emit only the carbon dioxide they absorbed, adding no new CO<sub>2</sub> into the atmosphere. All of these are promised, along with the possibility of \$1 to \$2 per gallon production costs.

## THE BASICS

“The process of sourcing, growing, and harvesting clean algae is a complicated procedure,” says Mark Hanson, a principal partner with Stoel Rives LLP. While the use of algae as a

biofuel is a relatively new technology, growing algae is not a new process—it has been done for nutritional products, nutraceuticals, animal feedstock, wastewater treatment, and CO<sub>2</sub> mitigation for a long time.

The primary requirements for growing are sunlight, water, and CO<sub>2</sub>. Algae also require nutrients (nitrates, phosphates, iron, and silica) and environmental conditions appropriate to the specific algal species. There are three primary algae cultivation systems being evaluated for biofuel production—open pond-like systems, photo-bioreactors (PBR), and hybrid systems.

Cultivating microalgae can employ fresh water, but saline or brackish water can also be used. Large waste CO<sub>2</sub> sources, such as flue gas from a coal-fired or gas-fired power plant, can also be used as a resource for algae biofuel systems.

The vegoil content of algae fuel can be converted to biodiesel, while its carbohydrate content can be fermented into bioethanol. Microalgae (unicellular algae micro-organisms) have a high lipid (oil) content (~60%) and rapid growth rates (one doubling/day), and produce more lipids per acre than plants (from 10 to 100×). Microalgae also do not compete with food or feedstocks. (See Table 1 for potential oil yields.)

While a theoretical maximum value is not yet known for the lipid content of microalgae, some researchers have estimated it to be as high as 85% of their dry cell weight. Higher lipid values in microalgae are, however, also associated with lower growth rates;

**TABLE 1. Potential oil yields**

Crop	Oil yield	
	Gallons/acre/year	Liters/hectare/year
Corn	18	168
Soybean	48	449
Rapeseed	127	1,190
Jatropha	202	1,890
Oil palm	635	5,400
Algae <sup>a</sup>	10,000+	

Source: National Renewable Energy Laboratory, Boulder, Colorado, USA

<sup>a</sup>50 g/m<sup>2</sup>/day at 50% triacylglycerides

therefore, a biofuel application would not try to maximize lipid content but attempt to develop maximum productivity.

“Making biofuels from algae is all about the economics,” says Nigel Quinn, a water resources engineer at the Lawrence Berkeley National Lab (California, USA). “In order to cultivate and convert algae into a biofuel, you need huge systems. Right now, algae biofuel can probably be made for a very non-competitive \$9 or \$10 per gallon.”

## THE ISSUES

While developing algae-based biofuels has only recently become relevant to our overall energy-sourcing picture, the failures of ongoing development programs reflect the complexity of this overall process. One of the largest issues concerning the development of algae into biofuel is the cost of the capital equipment for a pond or PBR process.

Pond systems require vast amounts of land. Harvesting in these systems is done with screens and needs to be automated. Water losses need to be monitored and controlled, but doing so may adversely affect the systems’ economics. Also, the larger the pond, the larger the mixing velocity and mixing power required, the latter of which goes up as a cube of the velocity.

Open pond systems are also prone to contamination, not just from nonbiological sources but also from the various algae species that might become invasive. Contaminants could also affect the culture medium (alkalinity and pH).

PBR are easier to control than pond systems but can cost 10 to 100× more. In a number of cases over the past 20 years, organizations tried PBR systems only to fail due to rising costs.

Gas sources and gas generation also need to be accounted for in the cultivation system developed for algae. For pond systems, a rich source of CO<sub>2</sub> needs to be ensured, which reflects on their siting preferences near large power plants. For PBR systems, the generation of O<sub>2</sub> from the algae needs to be managed.

Infestations of platyzoan rotifers (near-microscopic animals that eat algae) can also devastate an algae culture, requiring difficult- and expensive-to-clean systems. While a large number of algae species are known to exist, the type most often used in current culturing systems is a wild strain. Little work in the past has been made on selective breeding of algae species, especially for optimal oil yields.

## THE INDUSTRY

With all the promises that algae-based biofuels offer, and with economies of scale being one of the barriers to entry, more than 150 industrial companies are looking to create a process that can take advantage of these promises. ExxonMobil Research and Engineering Co., for example, announced in 2009 that it was investing \$600 million to develop liquid transportation biofuels from algae (see *inform* 20:577, 2009). Their effort involves a partnership with Synthetic Genomics, the La Jolla, California, company founded by genomics pioneer J. Craig Venter. “This agreement represents a comprehensive, long-term R&D exploration into the most efficient and cost-effective organisms to produce next-generation algal biofuel,” says Venter.

Chevron has also partnered with algae biofuel producer Solazyme (South San Francisco, California) and the National Renewable



*Researchers at Arizona State University utilize photobioreactors (PBR) to optimize the lipid output and growth rates of algae intended for biofuels.*

Energy Lab (Golden, Colorado, USA) to develop jet fuel and other biofuels from algae. Solazyme’s fermentation process, which takes place in PBR, is considered to be the closest to maturity.

Sapphire Energy (San Diego, California) was awarded \$104 million as part of the American Recovery and Reinvestment Act (ARRA) of 2009 and the Biorefinery Assistance Program. Sapphire Energy’s Green Crude from algae is a complete drop-in replacement technology for crude oil. The Green Crude can be refined directly into gasoline, diesel, and jet fuel.

“Sapphire has the largest cultivation of enhanced algal strains, with more than 200 patents in the algal fuel space,” says Brian Goodall, Sapphire’s vice president of Downstream Technology.

Melbourne, Florida-based PetroAlgae licenses commercial micro-crop technologies that enable the cultivation of algae-based biofuels. The PetroAlgae system removes 98% of the water used to grow micro-crops. The process includes large-scale open bioreactors that are harvested via vacuum skimming to stationary screen filters. A screw press dewater the resulting filtrate, which is then dried and refined into green fuel. PetroAlgae has formed numerous partnerships with US and foreign companies for its large-scale production facilities.



Naples, Florida-based Algenol Biofuels recently received a \$25 million grant from ARRA funds to build a biorefinery in Freeport, Texas, USA. The company is also expanding a plant in Mexico, where it partners with Sonora Fields to commercialize Algenol's "Direct to Ethanol" process. Their first commercial project is expected this year.

Algenol also stated that it plans to create two new programs: one to create algae-based biofuel from chemical feedstocks and the other in carbon dioxide management. The Algenol process links sugar production to photosynthesis with enzymes within individual algal cells. The naturally occurring enzymes are the same as those used to produce bread, beer, and wine and thus pose no risk to humans.

During a webinar, Algenol stated that its prototype production strains were expected to produce ethanol at a rate of 10,000 gallons/acre/year by the end of 2009 and could increase to 20,000 gallons/acre/year.

## THE RESEARCH

A large number of universities are also working on algae biofuels. Milt Sommerfield and Qiang Hu at Arizona State University's Polytechnic Campus (Phoenix, USA) are developing an algal species that would work well in Arizona's climate and produce the largest quantities of lipids. They have already identified that algae production increases when they are stressed, which is easily controllable in PBR systems.

University of Arizona (UA; Tucson) researchers are also looking to optimize algae species for hardiness, rapid growth, and biofuel capabilities. UA's Professor Joel Cuello is focusing the research of his team on a PBR they refer to as Accordion, which they use to grow *Botryococcus braunii*, an oil-rich alga that could be used to produce jet fuel. The device flows water and nutrients through a vertical series of clear polymer panels, allowing the mix to have a controlled flow and steady light gradient.

Martin Spalding, a researcher at Iowa State University (Ames, USA), is working on stacking traits in *Chlamydomonas* algae, similar to the way researchers have developed genetically modified corn. Working with ARRA funding, Spalding is trying to create algae biofuels that are similar to their petroleum-based counterparts.

## THE INSTRUMENTS

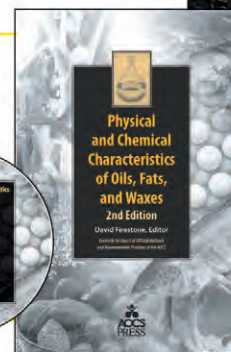
As researchers in industry and academia work to develop and commercialize algae-based biofuel production systems and materials, they are being aided by specialized instruments.

The Nicolet iS10 FT-IR (Fourier transform infrared) spectrometer from Thermo Scientific (Waltham, Massachusetts, USA), for example, was originally created for pharmaceutical high-throughput screening systems. It can, however, be applied effectively to the analysis of algae. Researchers are always looking to increase the amount of lipids produced by the algae. To achieve this, FT-IR can be used to characterize the composition of biological samples, including

CONTINUED ON PAGE 324

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## CALENDAR (CONTINUED FROM PAGE 263)

**COCOTECH Meeting and Coconut Festival, The Imperial Boat House Resort and Spa Hotel, Samui Island, Thailand.** Information: [www.apccsec.org/cocotech.html](http://www.apccsec.org/cocotech.html).

July 6–8, 2010. China Soybean Expo 2010, Harbin International Conference Exhibition and Sports Center, Heilongjiang Province, China. Information: [www.chinasoybeanexpo.com/en](http://www.chinasoybeanexpo.com/en).

July 8–9, 2010. AgriGenomics World Conference, Conrad Brussels Hotel, Brussels, Belgium. Information: [www.selectbiosciences.com/conferences/AGWC2010](http://www.selectbiosciences.com/conferences/AGWC2010).



July 11–16, 2010. 19th International Symposium on Plant Lipids, Cairns Convention Centre, Cairns, Australia. Information: [www.ispl2010.org](http://www.ispl2010.org).

July 17–21, 2010. Institute of Food Technologists' Annual Meeting and Expo, McCormick Place, Chicago, Illinois, USA. Information: [www.ift.org](http://www.ift.org).

July 18–20, 2010. Food Processing Suppliers Association Process Expo, McCormick Place, Chicago, Illinois, USA. Information: <http://fpsa.org/processexpo/processexpo>.

## August

August 1–6, 2010. 19th World Congress of Soil Science, Brisbane, Australia. Information: [www.19WCSS.org.au](http://www.19WCSS.org.au).

August 2–6, 2010. Curso Avanzado sobre Crushing de Semillas Oleaginosas (Advanced Course on Oil Seed Crushing), Rosario, Argentina. Information: email: [gabrielapage@asaga.org](mailto:gabrielapage@asaga.org) or [asaga@asaga.org.ar](mailto:asaga@asaga.org.ar).

August 22–26, 2010. 240th American Chemical Society Autumn Meeting, Boston, Massachusetts, USA. Information: [www.acs.org](http://www.acs.org).

August 22–26, 2010. 15th World Congress of Food Science and Technology, Cape Town International Convention Centre, Cape Town, South Africa. Information: [www.iufost2010.org.za](http://www.iufost2010.org.za).

August 26–27, 2010. Soy Innovation Africa, The Westin Grand, Cape Town, South Africa. Information: [www.iufost2010.org.za/SoyInnovationAfrica.asp](http://www.iufost2010.org.za/SoyInnovationAfrica.asp); <http://events.soyatech.com/conferences/SIA2010.htm>.

August 31–September 2, 2010. Farm Progress Show, Boone, Iowa, USA. Information: [www.FarmProgressShow.com](http://www.FarmProgressShow.com).

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## September

**September 1–3, 2010. JAIMA/JSIA [Japan Analytical Instruments Manufacturers' Association/Japan Federation of Scientific Instrument Associations] Expo: 2010, Makuhari Messe, Japan. Information: [www.jaimasis.jp](http://www.jaimasis.jp).**

**September 7–11, 2010. 51st International Conference on the Bioscience of Lipids, Bilbao, Spain. Information: [www.icbl.unibe.ch](http://www.icbl.unibe.ch).**

**September 9–11, 2010. 8th Encuentro de Gerentes de la Industria de Grasas y Aceites Alimentarios (Meeting for Managers of the Edible Fats and Oils Industry). Information: email: [gabrielapage@asaga.org.ag](mailto:gabrielapage@asaga.org.ag) or [asaga@asaga.org.ar](mailto:asaga@asaga.org.ar).**

**September 13–14, 2010. FAME Summit and Exhibition, InterContinental Hotel, Berlin, Germany. Information: <http://greenworldconferences.com>.**

**September 21–23, 2010. Analytica China 2010, Shanghai New International Expo Centre, Shanghai, People's Republic of China. Information: [www.analyticachina.com](http://www.analyticachina.com).**

**September 26–29, 2010. 124th Annual AOAC Annual Meeting & Exposition, Loews Royal Pacific at Universal Orlando, Orlando, Florida, USA. Information: [www.aoac.org/meetings/124th\\_annual\\_mtg/main\\_2.htm](http://www.aoac.org/meetings/124th_annual_mtg/main_2.htm).**

**September 28–30, 2010. 2010 Algal Biomass Summit, JW Marriott Desert Ridge Resort, Phoenix, Arizona, USA. Information: [www.algalbiomass.org/events](http://www.algalbiomass.org/events).**

## October

**October 3–6, 2010. GERLI (Groupe d'Étude et de Recherche en Lipidomique), 7th Lipidomics Congress:**

**Lipids in all states, Club Bellambra, Anglet Biarritz, France. Information: [www.cbm.u-bordeaux.fr/GERLI/index.php?tab=1](http://www.cbm.u-bordeaux.fr/GERLI/index.php?tab=1).**

**October 3–7, 2010. Practical-Short Course on Processing and Products of Vegetable Oil/Biodiesel, Food Protein Research & Development Center, Texas A&M University, College Station, Texas, USA. Information: <http://foodprotein.tamu.edu/fatsoils/scvegoil.php>.**

**October 4–6, 2010. 5th Soya & Oilseed Summit/Global Soybean & Grain Transport, Hyatt Regency Minneapolis, Minnesota, USA. Information: <http://events.soyatech.com/conferences/GSGTSOS2010.htm>.**



**October 4–7, 2010. 7th World Conference on Detergents: New Strategies in a Dynamic Global Economy, Montreux Music & Convention Centre, Montreux, Switzerland. Information: [www.aocs.org/meetings/montreux](http://www.aocs.org/meetings/montreux).**

**October 13–14, 2010. American Fats & Oils Association Annual Meeting. Information: [www.afoaonline.org/events.html](http://www.afoaonline.org/events.html).**



**October 16–19, 2010. 9th International Symposium on the Role of Soy in Health Promotion and Chronic Disease Prevention and Treatment, Capital Hilton, Washington, DC, USA. Information: [www.SoySymposium.org](http://www.SoySymposium.org).**

**October 17–21, 2010. Federation of Analytical Chemistry and Spectroscopy Societies Annual Conference, Raleigh Convention Center, Raleigh, North Carolina, USA. Information: <http://facss.org/facss/index.php>.**

**October 20, 2010. Cosmetic Technology Transfer Conference, Woodbridge Hilton, Woodbridge, New Jersey, USA. Information: email: [steve@stephen-herman.com](mailto:steve@stephen-herman.com); [www.nyscc.org/cttc.html](http://www.nyscc.org/cttc.html). ■**

## ATLANTIS PROGRAM (CONTINUED FROM PAGE 271)

He bought a bicycle for getting around and he was looking forward to attending Ghent University *futbol* (soccer) games with his classmates.

Howell Medders is coordinator of Agricultural Communication Services, Arkansas Agricultural Experiment Station, University of Arkansas Division of Agriculture. Contact him via email at [hmedders@uark.edu](mailto:hmedders@uark.edu). Andrew Proctor is a professor in the Department of Food Science, University of Arkansas, and conducts research on lipid chemistry and value-added research. He is US director of the current Atlantis Program, Integral Valorization of Bio-Production. He also consults with the food industry on production of value-added products from co-products. Lawrence A. Johnson is the director of the Center for Crops Utilization Research at Iowa State University, a center comprising 50 faculty members focused on developing value-added uses for crops. He was also recently appointed director of the ISU BioCentury Research Farm, which is an integrated research and demonstration facility dedicated to biomass production and processing. Ronald L. Madl is director of the Bioprocessing and Industrial Value Added Program in the Department of Grain Science and Industry, Kansas State University. He is also co-director, Center for Sustainable Energy, also at Kansas State University. Raj Raman is associate professor of Agricultural and Biosystems Engineering at Iowa State University. He is also currently serving as associate director of Education for the Bioeconomy Institute, as director of the University Educational Programs for the NSF Engineering Research Center for Biorenewable Chemicals, and as the director of Graduate Education for the Biorenewable Resources and Technology Program.



## BIOFUELS NEWS (CONTINUED FROM PAGE 286)

## GENERAL

## ActionAid International objects to biofuels

Current European Union (EU) policy is to acquire 10% of its energy from renewable sources by 2020. According to ActionAid International, a global antipoverty agency based in South Africa, this policy is a threat to food security and an inappropriate response to climate change.

ActionAid International Tanzania Country Director Aida Kiangi was quoted in the *Tanzania Daily News* (Dar es Salaam) as saying, "EU companies are acquiring land in developing countries at an alarming rate in anticipation of dramatically increased EU biofuel consumption by 2020 and the generous subsidies available to the biofuel industry."

Tanzania Food Security Advisor Elias Mtinda said that European companies were acquiring prime arable land, suitable for food production, "... contrary to the national biofuels guidelines which clearly state that cultivation of biofuel crops should be done on marginal land."

"The industrial biofuels scramble represents the latest chapter in the long-running land grab in poor countries," said Fatou Mbaye, ActionAid's biofuels officer in Senegal.

European companies have already acquired or are in negotiations for at least five million hectares of land in developing countries—an area larger than Denmark ([www.actionaid.org/pages.aspx?PageID=34&ItemID=557](http://www.actionaid.org/pages.aspx?PageID=34&ItemID=557)). ActionAid calculates that by 2020, roughly 17.5 million hectares of land may be required in developing countries alone, equivalent to over half the size of Italy.

Countries in Asia and the Middle East are buying land in Africa as well. South Korean company Daewoo Logistics has attempted to buy an area half the size of Belgium to farm corn and palm oil for biofuel.

## BIODIESEL

## US railroads test biodiesel

Norfolk Southern Railway (NS; Norfolk, Virginia), one of the largest railroads in the United States, and Electro-Motive Diesel Inc. (EMD; headquartered in LaGrange, Illinois) are partnering to test biodiesel for locomotive fuel applications. Eight SD70M-2 units and two MP15 switchers manufactured by EMD and owned/operated by NS will be used for the tests. The locomotives will run in regular service for 9–11 months under various operating and environmental condi-



tions. Then test units and components will be evaluated for emissions, fuel consumption, performance, and durability.

Amtrak has also decided to evaluate biodiesel for use in its interstate passenger trains. In 2011, Amtrak's "Heartland Flyer" will be used to test a 20% biodiesel blend made from beef fat and supplied by Direct Fuels of Euless, Texas. The Oklahoma Department of Transportation and the Federal Railroad Administration are funding the research.

Amtrak will analyze the engine oil every 10 days for signs of degradation or dilution. The fuel itself will be analyzed monthly to verify compliance with specifications. And at the end of the year the engine assembly will be evaluated to measure the impact on valves and gaskets. ■

## ALGAE PROMISE BIOFUEL SOLUTIONS

(CONTINUED FROM PAGE 321)

bacteria, single cells, and tissues. FT-IR has been documented as a viable method for determining the protein, carbohydrate, and lipid content in biomass from algae. Configured with a Smart iTR diamond accessory or Smart OMNI-transmission accessory, the iS10 can be used to obtain spectra from dried algae.

Similarly, a Raman-specific 1064-nm spectrometer from BaySpec Inc. (Fremont, California) was designed for measuring micro-algae. Using its Nunavut 1064-nm system, researchers are able to overcome characterization issues with fluorescence seen at lower wavelengths.

Metrohm's 873 Biodiesel Rancimat can be used to evaluate the oxidation stability of fatty acid methyl esters (FAME) present in oil. The amount of water in a biodiesel determines the calorific value and its shelf life. Biodiesel with high water content has a lower oxidation stability.

There also are a number of customized instruments that researchers utilize in the development of algae biofuels. The National Renewable Energy Lab and the University of Colorado, for example, collaborated to purchase a custom BD FaCS Aria (Fluorescence Activated Cell Sorter; BD Biosciences, San Jose, California) for high-speed algal cell sorting of populations and individual cells. This keystone system was put into the Colorado Center for Biorefining and Biofuels (Boulder, USA). Another one of their strategic equipment acquisitions for algae development was a cryopreservation system (MVE Eterne Series; MVE Bio-Medical Chart Industries, Inc., Marietta, Georgia, USA) for the long-term maintenance of algal cultures. These cryosystems minimize damage to the algae during low-temperature freezing and storage and thus maintain the long-term cell viability.

*Tim Studt is editor-in-chief of Laboratory Equipment and can be contacted via email at [tim.studt@advantagemedia.com](mailto:tim.studt@advantagemedia.com). The preceding article is reprinted with permission and is copyright 2010 Laboratory Equipment, Advantage Business Media. For additional information, visit [www.laboratoryequipment.com](http://www.laboratoryequipment.com).*



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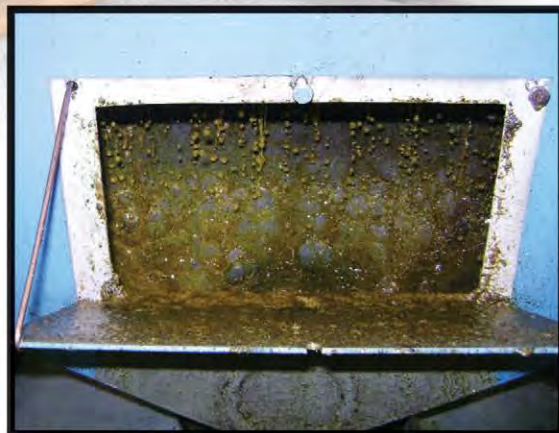
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